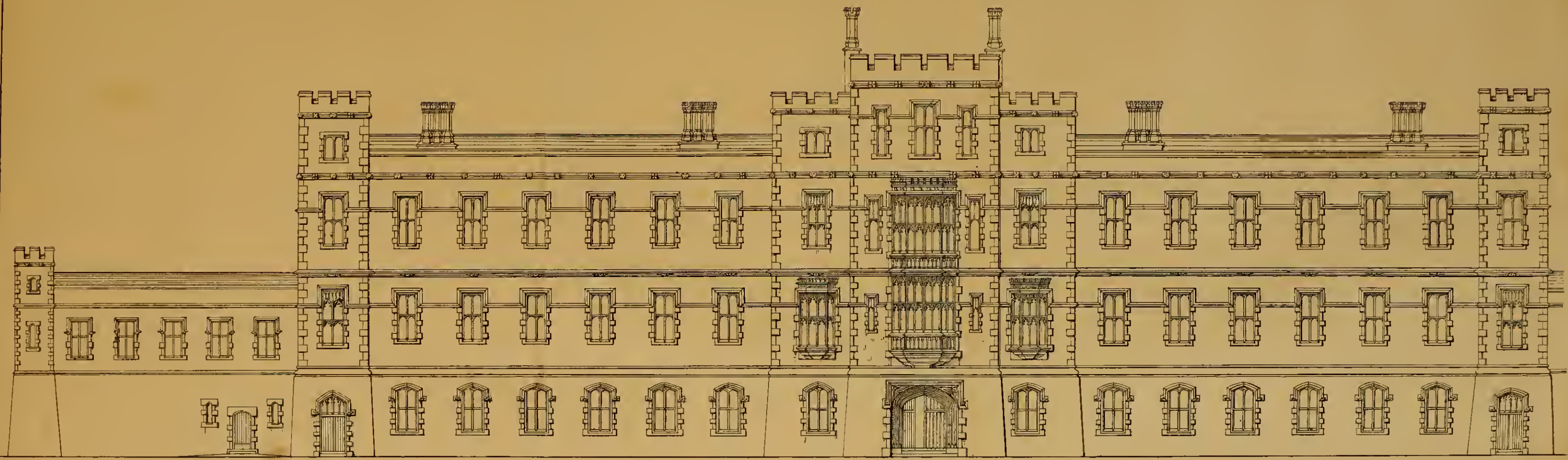
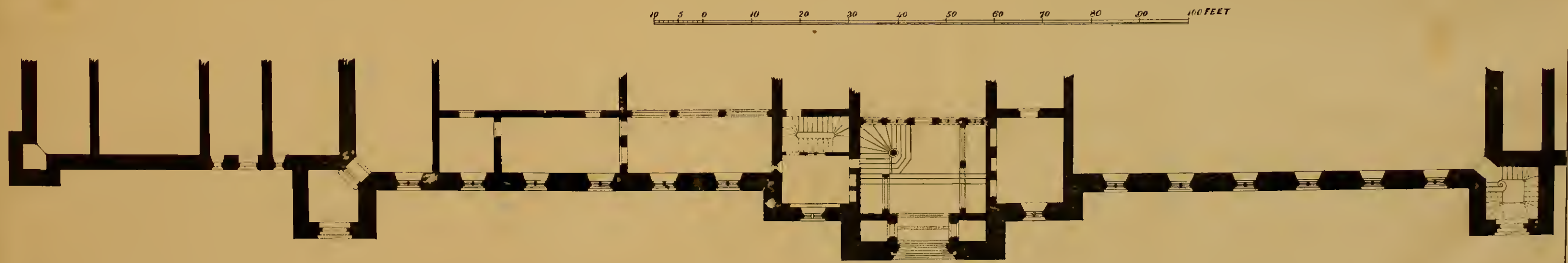
QUEEN ELIZABETH'S HOSPITAL BRISTOL





GROUND PLAN.

THOMAS FOSTER & SON, ARCHTS BRISTOL

THE

CIVIL ENGINEER AND ARCHITECT'S

JOURNAL,

SCIENTIFIC AND RAILWAY GAZETTE.

VOLUME VIII.—1845.

LONDON:

R. GROOMBRIDGE & SONS, 5, PATERNOSTER ROW; J. WEALE, 59, HIGH HOLBORN; WILEY & PUTNAM, NEW YORK; GALIGNANI, PARIS.

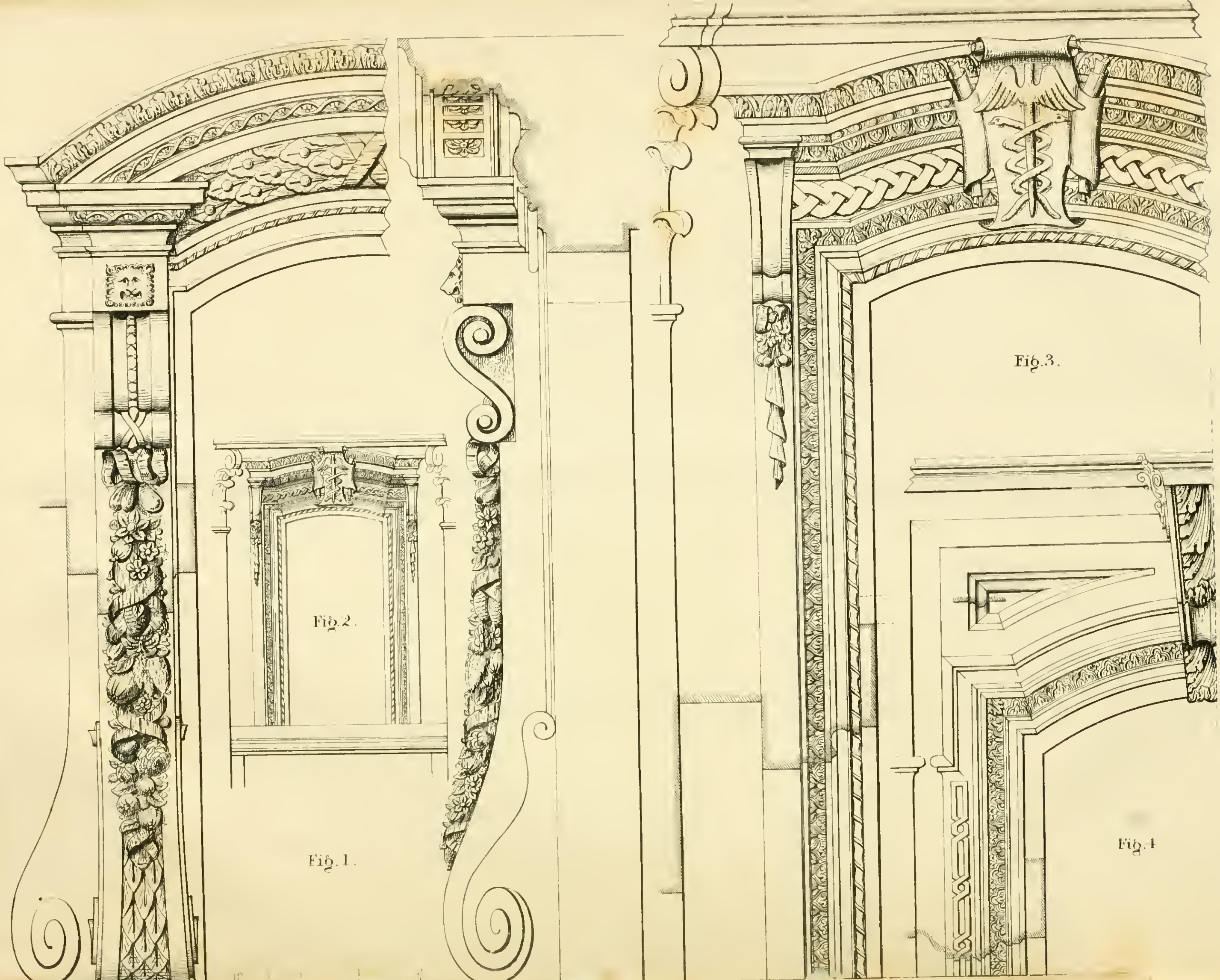


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4

THE

CIVIL ENGINEER AND ARCHITECT'S JOURNAL.

SPECIMENS OF WINDOWS FROM THE ROYAL EXCHANGE.

(*With an Engraving, Plate I.*)

Even were it not so in any other respect, the present Royal Exchange would still be interesting and highly deserving of notice on account of its windows, which exhibit great study of detail and composition, and also very considerable diversity of design, there being so many varieties of them introduced into different parts of the edifice, that they would form quite a series of examples, and of a kind apparently much wanted, inasmuch as they are not a little suggestive of ideas for features in regard to which paucity and sameness of ideas prevail. Owing to some strange perverseness, modern architects seldom bestow any study, or indeed any thought at all upon windows, notwithstanding that they are absolutely indispensable features in composition, while columns are so far from being such that it is difficult to introduce them at all, except in a portico, with any sort of sufficiently apparent motive, or so as not to appear mere expletives in design, and to be intended chiefly for effect. And where the character so aimed at is kept up consistently in all other respects, such excuse may pass as valid; but if merely a vile architectural solecism,—one that betrays a most barbarous taste, to introduce other features, without any sort of purpose, at the very same time that those which actually belong to the building, and which ought therefore to be made to give character to it, and contribute towards its decoration, are—if not, as is too frequently the case, left quite bare and unfinished, treated as altogether subordinate and valueless in design, We are, indeed, now getting by degrees, out of our mere "hole-in-the-wall" fashion for windows, still the dressings bestowed upon them are in general but a very short remove from nothing: they seldom amount to more than a plain border with a narrow moulding around it, which scarcely shows itself at all unless the front itself happens to be of red or dark brick; and there is nearly the same general air of blankness, and certainly quite the same degree of monotony as if there had been nothing of the kind at all. Nevertheless, we cannot be very surprized at the builders of street houses, for never attempting to go beyond that species of quakerism in architectural dress or dressing, by one who enjoys credit at least for classical taste—including, we presume, a highly cultivated feeling for all the proprieties and refinements of his art. Be his perceptive taste what it may, his action is of a very feeble kind, else he would hardly confine himself to nearly one and the same character, for his windows on all occasions alike, and that, too, of such kind as to *include* a variety of detail. No matter what be the style professed by the order,—Doric, Ionic, or Corinthian,—no matter whether his columns be plain or fluted, his windows are invariably of the same design—no, not design, but pattern,—the only difference between them being an occasional extra moulding when he can screw up his liberality to the requisite pitch.

Compared with the frigid things just alluded to, the windows of the Exchange are what the luxuriant vegetation of the tropical climes is to the eternal ice of the polar regions. They bespeak fulness and spontaneity of ideas, *gusto* and *con amore* relish, with pains-taking—no there we are wrong, not "pains-taking" but "pleasure-taking" earnestness in the task. In addition to "effect" of a different kind, they will, it is to be hoped, have the effect of thawing the frozen and frost-bitten taste of others. Just at present, indeed, it is not greatly to be wondered at that they should be considered exotic in taste, being so very much unlike what we are accustomed to see even in buildings where the windows are made principal and highly decorative.

Certain, however, it is that the windows of the Royal Exchange do not please every one, since by some they have been likened to picture-frames!—one of those convenient comparisons which are resorted to for the purpose of cutting short all argument and reasons for dislike. What it is that accuses such fatal resemblance, is not said: resemblance there certainly is so far as is in common to all *chambraults* or dressings to doors and windows, inasmuch as they serve as a framing to the aperture; but a picture-frame is continued alike all round. without any additional mouldings or ornament on its upper edge, on the contrary it is the four angles that are generally more enriched with ornament than the rest. The comparison in question—and questionable it assuredly is, would lead any one to suppose that the windows were in the Louis Quatorze style, which may justly enough be termed a "picture-frame" one, because it seems to be made up entirely of fragments of picture-frames and eccentric scroll-work, applied to every thing indiscriminately.

The characteristic differences above pointed out sufficiently vindicate the windows we are speaking of, from the charge of bearing an awkwardly striking resemblance to picture-frames. Consequently, if they nevertheless partake too much of the latter character, it must be owing to their details and mouldings. Yet these are surely of quite distinct nature and very differently composed from those belonging to frames of the other sort,—so much so that were they applied to the latter, such frames to pictures would at once be called "window-dressings," and be objected to as too decidedly architectural. We admit that in all such cases, injurious comparison does not mean to say that the offensive resemblance is complete in all points, but merely that there is more of it than there ought to be, and enough to warrant the comparison being made. Whether the comparison so made be warrantable or not must depend upon the facts and circumstances of the particular instance; but if ever so unwarrantable, it is impossible to check those lively sallies of a funny imagination which some endeavour to palm upon us for "knock-down" argument.

In the instance of the Royal Exchange, what is really meant as a strong objection, probably is that the windows are marked by a fulness and luxuriance of ornamentation for exceeding what we are accustomed to, and otherwise also of very peculiar character. Who disputes it? Most assuredly not *we*, since it is on that very account that we here take such especial notice of them, and exhibit examples of three of the varieties of them. Undoubtedly they may be said to be in an exaggerated style,—even extreme and *outré*, composed with examples of the Palladian, or a rival Italian school, whose windows exhibit little or limited diversity in regard to the general composition of their dressings and the proportions observed for them. Those proportions, as is very evident, are greatly exceeded here; the jamb-dressings, or upright border along the sides of the aperture, being unusually wide, and differently composed from what is the ordinary practice; and to the expression of luxuriance thus produced is added that of carved and sculptured enrichment,—the first for some of the architectural surfaces, the other for ornamental foliage, as in the centre windows of the south front of the building. Probably it was the embellishment of this latter kind that suggested the "picture-frame" comparison, yet here it is no more than what is in keeping with other sculptured decoration in the general design.

If what is here done seems to some to be in certain respects over done, it is easy to correct excess of that kind by simplifying; nor ought they on that account to withhold their commendation from what is so well entitled to it, for it is a very great matter to obtain some fresh ideas, and to be convinced that it is possible to break through the trammels of ordinary rules, not unsuccessfully: of course, those who can judge only by currently established rules and standard authorities, are not likely to praise what transgresses limits which they have taught themselves to consider inviolable. But, we think, on examination it will be found that although treated with artistical freedom, are not justly chargeable with being capricious compositions. Less orthodox Italian than Mr. Barry has given they undoubtedly are, for, if the truth may be spoken, Barry has not shown himself ambitious of decided originality. Refinement and elegance of taste seem be chiefly his forte; and, as far as Italian is concerned, he showed his taste in such manner as to obtain credit for originality, by introducing into this country a species of Italian previously unknown to it, and markedly different from the Palladian species.

One thing in the Exchange windows that is rather contrary to *Italianism*, is the heads of the windows, and the whole of the dressing above them being neither straight nor fully arched, but curved segmentally. To such modes as an occasional variety we do not object, and here, perhaps, the curves serve to give an appearance of "springiness" that takes away the heaviness that might else have attended the same composition.

Should we be able to give the design of the windows within the merchant's area, we may then perhaps go more fully into the subject, but must here conclude for the present, and merely subjoin—

	Aperture.				Entire Dressing.			
	High.		Wide.		High.		Wide.	
Centre windows of south front	11	10½	5	7½	16	3	9	10½
Other . . do.	11	10½	5	7½	15	7½	10	0
Centre windows of north front	11	7½	5	4½	16	0	9	1½

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXI.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Among the odd and out-of-the-way conceits that have come into my head, I have sometimes fancied that it would not be amiss were an Hospital or Sanitorium to be established for architectural patients, where they might be treated accordingly as their particular case might require. He, for instance, who was simplicity-mad, and whose sickly palate could relish nothing of higher flavour than the mere water-gruel of the art, would stand in need of a regimen of generous stimulants to give a healthy tone to his puling taste; whereas another might require to have a good dose of simplicity infused into him. Some there are whose microscopic vision allows them to see only the merest minutiæ: they can tell you to the hairbreadth fraction of a "part" the legitimate breadth of every moulding and fillet, but are quite unable to discern any thing more, and unable even to comprehend what is meant by ensemble—character—effect. Others again, there are who labouring under quite a contrary defect of optics, have no eyes at all for detail; any common-place stuff of the kind will satisfy them just as well as the best;—Barry is to them no better than Nash. But it is to be feared that no hospital could benefit either of these two classes. It is also questionable if any treatment in a Sanitorium could bring to their senses or to common sense, the lunatics who rave on the one hand about Vitruvius and Palladio, or on the other, about architectural mysticism and precedent. As for Sir R. S. it is evident enough that he, poor man! is hopelessly incurable. The only thing to be done with *him* is to keep him from doing further mischief.

II. Architectural description, or what purports to be such, is sometimes so unintelligible as to be quite incomprehensible—impossible to be made out at all without some interpretation of it. If we are acquainted beforehand with the building spoken of, then, indeed, we know what is meant to be said, but otherwise are left quite in the dark. A pretty strong instance of the kind is furnished by the account that has been given in an English publication of the new structure at Kelheim, in Bavaria, called the *Befreiungs-halle*, or Hall of Deliverance, and which is now in course of erection from the designs of Gärtner, the eminent Munich architect. "The whole building," it is there said, "will become a rotunda, of ancient Italian style, surmounted by a cupola, and surrounded with a grand archway forming a polygon of eighteen angles"! How this may be expressed in the original—it being no doubt, *done* into English from the German—I know not, but in itself it is palpable nonsense, it being impossible that *a* great archway—a single one—should *surround* a building. The blunder, however, here happens to be of a kind that may be easily accounted for and rectified, there being no doubt that what is meant—not in deed by the translator since he stands convicted of ignorance—is that that polygonal part of the exterior consists of eighteen sides, each of which has a large arch or arcade, whereby a continuous arcade of eighteen arches is formed around the entire building: which is surely a very different matter from a single "large *archway*," the last-mentioned term expressing some sort of arched *gateway*. That explained, some idea is afforded of that main division of the structure; but then again we are left quite at a loss to understand what can be the design of the basement or substructure on which it is raised, for all that we are told concerning it is, that it consists of "three great divisions," whose added heights amount to 24 feet. Hence the probability is that the substructure is a solid mass, and the divisions formed by so many terraces, with flights of steps from one end to the other,—probably after the manner of those of the "Walhalla," so that the basement spreads out below, far beyond the superstructure. Yet surely a word or two just to say so, and to inform us whether the basement itself is square, or of the same form as to its plan, as the body of the edifice, would not have been superfluous. The diameter of the building is said to be 236 feet, but whether this includes the greatest extent of the basement, below, is not specified; nevertheless that such is the case may be presumed, the diameter of the "cupola" being stated to be only 100 feet, than which the rotunda or "spherical large room"—as it is termed—within, is probably no more, at least not as measured within the columns. These last are eighteen in number,—corresponding with that of the angles of the polygon, but they seem to be exceedingly low in proportion to the space covered by the dome, being only 24 feet high—if that measurement be correct;—and as they are also stated to be four feet in diameter, we must conclude that they are of the Doric order—another circumstance that might just as well have been distinctly specified;—although such order is not the most suitable for a circular plan, and one covered by a hemispherical vault, more especially as a considerable degree of *Roman* magnificence seems to characterize this interior in all other respects, a "Victoria" being placed before each column, the floor being a mosaic marble pavement, and the *eye* of the dome (which is 25 feet in diameter) a "gorgeous window,"—which epithet would lead us to suppose that it must be filled with stained glass.

III. Of architectural description it is not easy to find a more complete and satisfactory specimen than that of the Royal Exchange, which appeared in the "Times," and was thence transferred to this Journal. Although of newspaper extraction, it is very far above the average of newspaper quality, particularly on such a subject. It is in many respects as precise and definite a description of the kind as is usually the very reverse—vague, indistinct, and full of gaps. One is able to follow it, pencil in hand, and sketch out at least all the separate elevations. Well worthy was it therefore of being preserved in a far more convenient as well as less perishable form than that of an article in a daily newspaper.

IV. As an instance, on the contrary, of what may be called "description non-descriptive," is that which an eminent travelled critic has given of the portico of the Glyptothek at Munich, nothing further respecting it than that it has twelve columns of the Ionic order. The number of columns stated correctly, but the slightest architectural knowledge would have apprised any one, that unless their arrangement also was explained, a most erroneous idea of the sort of portico might be conveyed. Although they are all dissimilar in plan, in every one of the following examples the portico has *twelve* columns, viz., the

Chamber of Deputies at Paris, the London University, the National Gallery, and the new Royal Exchange. The first of these is *dodecastyle*, or has all its twelve columns in front; the second *decastyle diprostyle*, or with ten columns in front, and two intercolumns—consequently one column, on each flank; while both the others are *octastyle diprostyle*, with the addition of two columns within, making altogether *twelve*. But if they so far agree in plan—other resemblance is out of the question,—the two last examples differing materially in regard to the position of the inner columns, which in the first of them are placed parallel to the two centre ones in front, so as to form a *distyle in antis* recess; whereas in the other the two inner columns are put behind the third column from each angle of the front, and their architraves extend from front to back, or across the plan, which is thus divided into three compartments in the proportion of three to two; that is, the centre one is equal to three intercolumns in width, and each of the others to two. Of these examples then, no two are alike, although all agree in having twelve columns; and what is more, the Glyptothek portico differs decidedly from every one of them; therefore, even to be told that it is octastyle would still leave it quite doubtful how the remaining four columns are disposed. The most obvious supposition would be that there are two on each flank, making it *triprostyle*, or projecting three intercolumns; whereas, it is in fact *monoprostyle*, or projects only one intercolumn, and has within a second row of four columns in antis, or five open intercolumns, dividing the inner or recessed portion of the plan from the outer or projecting one. It is not, indeed, every one who could explain this technically, but that any one who had seen the portico should merely say of it that it has twelve columns, without taking notice of so important a circumstance as that of four of them being behind the others, is assuredly strange.

V. At present, the new streets from Leicester Square and Oxford Street, to Holborn and Bloomsbury, promise very poorly. In favour of what has actually been done or is doing, little more is to be said than that the fronts of the houses will not present the appearance of so many separate upright slices, nor will the windows be so crowded together as is usual in shop streets; but beyond that, little or no improvement is as yet discernible. We perceive the old faulty system of putting cornices *beneath* the uppermost windows, instead of over them, still adhered to, although such practice may fairly be termed *nonsensical*, as being contrary to architectural meaning, because a cornice so placed does not express its purpose as the eaves of the roof. Subordinate cornices, or string-courses partaking of that character, are certainly allowable enough, but then, in order for them to be subordinate, there must be a principal one, crowning the entire elevation. If that be omitted, all that is above whatever other cornice there may be, looks quite unfinished, and produces an air of poorness and meagreness that is not to be overcome by embellishment applied elsewhere. It was to be hoped that what had been done in Maddox Street would have been looked at as exhibiting a specimen of street architecture of superior quality. We might at least endeavour to get out of the old track, and new streets of the kind in question certainly afford opportunity for making such attempt, because should it prove unsatisfactory in itself no very great harm is done, and even comparative failure might yet give us something far better, and at all events more novel, than what we are now likely to obtain. If we are not to experimentalize upon such occasions, when are we to do so at all? and if we do not do that, how are we ever to arrive at, or in any degree approximate towards, what is urged upon us by some as one main desideratum—namely, a style of our own?

VI. In regard to that same "style of our own," it does not seem as if we were likely to get it in practice, even from any of those who warmly advocate it in theory. We are told that both construction and materials ought to be allowed to show themselves more undisguisedly, and to be made to subserve to characteristic design and decoration; yet no one cares to make the attempt, at any rate not so as to exhibit any really fresh elements of design, capable of either serving as the groundwork of a fresh style, or of being amalgamated with any existing style. On the other hand, there seems to prevail among us a feeling diametrically opposite and opposed in tendency—a most obstinate determination to resist all attempts at further progress, to move, if at all, only in a retrograde direction, by falling back upon "precedents," and adhering to them with the most slavish literality; neither is that all, it being further demanded of us that we should attach an esoteric and mystical value to certain styles and architectural conventionalisms peculiar to a creed we reject, and to forms of worship we have divorced ourselves from. So long as it be only backwards, innovation is absolutely meritorious, it is then praiseworthy *revivalism!* We are told, by implication at least, that so far from hankering after any thing new, any thing precisely adapted to our present purposes and wants, and distinctly stamped as belonging to our own age, we ought to take refuge in despair, and congratulate ourselves upon our utter incapacity of accomplishing anything of the sort. And most assuredly will the prophecy of such incapacity be fulfilled, if we persist in never making the attempt—an attempt, however, be it remembered, not to be made by every one or any one, but those who have within them some spark of original mind and the flame of geniality. Almost every preceding period or century, which has had any architectural style at all, has had one that has been more or less peculiar to itself. Of the nineteenth century, on the contrary, future historians of art will have to speak as that of mere *imitation* in architecture—one which contributed nothing to the stock bequeathed us by former ages, and which even took vast credit to itself for dealing exclusively in second-hand ideas. At no other period do we observe anything like retrogression—any direct imitation, return to, and re-assumption of a style that had been laid aside, as having, according to one of the queer cant phrases now in vogue, "*performed its mission*." Neither Norman nor any subsequent style was ever employed when once laid aside, not even for occasional purposes, or at the dictates of individual taste. The Elizabethan architects did not ever think of erecting mansions aiming at the character, at least at the titles, of either feudal castles or abbeys. Although they both borrowed in their turn, neither Rome copied Athens, nor Byzantium, Rome. Again, even on the so-called "revival" of ancient architecture in modern Italy, more of the spirit of free imitation than of direct copying was manifested; a style of different texture from that of any former was then wrought out;—antique and modern were worked up together as woof and warp of a new species of tissue. And of what was thus elaborated we may now behold specimens both in Pall Mall and St. James's Street,—astylar in the one, columnar in the other.

VII. It is rather overweening antiquarian taste with its prejudices, than real architectural sympathy, at the present day, which causes so much stress to be laid, as is now done, upon strict, even bigotted adherence to positive precedent in all matters architectonic. Nor is this greatly to be wondered at, since antiquarianism is no Janus; it looks only backwards, till it is petrified into a pillar of salt. It renounces all claim to vitality of ideas—or any ideas of its own. It can imagine nothing but what has been—will not even receive anything else, but maintains that the "has been" is what always ought to be. It judges of everything by precedent; it has no other touch of criticism; where it does not grope about in dark places with that, it can see nothing. Bring it out into the broad daylight, and it stands aghast!—completely bewildered by objects which it is utterly unacquainted with and mortified to find that its own link, which showed so brightly amid surrounding gloom, does not look very much like the irradiating flame of genius. Of course all this will be set down by a certain set for exceedingly profane, treasonable, and heretical—scurrilous, scandalous. Perhaps I shall be charged with endeavouring to decry and depreciate antiquarian and archæological studies. I certainly think they might be pursued somewhat more rationally, and with less of that minute and micrological pedantry, than they usually are. It is good to know all that has been done, but it is foolish to abide by it obstinately, and to refuse to tolerate anything that is not recommended by the sanction of antiquated precedent. *Studying* is one thing, and *copying* another; of the first we cannot, perhaps, have too much, of the second hardly too little.

VIII. One very great fault in the generality of papers upon architectural topics in miscellaneous periodicals is, that they almost invariably set out with a quantity of tedious humdrum about architecture itself, its principles, origin, and progress; merely repeating what has been repeated *ad nauseam* before, without adding a single fresh idea or remark. The avowed and immediate subject, and which therefore ought to be treated as such, is sometimes smothered altogether by irrelevant and useless matter of that kind, so that if you skip in order to come to the matter in hand at once, you perhaps find that you have to skip to the very last page of all, and then find an apologetic phrase of "want of room," "our limits," and so forth, in excuse for saying nothing further at all. Writers of that class must always drag in some schoolboy impertinence, or anile rigmarole and twaddle; and the mention of the Royal Exchange would for them be the signal to begin to cackle about Pericles and the Parthenon.

SIR JOSHUA REYNOLDS.

Sir,—As Mrs. Gwatkin has kindly allowed me to publish the remainder of the extracts made from Sir Joshua's private memorandum book, I will proceed.

EXTRACTS.

July 7th, 1766.—Mr. Pelham, painted in lake and white and black and blue. Varnished with gum mastic dissolved in oil with sal. saturnia and rock alum, col. yellow, lake, and Naples and black mixed with varnish.

2.

Miss Kitty Fisher—Face cerata—drapery painted con cera e poi V. (varnished.)

3.

Lord Villers—given to Dr. Barnard, painted with vernice fatto di cera et Venice torpentine, mesticato con gli colori macinati in olio, carmine in lieu di lacca.

4.

1767—Count Lippe, senza olio in finishing.
(Exhibited at the B. G. since; had stood well.)

5.

My own, ditto—Mrs. Goddard, ditto.

6.

Miss Cholmondely—con olio e vernice con Yeo's lake and macgylp.

7.

Mio proprio, given to Mrs. Burk, con cera, finito quasi, poi con mastic ver. finito interamente, poi cerata senza colori.

8.

Offe's picture with cera et cap. solo cinabro; glazing—senza olio, varnish of mastic solo—Yeo's yellow, vermilion and blue.

9.

Sir Charles and Master Bunbury, 1768.—July 29, 1768—in vece di nero, si puo *servire di turchino* e cinabro, e lacca giallo. (Nov. 28th, 1768, probatum est.)

10.

2nd sitting too yellow.
The glazing di cinabro e turchino senza cera.

11.

April 3rd, 1769.—Per gli colori. Cinabro, lacca, ultramarine e nero, senza giallo—prima in olio, ultimo con vernice solo, e giallo.

May 17, 1769.—On a grey ground, first sitting verm. lake, white, black; second, ditto; third ditto, ultramarine; last, senza olio, yellow ochre, black, lake, verm. touched on with white.

12.

Mrs. Boverie.—The face senza olio and the boy's head, the rest painted with olio, and afterwards glazed with varnish and colour, except the green, which was glazed with oil and then varnished—the vail and white linen finished senza.

13.

July 10th, 1769.—My own picture, painted first with oil, painted with lake, yellow ochre, blue and black, cop. e cera vernice. Doctor Johnson and Goldsmith, first olio, after with copaiva with colori but without white, the head of Goldsmith with cop. and white.

14.

Mrs. Horton.—Con copaiva senza giallo, quando era finito, di pingere con lacca e giallo, quasi solo, e poi glaze with ultramarine.

June 22nd, 1770. { Sono stabilito in maniera di dipingere.
I am established in my mode of painting.

After saying this, from the rapture of the moment, he details what is the manner in which he is established, as follows.

15.

Primo e secondo, o con olio, o copivi gli colori. (First and second painting, *either* oil, *or* copaiva—if *either* will do he was not established.)

Secondo medesimo—ultimo con giallo okero, e lacca, e nero, e ultramarino, senza biacca—ritoccata con poco biacca e gli alteri colori. My own, given to Mrs. Burk.

This he says is now his fixed manner.

16.

Feb. 6th, 1770—Primo olio, biacca e nero (first oil, and black and white); secondo biacca e lacca (terzo) lacca e giallo e nero senza biaacc, in capivi.

17.

May, 1770.—My own picture—canvas unprimed, cera finito, con vernice.

18.

June 12th, 1770.—Paese (Landscape), senza rosso, con giallo nero, e turchino, e biacca—cera.

19.

The Nicæan Nymph with Bacchus—principato con cera solo, finito con cera e copivi, *per causa it cracked*! Ditto, *St. John*! [Very likely.—B. R. H.]

20.

Offe—Interamente con copivi e cera—in testa sopra un fondo preparato con olio e biacca.

21.

Lady Melbourne.—Ditto, sopra una tela di fondo (a raw canvas).

22.

Hickey.—Verm. carmine azzuro (Venice turp. e cera).
Stabilito in maniera de servirsi de Jew's pitch!
(I am established in my mode of using Jew's pitch.)
Lake, verm. carmine azzuro e nero; vernice—Ven. turp. e cera. (Varnish—Venice turp. and wax)!!

23.

My own, April 27, 1772. } First acqua (water) e gomma dragona, verm. lake, black without yellow; varnished with egg after Venice turpentine!!!

Good Heavens! Egg after a resin!—B. R. H.

I have still enough for a third letter on this interesting subject, which I think likely to show the student the fatal consequences of such eternal change of material. It was certainly an infatuation which would have ruined any ordinary talent, and it very nearly seriously injured Sir Joshua's repute, though the perpetual appearance of splendid things, in spite of his cracked and faded works, proved he had generally benefitted by his daily experiments. Every picture which Reynolds spoilt was a loss to the world. Your readers must feel greatly indebted to the liberality of Mrs. Gwatkin.

B. R. H.

London, December 13th, 1841.

P. S.—I have copied every word literally, and am not answerable for any false concords or mis-spelling.

THE APOLOGY.

SIR JOSHUA REYNOLDS' M.S. DIARY.

"If knaves and fools I lash, 'tis mine to spare
The breast of worth and head of silvered hair."

SIR,—In a firm reliance on the word of Sir Martin Archer Shee, as President of the Royal Academy, an artist, a gentleman, and the asserted personal friend of Sir Joshua, my pen threw a doubt and slur on the authenticity of that, however vacillating and mistaken, still unquestionably *illustrious* man's autographic remains, and gave unmerited pain to his respectable relative Mrs. Gwatkin, to whom I tender here my humble apology and regret.

I have seen the *leaf* she transmitted to London, and compared that leaf with a copy made many years ago by another person, and placed in my hands three weeks before I saw Mr. Haydon's letter in your Journal.

I have ascertained also that six correct copies are in existence, viz., the one spoken of by Mr. Haydon as made by Sir William Beechy, one made by Mr. Dinsdale, as a *fac simile*, from Mr. Eastlake's, and four others in the hands of Royal Academicians, who have held them under Sir Martin's nose many years, viz. Mr. Eastlake's, Mr. Pickersgill's and Mr. Dyce's (both made from the first), and one in the hands of Mr. Phillips, the history of which I am not acquainted with.*

Now to suppose Sir Martin ignorant, two years ago, of their existence or their authenticity would be absurd. I must leave the discovery of

* I have strong reason to believe Mr. Phillips made the first copy since Sir Joshua's death.

the *animus* of his assertion, therefore, to abler heads. I can easily conceive the mere exclamation of Reynolds, that he would give "*a thousand guineas to know this and that*," would be *more* readily made by the man accustomed to keep, and therefore to rely upon, a diary, than by persons who keep none and exercise memory; and, while I abstain from any uncourteous language, I do say, if Sir Martin *were ignorant* of the existence and authenticity of these four copies, on the one hand, or knowing and feeling the fact, could fail to appreciate the worth of what may justly be compared to the mariner's compass in its applications to painting, few, very few could envy his head or heart; and it is with genuine sorrow I confess an error arising out of a natural and manly reliance on his word.

The instant I discovered the fact I suggested to a friend an immediate hint to Mr. Eastlake, in his public capacity, that either the Royal Academy or the British Museum ought to possess the Diary, if "it could be bought;" and I am happy one satisfaction, at least, arises out of the business,—a shabby attempt to put it down ends in fixing irrevocably its unquestionable truth.

Mr. Haydon, in speaking of me, Wilhelm de Winterton, says, an "intelligent correspondent"—does he consider this a compliment? It is, I confess, a wee bit something, as Wilkie might have said, higher on the easel of creation than the animals he describes so boldly; but, while new print dresses and tyro scribes are the creatures for commonplace, my poor tatterdemalion vest, after thirty years' hard wear, would have been more appropriately spoken of, and to, by a free comment on anything I may have written respecting his Art.

I am, &c.,

WILHELM DE WINTERTON.

December 10th, 1844.

ON THE OILS HITHERTO USED IN PAINTING;

AND THE NATURAL AS WELL AS REQUIRED PROPERTIES OF ALL OILS FOR ITS USES.

No. I.

SIR—Nearly thirty years devoted to this subject have taught me that the statements and opinions of your correspondent Wilhelm de Winterton, emanate from no trifling degree of thought and more experience; twenty-five or six years ago I broached both in public and private the fact he now proclaims, that fine and pure oil excelled every mixture of varnish in beauty and effect, provided such oil were not used in excess; and that the principle of permanence in oil painting, was to be looked for in such a source alone; while paintings in water had no resource but pigmental permanence or outer varnish. I have expended some hundreds on the subject, especially in fruitless attempts to render the permanent white used in water more opaque, *i. e.* fuller of body or covering power, and expended them in vain; but I have no hesitation in asserting that, had I succeeded to my heart's content—although my purse might have been immensely profitted—for all painters incessantly cried hourly for a permanent oil white—the thing would have been worthless and deceptive in itself—inasmuch, like ultramarine it would have practically changed—that is, the oil would have *risen* and changed; and, as a consequence, a permanent white would have appeared yellow, as that pigment appears green from the same cause.

Your correspondent is also right with reference to the acute and correct observance of fact displayed by the old masters in painting, who, like their contemporaries in physic, were keen observers of facts, not flippant teachers of airy nothings: and, as a proof, I instance Leonardo da Vinci, who *had* observed the rising of oil and its subsequent discolouration; but, taking up a mistaken idea of the cause, viz., that the husks of his nuts gave out a dark colouring matter—he blanched them after soaking in hot water by rubbing off the skins, as the apothecaries blanch almonds prior to making a milky emulsion by beating them with water in marble vessels—he fell then, upon a remedy worse than the disease, for believing implicitly in the purity of his oil—subsequently procured after the manner of the Persians, who extract the attar of roses, viz., by pouring boiling water on his bruised kernels and skimming off the ascending oil—Leonardi used more oil than other painters of his day, and hence his pictures rank by no means high as to permanence: Wilkie, when it Italy, described his Last Supper as awfully gone, when a fresco painted in the same building, long antecedently, remained fresh. It must be remembered too, that Rubens, at any rate *after*, if not before, he painted the Brazen Serpent,[1] used infinitely *less* oil, and yet his pictures are not only *more* perfect, but defy the picture cleaner's solvents—simply because he used *more* turpentine, or naphtha, and glazed with—some say copal—I say amber.

This must not be doubted, because such painting, in the *lighter* portions of many, flatten skies, easily *rubs out*, and is *not solid*. Resinous matter (solid turpentine which, in nature, is often mixed with gum,) was also much used *one hundred years* before his day, as well as subsequently; and resinous matter gives as much solidity as any oil, an example whereof I examined from the easel of a pupil of Georgione, which was so perfect a mass of resin the whole picture might have been crumbled into dust, like mastic varnish; a state no painting, however old, *could* reach if painted with excess of oil; and I am strongly induced to believe, that to a knowledge of this fact, but a misapplication of the principle, we owe more than half of Sir Joshua Reynolds' fine tone, colour, and effect being lost in multitudinous cracks. Sir Joshua was not aware, also, that the law which governs the drying of oils, and resins dissolved in oils, is *inversed* in the drying of liquid resins, or resins dissolved in spirits, as I shall fully develope in my next paper, simply premising here, by way of elucidation, the more hard and fiercely drying the former are the more they are disposed to crack; whereas, the more soft and destitute the latter in drying power the greater is the cracky tendency.

Holding these opinions, I taught them, and was laughed at as the best compliment due—even after I pointed out the superior permanence of house-painters flatten, and caused a room to be so painted by a very worthy man, the late Mr. James Newman, at his country residence, Whetstone House, at the time another was painted in Soho Square with oil; and the result answered my expectations fully; the one became whiter, and the other a filthy yellow. Again, in 1821 I saw a most respectable picture cleaner residing with me, rub off some of the permanent skies while the oil saturated ones were changed even where ultramarine had been used: still did art reject the proffered boon, and artists laugh at me: Mr. George Saunders alone listened respectfully and acquiesced. Now what are the properties required? Simply those De Winterton has presented to your readers, but, of course, in justice to the limits of your pages, in general language only.

The hasty opinions of M. Merimeé, like him, I regret: our object is not to brighten colours, but to render them permanent—to dry them rapidly in this, and all similar climates, without rising and without horn, which cannot be done except by approaching these ancient skies and this flatten in elementary power; but to oil.

Nut oil, I believe with him to be worthless, except to grind colours in which are intended to be kept—because it does not dry:—poppy and linseed oils are those obviously indicated by common sense, because they do dry—to which may be added, in this and similar climates, oil of hempseed (if properly made), and in hot ones castor oil, not that of olives, very generally used in Italy to prevent drying; it must, however, be carefully used or it will beget tack; and wherever an Italian picture of the higher order has failed, it has either been from excess of oil, or the use of olive oil as a check upon drying. Some silly offspring[2] of the easy chair of an institution has suggested to English artists the separation of the oil into elain and steirine, its elementary principles—without a vestige of practical knowledge or rational motive—supposing the fatty, but more solid steirine injured the oil—whereas the elain, once separated, *dries much worse*, and is of an inferior colour—rises as much—horns as fully, and deteriorates as perfectly as before: so much for the worth of institution gentry, the moment they leave the mere schoolmaster's chair. Alas! you might as rationally expect the pedagogue who teaches the elements of navigation to practically steer a ship; what would be the result? and yet, these men are laughably enough looked up to, *on practical matters*, and strutting in all the false plumage of the daw, in which you have ridiculously decked their backs, are permitted often to spoil the best of arts, and damn the best of plans.

Such men, Sir, like the pedagogue, may be highly and unquestionably respectable in their sphere, but keep them in it in the name of all the saints—out of it they remind you of Scaliger, and Ben Johnson's—

"Word catchers, youth cheaters, vain-gloryosophers,
For such are your seekers of virtue-philosophers."

[1] Some persons, and gifted men too, assert that, in a blind reliance on the "subsequent" practice of Rubens, and the invulnerable powers of his "glazing," the picture cleaner has spoiled this picture by taking off all that finer finishing which 'once existed.' Others, and accomplished men also, say, The Brazen Serpent 'never had been glazed at all:' and I am not so truly presumptuous as to give an opinion.

[2] A note to Haydon's Lectures shews us some of the minor fry of theory have infected him too, about olein and steirine; why, so far from being 'siccative;' the discoverer of elain or olein many years ago suggested it to watchmakers as a substitute for oil of the ben nut, because it would not dry!

Or of Heylyn the geographer who, as such, was a valuable man, and of great knowledge as a teacher, yet lost himself in the bye path of a wood at home; but enough, we require a new class for the amphibiæ, for at this moment the poor Germans are bewildered and bewildering themselves on the subject of oils. One Fernbach, who calls himself a painter as well as a chemist, full of the elementary fractions and elements of fractional elements of matter, with which Leibig is muddling the brains of man, has published his lucubrations, and a German lucubration is no joke. The national character of the man is obvious; a German is a hard-working, word-catching, matter-spinning pioneer, but attempt to follow his practice and you are as absurd as the fool who without being able to swim, because of some learned crochet just acquired at one of these gingerbeard rostrums, takes a bath in Lake Huron and finds his just level some hundred fathoms below the earth's surface.

Fernbach is a goose. Seeing that all oils have something like acid characteristics, that is neutralize alkalies and form soaps, determines at a leap that this oleic acid, which he has pre-supposed, is the source of pictorial change; and like the wooden leg invented by a talented Dutchman, Mynheer Von Wodenblock, of Amsterdam, the springs of which, if once *touched*, set in motion a more than monster of Frankenstein power, which thenceforth strode, in defiance of his skill, over mountain and moor, sea and land, to the end of time,—M. Fernbach proceeds at a similar pace, and, *ex officio*, teaches painters what colours to use and *how* to use them! Now, of all the monsters the freaks of nature have generated; a stupid Scotchman or a metaphysical German the most defy description.

Pictures change, in oil, from the simple cause already explained, and by the mere oxygenisement of that oil which has *not* sufficiently rapidly become dry or fixed—hence the time for rising and formation of horn. And here I appeal to your correspondent, B. R. Haydon, who *uses a very pure, simple*, and non-tampered with oil, and yet it rises and horns. Pictorial change, then, *can in no other way be avoided* than by the means suggested by me to the Secretary of the Royal Commission of the Fine Arts[3] for conditional publication; or, for I by no means play the egotist, means acting by similar *modus operandi* in drying.

To dable with oils is absurd and fruitless. Oil bleached by light alone, until it becomes as limpid and as colourless as water, *rises as soon* and *horns as much* as oil untouched by Art; to bleach it, therefore, is but a trick of trade, a change of the mere glowworm's light to the true *ignis fatuus* flame of the moor.

Oils, Sir, may be bleached in two opposite ways—by a pellet of potassium, weighing three grains only, loosely rolled in white-brown curl paper, to every quart, and exposed corked to light, but here it is bleached by abstraction of oxygen from its elements, its drying powers are injured while the painter wants them *increased;* or by passing chlorine into them, agitating them with the gas *over water*, and ultimately separating the oil, here the object is *better* effected because brought about by *abstracting* hydrogen and leaving oxygen in excess in its elements—something like this is done by Messrs. Winsor and Newton—the result is beautiful to look at, but deceptive as I have just shewn; besides, the instant you use it, with eight pigments out of ten it begins to go back again by an unerring law of nature, and skins more, also, where oxides of lead or other metals are used. I may, then, ask *cui bono?* let the smatterers who bleach oil, or those who oxygenise it, reply if they can.

Your correspondent, De Winterton, is also right in saying that the sulphate of zinc is some exception to the rule, when really anhydrous, as all pigments and dryers ought to be—it partially bleaches oil as it dries; but I am now prepared to suggest a much superior power, and which shall fully render flake white, in practice, equal to ultramarine in ordinary oil; and Heaven knows my interests therein may be unable to prevent the collapse of a nut's shell, I shall therefore publish what I know.

These may be taken as axioms: all native oils dry in something like the ratio of their quantity of mucilage; and in proportion to their oxygenisement, or their affinity for oxygen; all oils, by age, become oxygenized spontaneously—a state *miscalled* fat—when they are approaching the characters of varnish, and as an inverse proof, all tacky varnish if de-oxydized by potassium (treated as described) becomes *really fat*, that is, oily and flows well *without* tack; all oils dry by the *formation of skin*, which becomes horny and yellow,—hence, the use of Mac Gelp and boiled oil, which have an *increased* skinning power, is sheer blindness and infatuation, besides the use of a dirty solution of lead, repeated layers of which form a near imitation of caoutchouc.

[3] In which I sacrifice, for public good, £100 out of £150, and the further loss of more than £80 in expenditure on this subject alone, without any reference to the cost of fruitless attempts at effecting a permanent barytic oil white, which I do not regret because, had it been effected, it would have been worthless.

There is an error also, and a very natural one of practice, viz. to use dryers only with non-drying colours; now a proper dryer and vehicle ought to be used also with *good* dryers, as for example flake or Kremnitz white; without adding a dryer so as *to transfix it rapidly* its necessary action on the oil, combined with its gravity, increases the disposition to skin, hence its rapid failure and horn, and it is but sheer supererogation to add, he who makes a Mac Gelp *with any bleached oil* deceives himself; and he who uses any Mac Gelp at all, or boiled oil, wants his eyes couching and his perceptions bleaching by my *hitherto* endless waste of time, money, and mind.

I am, faithfully yours,

W. MARRIS DINSDALE.

December 18th, 1841.

WESTMINSTER IMPROVEMENTS.

With an Engraving, Plate II.

SIR,—I know of no other means of bringing this important subject fairly and effectually before those who can judge of its character, than by detailing what is required and what is proposed to be done, in the columns of a scientific journal, where the object itself, and not the interests connected with it, is reviewed, and where harsh terms are not likely to become substitutes for reasoning, I therefore beg the favour that you will lay before your readers the following statement of what is proposed to be effected in Westminster, and a few remarks relevant to the subject in general.

Accompanying this communication are two plans, shewing the same parts of the city of Westminster, but having on one the line of street which I have laid down, and which has received the sanction of the Metropolitan Improvement Commissioners, and on the other the line proposed by Mr. Pennethorne and those by the inhabitants of Tothill Street. The line laid down by myself is marked A A A, called the South line; that by Mr. Pennethorn, B B B, and the one which now is opposed to mine, laid down by the inhabitants of York Street, is marked C C C, called the North line.

The line I propose, A A A, the South line, is nearly similar to that suggested by Mr. Rigby Wason some years since, differing only in its sinuosities, which have been arranged in their present form to avoid expensive public buildings and manufactories—namely, the Workhouse at the East end, the Westminster Bridewell at the West, Wood's Brewery and Bryan and Price's Manufactory in the middle, these are rocks a head, but it is the Workhouse only which obtrudes itself objectionably, had it not been there the opening of the West end of Westminster Abbey would have been all that could be desired, as it is, the opening will have no mean effect, the towers will be seen along the whole line, and the whole end of the abbey will suddenly break upon the observer some distance up the street, forming one side of a magnificent quadrangle. The lines of a street gently curved, it is well known, are very much more striking than those of a straight street, and much more opportunity is afforded on a curved line for architectural effect and observation, so that I cannot, otherwise than for the abbey's sake, regret that the line is not straight between its termini, particularly as the radial lines of party-walls and the frontages will be practically straight, and ventilation will not be impeded. I would refer to the effect of the High Street, Oxford, and the Boulevards, at Paris, for the superiority of turned lines in wide streets over those that are long and parallel.

I am sensible that an effort should be made to satisfy the public in respect of the abbey, but the sum allotted for the whole street would barely suffice to purchase the property in the way, and the question remains, whether the lengthened view of the end of that building, or indeed the gothic of Wren, is worth the large sum necessary for its attainment. Perhaps those who have raised this objection, apart from a consideration of the circumstances which oppose its remedy, may after this explanation be induced to relinquish opposition, and assent that a large amount of good should not be relinquished because the whole amount they desire is unattainable. It has been said that Arabella Row is the opening to which the street should be directed, but I have not heard so from any practical men; the environs are, it is well known, extending rapidly to the North-west, and in that direction improvement should follow. With respect to Mr. Pennethorne's line, B B B, that gentleman, like myself, saw the futility of designing a street which should cut through the workhouse, and his much greater experience in these matters induced him to prefer even a quick curve in his line when economy required it, to an expensive straight one. The lines C C C, suggested by the residents and owners of property in York Street, and must be considered highly effective, for they not only include the improvements of my line B B B, but also the entire demolition of all this part of Westminster, requiring an expenditure of at least £500,000 instead of £50,000. The plan is a bold one, and when it is viewed as the production of tradssmen in the neighbourhood, will not be viewed with asperity. The principal features are the *cul de sac* in Dean's Yard, and the ingenuous avoidance of the Houses of Parliament, which all other lines have designed to open.

On the plan which shows the line A A A are marked some suggested improvements, which may be carried out at a comparative small cost, and which would effectually open the New Houses of Parliament, forming drives for carriages attending there: the principal line would command Victoria Tower. All discussion of the merits or demerits of the proposed street must lead to good, and when it is carried on by those who are really disinterestedly interested in the subject, even its immediate promoters should not be disappointed at objections, unless when deprived of the right to offer explanation to remove them. One great outcry raised against the line about to be carried to parliament, is on account of its course through the churchyard in the Broadway, and a part of the press has been set to work to protest against such a desecration, although in other cases a sturdy advocate for the removal of the dead from crowded neighbourhoods, but no interests clashed on these occasions.

"Dat veniam corvis, vexat censura columbas."

With respect to the churchyard, I desire to be silent, for were I to give the commonest narrative of the horrors of that place, and its management, your readers would give me credit for plagiary from De Foe; suffice it to say that the subject received due consideration in the proper quarter, and that the measure has received the sanction of the Bishop of Loodon. Many difficulties have been vexatiously thrown in the way of our proceedings, but such is usually the case in these matters, and I have recorded only those which appear to have some sort of justification.

A sketch of the present condition of the part of the city of Westminster now about to be improved, will set at rest any question as to the necessity for improvement, and leave for consideration only where the axe should be first laid, and upon what course a new line of street should be effected. Upon this question there is a division,—one party insisting that vice, filth, and misery should be at once uprooted, and that a thorough ventilating line, which should effectually drain the district, ought to be carried: another party desiring to make respectability still more respectable, advocating the improvement of old, rather than the creation of new thoroughfares, and asserting their claims as rate-payers to the first draught from the cup of public bounty.

This difference of opinion, or rather this struggle for preferment, has existed for some years, and those who advocate the improvement of York Street and Tothill Street, rather than the new line of street now proposed to be made to the southward of these streets revive part of a plan for which the Dean and Chapter of Westminster obtained an act of parliament in the year 1841, and subsequently abandoned as impracticable, while those who promote the other course adopt the plan recommended to Parliament by the Committee of Improvement of the years 1832, 1834, and 1835, by the report to the Lords Commissioners of the Treasury in 1837; and, finally, after due consideration by the Metropolitan Improvement Commissioners, in 1844.

The line adopted by the Dean and Chapter failed for want of funds, the one often recommended by the Surveyor of Woods and Forests, was as often strangled in its birth by strings of figures, easy to write, difficult to read, and impossible to meet in pounds sterling. These two plans are neither incompatible nor antagonistic, and possibly the one will eventually be the means of effecting both, but 50,000*l.* is now offered for the one, and a scramble is called for first chance by the promoters of the other. The field of contest is a district, having York Street and Tothill Street for the north boundary, and Great Peter Street for the south. York Street and Tothill Street are closely contiguous to St. James's Park; they are respectably occupied and well ventilated, but York Street on its south side is closed in by courts and alleys, densely occupied by the labouring poor. These courts and alleys are bounded on the south by the Broadway, and beyond this the neighbourhood is more open and less densely populated. Through this part runs the line C C C.

At the Tothill Street End, on the South side, commencing at the East, is a mass of infamous property, extending in a South-westerly direction to the Horseferry Road, containing the Almonry, Orchard Street, Duck Lane, Pye Street, and intersecting courts and alleys, too numerous to mention, the resort of criminals, the very focus of vice, and the foul spring of early depravity,—where disease and want, rife as they are, lose their horrors in the contemplation of human souls withering in a fearful pestilence of blasphemy, crime, violence, and ignorance. Seventy houses are occupied by some 800 of a class, whose success in crime enables them to live and dress in a manner which does not disgsut the common observer. Fifty other houses are occupied by the lowest thieves and the most wretched and abandoned of women, some five hundred in number. Forty other houses are either unoccupied, or occasionally resorted to by the utterly destitute, or by those who, having filled their measure of crime, seek to elude the law's last vengeance. Such is the district through which the proposed street B B B is designed to pass—and thus a great object would be attained, namely, the annihilation of a dense mass of infamy. In the other the object attained would be but the improvement of a neighbourhood having nothing to disgrace it but the neglected wants of the poor. A reference to the plans will show the direction of both lines; and it must be observed that in each project only one street can possibly be carried into execution with the allotted funds, and also that the cost of the northern line would put it far beyond the sum allotted.

Having laid before you a description of the district through which the B B B line is proposed to be carried, I will lay before you a concise statement in repudiation of the charge current that the scheme is a job.

It is well known that Mr. Rigby Wason, and other gentlemen, have for many years laboured to alter the condition of Westminster, but it is not generally known that Mr. Wason, Mr. Ashton Yates, and Mr. Richard Rushton Preston, to promote the measure did, with the sanction and privity of Lord Duncannon, the then Chief Commissioner of Woods and Forests, conjointly, purchase in aid of the scheme an intervening property on the line, and that this purchase now enables them to carry out the measure, and for a sum much less than one-half what Mr. Pennethorne estimated for a street 20 feet less in width, having the same termini, but much more circuitous. To the liberality and perseverance of these gentlemen may be attributed the advancement now made in the arrangement for this line of street, and I refer your readers to the evidence given before the Metropolitan Improvement Commissioners during the last session of Parliament as the best corroboration of this statement.

In conclusion, the objects of the proposed line of street are—

1st. To destroy the infamous part of Westminster.

2nd. To drain and ventilate it.

3rd. To form a direct and handsome line of communication, 80 feet wide, between Westminster and the north-west suburbs, and to open the Houses of Parliament.

4th. To provide healthy and commodious dwellings for the poor.

The first object would most obviously be secured by the plan laid down. As respects the second it must be observed that many parts of the line are now below high-water mark, and that none are much above it, that with regard to ventilation by the plan suggested, both sides of York Street and Tothill Street would be ventilated instead of one side only; and also the district South of the line extending to the Horseferry Road, Palmer's Village, other parts also, now below drainage and unwholesome, would be likewise improved.

With respect to the required communication, it may be said that there is now no safe way at night from the Houses of Parliament to the four or five thousand new houses in Belgrave Street and Hyde Park Gardens, except by Charing Cross. With respect to the poor on the line, all will agree that their claims should be well considered, they have received notice that habitations will be provided for them, properly drained and ventilated, at a moderate rate. Finally, it may be observed, that the projectors give the public a large part of the line of thoroughfare, and that were they not to do so, the street could not be opened for the small sum for which we have undertaken to complete it. I am, Sir, yours, &c.

Torrington Street, Russell Square, HENRY ROBERT ABRAHAM.
Dec. 19, 1844.

THE OXFORD CHORISTER'S SCHOOL COMPETITION.

SIR,—If all the circumstances stated by "A Constant Reader" be correct, I think they go to inculpate very strongly the high characters of the parties who had to make the selection in the competition alluded to; nor is it any excuse for them to attribute to a want of knowledge of business on their part, what seems to have been nothing more or less than a want of honour, honesty, and fair-dealing, and even a disregard of appearance. What are we to make of the very startling fact that in open violation of the implied contract with the rest of the competitors, Mr. Derrick was allowed to send in his drawings at least two weeks after the time specified, and when he had or might have had access to the designs of his less favoured rivals? And the presumption that he did not scruple to avail himself of the latter opportunity it being evident that he was not influenced by any high sense of delicacy, otherwise it would have deterred him altogether from entering into a competiton whose terms—made binding upon others he has evaded. What renders matters worse, and appearances all the more suspicious, is that Mr. Derrick is an Oxford man. This has at least an awkward look; for although we are told that no man is a prophet in his own country, many a one is a great man in his own parish who would not be thought much of out of it, parish pride and parish favour being not without their influence.

So far then as Mr. Derrick is concerned, he must rest under a most humiliating imputation unless he can now come forward and boldly contradict what has been asserted with respect to his sending in his designs a full fortnight after the expiry of the time afforded others. Nor is it he alone who must put up with the discredit resulting from such transactions, since it must be shared by those who sanctioned it, and who are thereby guilty of a gross breach of faith,—of shuffling and double-dealing. And if they have so far notoriously criminated themselves, what pledge have we that they were strictly impartial in all the rest of the business, and dealt out even-handed justice without favour to any one? It is mere cant to talk upon such occasions of the honour and respectability of parties whose very honesty is called in question. Their position in society may give them what is called "respectability," but their honour stands impugned *de facto;* and however it may regulate their general conduct, that is no excuse for disregarding it in particular cases. It is but sorry consolation for being duped, to know that you have been duped by men of fair characters—people who stand well with the world and its opinions. There ought not to be room for even any suspicion of foul play and underhand dealing.

A very strange disclosure would, I fancy, take place could we sometimes compare designs that have been rejected at competitions, with the building executed from the selected one. The taste, if not the honour of those who made the choice, would frequently be sadly reproached, and stand convicted of gross error. Either such would be the case, or in many competitions there could have been no sort of talent and taste whatever, if we may judge from the thing on which "the pippin of preference" had been bestowed,—of course, as being the very best.

Competitions being for the most part managed so very unsatisfactorily, the usual advice given by their friends to architects is; "Have nothing at all to do with competion." Yet that differs little from saying: "renounce every opportunity, every chance that presents itself to you in such shape." The counsel is fitted only for those who have no occasion to go in quest of opportunities.

As to the Institute.—instead of asking what it can do, the most proper question would be—"what has it *tried to do* towards remedying any of the abuses complained of, in competition?" Its other labours for the weal of the profession, and the interests of the art, do not appear to be so onerous and so extensive as to prevent its troubling itself about such "petty matters." It might at least express a desire to receive communications and evidence upon the subject, and to take into careful consideration whatever could be suggested as a likely mode of reforming the present system of competition. Will the Institute ever do this?—Yes: but *when!*—on the thirty-*second* of January.

JAMES.

THE CAMBRIDGE CAMDEN SOCIETY.

Our readers may have heard of "straining at a gnat and swallowing a camel." We cannot help thinking the following letter a lively illustration of this curious phenomenon:—

To the Editor of the Cambridge Chronicle.

Trinity College, Dec. 13, 1844.

SIR—It having lately become a common practice, and one not unlikely to be imitated, for anonymous publications to issue from the press, purporting to be written by "A Member (or members) of the Cambridge Camden Society," I feel it to be due to the society and myself, with your permission, to remind the readers of any works so published, that these are in no way to be considered as having the approval or sanction of the society, or of any of its members.

I might extend this remark to publications, not anonymous, issued by writers known to be officially or otherwise connected with the society; but my present communication has more immediate reference to a new publication, which has just met my eye, and of which I should be sorry to leave any but as to my sentiments of disapprobation.

I address you in my personal character, having no opportunity of consulting the committee, which has broken up for the vacation.

I remain, Sir, your obedient servant,

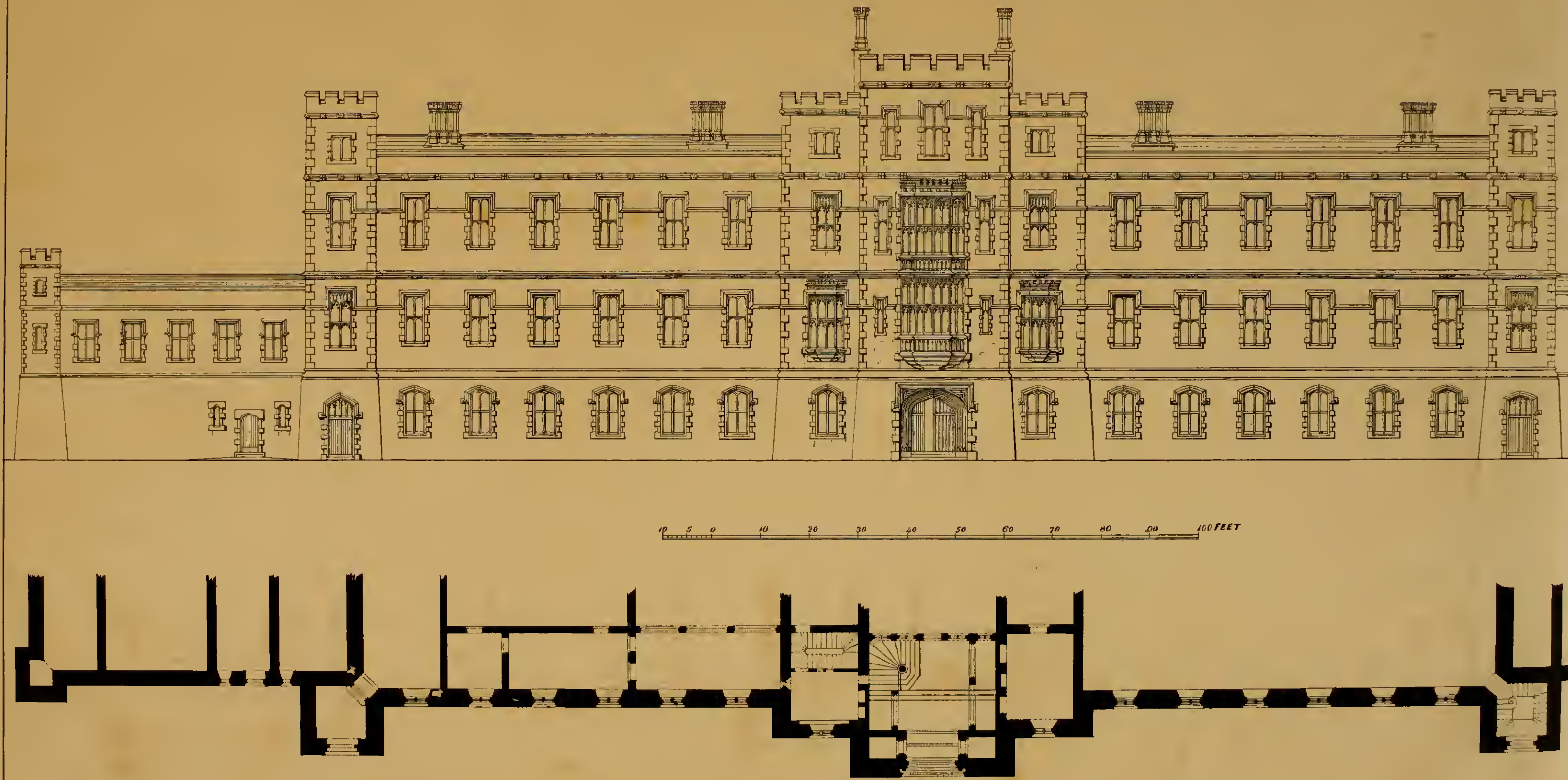
THOMAS THORP.

We must confess ourselves in the highest degree puzzled to conceive any thing that may issue from the press anonymously or not, as being likely to embarrass the deglutition of the Venerable gentleman who rejoices in the office of President of the Cambridge Camden Society. If the work to which reference is made in this letter, be the production to which a review appears in another part of the Journal, we are at a loss to discover any thing in its pages which has not already been virtually set forth again and again in the "Ecclesiologist" and other publications, the full responsibility of which the Reverend Archdeacon will hardly pretend to disclaim. More than this, we fear lest the Venerable President should lie open to no light charge of ingratitude in dealing this unkind cut to the "writers known to be officially or otherwise connected with the Society," who have certainly during the last three years stuck at nothing, true or false, clean or dirty, to promote the objects of the Society, and therefore, we might be justified in presuming, objects not disapproved by its President. Taking it for granted, however, that the pupils of the Reverend Archdeacon have stretched a point beyond the limits to which he must be supposed to have confined them in their recognized publications, he ought to recollect that during the period which has elapsed since he organized them into a Society, their beards have grown—from hobbledehoys they have become men, in years, if not in discretion—and they must have profited little by the sort of encouragement given them by their tutor, if they do not conceit themselves to be as good men as himself. Moreover, what result (we ask) could he expect from a Society founded on false pretences? Its very name is a false pretence. We can vouch that numerous communications have been opened with the Society, especially by clergymen in distant parts of the country, under the mistake that they were corresponding with a long established and honourable association—*the* Camden Society—very different from the official staff who take upon themselves to exercise the functions of the other Camden Society at Cambridge; and we presume the success of this ingenious manœuvre is the success boasted of in the preface to the collected volume of the "Ecclesiologist." False pretences have been the staple commodity of the Society. Its ostensible business has been the improvement of ecclesiastical architecture—its real and notorious object to promote the views of one of the hostile divisions of the church. Influenced by parties who are concealed behind the show box, and pull the strings by which managing committee are made to dance, their whole powers have been thus unremittingly directed almost from the foundation of the Society to the present time. On this part of the subject we shall not dilate. We are of no party, and lament that any question connected with the church should be disgraced by such advocacy.

There is yet another pretence which we know to have been professed by the Venerable President as a motive for promoting the original establishment of the Society—viz., that it would afford a laudable occupation for the leisure of the young gentlemen of the University, and it is but justice to the Archdeacon to admit the excellence of this motive, and the degree of success which has attended it. Since the establishment of the Society we have not again heard of any posting of the names of Fellows for non-attendance at Chapel, or of discussions ont their moral qualifications for the office of Proctor,—and the pages of the *Ecclesiologist* give abundant evidence that it has acted as an outlet to a spirit which could not have failed to vent itself, probably in the shape of sedition and nastiness, in periodicals of another class. On the other hand, (for every question has two sides,) it may be doubted whether it is perfectly just to check the torrent of insolence and scurrility merely to turn it in another direction, and whether it is quite fair toward the young men themselves, to encourage them in a course which they may be tempted to follow at a more responsible period of their lives, and which may entail upon them the punishment, legal or illegal, which is apt to overtake a taste for writing and editing "*Ecclesiologists.*"

We beg to be understood, that these remarks are meant to apply only to that class of the members by whom the Cambridge Camden Society is *worked* at head quarters. The general list of the Society includes the names of many who must be totally ignorant of its real proceedings, and it is notorious that many of those whose high characters and reputation were mainly influential in enabling the President to found the Association, have long since quitted it in disgust; a fact for which the reader may search in vain among the reports pretending to detail the transactions of the Committee at Cambridge, in which nevertheless all accessions are carefully recorded. We beg also to be understood that whatever we may have felt bound to say, we entertain the most profound respect for the President. Whether he respects

QUEEN ELIZABETH'S HOSPITAL BRISTOL



GROUND PLAN.

THOMAS FOSTER & SON, ARCHTS BRISTOL

himself when he permits his gown to be made a screen for the writers of the "Ecclesiologist," is a question it does not become us to handle.

That our readers may judge whether we have taken a candid view of the President's unkind reflection on the writers to whom he alludes in his letter to the "Cambridge Chronicle," we propose, in a future number, to extract a few "beauties" from the authorized publications of the Society, which we have a right to suppose have been issued with his concurrence.

COMPETITION.

[*Of letters received by us on this subject we insert the following.*]

Sir,—Complaints on the subject of competition are, I find, again rife, and apparently not without reason. The case of the Choristers' Schools, Oxford, is not free from a very strong and ill-flavoured stain of the suspicion of singular unfairness,—to be removed only by Mr. Derrick's now rebutting what has been alleged against him as regards his taking what was a decided advantage over the other competitors. Nor is it merely his taking it that has a strange appearance, it being quite as unaccountable, if not more so, that he should have been *allowed to* take it. If this last circumstance does not look like direct connivance and favour, I do not know what can be so called.

Another case—of little or no moment perhaps in itself, yet more than a little edifying and instructive, as showing with what sort of honour competitions are conducted—is that of the "Hardy Testimonial," the design chosen for which was one by Mr. H. Dyke Ackland, an amateur architect—not that his being so was particularly exceptionable—and, moreover, actually *one of the committee!* This is really quite staggering—so outrageously gross as to be hardly credible, except it be confirmed by not being formally contradicted.

If nothing further is to be hoped for, hoped it may be that such exposures will do some good preventively, and also by forcing attention to the subject. Yet the merely pointing out such instances will not lead to present remedy. It is highly desirable that some *stir* should be made about them, and the matter be taken up by the profession generally—especially those of influence in it—and not left entirely to individuals, who are besides immediately interested parties in the respective cases, they being the aggrieved ones.

As one salutary check upon what are now secret and irresponsible committees, the profession should agree, and make known their determination, not to enter into any competition unless all the names of the committee were given in the *programme*, and should further stipulate that it should be afterwards made known how they voted. At present it is quite impossible to know by what sort of majority a design is elected,—much less on account of what particular merits, real or supposed,—although the only reason for withholding reasons that would justify the choice made, appears to be the utter inability to assign any that would pass as such.

I remain, Sir,
Your obedient servant,
T. H. T.

REVIEWS.

THE CAMBRIDGE CAMDEN SOCIETY.

The Church Restorers.—A Tale treating of Ancient and Modern Architecture and Church Decoration. By F. A. Paley, M. A., Honorary Secretary to the Cambridge Camden Society. London: John Van Voorst.

We promised to again consider the views advocated by the Cambridge Camden Society, and the publication of the work before us gives us the opportunity of doing so. This work, the production of the Secretary of the above Society, professes to give an account of the foundation of a Saxon church, its successive additions, alterations and perfection, its mutilation at the Reformation, its subsequent degradations, and finally its restoration by a "youthful Ecclesiologist."

We must premise that, the work being published by the writer on his own responsibility, and not in his official capacity, our remarks can only in a limited sense be considered a criticism of the opinions of the Camden Society. Nor do we consider ourselves entitled to the same liberty in reviewing the publications of a writer who avows his name, as those published by a society collectively and anonymously. At the same time, there will, we suppose, be no objection to our assuming thus much,—that if the opinions of Mr. Paley should appear to the Society, of which he styles himself secretary in his title page, to tend to superstition, innovation or schism, it, as an academical and for the most part clerical body, would take some means of expressing their disapproval.

That the writer imagines his doctrines of a somewhat novel and exciting tendency may be inferred from his commencing his preface with the following passage—

It is very possible, and somewhat to be feared, that the following tale, if it attracts any notice at all, will excite the wrath of one party, the ridicule of another, and the suspicions of a third. By all three it will probably be called popish, superstitious, flippant, satirical, and a great many other hard names of the like kind.

Now it is clear that a book must be very bad indeed to deserve all this; and an author must either have some sinister end in view, or entertain an overweening opinion of its merits or usefulness, to risk the danger of such abuse.—P. vii.

The story of the book, for there is a story, opens with an account of a band of Christians flying from "the murderous Danes," and building a Saxon church of simple construction at a place called Letherton. The spot chosen for the church is indicated by a spring bursting miraculously forth from the ground, whereon some "sacred relics" they had brought with them rested. Of relics Mr. Paley seems, both here and elsewhere, to have considerable admiration. In the present instance they consisted of part of "the precious body of the holy saint and martyr Winifride," of whose name, by the bye, we can find no mention in the calendar of our prayer books; but then, as we have said before, the compilers of the prayer book did not know half so much about church matters as we do, and it was this feeling no doubt which induced Mr. Paley to speak as he has done, notwithstanding that the twenty-second of the articles of religion declares "the adoration of reliques" to be "repugnant to the word of God."

The story goes on to tell us, that many years after the first foundation of the church, a certain Sir Aubrey de Kynastone came into the parish, and possessing a much stronger predilection for monks and masses than the hard fighting gentlemen of Henry the Third's time usually get credit for, rebuilt the church with far greater splendour than it could originally boast of. The description of the church certainly displays great architectural knowledge, though rather prolix. Let the masons of our own time read the following passage on the construction of the church, believe (if they can), and be ashamed.

It was surprising to observe how perfectly the masons appeared to understand their business without either drawings or a word of instruction. You might see a shapeless lump of stone left at the top of a column gradually expand under the magic touch of the artist's chisel into the most exquisite bunches of flowers, which seemed to start into life from out the solid mass, and to curl and creep and cluster in a thousand fantastic knots and interlacing excrescences. Then the doorways were amazing to behold. The highest powers of a never-failing genius seemed to be exerted in their design and enrichment. They freely invented; in fact, scarcely any two details were actually the same: yet all were perfectly consistent in general appearance and contour.—P. 29.

Robert Grostête, bishop of Lincoln, consecrates the church, and is entertained by Sir Aubrey. The following incidental description of a visit paid by the bishop to the warlike knight's daughter, the Lady Etheldreda, is, we think, (barring the theology) very beautiful.

Ascending a steep staircase through a low Norman arch, and between narrow walls, the Lord Kynastone knocked softly at a small door. It was opened by a female servant; and the Bishop and the Abbat found themselves unexpectedly in the presence of the Lady Etheldreda. She was young, and very fair; but an air of placid melancholy, and perhaps ill health, or the effects of protracted study, sate upon her brow. She received the guests with that respectful courtesy and affectionate regard which is felt by a devoted daughter of the Church towards its saintly ministers. As she knelt to receive their united blessing, her eye was instinctively turned towards a small silver crucifix which stood upon a stone bracket in the wall: and the good Bishop failed not to note that the ground before it was worn by the knees of this holy maid. She was pleased, she said, that they had condescended to visit her little oriel, which she had not hoped ever to see thus highly honoured; but it would be yet dearer to her from that day. Yet to view such a bower and such an inhabitant might angels have come: as, perhaps, they often did.—P. 41, 42.

The edifice increases in size and beauty until the time of the Reformation, at which time it is owned that the church "had become venial and corrupt, and careless of her charge." Of the Reformation, nevertheless, Mr. Paley seems, from the following passage, to have but small admiration.

Even yet we view with indifference the sad scenes of this fearful havoc, and talk about the "glorious Reformation." Perhaps we never think that a urse can have attended such worse than heathen impieties.—P. 62.

Little cared the godless possessors of the Church's lands for the solemn anathema which She had pronounced of old on the heads of the spoilers. But the judgment came, and fearfully and visibly it fell. Great families one by one became rapidly extinct. Awful deaths, grievous visitations, fruitless marriages, were the penalties which attended sacrilegious wealth. Property passed from hand to hand, but remained with none. The finger of God was manifested against the deeds of that day; but man in its blindness saw it not.—P. 63.

We dare say not. George Fox, in his diary, records with great complacency the fate of some of those who opposed his labours to advance Quakerism. The justices who imprison him are "cut off," or by the death of a wife "left with fourteen motherless;" one gaoler is "cut off in his young days," another "in his wickedness," and others are "ruined in their worldly estates."

Mr. Paley seems to view the calamities, or supposed calamities, of the reformers of the church, "venial and corrupt and careless" as he confesses it to have been, in a similar self-congratulating, amiable spirit. Did he ever hear of the Tower of Siloam?

The history of Letherton church subsequent to the Reformation is traced in most pathetic terms. The Puritans continue the spoliation commenced at the Reformation, and the degradation of the sacred edifice goes on to the commencement of the present century. At that time the church fortunately comes into the hands of a rector whose son is addicted to church architecture, and is a member of the Oxford Architectural Society. (It would have smelled of the shop, we suppose, to have made him a Camdenian.) This young gentleman, who adopts the chronological notation invented by Dr. Pusey, and dates a certain letter to his papa, "Oxford, the Feast of St. Matthew," set about restoring the church, something in the same fashion as the Cambridge Camden Society have *restored* St. Sepulchre's at Cambridge, and so the story ends.

Having thus analyzed the book, we shall give a few extracts to exhibit some of its peculiar tenets. The following show the writer's notions of chancels.

A screen of wood was placed in the chancel arch to divide the people from the throne of the adorable Mysteries.

Does the chancel convey to a religious mind no esoteric meaning? Is it a mere oblong projection of the nave towards the east? Do we not instinctively feel that while the nave is, as it were, the vestibule, the chancel is the palace of the Great King? Can we see its solemn screen—its most ancient *cancelli* across the entrance arch,—without hearing the Church say to the careless intruder, *thus far shalt thou come and no further!* The *use* of the chancel is just the same to us as it was before the Reformation; namely, to receive the clergy as distinct from the laity; the communicants from the non-communicants; the priest who offers prayer, from the people who follow and join in it. The chancel is the choir of the angels; the Church triumphant; the Holy of Holies. It is the feature which essentially distinguishes the form and character of a church from a secular building. It holds apart from the vulgar gaze the seat of the blessed Mysteries.—P. 105.

It is singular, that in promulgating these tenets, Mr. Paley has forgotten to support them by texts of scripture, or passages from the prayer-book. He is content with bare assertion—even arguments of common sense are deemed superfluous.

The next peculiar doctrine of this book is faith in modern miracles! Our readers will perhaps scarcely credit that the tales of the marvellous, so prevalent three centuries back, are here set down as sober truths. On the first perusal, we charitably imagined that we had mistaken Mr. Paley's meaning, and that the stories of miracles were merely introduced to give an antique air to the book. The following description, however, of a case far exceeding any in the annals of hydropathy, which occurred "very recently at the Holy Well of St. Winifride, near Chester," is conclusive.

A young Irish lad was grievously afflicted with that almost incurable disease, a white-swelling in the knee-joint. He was brought, truly in faith, from a very great distance to St. Winifride's well. The bone, I believe, was quite diseased; at least the pain and suffering were so severe that the poor lad could only bear to sit at the well and pour the blessed water with his hand over the joint. In a week he could walk: in a month he was *perfectly* recovered by these means alone. People said cold water must be a specific for white swellings; and perhaps, if they had said the cold water of St. Winifride's well, they would have been right.—P. 163.

The Lady Etheldreda has a withered limb restored by touching relics, several sober pages are occupied by tales of bodies of monks laying in their graves centuries without decaying; "miraculous cures performed at Gutherin, Shropshire, and Holywell;" mysterious disappearances and dreadful apparitions. Had Mrs. Radcliffe lived to read this book, she had well nigh died of envy.

For ourselves, we thought that miracles were long passed; the few that have been got up of late years have turned out anything but well. The Cock Lane ghost was laid, Johanna Southcote proved a failure, and the Man in the Iron Mask has ceased to torture the curiosity of Europe. An idea is getting prevalent that the steam engine and the printing press are sadly inimical to miracle stories. James Watt has banished more ghosts than James the First. Mr. Paley, however, has evidently no faith in the march of intellect, and all that; he does not wish to float onward with the stream of time; the retreats of a college secure him from the full force of the current, and like the countryman in the fable he is fondly waiting for it to come to rest. It is hopeless to argue with him; it is useless to satirize him—who would waste good jokes on those who cannot feel them—who would satirize a gate-post? We can only wish our good tide-waiter prosperity and patience, and bid him not to be so *very* spiteful against those whom he suffers to shoot ahead of him.

We cannot accede to the criticism on the Fitzwilliam Museum, expressed incidentally in the following passage—

The middle ages had in most respects the same requirements as ours: vast halls, great houses, places for worship, business, and amusement, were as much wanted then as now. But would the builders of that time (had they known them) have copied pagan temples, retaining expensive and perfectly useless parts merely to keep up the necessary effect? Would they have added an imposing stone portico, of no manner of use in the world, to a clumsy square body made up principally of brick, cast-iron, and plaister of Paris, merely to make a street elevation, as we have done in the new Fitzwilliam Museum at Cambridge?—P. 191

Though we readily concede that "architecture is in its origin and consistent development the expression and the type of the purpose of its use," the above censure of the Fitzwilliam Museum seems to us by no means an obvious deduction from this canon. The edifice criticised, though doubtless in many respects faulty, will hardly be condemned by any one, but a rule and square critic, for the magnificent portico which forms its chief beauty. The use of this architectural member, in those great prototypes the Grecian temples, must have been to defend the worshippers from the scorching heat of the sun and the inclement weather. To the same purpose the portico of the Fitzwilliam Museum is applicable. The obvious origin of the columns of the portico was the necessity of supporting the gable of the roof. But can it be asserted, that in buildings like the Parthenon or Temple of Theseus, there existed the same absolute necessity, as in more primitive structures, for supporting the roof by a portico? When an area within that occupied by the columns became enclosed by an inner wall, the portico became a projection, an appendage—serviceable indeed for *some* purpose, but certainly not for that for which it was originally intended. At the later period of the art, the part supported that part only of the roof which was immediately above it. That part of the roof was, however, we apprehend, of no service when an inner area was enclosed, but as a shelter to persons entering or quitting the building;—and for precisely the same service the portico of the Fitzwilliam Museum is available. It cannot, therefore, be condemned on the ground of utility; the real fault lies in the ugly structures projecting above and by the side of the pediment of the Museum, and which, it follows from the above observations, vitiate the original idea of a portico.

The maxim that Grecian architecture is wholly inapplicable for modern purposes, is insisted upon in the present work as strongly as in the "Ecclesiologist." We are told that "*pagan architecture must die the death*;" and the writer considers such arguments as the following sufficient to bear out his opinion—

As many persons ask *why* Grecian and other antique styles may not be used at least for modern secular purposes, we will endeavour briefly to answer them. All architecture whatsoever is in its origin and consistent development *the expression and the type of the purpose of its use*. That is to say, the architecture of every age and every nation owed its existence and formation to the requirements of the religion, or other objects for which it was intended. Thus, a Grecian temple contained arrangements adapted to the worship of a heathen deity, or the reception of the worshippers, and ornaments and members possessing manifest fitness as parts of a whole; material, climate, mechanical skill, and other subordinate influences being taken into consideration. In Christian architecture, in which this principle was invariably carried out to the fullest extent, we find in the same manner a definite use for every single part of a secular as well as of a religious edifice. Now the question is this: *can we retain the form irrespective of the use, without violating the fundamental principles of architecture?* Clearly we cannot. If we alter or curtail the form, we lose the true proportions and effect, and thus travestie, not imitate. If we retain it, and copy exactly the ancient temples, we waste money and space on mere show. One or the other of these alternatives *must* attend the practice of modern architects; and an examination of any pseudo-Grecian building in the kingdom will readily prove this. The style is manifestly unfit for us.

We fully concur with the writer that the very essence of architecture is the exhibition of *form* in strict dependence upon, and subservience to *use*—taking the word "use" in its most extended and liberal signification. But were the requirements of the Greeks so entirely diverse from those of the moderns, that the architecture of the former, as regards utility, be altogether inadequate for the latter? Did not the Greeks require rooms for sleeping, rooms for eating, rooms for studying, as well as we? Did they not need theatres, courts of justice, prisons, and palaces, just as we do? The same defence against the heat of summer and the severity of winter? for, indeed, the severity of winter was felt at Athens almost as in London. Had we, indeed, adopted the architecture of a people who never needed protection against the rays of the sun on the one hand, or of a land where ice and snow were unknown on the other; were we to imitate the dwelling places of the tropics, where every cool refreshing breeze is suffered and courted to enter the open trellis and shaded lattices; or again, were we to import the Norwegian hut, with all its defences against the fury of the storm and the bitterness of arctic cold, we might well be accused of inconsistency. So, also, if the habits of the people whose architecture we copied totally differed from our own, we should obviously be liable to the same charge. But our models of architecture are taken neither from Lilliput nor from Brobdignag, nor from the land where Munchausen tells us the people fed themselves once a month by means of holes in their sides. Houses constructed after such types would certainly be as useful in England as mangles in New Zealand, or umbrellas in Egypt. But the people whose architecture we endeavour to imitate, ate and drank and slept as we do, were as civilized as we, and, in a word, seem to have strutted about this world-stage and to have acted their parts, (in tragedy or comedy as might happen,) in much such fashion as ourselves.

We seem, therefore, safe in concluding that the architecture which would satisfy the wants of the Greeks would be neither totally impracticable nor totally inadequate for ourselves; and therefore no obstacle need arise to its adoption on the score of *utility*.

If we view church architecture as we have done secular architecture, we shall come to nearly the same conclusion respecting the adoption of the Greek model. It has never, we think, been shown that christian architecture is a necessary part of christianity; that the rubric can be complied with and the sacraments duly administered in a mediæval edifice. Had Christianity and christian architecture been necessarily connected, they must have been also coeval, whereas the latter was not invented till centuries after the establishment of the former. If christians can only worship properly in buildings of one particular form, we can scarcely imagine that that form would be left to be devised by human skill; it may be imagined rather (we speak reverently), that both the religion and its appropriate architecture would be subjects of the same Divine revelation. We dare not quote scripture in this place, but our readers will surely remember passages which plainly show that there are no temples in which exclusively men ought to worship. As if forms of doctrine were identical with forms of construction! Preposterous creed! It is heathenish—derived from the temples of Jupiter and Minerva, the minarets of Mahomet, or the pagodas of Vishnu. Among idol-worshippers it is no more than a vain foolish thought, born of ignorance and nurtured by superstition; in a christian land far worse, it is insidious idolatry!

Let, not, however, our architectural tolerance be misapprehended. While contending that there are many cases in which classic architecture is admissible and even to be preferred for ecclesiastical purposes, we cannot deny that the mediæval styles are best adapted for general employment. Setting aside the facility of adaptation, so admirable an attribute of Christian architecture, we cannot help seeing that its nationality, its apparent antiquity (to the unaccustomed eye, a Grecian structure *must* appear modern) and the consecrated associations attached to it must demonstrate to the most coldly calculating judge, its manifest reciprocity for religious purposes. Speak to an Englishman of the secluded hamlet, and his mind instantly pictures the tapering spire, the massive buttresses, the mullioned windows of the hamlet church. How the mind loves to wander back to some well remembered spot where

" The rude forefathers of the hamlet sleep."

How strange and cold would seem in such a place the noblest monuments of Athenian art! But the old village church has a *feeling* in its stately simple beauty—a poetry—a religion which attracts the affectionate reverence of the untutored peasant, and makes it the last stronghold of happy recollections. The village churches! They are among the best things we have to boast of. Our village churches, our Shakespere, our Martyrs of the Reformation, and a few more such glories *make up* Old England.

Still, still there are exceptions. The crowded cities and busy haunts of men have nurtured but indifferently our national architecture. Like sickly vegetation it fares but ill in the unwholesome stinted atmosphere of populous towns. From the metropolis, excepting one or two noble edifices too vast to be entirely destroyed, our ancient churches have almost all disappeared and been succeeded by hideous caricatures of classic architecture. The instances of attempts to rebuild on the ancient Christian model seem seldom successful: buildings so constructed are either too bad for criticism, or at best exhibit an air of parrot-like imitation, the downcast look of a dog which has been beaten into performing a trick which it cannot understand.

There are one or two reasons why modern pointed architecture is seldom effective in great cities. One of those is that while the classic architecture abounds in long horizontal lines, and attains but a small elevation, the Christian mode of construction is characterised by vertical lines, high roofs, and towering spires. The buildings of the latter kind therefore require for the most part to be viewed from a distance, and seldom appear effectively unless when constructed in an open unencumbered situation. In London, however, it is frequently necessary to build churches in situations where little more than the front elevation is conspicuous. The classic architecture, moreover, is more essentially artificial and harmonizes better with a surrounding crowd of artificial objects. The Christian styles, on the contrary, if not suggested (as some say) by nature, are at least perfectly assimilated with it, and never appear so nobly as in amid rural scenery. These considerations, supported by numerous examples, satisfy us that mediæval architecture should seldom be imitated in large cities except in very unconfined situations. In all other cases we feel convinced that it is far better to take some one of the beautiful Athenian models, which (and they are sufficiently various) appears most suitable, to copy it *faithfully and correctly*, and to make no more alterations in the original design than are requisite to adapt it to modern purposes. No one can view *true* Grecian architecture, can even turn over a book of plates of Athenian edifices, without being delighted with their stately magnificence. They may be readily adapted for the celebration of the church service in strict accordance with the Rubric—and as for the objections about the chancel being "the holy of holies," and the middle aisle " the pathway of meek devotion," that is, mere goose-gabble.

Doubtless the objection against the employment of the classic mode is produced in many of the more temperate members of the Cambridge Camden Society by the wretched specimens of the art exhibited in this country. It is a humiliating confession; but there is scarcely an edifice from St. Paul's downwards in which the true feeling and spirit of classic architecture are not more or less violated. Columns, which should be the main support of a building, supporting nothing! Pediments, which should be the continuation of the main roof, overwhelmed by hideous elevations courteously called spires! Architectural pepper-pots, immense inverted porringers of stone, candle-extinguishers done in plaster! How remote are all these things from true classic architecture! Here and there a correct pediment or a row of symmetrical columns is stuck on—

(" Assuitur pannus splendidus unus et alter,")

and for the rest, the architect deems himself at perfect liberty to indulge his own miserable fancy, without paying the very slightest regard to unity or even congruity of design.

As the question respecting the exclusive employment of Mediæval Architecture is one of the principal and most interesting features of the book before us, and of the authenticated publications of the Camden Society, we offer no apology for some further considerations of the subject. The two chief requisites necessary in any kind of architecture employed for ecclesiastical purposes in this country are manifestly these,—suitability for the end proposed, namely, the celebration of services of the Church, according to the precepts of the rubric, and secondly, intrinsic beauty in the style adopted. Concerning the first of these requisites, we deem it unnecessary to eulogize; it can scarcely be maintained that in all the edifices professedly constructed on classic models the rubric has never been complied with; and even if this be granted, it still remains to be proved that these edifices cannot be altered so that the Church service may be duly celebrated within them.

One or two observations may, however, be acceptable respecting the intrinsic beauty of the styles adopted. There is an opinion among many who have only cursorily examined the subject, that the Classic and Christian styles owe their apparent beauty to the circumstance of our eyes being, so to speak, disciplined into taste for them, and that, therefore, the architecture of Turkey or Hindostan is as truly beautiful when viewed by a Mahomedan or Hindoo as the European styles to a Christian. Now the error seems to be the assumption that the appreciation is *solely* the result of habit, and in no way dependent on natural causes; on the contrary, we wish to show that there is a real abstract principle of beauty independent of accidental circumstances.

The definition of this principle is an impossibility. In literature it is called poetry; but pervading as it does every art and even sciences the most exact, we may fairly say that there is a poetry of painting, a poetry of sculpture, a poetry of architecture, a poetry of music, a poetry of science. The definition of "poetry" has been frequently attempted and confessedly hitherto without success. The reason of this ill success appears to us obvious. It is impossible to resolve into simple elements a fundamental principle of the mind. Poetry, using the word in the general sense as the appreciation of beauty, is in nature as elementary as one of the seven senses; and we conceive it as impossible to give an idea of poetry to one totally unpossessed of it, as to realise the idea of music to a deaf man, or to explain touch to any destitute of that sense.

Whence the feeling of poetry arises is a question too metaphysical for our purpose. The form may, perhaps, be born with us and in us as the senses are; but, however this may be, it is obvious that both it and they will be powerfully affected by subsequent impressions. Concerning the poetry of form, and especially architectural form, to which we are here to confine ourselves, it seems plain that, as ideas of form are received from the view of external nature, natnre must be the source, or at least the standard of architectural beauty.

Here a question arises.—Is it to follow then that the exact imitation of nature will produce the beautiful in art?—By no means. One great source of our pleasure in viewing nature is the obvious subserviency of every part of her creations to the object in view. Exact imitation of nature in art would be continually repugnant to this great source of a perception of the beautiful utility. Here, then, another great principle comes to our aid, *idealization*. By it, instead of exactly imitating nature, elaborate as it were, all accidental accessories, and borrows only those ideas (independent frequently of actual forms) which idealization teaches us are the elemental sources of beauty. It is somewhat difficult to give separate examples of idealization; take, however, the case of architecture. We are taught by nature that one source of beauty is distant perspective; another, symmetry; another, alternation of light and shadow: all these sources of the beautiful have been naturalized by poetical architecture. Of course, in the embodiment of beautiful in architectural form, ten thousand other ideas must be received and modified from nature. These ideas will, for the most part, be so impalpable—they will be instilled into the human mind unconsciously, not by any reasoning process but by the mere powers of perception. The instances, however, which we have adduced are sufficiently obvious to allow being reasoned upon, and therefore answer our purpose as illustrations of the mental operations which in every branch of art extract the *beau ideal* from nature.

Now, if we have been successful in showing by the above brief exposition that the beautiful is not an accidental feeling of the mind, but is borrowed from a fixed source by fixed principles, we are in a position to admit the testimony of observation respecting the intrinsic beauty of classic and christian architecture. We might, perhaps, be able to show by reason, independent of the aid of testimony, many instances in which the elementary and natural principles of beauty are practically and *systematically* violated in all but those two modes. The subject, however, would be a distasteful and prolix one, and if the above views be correct, we shall have no difficulty in admitting the innumerable and concurrent testimonies of indisputable authority, from the enthusiasm of the poet to the untutored admiration of the unlettered, in adjudicating the beauty and sublimity of these noblest effort of human genius, classic and christian architecture.

Here we close our review. The Camden Society are about, we believe, to publish their periodical in a new form.

> " Qualis ubi in lucem coluber mala gramina pastus
> Nunc positis exuviis, nitidus que juventâ
> Lubrica convolvit sublato pectore terga."

With all their talents and knowledge we have many reservations in wishing them prosperity in their undertaking. If any one of their body should chance to read these remarks, he will, doubtless, set them down as the production of an iconoclast, an admirer of penny literature, a dissenter, or a republican (for people have a strange way of coupling these together). But the present reviewer is neither one of these. He certainly has a great admiration of steam-engines, but prefers a cathedral town to a manufacturing one, he reverences old customs, confesses to folios, and indulges in black letter; and yet for all that he *cannot* believe in modern miracles, nor deem the Reformation "heathen impiety." He would yield to no Camdenian in true reverence for the Church, but he cannot feel in a Chancel the awe of a Brahmin entering the shrine of his idol-god.

London Interiors: a Grand National Exhibition, &c. &c. Parts I—XXXVIII.

Notwithstanding that it is a curiosity in its way, we have cut shor the very prolix title-page, which we must say is no great recommendation to the work, it being in insufferably bad taste,—by far too much in the strain of Macassar oil advertisements. What we have to say is, that this "Grand National Exhibition" is itself now cut short, for without any previous intimation to that effect, it has been suddenly wound up,—not like a clock in order to be kept going, but in order to bring it to a stop at its 38th number. Most assuredly this has not happened because materials for it were exhausted, since many of the very best and most interesting subjects of all, at the same time the most fresh, and which were probably looked forward to with eagerness by many, have been left untouched, while a considerable proportion of those which are represented have little to recommend them as architectural scenes, neither are they at all set off to advantage by any beauty of execution. This last consideration, together with the want of judgment and taste shown in selecting subjects for the pencil, may the better reconcile us to that being abandoned which, although an excellent idea in itself, was very badly carried out.

On the other hand, the consolation so derived is greatly diminished by the apprehension that what has been so ill-done, will now prejudice against and deter from any other series of similar subjects being undertaken. It certainly ought not to do so, because there is room for something much better; yet if the *field* is left open, the *market* is not so,—at least will not seem to be so to those whose business it is to supply it; and thus it not unfrequently happens that by pre-occupying the ground inferior publications stand in the way of better ones —for a considerable time at least, and prevent their being brought out. We have heard this remarked with regard to Gwilt's Encyclopædia,—that it blocks up the way against what might be more judiciously planned, and much more satisfactorily executed.

As to the "Interiors,"—the work seems to have been carried on without any plan at all, or as if it were intended to be carried on indefinitely so long as any subjects could be found for it; since had not such been the case, greater care and discretion would, no doubt, have been shown in selecting them, in order to secure the appearance of those which are of greatest intrinsic interest, whereas a course directly the reverse has been pursued. That the "entire scheme has not been realized," is admitted in the wrapper advertisement to the last Part; yet when we find assigned as a reason for the discontinuing —there called the *completion* of the work—that "to have carried the undertaking further, would have been merely adding to examples without extending the classes of the London Interiors," we cannot help considering it a lame one; inasmuch as there are several classes which are now not represented at all,—for instance, bazaars, shops and show-rooms, the Pantheon Bazaar with its picture galleries and its Conservatory,—the new Saloon at Williams and Sowerby's, Oxford Street, Brown's Gallery in University Street, the Pantechnicon, new Exeter Change, &c., which would have furnished many views far more pictorial than most of those which are given.—As to the literary part of the work, we have already expressed our opinion not unfavourably in the note at page 253 of our present volume, where we gave some extracts from the description of Goldsmiths' Hall. At some other time we may perhaps bestow further notice on the architectural remarks and opinions which occur in the letter-press. In the mean while we give as a specimen of their free uncompromising tone, the concluding sentence of the very last article, when speaking of the British Museum the writer says: "The idea of thrusting forward two ranges of mere dwelling houses as wings to the main building, when the most dignified and classical character ought to be kept up throughout, seems to us such a solecism in taste, that were it not for the approved adage *De gustibus &c.*, we should bestow on it some exceedingly harsh epithet;—at all events our taste differs antipodically from Sir Robert Smirke's, and for that, though without thanks to him, we are thankful." Poor Sir Robert, and poor British Museum!—what between Barry and Tite, between the Palace of Westminster and the Royal Exchange, both Smirke and his building will now cut but a sorry figure.

METROPOLITAN BUILDINGS ACT.

This Act will come into general operation on the first day of the present year; it embraces many very important provisions that were not contained in the old Building Act, such as relate to health. It enacts that every new building must be provided with drains, and if practicable to lead into a sewer if within 100 feet, and that the basement floor must be of such level as will admit of drainage; it also provides that rooms in the basement to be used as separate dwellings, shall have a fire-place and a window, also an area on the outside. the paving of which must be at least 3 inches below the level of the floor. It also regulates the width of streets and alleys; the former must not be of a less width than 40 feet, and alleys and courts less than 20 feet.

Besides the appointment of additional districts and surveyors, there are two official referees appointed to whom most important duties are assigned, and under whose special superintendence are to be placed all buildings of the third class.

The Act extends to the following parishes, which were not included in the old Building Act:

List of the New Districts and Surveyors appointed.

In Middlesex.

Bromley—John Blyth.
Fulham—Andrew Moseley.
Hampstead—Henry Edward Kendall, Junior.
Hammersmith—James Charles Christopher.
Hornsey—Alfred Bartholomew.
Kensington North—Thomas Leverton Donaldson.
Kensington South—Charles Beachcroft.
Stoke Newington—William Lovell, Junior.
Tottenham—John Henry Taylor.

In Surrey.

Camberwell—William Crawford Stow.
Clapham, and part of Battersea—Richard I'Anson.
Streatham—John Mullins.
Tooting and Wandsworth—Alfred James Hiscocks.

In Kent.

Charlton, Kidbrook, and Lee—Collis.
Deptford—Martyr.
Greenwich—Brown.
Lewisham—Badger.
Woolwich—George Aitchison.

The following extracts and illustrations from the Act explain the different rates and classes of buildings, and also the construction of the walls.

FIRST OR DWELLING HOUSE CLASS.

SCHEDULE (C.)—Part II.—(See Sec. 5.)—Conditions for determining the Rates to which Buildings of the First or Dwelling House Class are to be deemed to belong, and the Thickness of the External Walls and of the Party-Walls thereof.

FIRST RATE DWELLINGS.

If the Building be in height more than 70 feet, and not more than 85 feet.

If the building cover more than 10 squares, and not more than 14 squares.

If the building contain 7 stories.

EXTERNAL WALLS.—The thickness must be at the least 21½ inches from the top of the footing up to the underside of the floor next but three below the topmost floor; and at the least 17½ inches from the under side next but three below the topmost floor up to the under side of the floor next below the topmost floor; and at the least 13 inches from the underside of the floor next below the topmost floor up to the top of the wall.

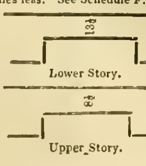
PARTY WALLS.—The thickness must be at the least 21½ inches from the top of the footing up to the underside of the floor next but three below the topmost floor; and at the least 17½ inches from the underside of the floor next but three below the topmost floor up to the underside of the floor next below the topmost floor; and at the least 13 inches from the underside of the floor next below the topmost floor up to the top of the wall.

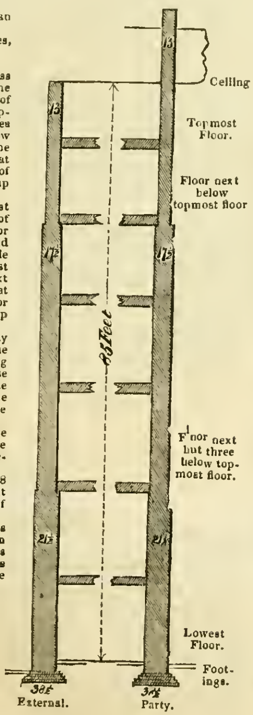
FOOTINGS.—To both external and party walls the bottom of the footings must be 17½ inches wider than the wall standing thereon, and 11 inches high. The top course must be 3 inches below the surface of the ground adjoining and 9 inches below the surface of the lowest floor. See Schedule D., p. 56.—(See Diagram, page 52.)

PARAPETS to external walls must be 8½ inches thick and one foot high above the highest part of the gutter. See Schedule D., Part iii., p. 59.

TOP OF PARTY WALLS must be 18 inches above the roof measured at right angles, and 2 feet above highest part of gutter. See Schedule D., Part iii., p. 61.

CHIMNEY BACKS.—To be 13½ inches thick in the lowest story and 8½ inches in every other story—To be the same thickness between when built back to back; in walls not being party walls the thickness may be 4½ inches less. See Schedule F., p. 63.





EXTRA FIRST RATE.

If it be in height more than 85 feet.——Or if it cover more than 14 squares.——Or if it contain more than 7 stories.

EXTERNAL WALLS.—The thickness must be at the least 21½ inches from the top of the footing up to the underside of the floor next but two below the topmost floor, and at the least 17½ inches from the underside of the floor next but two below the topmost floor up to the top of the wall.

PARTY WALLS.—The thickness must be at the least 21½ inches from the top of the footing up to the underside of the floor next but three below the topmost floor; and at the least 17½ inches from the underside of the floor next but three below the topmost floor up to the underside of the topmost floor; and at the least 13 inches from the underside of the topmost floor up to the top of the wall.

FOOTINGS and CHIMNEY BACKS as to first rate.

PARAPETS to external walls must be 13 inches thick and one foot high above the highest part of gutter.

TOP OF PARTY WALL as first rate, p. 48.

SECOND RATE DWELLINGS.

If the building be in height more than 52 feet, and not more than 70 feet.

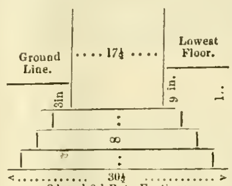
Or if it cover more than 6 squares, and not more than 10 squares.

Or if it contain 6 stories.

EXTERNAL WALLS.—The thickness must be at the least 17½ inches from the top of the footing up to the underside of the floor next but one below the topmost floor; and at the least 13 inches from the underside of the floor next but one below the topmost floor up to the top of the wall.

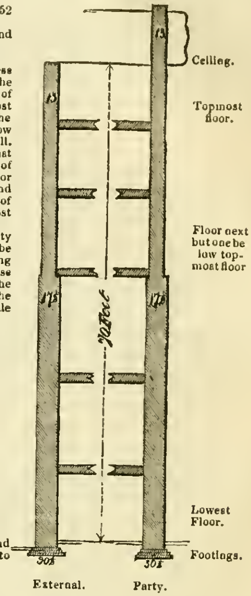
PARTY WALLS.—The thickness must be at the least 17½ inches from the top of the footing up to the underside of the floor next but one below the topmost floor; and at the least 13 inches from the underside of the floor next but one below the topmost floor up to the top of the wall.

FOOTINGS.—To both external and party walls the bottom of the footings must be 13 inches wider than the wall standing thereon, and 8 inches high. The top course must be 3 inches below the surface of the ground adjoining and 9 inches below the surface of the lowest floor. See Schedule D., p. 58.



2d and 3d Rate Footings.

CHIMNEY BACKS, PARAPETS, and TOP OF PARTY WALLS the same as to first rate, p. 48.



THIRD RATE DWELLINGS.

If the building be in height more than 38 feet, and not more than 52 feet.

Or if it cover more than 4 square, and not more than 6 squares.

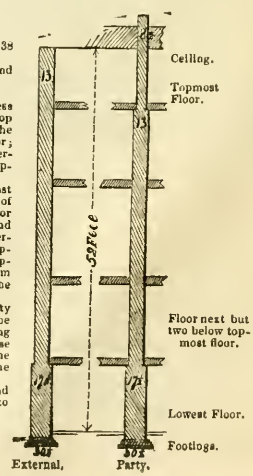
Or if it contain 5 stories.

EXTERNAL WALLS.—The thickness must be at the least 17½ inches from the top of the footing up to the underside of the floor next but two below the topmost floor; and at the least 13 inches from the underside of the floor next but two below the topmost floor up to the top of the wall.

PARTY WALLS.—The thickness must be at the least 17½ inches from the top of the footing up to the underside of the floor next but two below the topmost floor; and at the least 13 inches from the underside of the floor next but two below the topmost floor up to the underside of the topmost floor; and at the least 8½ inches from the underside of the topmost floor up to the top of the wall.

FOOTINGS.—To both external and party walls the bottom of the footings must be 13 inches wider than the wall standing thereon, and 8 inches high. The top course must be 3 inches below the surface of the ground adjoining and 9 inches below the surface of the lowest floor.

CHIMNEY BACKS, PARAPETS, and TOP OF PARTY WALLS the same as to first rate, p. 48.



FOURTH RATE DWELLINGS.

If the building be in height not more than 38 feet.

Or if it do not cover more than 4 squares.

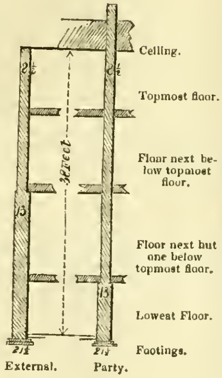
Or if it do not contain more than 4 stories.

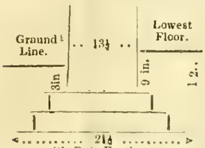
EXTERNAL WALLS.—The thickness must be at the least 13 inches from the top of the footing up to the underside of the floor next below the topmost floor; and at the least 8½ inches from the underside of the floor next below the topmost floor up to the top of the wall.

PARTY WALLS.—The thickness must be at the least 13 inches from the top of the footing up to the underside of the floor next but one below the topmost floor; and at the least 8½ inches from the underside of the floor next but one below the topmost floor up to the top of the wall.'

FOOTINGS.—To both external and party walls the bottom of the footing must be at the least 8½ inches wider than the wall standing thereon, and 5 inches high. The top course must be 3 inches below the surface of the ground adjoining and 9 inches below the surface of the lowest floor.

CHIMNEY BACKS to be 8½ inches thick.





4th Rate Footings.

SECOND OR WAREHOUSE CLASS.

SCHEDULE (C.)—PART III.—(*see* Sec. 5.)

Conditions for determining the Rates to which Buildings of the Second or Warehouse Class are to be deemed to belong, and the Thickness of the External Walls and of the Party-Walls thereof.

FIRST RATE WAREHOUSE.

If the building be in height more than 66 feet.

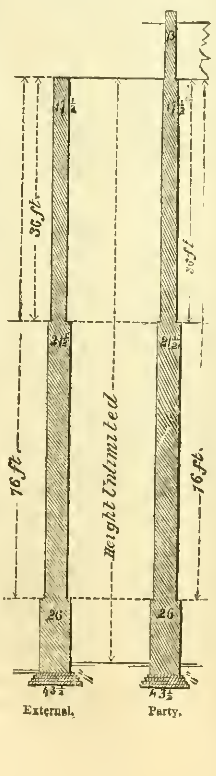
EXTERNAL WALLS.—The thickness must be at the least 26 inches from the top of the footing up to the level of 76 feet below the topmost ceiling; and at the least 21½ inches from the level of 76 feet below the topmost ceiling up to the level of 36 feet below the topmost ceiling; and at the least 17½ inches from the level of 36 feet below the topmost ceiling up to the top of the wall.

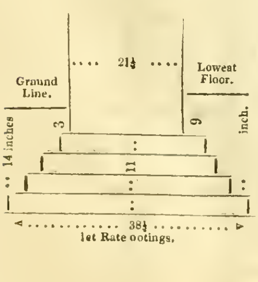
PARTY WALLS.—The thickness must be at the least 26 inches from the top of the footing to the level of 76 feet below the topmost ceiling; and at the least 21½ inches from the level of 76 feet below the topmost ceiling up to the level of 35 feet below the topmost ceiling; and at the least 17½ inches from the level of 36 feet below the topmost ceiling up to the level of the topmost ceiling; and at the least 13 inches from the level of the topmost ceiling up to the top of the wall.

FOOTINGS as first class, p. 48.

PARAPETS to external walls must be 13 inches thick and 18 inches high above highest part of gutter. See Schedule D., p. 58.

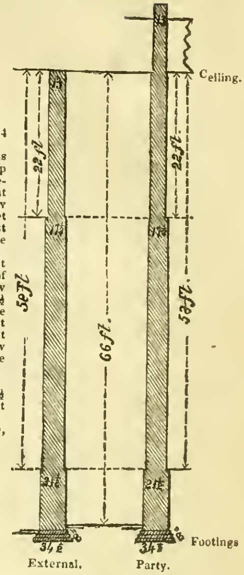
TOP OF PARTY WALLS must be 18 inches above roof measured at right angles, and 3 feet above highest part of gutter.





1st Rate ootings.

SECOND RATE WAREHOUSE.



If the building be in height more than 44 feet and not more than 66 feet.

EXTERNAL WALLS.—The thickness must be at the least 21½ inches from the top of the footing up to the level of 58 feet below the topmost ceiling; and at the least 17½ inches from the level of 58 feet below the topmost ceiling up to the level of 22 feet below the topmost ceiling; and at the least 13 inches from the level of 22 feet below the topmost ceiling up to the top of the wall.

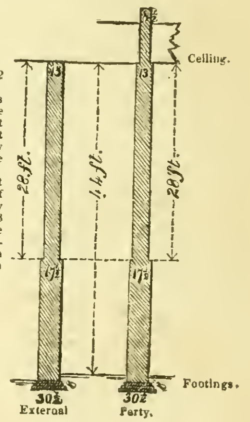
PARTY WALLS.—The thickness must be at the least 21½ inches from the top of the footing up to the level of 58 feet below the topmost ceiling; and at the least 17½ inches from the level of 58 feet below the topmost ceiling up to the level of 22 feet below the topmost ceiling; and at the least 13 inches from the level of 22 feet below the topmost ceiling up to the top of the wall.

FOOTINGS as first class, p. 49.

PARAPETS to external walls must be 8½ inches wide and 12 inches high above highest part of gutter.

TOP OF PARTY WALLS as first rate, p. 52.

THIRD RATE WAREHOUSE.



If the building be in height more than 22 feet and not more than 44 feet.

EXTERNAL WALLS.—The thickness must be at the least 17½ inches from the top of the footing up to the level of 28 feet below the topmost ceiling; and at the least 13 inches from the level of 28 feet below the topmost ceiling up to the top of the wall.

PARTY WALLS.—The thickness must be at the least 17½ inches from the top of the footing up to the level of 28 feet below the topmost ceiling; and at the least 13 inches from the level of 28 feet below the topmost ceiling up to the level of the topmost ceiling; and at the least 8½ inches from the level of the topmost ceiling up to the top of the wall.

FOOTINGS as first class, p. 50.

PARAPETS as second rate, p. 52.

TOP OF PARTY WALLS as p. 52.

FOURTH RATE WAREHOUSE.

If the building be in height not more than 22 feet.

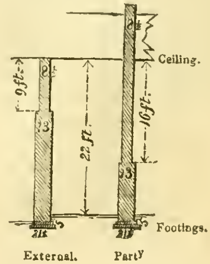
EXTERNAL WALLS.—The thickness must be at the least 13 inches from the top of the footing up to the level of 9 feet below the topmost ceiling; and at the least 8½ inches from the level of 9 feet below the topmost ceiling up to the top of the wall.

PARTY WALLS.—The thickness must be at the least 13 inches from the top of the footing up to the level of 16 feet below the topmost ceiling; and at the least 8½ inches from the level of 16 feet below the topmost ceiling up to the top of the wall.

FOOTINGS as first class, p. 51.

PARAPETS as second rate, p. 52.

TOP OF PARTY WALLS as p. 52.



THIRD OR PUBLIC BUILDING CLASS.

SCHEDULE (C) PART V.—*Requisites for determining the Rate to which any Building of the Third or Public Building Class is to be deemed to belong.*

If any building of the third or public building class correspond in form or structure or disposition with a dwelling-house, then the rate thereof is to be determined by the same rules as the rates of the first or dwelling-house class, and the thicknesses of the external and party-walls, and the width of the footings thereof, are to be at the least four inches more than is hereby required for the external and party-walls, and the footings thereof, of buildings of the same rate of the first or dwelling-house class, unless the official referees, on special supervision in each case, shall otherwise appoint. But if it correspond in form or structure or disposition with a warehouse, or any building of the second class, then the rate thereof is to be determined by the same rules as the rates of the second or warehouse class; and the thickness of the external and party-walls, and the width of the footings thereof, are to be at the least four inches more than is hereby required for the external and party-walls, and the footings thereof of buildings of the same rate of the second or warehouse class, unless the official referees, on special supervision in each case, shall otherwise appoint. But if it do not correspond in form and structure, or in either, with buildings of the first or second classes, or any of them, then such building is to be subject, as to its walls or other construction, to the special approval of the official referees.

ATTACHED, DETACHED AND INSULATED BUILDINGS AND OFFICES.

SCHEDULE (C.) PART VII.—*Rules concerning attached and detached and insulated Buildings, as to the Rates and Walls thereof.*

ATTACHED BUILDINGS AND OFFICES.—With regard to buildings or offices now built or hereafter to be built (except greenhouses, vineries, aviaries, or such like buildings), and that, whether such buildings or offices be attached to or detached from the buildings to which they belong. Every such building is to be deemed, in respect of the walls thereof, and all other requisites, as a building of the rate to which it would belong if it had been built separately.

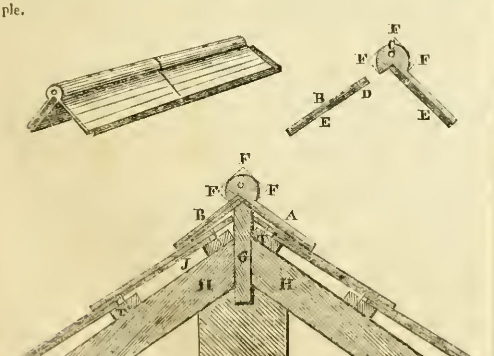
INSULATED BUILDINGS.—And with regard to buildings of the first or dwelling-house class, and of the second or warehouse class, which shall be insulated, so far as relates to the distance thereof from a public street or way,—every such building must be distant from any public street or alley one-third of the height thereof at the least; and if the building do not exceed twenty-four feet in height,—then it must be so distant at the least eight feet; and with regard to such building, so far as relates to the distance thereof from any other building, or from ground not in the same possession or occupation therewith, or connected therewith only by a fence or fence-wall, it must be distant from such other building or such other ground at the least 30 feet; and if such building be so distant from a public street or alley, and from any other building, or from ground not in the same possession or occupation thereof,—then such building is not to be liable in respect of the dimensions and materials thereof to the rules and directions of this Act.

INSULATED BUILDINGS AFTERWARDS DIVIDED.—Provided always, that if any such building be hereafter divided into two or more distinct buildings, and the several parts of such building so divided be not at the aforesaid distance from each other, and from other buildings and ground, then such several parts must be separated from each other by such party-walls as are herein prescribed for the rates to which such several parts, if adjoining, would belong. And if such requisites be not observed, then such several parts of such buildings in respect of which they are not so observed, shall be deemed a public nuisance, and as such be taken down, according to the provisions of this Act in that behalf.

TOLL-HOUSES, &c.—And with regard to certain buildings which shall be built for the purposes of trade or the collection of toll, if such buildings be situate fifteen feet at the least from any other building, and do not cover an area of more than one square and a half, and the height thereof do not exceed twelve feet from the ground to the highest point of the roof, then every such building may be inclosed with any materials whatsoever; but the roof thereof must be covered as herein directed with regard to roofs, and the chimney and flue (if any) must be built as herein directed with regard to chimneys and flues.

WILLIAMS' PATENT SLATE RIDGES AND HIPS.

This invention is an excellent substitute for lead, and we are of opinion is superior, as it is not liable to be deranged by high winds, it is cheaper and saves a roll in wood. The annexed engravings sufficiently explain the principle.



A. Ridge side with roller. **B.** Ditto loose, to fit under ditto. **C.** Pin hole in the end of the roller. **D,** Screw hole to fasten the under piece to the ridge. **E E.** Rabbeted joints. **F F.** The dotted part shews the form of the square top

In order to put on the ridge the wood ridge piece should be kept up about an inch clear of the slating, and bevelled off on each side so that the upper edge of the under part of the slate ridge should bear solid on the bevel of the wood ridge, the lower end will then bear tight on the slating when screwed on. The part of the slate ridge which has the roll is to be bedded on the other in oil cement. The cross square joints (of those not rabbeted), are to be secured, if required, by putting a small strip of lead or zinc across the wood ridge under the joints of the slate ridge.

The roll part is secured by a small copper dowel placed into a hole in the end of the roll made for that purpose. It will be necessary to secure the smaller ridges, by screwing on the part that has the roll to the wood ridge, as a bolt in the end would not be sufficient. The screw holes should be filled with oil cement first, then screwed, and the head of the screw filled up with the oil cement.

The sizes that are generally used vary from 2¾ to 4½ inches for the circumference of the roll, and from 4½ to 5¾ inches wide for the hooping part; the price varies from 7*d.* to 10*d.* per foot run, if the joints be rabbeted 1*d.* per foot extra, and if square roll instead of round 1*d.* less. Specimens of the ridge may be seen at Messrs. Sharp's Yard, Tooley Street.

THE RETRIBUTION.

This vessel is a first-class war steamer of 1641 tons burthen, built at Chatham, for her Majesty's service; she has been fitted with engines of 800-horse power, by Messrs. Maudslays and Field, the largest power, we believe, that has yet been applied to any war steamer. They are on the double cylinder principle, patented by Messrs. Joseph Maudslay and Field, and described in the *Journal*, Vol. III. for 1840. There are four boilers on the flue principle set in pairs, back to back. The beginning of last month the engines were tried in the West India Docks, in the presence of the Lords of the Admiralty and several scientific gentlemen, they worked beautifully, and were the admiration of all parties on board. The following are the dimensions:—Length of the vessel between perpendicular, 220 feet; breadth, 40 feet 6 inches; depth of hold, 26 feet 4 inches; length of engine-room, 75 feet. The engines have two pair of cylinders, 72 inches in diameter, 8 feet stroke, performing 15 strokes per minute, diameter of paddlewheel 34 feet, and width 13 feet.

ELIZABETHAN FURNITURE.

Abstract of a Paper read at the General Meeting of the Decorative Art Society, February 28th, by GEORGE FILDES. *On the Style of Furniture in Use during the Reigns of Elizabeth and James I., and its applicability to Modern Purposes.*

The great prevalence of the Elizabethan style, both in the exterior and interior decorations of the present day, renders the subject one of great interest and importance to all those connected with decorative art.

It was at first my intention to give a brief sketch of the state of domestic interiors previously to the time of the Tudors, and the progress of improvement in the arts connected therewith; but finding that even the slightest approach to detail would occupy more time than could be devoted to the subject, I will content myself with a slight reference to the reigns of Henry VII. and his immediate predecessors, and then pass to that of his son, during which, were introduced those changes, that caused so material an improvement in the domestic decorations of the age, and led to the formation of what we call the Elizabethan style.

From the time of Henry IV. to that of Henry VI., the style of furniture in use in England was of a rude substantial character, occasionally varied by sumptuous and splendid novelties introduced from Italy and the East; such exceptions, however, proving more forcibly the utter want of comfort in the general arrangements of the period. The princes and nobles wasted their revenues either in foreign or domestic warfare, or in the exercise of the most wasteful and lavish hospitality, without seeking or estimating the comfort which is so essential an ingredient in the enjoyment of modern existence.

During the succeeding reigns of Edward IV. and Richard III. some improvement was undoubtedly taking place; but it is not till the accession of Henry VII. that any material change is perceptible. That wise prince, with the view of breaking up the remains of the feudal system and controlling the power of his nobles, endeavoured to lead their minds to the re-edifying and decorating of their mansions and halls; hoping by inducing them to exhaust their wealth in such pursuits, to deprive them of the means of keeping up the large bodies of retainers, by which, in former reigns, they had arrived at such a height of power, as to become formidable neighbours of royalty, and keep the occupant of the throne in a constant state of apprehension.

The general introduction of chimneys, which took place about this time was, therefore, a material improvement for health as well as convenience. Hollinshed mentions in his chronicle, that within his own remembrance, there were not above two or three chimneys "if so many, in most of the uplandish towns of the realm (the religious houses and manor places of their lords always excepted, and peradventure, some great personages,) but each man made his fire against a rere-dosse in the hall, where he dined and dressed his meat!" In spite, however, of their mean dwellings, their mode of living was not in a similar style, for we find continual expressions of surprise from foreigners of the time at the abundant hospitality exhibited by men who were content to live in houses of "sticks and dirt."

The style of the interior decorations of this period took its character, such as it had, from the architecture of the exteriors; and, as that gave way before the new fashion introduced from Italy, so the character of the interior fittings up was changed with it. The Tudor style of architecture which prevailed in the dwellings of the nobility and clergy, was an elaborate alteration of the Gothic, the principal characteristics of which were numberless gables, groups of bulbous turrets, and clusters of chimneys.

In fact, it is not till the reign of Elizabeth was somewhat advanced, that we need look for anything like an approach to the comforts and conveniences of modern times; but by her practice and example an impulse was given, which spreading through the nobility and gentry, reached at length to the middle classes; for we are told by Harrison, that farmers and even mechanics were then able to "garnish their cupboards with plate, their beds with tapestry and silk hangings, and their tables with fine napery." This appears somewhat incredible, and should be taken with some grains of allowance, although Harrison is generally considered a most faithful and trustworthy writer. It cannot, however, be doubted, that the household furniture and domestic comforts of the middle classes were now greatly superior in many respects to those of the nobility in the preceding reigns.

But classical taste in architecture was reviving at this time in Italy, and, spreading as from a centre among the other nations of Europe, was pervading the public mind. The Gothic, however, being more firmly established in those nations, still struggled for supremacy, and the dispute ended in a compromise between the two styles, the Classic and the Gothic, combining in what we call in England the Elizabethan style.

This blending of the Classic with the national style was attended with better effect in England than in France and Flanders; our buildings having escaped the disfigurement of the high pointed roofs, which form so striking a feature in the architecture of their cities.

The introduction of this new style may be attributed to the desire evinced by our Henry VIII. to rival his contemporaries of the continent. Being himself in some degree conversant with architecture and the fine arts, with the purpose of embellishing his court and improving the taste of the age, he invited several foreign artists of eminence; among others, Raffaelle and Titian. These celebrated men, however, did not choose to exchange the high consideration which they had attained at home for the doubtful courtesies of so capricious a monarch: but he obtained several from Italy and Flanders.

It is impossible, in treating the subject of Interior Decoration, to avoid recurring frequently to the architecture of the time, from which it copied its peculiar character, both as to solidity of structure and elaboration of ornament. A recent author observes, "the characteristic of the scroll ornaments which enter so abundantly into the decoration of this period, has been well described as an 'intricacy of design which defies explanation;' but the knobs and bosses, with the fanciful cut work round them, peculiar to the Elizabethan style, were evidently intended to represent jewels. They are clearly alluded to by Laneham, in his account of Kenilworth Castle, as 'great diamans, rubys, sapphyrs, pointed, tabled *rok* and round, garnished with their gold, &c.;' a poor substitute, even with all the help that blazonry could afford, for the precious marbles and *pietre dure* of Italy. In the more sculptured decorations, the taste of the age displays itself no less in the subjects than the style; and the staple commodities of armorial bearings and devices are mixed up with figures and allusions, allegorical, mythological, and classical. The chimney-piece, occupying the whole height of the room, and forming part of the general design when it possesses an architectural character, is generally made a focus for the display of decorations of the kind." These were often executed in a grand and imposing style, but more often deformed by extravagant allusions and conceits.

Even in the plans of the buildings, propriety was often sacrificed to this prevailing folly. Many of the mansions of the time were built with two projecting wings and a porch in the centre, the ground plan of which was similar in form to the letter E, and is supposed to have been intended as a compliment to Queen Elizabeth. Far-fetched as this may appear, it is perfectly in accordance with the taste of the age. John Thorpe, an architect of great eminence during the reigns of Elizabeth and James, left behind him a large and valuable collection of drawings and designs for houses, which have been engraved and copiously illustrated by Mr. J. C. Richardson. Among these is one for his own house, the plan of which forms the initials I T. Philip II. built the Escurial in the form of a gridiron, in honour of St. Lawrence; and mystical allusions abound in the plans of churches and castles both at home and abroad.

Such absurd fancies as these could not but be prejudicial to the art; still, however, it flourished, although the encouragement it had received from Henry seems to have been in some measure withdrawn by Elizabeth, whose taste for the fine arts may reasonably be doubted, as she appears to have patronized them chiefly when ministering to her vanity, if we may judge from the multiplicity of her portraits; which, however, she forbade to be executed by any but "special cunning painters," a proclamation to which effect she issued in 1563.

The style continued to flourish during the whole of the reign of Elizabeth, and seemed to have reached its utmost point of perfection at the commencement of James's reign, from which time we may date its decline; as the artists of the day, in their search for variety, grafted upon it all manner of incongruous ornaments, every one thinking himself privileged to introduce whatever ideas his wayward fancy might suggest, thus inducing combinations which Walpole, in after times, somewhat harshly stigmatized with the name of "King James's Gothic."

It is worthy of remark, that while the architectural taste of the time was declining, the domestic fittings-up of the interiors were increasing in comfort and accommodation. It continued in this progressive state till the accession of Charles I., whose well educated mind and refined taste led him to the adoption of an entire change.

Having now arrived at the period when Inigo Jones, by the revival of a classical spirit, and the introduction of the architecture of the Palladian school, had virtually put an end to the Elizabethan, we may conclude this imperfect historical sketch of the progress of the art, and pass on to the detail of the fittings-up of Elizabethan interiors.

Before proceeding to describe the moveable furniture of the time, it may be advisable first to notice the flooring, ceilings, &c.

Previously to Elizabeth's reign, the floors were of different materials. From a very early date, we find them described as sometimes paved with tiles, of various colours, and laid in chequer-work:—the Hall at Hampton Court was "floored with painted tyle:"—they were also of stone; and when boarded floors were adopted, they were of coarse substantial workmanship; sometimes, instead of crossing, laid parallel only with the joists, and not depending on them for support.

The doors also were of a rude character, being seldom framed, as they were usually covered by the arras;—but, in Elizabeth's time, doors of all kinds were panelled, as well as the ceilings and wainscotting of the walls, and often decorated with painting and devices. The elaborate fretwork of some of the ceilings of the time, ornamented with bosses and pendants, is admirable both in design and execution; and the framed roofs of the great halls were so well put together, and of so ornamental a character, as to form one of the principal features in old houses. The roof of the Great Hall, at Hampton Court, is an admirable specimen (though partaking more of the Gothic than the Elizabethan), and has the advantage of being easily accessible to an enquiring observer.

Glass windows were another prominent feature in these dwellings. This material, though early introduced into England, was so costly, that it was not unusual to take out the window-lights on the departure of the master of the house, and lay them up for safety; but in Elizabeth's time it was in general use, and was sometimes carried to great excess. "You shall have," says Lord Bacon, "fair houses so full of glass, that one cannot tell where to be come to be out of the sun or cold." And Lysons mentions a window, at Collacombe, in Devonshire, containing 3200 panes of glass.

Stained glass, also, was a favourite ornament of the superior rooms of mansions and palaces, adorned with figures in the most splendid clours. It was known as early as the thirteenth century, and was much cultivated in the reign of Henry III.

Carpets not having at this time come into use in England, except as the coverings of tables, or occasionally as foot cloths for the throne, &c., rushes and sweet herbs appear to have been the substitute, both in public and private houses. Though the private rooms and rooms of state were sometimes matted yet rushes were the general strewing; Queen Elizabeth's Presence Chamber even was strewed with them; and we meet with constant reference to them in old authors. Footing must have been very insecure on such floors, though it appears they were used even in ball rooms.

One of the principal articles of furniture among our forefathers was the "hangings" of the walls, or tapestry or arras, some varieties of which had been known in early times. The Bayeux tapestry is considered the earliest in existence, illustrative of William the Conqueror's descent upon England. The title of arras was derived from the town of that name, which was the principal seat of its manufacture in Flanders. The weaving of tapesty was known in this country at an early period. Strutt says that in Alfred's reign, and before, York and Canterbury were adorned with pictures and tapestry; but the art seems to have been lost during the civil wars of York and Lancaster. It was afterwards revived by Wm. Sheldon, in the reign of Henry VIII., and became of considerable importance under James I., when a manufactory was established at Mortlake, the king himself taking such interest in it, as to advance £2000 towards the undertaking, and an artist named Francis Cheyne was engaged to furnish original designs.

The tapestry appears to have been simply hung upon the walls. "The usual manner," says Percy, in his preface to the Northumberland Household

Book, "of hanging the rooms in the old castles, was only to cover the naked stone walls with tapestry or arras, hung upon tenter hooks, from which they were easily taken down upon every removal."

The walls of the Gallery at York Place, the residence of Cardinal Wolsey, were "hanged with cloth of gold and tissue of divers makings, and cloth of silver likewise on both the sides, and rich cloths of *baudkin*, of divers colours."

That tapestry had long been in common use, and that the execution of much of it was very inferior, is proved by the frequent allusions to it in old authors; and the uncouthness of the figures with which it was wrought was a subject of ridicule with the wits. Shakspere, for instance, compares a person to the "shaven Hercules in the smirch'd worm-eaten tapestry."

The story of Hercules seems to have been a great favourite with the weavers, among other fabulous subjects. Historical scenes, likewise, both sacred and profane, landscapes and hunting pieces continually occur, as well as heraldic representations; but, besides these common tapestries, the more splendid rooms were furnished with cloth of gold, velvet, and flowered brocade.

A cheaper sort of hangings was used, under the name of "painted cloth," being in fact, nothing more than canvas painted in tempera or oil with various devices, mottoes, moral proverbs, and wise sayings. Falstaff, in the enumeration of his ragged regiment, describes some of his fallowers as "slaves as ragged as Lazarus in the painted cloth," and Beatrice playfully boasts of having borrowed her pithy answers from the "painted cloths."

Hangings, also, of embossed leather were introduced about this time from Spain, ornamented with figures of various kinds in gold, silver, and colours, and were mostly used for the smaller rooms. Some specimens of these still remain.

In the seventeenth year of Elizabeth's reign, a petition was presented to the House of Commons from the chartered Society of Painters, complaining of the decay of the art and praying a redress of their grievances. It concludes with the following passage, "These walls, thus curiously painted in former ages, the images so perfectly done, do witness our forefathers' care in cherishing this art."

Painting on walls in England is of high antiquity; Henry III. kept several painters in his service, and Chaucer has many allusions to the painting on the walls of his time.

The walls were sometimes divided about halfway, the upper part being decorated with figures relieved in plaster and painted in their proper colours on the white ground, and the lower division either covered with panelled wainscot, or hung with tapestry.

On the vacant spaces were often suspended the antlers of the deer, affording at once an ornament for the walls and a subject of conversation for the host and his guests; and a great hall was scarcely considered complete without the display of suits of armour and warlike weapons.

The furniture of the hall was but scanty; it consisted chiefly of oaken tables and benches, cupboards for plate, glasses, &c., a rere-doss for the fire in the centre of the floor, a fire-fork and tongs.

The tables were of clumsy make, on massive shaped standards, morticed to the floor; others were hinged for the convenience of folding, and supported by trestles. Capulet says

"More lights, ye knaves, and turn the tables up."

At the end of the hall, on a platform or dais raised by three or more steps, was the seat of the master, at the "orsille" or high table under a canopy or "cloth of estale," as it was called, with his family around him and his retainers at two tables down the sides.

The cupboards were in many respects the prototype of our modern sideboards. They were of different kinds, some of common boarding, supported by trestles, with carpet or tapestry coverings; others were framed in stages for the display of plate, and richly carved, and were then generally called court cupboards.

Of the plate itself and the other services of the table it will be beyond our subject to take notice; but those who would wish more information on this point cannot do better than consult Hunt's valuable work on Tudor architecture, from which many of the details in this part of the paper have been taken.

The coverings of tables, previously to the Tudor period, had been of carpets. "In the 16th century," says Fosbroke, in his Encyclopædia of Antiquities, "we find carpets of English work, with arms in the centre, a square carpet-cloth for the table with arms; one large carpet for a *coop-board*; and carpets fringed with crewel;" but in Elizabeth's time, fine linen or *napery*, as it was called, was generally used by the higher classes. At Wolsey's feasts we read of "fine damask table-cloths, sweetly perfumed." Many of these were of most expensive make. In Ben Jonson's "Silent Woman," one of the characters complains of a table-cloth being stained which had cost her £18.

The remaining furniture of the hall consisted sometimes of shove-groat tables and shovel-boards, the latter of which were sometimes made of rare woods, and may be considered as the billiard tables of the age.

There were also boards for playing dice, cribbage, trictrac, (similar to draughts) and trou-madame, a kind of bagatelle.

In the houses of noblemen and rich commoners there were generally superior rooms, called the "great chamber," the "gallery," and the "parlour" or privy room," appropriated to the use of the proprietor and his guests. The furniture here was of a more costly character; we read of high-backed carved chairs, joined stools with cushions covered in various rich materials and fringed, foot-stools, turned chairs, and "lytle guilt chairs for the women,' curtains over the windows and doors, high screens of many folds with tapestry cloths thrown over them, long tables and square tables with rich coverings, and smaller tables of rare woods, sometimes prepared for chess or backgammon, a small tapestry carpet before the fire, "conversation stools" with ornamented ends and backs, varieties of cushions and window pillows, carved cabinets, coffers and chests of cypress and ivory, and andirons of different metals on a raised hearth, with the other fittings of the fire-place.

We cannot afford much space to go into the detail of these matters, but a few may be noticed.

The tables appear to have had but little variety; and their workmanship was in general of a rude character, being concealed by the rich coverings. We have described them above as oblong and square, and we find round tables on pillar and claws mentioned by the writers of the time. There is an elegant one in Montfaucon, and several are engraved in Shaw's work. They could not have been very uncommon, for in Henry IV., the hostess speaks of Falstaff's sitting at her "round table by a sea-coal fire."

Chairs and settees were in some variety, as before remarked. There was usually a canopy or cloth of state over the chair of the noble master of the house. Malvolio, in his dream of greatness, imagines himself "sitting in his state," and Coriolanus is described by Menenius as "sitting in his state, like a thing made for Alexander."

We have accounts of arm-chairs with stuffed backs and sides, and others called "Flemish" chairs, "scrolled" chairs, and "turned" chairs, in ebony, walnut, cherry-tree, &c., with long panelled backs; and low arm-chairs adorned with ivory knobs and inlayings, of Flemish or Italian manufacture; but the more usual seats were stools with rich cushions.

The pillows and cushions with which the stools and window seats were furnished, may be considered as the precursors of our modern Ottomans, and seem to have afforded a favourite field for the display of the taste of our ancestors: they were variously shaped and richly ornamented with embroidery, sometimes of gold, silver, and pearl. Shakspere mentions "Turkey cushions bossed with pearl," which would imply that they were often imported from the East.

The cabinets were of massive form, with heavy turned pillars, both these and the panelling overloaded with elaborate carving; but the interior fittings in a very rough and comfortless style.

The chests were generally raised upon feet, and profusely ornamented with carving. They were often made of cypress wood, which was esteemed as having the property of neither rotting nor becoming worm-eaten. Some commentators on the Bible have considered it identical with the Gopher wood, of which Noah framed the ark.

The ivory coffers for holding jewels were small, with silver and gilt locks, and richly decorated. Shakspere has an illusion to these chests in Twelfth Night:

"——— The beauteous evil
Are empty trunks, o'er flourished by the devil."

Standing and folding screens were sometimes painted, but more generally mere frames, over which rich coverings were thrown; though some were occasionally used which are described as "little fine wicker screens," in frames of walnut-tree.

The pictures on the walls, or "painted tables," as they were called, and the musical instruments, such as the virginals, we must pass over.

Table clocks were used, richly chased and gilt; they sometimes had a double set of hours, that is, were numbered from one to twenty-four.

Looking-glasses were to be found in a few of the houses of the time, but were by no means a general ornament, being confined chiefly to the best bedchamber. They were principally imported from France. In the privy-purse expenses of Henry VIII. in 1532, we meet with payment to a Frenchman for "certaine looking-glasses," and at Goodrich Court is a fine specimen of one of the time of Queen Elizabeth, which has been engraved by Mr. Shaw. It is dated 1559. Small mirrors were carried about their persons by the fashionables of the day.

Among the presents to Queen Elizabeth, we find a "standish of ebony garnished with silver, with two boxes of silver for ink and dust, with a looking-glass in the inside of the cover," and Wolsey is said by Stow to have used a standish of silver gilt. Elizabeth also received as a present "a desk to write on with divers devices, and a pair of tables and chess-board, three silver boxes for the compters, and forty compters."

It must not be supposed that all these luxuries and conveniences were to be found in every nobleman's house of the time: even in the court itself there was a deficiency, as appears from a whimsical passage in Harington's "Nugæ Antiquæ." He complains of the hardness of the seats, and inquires if it would not "as well become the state of the chamber to have easye quilted and lyned forms and stools for the lords and ledyes to sit on, as great planke forms, that two yeoman can scant remove out of their places, and waynscot stools so hard, that since great breeches were layd aside, men can scant indewr to sit on."

There was one room, also, which does not occur in every mansion of the time, namely, the library; but where it does it seems to have been highly considered, so much so, as to be entitled "Paradise." In the descriptions of old houses "*great* and *little* Paradise," frequently occur. At Wressil Castle, Yorkshire, an ancient seat of the Percies, there was "one thyng," says Leland, "I likid exceedingly in one of the towers; that was a study callid 'Paradise,' wher was a closett in the middle, of eight squares lattised about; and at the top of every square was a deske ledged to fit bookes on and cofers within them, and these seemed as yoined hard to the top of this clossett; and yet by pulling, one or al would come down briste high in rabattes and serve for deskes to lay bookes on."

In noticing the fittings-up of the bed-chambers, we need mention little except the bedstead and bedding, as the chairs, stools, &c, were very similar to those of the other rooms. To this we may add that the bedsteads were of a massive character, with the pillars, headboards and canopies, or spervers, elaborately carved and variously painted in lively and decided colours, hatched with gold. The pillars were sometimes surmounted with gilded vanes. The hangings need not be farther described, than as being of the richest materials, often worked by the hands of the ladies of the family. The art of needlework was the fashionable pursuit. Henry VIII.'s daughters, Mary and Elizabeth, were good needlewomen, and Anne Boleyn embroidered the tester of a bed for her husband. They were bequeathed from one generation to another, and often, indeed, entailed.

Some of the state beds of the time exhibited the utmost magnificence, and were distinguished by highflown appellations. Wolsey had one called the "Infantilege" and another called the "Sun."—The bedstead was generally placed on a raised step, and was sufficiently high to allow a smaller one on castors to be rolled under it in the day time, forming the "standing-bed" and "truckle-bed" alluded to in the Merry Wives of Windsor. The latter is sometimes styled "trundle" bed.

There seems to have been no want of well-stuffed wool mattresses, down beds and bolsters, blankets of fustain or wool, and sheets of fine linen; but in the counterpoints or counter*panes*, as they were afterwards called, from being worked in diamond or square figures, the utmost magnificence was displayed;—coverlets of satin; damask, velvet and the richest furs are of constant occurrence in old wills and inventories.

Large heavy wardrobes, with curtains to draw, were another article,—and large trunks called trussing-chests were used as depositories of the bedding for removal.

Beside the bed lay a narrow carpet of tapestry,—and rich chairs and seats were not wanting in the chamber.

The dressing-table was also elaborately furnished with rich coverings, and over it sometimes hung a mirror of polished steel in velvet frame embroidered with gold.

We may here conclude this list, for the inferior rooms and the offices scarcely demand our attention.

In considering the proper manner of adapting the Elizabethan style to the use of the present day, it may be necessary in the first place to divest ourselves of whatever predilection we may feel for any other style of decoration. The influence of taste or the prejudice of education may lead some to contrast it disadvantageously with the classic style, and it would be scarcely fair to expose it to so severe a test, Comparisons are proverbially invidious, and we must judge it by its own merits alone, without reference to those of others.

An excellent study of the general features of this style is to be found in Mr. Nash's admirable work on the "English mansions of the olden time." It is not alone for the faithful delineation of the mansions themselves that it is so truly valuable. The appropriate furniture of the apartments, and the picturesque grouping of the figures, represented as engaged in various occupations or sports, exhibit the most perfect acquaintance with the habits and customs of the different periods, and bestow a charm on the whole, which mere architectural details alone would never have imparted. As the work, however, includes mansions of all dates, those who consult it with reference to the Elizabethan period must be careful not to confound the examples with those of later date. Another work of similar kind, and entitled to equal consideration is, the "Baronial Halls," now publishing by Mr. S. C. Hall, which is illustrated by some of the best artists of the day.

To those who are prevented visiting the mansions themselves, nothing better can be recommended than the study of superior works like these, from which the modern adapters of the style may select those particular beauties which give it its distinctive character, and at the same time learn to avoid its peculiar faults.

An architect would be justly exposed to ridicule, who in designing a mansion in this style should borrow its faults instead of its beauties, or adopt its more elegant features only to misapply them. While with praiseworthy ambition aspiring.

"To raise the ceiling's fretted height,
Each panel in achievements clothing,"

he should be careful not to expose himself to the charge contained in the rest of the verse, by adopting the

"Huge windows that exclude the light,
And passages that lead to nothing."

So we ourselves in the Interiors committed to us should studiously strive to avoid the redundances that disfigure it; for even in the best specimens that are left us, in the midst of all their beauties, there is continually something appearing which detracts much from our admiration. Turn for instance to Richardson's work, and observe some of the illustrations of Claverton House. Nothing can be in better taste than some of the details (The Screen, Plate viii.—The enriched Columns of Plate xi.—The Pilaster, Plate xvi. &c.): but on the other hand examine the barbarous figures in the carving (Chimney-piece of Hall, Plate xv. &c.); no one can look at them with any pleasure, except as a curious object of antiquity, and with the same mixed feelings which are excited by the strange attempts at perspective in a highly-finished Chinese painting. Not even the most enthusiastic admirer of the Elizabethan style can defend such outrageous representations, or wish them adopted in modern imitations Mr. Howitt in his "Visits to Remarkable Places" describes in an amusing manner some uncouth specimens of the kind, which he saw at Compton Wynyates, an Elizabethan mansion in Warwickshire.

The multitude of small square panels introduced on the walls is also a sad disfigurement: look in Richardson at the illustrations of the Duke's House, Bradford, and more particularly at the Star Chamber, which fully confirm these remarks. That splendid structure, Holland House, with all its beauties, is in some parts liable to the same charge. These objections may be considered presumptuous; it is by no means, however, in a spirit of cavilling that they are made, but solely from an anxious desire to arrive at the best mode of carrying out the style effectually. In fact, the pruning-knife appears to be the principal requisite, for the very luxuriance of the style is its greatest fault. It is too elaborate, the ornaments too complex and redundant, and the general effect is often lost sight of in too great an attention to details.

The barbarous representation of the human figure, alluded to above, in the carved relievos of chimney-pieces and panels, was also one of the great defects of the arras hangings. Some of the tapestry of the age was doubtless of the best execution; indeed the very fact of Raffaelle having been employed to design Cartoons for the purpose of being worked sufficiently attests it; but there can be little doubt that by far the greater part was in a barbarous style; for judging from the quantity of rubbish that has descended to us, we may make a tolerable estimate of what has perished.

The revival of a taste for this article for covering walls cannot be desired; they can be decorated in a better and cheaper manner; the varieties of paper-hanging and painting, with the facilities they afford for continual renewal, and the recent revival of fresco-painting will be quite sufficient without these "fly bitten" tapestries. They have, however, admirers, and have of late been introduced somewhat largely into this country;—many specimens have been of good design and most brilliant colouring; but it is impossible for the most skilful hand to represent the human figure, or even landscape, in tapestry or needle-work with half the effect that would be given by the pencil and colours of the artist. The nice gradations of nature cannot be produced by the materials employed, and the general effect of the representation is consequently crude and raw.

There is one description of hangings used by our ancestors, which has been recently revived in France and imported into this country—namely, embossed leather. From the great control the manufacturer has obtained over this article, there is little doubt of its being capable of introduction with good effect; but there is a limit to its capabilities, and the attempt to execute it in high relief has proved a comparative failure.

The representation of festoons of fruit, flowers, &c., in the same material (the "*Peau en plastique*," as it is affectedly called, when an English name might as well be used) has obtained much patronage of late years. It is susceptible of being used with advantage as an enrichment, taking care not to overdo it, but there is great room for improvement, as a metallic harshness of appearance is perceptible about it, which renders it very inferior to good carving in wood, to which some of its admirers have not hesitated to pronounce it fully equal.

How far the use of this article can be justified in an Elizabethan interior is however a matter of consideration. It has no precedent in the edifices of that age, the more perfect imitation of nature which forms its principal recommendation not having been introduced until nearly the end of the seventeenth century by Grinling Gibbons and his contemporaries. But the effective manner in which it would harmonize with the more elegant features of the Elizabethan might almost reconcile us to the anachronism.

There is another feature of the Elizabethan style, that is, the introduction of elaborate open work in panels, friezes, &c., which modern improvement in mechanics renders easy of adoption, thereby affording a handsome and characteristic mode of decoration at a comparatively small expense. When the more prominent parts are slightly relieved with carving, the effect is greatly enhanced.

The intricacy of the pattern in old works of this kind exhibits a wonderful play of fancy in the artists of the time, reminding us in some degree of the light and graceful arabesques of the East; but occasionally, in seeking for new combinations, their scroll-work became stiff and heavy, teeming with abrupt turns and sudden transitions, and producing a feeling of wonder rather than pleasure. It is here that judgment is most required on the part of the imitator, leading him to adopt the beautiful and avoid the absurd; for there is no style, not even the Louis Quatorze, that affords a more fatal facility than the Elizabethan for the exercise of bad taste.

The knobs and bosses and the imitative jewels which abound in the ornamental work of the age may also be used with good effect, and the introduction of emblazoned letters and armorial bearings will give a richness to a piece of furniture eminently characteristic of the style.

The carved enrichments so abundant in old houses have been much sought by our modern adapters. We cannot but observe with pain the gross absurdities into which they have been led, sometimes by their want of taste, but more often, it is be feared, by want of principle. The immense quantities of rubbish imported of late years from the continent is really amazing. England seems to have been regarded by foreigners in these respects much in the way savages were estimated by our early navigators, in whose eyes a worthless button or a glass bead was equivalent to the most valuable article. Shiploads of brackets and panellings, rails and staircases, the refuse of old Flemish houses, disfigured, instead of ornamented, with the most barbarous carving, have been brought over by speculating individuals, and worked up, without the least regard to propriety of design, into articles for modern use. To the disgrace of the national taste, these wretched combinations, offered under the name of Elizabethan, have met a ready sale, and realized a good profit to the mercenary speculators. The sight of some of our old curiosity-shops is sickening to the eye of taste. It is possible there may be a few valuable articles concealed among the heaps of rubbish, but they are like Gratiano's two grains of wheat hid in two bushels of chaff.

Many of the points of the Elizabethan style, in themselves beauties, cease to be so, if introduced out of place, or too often repeated in the same room or the same set of furniture. Spiral pillars, for instance, are in themselves elegant and very characteristic of the style, but the excessive use of them cannot be too much deprecated. We see them often repeated perpendicularly, horizontally, diagonally, till the eye becomes absolutely fatigued. The perpendicular position may be safely recommended as the only one warranted by correct taste. Handsome as they are, however, there is one manner in which they are introduced in old houses and articles of furniture, that had better be avoided in modern use:—it is when a large spiral column is supported by two, three, or four smaller ones, in defiance of the ordinary principles of almost every order of architecture.

In adapting this style to modern articles, it is not enough, as if often done, to introduce a few Elizabethan features in the detail, leaving the form and mouldings framed after the Grecian. We must all have often observed with pain the exhibition of pieces of furniture professedly executed in this style, the only genuine feature of which is perhaps a clumsy shield-like panel, or a couple of distorted brackets, the rest being a barbarous mixture of Grecian foliage and French scroll-work. Such combinations are most offensive to the eye of taste. The whole form and outline should be changed, and assimilated, as much as modern convenience will allow, to its Elizabethan model. But in imitating old chairs. sofas, settees, &c., we should not slavishly follow them; for their high backs and shallow seats are scarcely compatible with modern ideas of comfort; the necessary alterations in these cases must be left to the judgment of the adapter. We may observe that pinnacles, crockets, and sharp points should be avoided, as being likely to prove destructive of female apparel.

Care also should be taken to avoid introducing the ecclesiastical style into household furniture. Hunt, in his valuable work, observes that "church and house architecture were not so dissimilar in character as church and house furniture. Making, therefore, dining room seats diminutives of cathedral stalls, crenellating footstools and machicolating bedsteads, as has been the practice, are still more glaring incongruities than mingling ecclesiastical with domestic features in the construction of one edifice."

These remarks of Hunt's should not be disregarded, although they refer more to the Gothic than the Elizabethan, for the principle is the same in both; but we may take this opportunity of recommending that in the following-out of the Elizabethan, so as to give it a distinctive character, care should be taken to lean rather to the Italian than the Gothic.

The state beds of the age of Elizabeth are in many respects worthy of admiration, and afford good examples for imitation, with some exceptions. The supporting pillars are often outrageously heavy in the design, and the carving both of them and the headboards is sometimes overdone. The same remarks will apply to the supporting frames and standards of the tables, &c.

In concluding this imperfect essay it may be advisable once more to remind the modern imitator of this style of the necessity of exercising a careful judgment in the selection of his models, with a view of adopting only the more excellent features; for as this style has a very magnificent effect when properly treated, so there is none more ridiculously offensive when imitated without taste or discrimination.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE ROYAL SCOTTISH SOCIETY OF ARTS.

The following communications were made:—1. Description of the Climbing Machine, used in examining a Rent in the great Chimney at St. Rollox. By Professor Gordon, University of Glasgow, and Lawrence Hill, Esq., civil engineers. Communicated by David Stevenson, Esq., Vice President. A model and drawings were exhibited. The great chimney built by Messrs. Tennant, at St. Rollox, for carrying off the noxious gases from the works, and dispersing them at such an elevation that they may be diluted before descending to the surrounding houses, measures 440 feet in height from the surface of the ground The foundation courses are 15 feet in depth, so that the whole height of the building is 455 feet; it is 40 feet in diameter at the base and 13 at the top. There are 1¾ millions of bricks in it, and the whole work was completed in six months, without accident. It was finished in June 1842, and in May 1844, a rent was discovered in it on one side about 36 feet long, and extending from a point 100 feet from the top downwards. It gradually increased during June and July, and then a similar one was discovered on the opposite side. This created some anxiety, and it was considered advisable to examine them, but a difficulty occurred in reaching this point, 280 feet from the ground. Scaffolding was first thought of, but the expense of this would have been great; a balloon was proposed, but that also, for obvious reasons, was not carried out. Professor Gordon and Mr. Hill have solved the difficulty by the invention of their climbing machine. By this simple apparatus, a working model of which was exhibited to the Society, two men worked themselves up at the rate of 30 feet a-day, gaining the desired elevation in nine days. The machine consists of a cradle, which was hoisted up through different stages of five feet in height, by means of two ropes, one on either side of the cradle, these ropes were attached by hooks to lewises driven into the building, in advance of the cradle as it travelled upwards, and passing round pulleys fixed to the cradle, it was worked up by means of an ingenious apparatus. The height of the lewises being gained, safety chains were made fast to them, and the ropes being unwound were hooked to other two lewises fixed in the wall five feet above the cage or cradle, and it was again hoisted through another stage, and so on to the height of 270 feet. The cracks were examined, and supposed to be produced by heat; they were plastered up, and another ascent is to be made soon to ascertain if they are continuing to increase, when means will be taken to secure them. The succeeding ascents will be rendered comparatively easy, as the precaution was taken to fix a pulley in the chimney, at the site of the cracks, through which a rope passes communicating with the ground A process has been discovered by which the gases evolved in the progress of the works can be disposed of without passing them up this chimney; but 120 tons of coal are consumed in the St. Rollox works daily, the whole products of which pass up the great chimney, drawn in some cases through flues 100 yards long.

2. Verbal Description of a Self-Registering Barometer, invented by Robert Bryson, Esq., F. R. S. E. The instrument was explained and exhibited in action by Alexander Bryson, Esq. This barometer has been in action since 22d June, 1843, and has registered at every hour, day and night, the height of the column of mercury. Since its commencement it has registered upwards of 12,000 observations which have been tabulated, and were exhibited to the Society. Mr. A. Bryson stated that he would give a written description of the instrument when he gives the second portion of his communication, viz., the results of the observations, with the light thrown by means of them on barometic diurnal variation. Thanks voted and referred to a committee.

3. Sir George S. Mackenzie, Bart., exhibited another specimen of Mr. Cheverton's Sculpture in Ivory, being a bust of the late Professor Playfair. It was much admired on account of the accuracy of the likeness, and great delicacy of the sculpture. Thanks voted.

4. Account of the Prussiatype, a new Photographic Process. By Mr. R. E. Smith, Blackford, Auchterarder. Specimens were exhibited. In reference to this new process, it was observed by a member that it promised to be a very useful and simple method, inasmuch as by it positive pictures are at once produced without the necessity of first having a negative one; and that thus the pictures were likely to be sharper than where negative pictures are first used, providing it shall turn out on trial that the photographic paper prepared in this way is sufficiently sensitive.

INSTITUTION OF CIVIL ENGINEERS.

March 12.—The PRESIDENT in the Chair.

TOWN AND HARBOUR OF PULTENEY-TOWN.

"*Account of the Town and Harbour of Pulteney-Town* (*Wick, Caithness*), *from their origin in* 1803 *to the year* 1844."—By JAMES BREMNER, M. Inst. C. E.

Pulteney-Town and Harbour, situated in N. latitude 58° 26′ 45″ and W. longitude 3° 3′ 56″, are the property of the British Fisheries Society, which was established under Acts of Parliament, for the purposes of extending the fisheries, and improving the sea-coasts of North Britain. They were under these Acts, empowered to construct this harbour, which, with the town, was planned by Mr. Telford in 1803; both are located upon the property of Sir George Dunbar of Hempriggs, and are separated from the burgh of Wick by the river, which is spanned by a stone bridge of three arches, with a clear water-way of 156 feet: it was built in 1805 by Mr. G. Burn, also from the designs of Mr. Telford. In the same year, the old or north harbour (Fig. 1), was commenced. With the exception of the pier heads, which were founded by the author, for the contractor, at a depth of 4 feet below low-water mark, the outer walls were all constructed above that level, on a bed of blue clay mixed with stones. The works were of ordinary construction, having behind the face-walls clay puddle, within which, sand was used as hearting. A mass of boulders, whose tops reached the level of half tide, lay outside the pier heads, and protected them from the action of the sea. This harbour was finished in 1811 at an expense of £16,400.

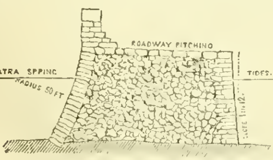
The bed of Wick Bay is sand to a considerable depth; this sand, when disturbed by storms, is driven in great quantities to the head of the bay, where the river empties itself into the sea; with freshes, in easy weather, the river carries the sand, thus lodged near its course, towards the harbour entrance. The north harbour thus soon became nearly filled with sand, from the nature of its situation and the position of its entrance, and owing to this, and the very small rise of tide at this place, the depth of water in the interior, with ordinary spring tides, did not exceed 8 feet 6 inches.

Fig. 1

Plan of Pulteney-Town Harbour, with improved improvements. By J. Bremner, M. Inst. C. E.

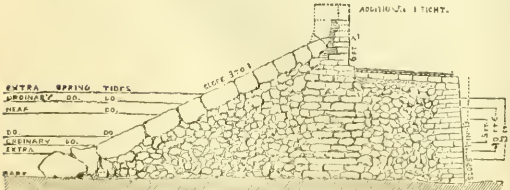
The rise of tide at Pulteney-Town, as shown in the accompanying sections (Figs. 2, 3, and 4), is, with neap tides, 5 feet; with ordinary springs 9 feet 6 inches; and, with extraordinary springs, from the point of the lowest ebb, to that of the highest flow, is 13 feet. From this some idea may be formed of the difficulty of making a harbour, sufficient for the ingress and egress of the ordinary size of vessels, even with spring tides; so that to obtain a sufficient depth of water, it was requisite that the piers should be formed under low-water mark. To account for this limited rise of tide is not difficult. The Bay of Wick is only 17 miles from the east entrance of the Pentland Frith, which separates the Orkney Islands from the mainland. This frith, or strait, being only 7 miles wide, is quite inadequate to communicate each tide to the Moray Frith, the rise and fall of the North Atlantic ocean on its western side. From this source, the tide in it flows for 7½ hours at the rate o

Fig. 2.



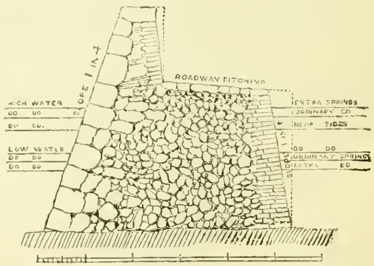
Cross Section of North Pier.

Fig. 3.



Cross Section of South Pier.

Fig. 4.



Cross Section of Proposed Pier.

11 miles an hour; while from the Moray Frith, at the north side of the mouth of which Pulteney-Town is situated, it ebbs only 4½ hours, on account of the barrier formed by the Orkney Islands; accordingly, vessels bound to the eastward find no difficulty in getting through this strait; while those proceeding westward having so limited a tide, are often put back from near Cape Wrath in attempting to get round it. The north harbour was first used by coasting vessels, which at that time were of a very small size, from freights being so high as to enable the smallest class of vessels to pay well. After the conclusion of the continental war, however, freights were lowered so that small vessels, for which this harbour was only fitted, could no longer be lucratively employed. This occasioned the use of vessels of a larger draught of water, which rendered the north harbour almost useless.

The practice of partially loading in the harbour, and finishing in the bay by means of boats, was not only attended with extra expense, but also, in many cases, with the loss of lives and property, owing to the very great exposure of Wick Bay. This, together with the cost of removing the sand that accumulated in the harbour, and the rising prosperity of the town, led to the erection of the south harbour in deeper water. This prosperity was chiefly induced by the success of the herring fishery, for which Pulteney-Town has always sustained a high reputation, and it is now perhaps the largest fishing-port of the kind in Great Britain.

Construction of the Harbour.—The survey for the south harbour was made by Mr. J. Mitchell, and his plan for it, after being revised by Mr. Telford, was adopted in 1823. The contract, which embraced the present quay, and 175 lineal feet of the south pier from the inner angle, was let to the author, and in 1825 he was directed to extend this pier 100 feet further; and in 1826 he was again called upon to construct an extension of the south pier to its present length, a great part of it being from 4 feet to 8 feet under the line of the lowest spring tides. In the same year, the author entered into a contract for building the north pier; building and embanking the jetty; making an opening from the south to the north harbour; and closing in the old entrance of it; and for completing the harbour as it remains at present.

In preparing to carry on these works, two powerful barges of 40 tons and 60 tons burthen respectively, were built; one of them having one crane, and the other two cranes on a new construction. By means of a double line of railroad to the quarry, a plentiful supply of stone was procured at all times. The barges were also, in good weather, enabled to carry stones from a part of the bay about a mile without the harbour, and were worked with safety and expedition, by means of track-lines laid out in the direction of the loading place. The importance of having a large supply of materials for a work of such magnitude and hazard, will at once be seen, when it is stated, that only about 24 weeks in the year are fit for carrying on such works. Aware of this danger, and of the heavy nature of the work of forming the last 100 feet of the south pier, the author had a large number of masons, quarriers, lightermen, and other men employed night and day in the season of 1827, and had made rapid progress towards its completion. All would have been finished by the 20th of September of that year, but unfortunately on the 10th of that month a violent storm arose, and, notwithstanding the temporary blocking up, which was used as a precautionary measure, about 100 feet of the pier head were swept down in one tide, to the level of low water. From having to bond the last portion properly with the end of the former, this joining was laid open, and 20 feet within it was also laid in ruins by the next tide. The stones were carried to a distance of nearly 100 feet from the work, by the force of the sea, and chiefly into deep water.

To prevent the breach from spreading, and causing the destruction of the whole work, 50 shipwrights, and 300 masons and labourers were employed, in placing nearly 40 tons of chain cables round the open end, and upon the pitching of the roadway, and fastened them securely inwards; this was accomplished in two tides, although the storm did not abate. Very large stones were afterwards laid on the open end; this proceeding, with due attention to the chains, was the means of avoiding the destruction of the whole work, during the stormy winter that followed; as it was, the loss sustained in the two tides amounted to 5,000*l.* The cause of this failure, may justly be ascribed to the great slope and the low parapet, by which the sea was thrown bodily upon the roadway, the pitching of which first gave way; a portion of the hearting then followed; afterwards the front wall fell, until at length all support was removed from the pitching stones of the slope, and they also were carried away.

In order to prevent such an occurrence in future, a wall of large rough stones was built under the parapet, as shown on the cross section of the south pier (Fig. 3); the roadway pitching was, in addition, wedged firmly with fir wedges, on which cills of 1½ inch boards, going along the roadway, were spiked down at intervals of 10 inches apart; on these cills, boards 1 inch in thickness were fixed and closely joined together, the outer ends laying to the foot of the parapet, while the inner ends reached half way over the coping of the front wall, so that the sea in falling from the parapet, was not allowed to touch the pitching.

Early in the spring of 1828, preparations were made for rebuilding the work which had been thrown down; so much difficulty was experienced in the erection of machinery and clearing out the old materials, that it was found easier to quarry most of the stones afresh, than to drag out of deep water the stones which had been carried thither by the sea.

The machinery used by the author, consisted of four jib cranes, which were set in strong frames of timber, of sufficient height to build the front wall and the parapet. There were also two radiating beam cranes, each 110 feet in length working upon rails supported by posts built into the slope, moved, round by a small rope tackle on each side, and having a travelling carriage on each for the crane chain. These cranes took in the whole range of slope, without being moved, and were very efficient.

The stones used for the construction, were of hard quality and naturally well shaped for the work; they varied in dimensions from 3 feet to 20 feet in length, by 3 feet to 8 feet in breadth, and 8 inches to 15 inches in thickness. In the slope they were set on edge, and the courses were placed diagonally; in the front wall they were laid flat, the beds being perpendicular to the line of face.

In laying the foundations under water, the two-crane lighter was particularly useful, one crane being used for clearing away the sand, by means of a bag and spoon, while the other set the stones in their places. The foundation course of the slope, consisted of large blocks of stone, each from 15 tons to 20 tons weight, and it was for floating these stones, that the author first used the casks, of which he presented the description to the Institution.

In the month of September in the same year, the whole length of 120 feet of pier was completed, and since that period not a single stone has been removed by the sea.

The parapet of the south pier being only 6 feet in height, with a flat slope on the outside (Fig. 5), was but ill adapted for affording a shelter on the inside of the pier in storms; in fact the sea broke over it at high water as over a half-tide rock. After many representations on the part of the author, it was resolved to raise the parapet to the present height of 14 feet (Fig. 3), which was done in the following year. The necessity for this, appears from the fact, that even now, during storms, the spray is carried a distance of 100 feet, after passing over the parapet. If the slope had been less, the force of the receding wave would have been increased, so as to counteract the force of the wave, on meeting it, before touching the slope; at its present inclination of 3 to 1, the receding wave only adds to the bulk and violence of the approaching wave.

During the year 1830, great progress was made with the north pier and the interior works. The harbour was excavated to the level of low water of ordinary spring tides, and the material obtained was used in the hearting of the jetty. A very slight batter was given to the back wall, because the sea, in running along the face of the pier, at an angle of 45°, exerted but little force against it.

The south harbour was completed in 1830, and 20,900*l.*, including the opening connecting it with the north harbour, closing the old entrance, and all repairs for three years after its completion; the quarry was near, and labour was cheap, or nearly double the amount would have been expended.

The effect of the north pier, in contracting the bay, has led to a large accumulation of sand on the north side of the river, which is a proof, in the author's opinion, that if the sea be carried past the entrance of any harbour, the sand is, necessarily, carried past with it; in this case, great change was produced by the junction of the two harbours. The north harbour was rendered much more convenient and safe, and less liable to be sanded up; it was soon after deepened, and the pitching of its roadways partially relaid.

It is still to be regretted, that in stormy weather, the south harbour does not afford proper shelter, and considering that it is surrounded (excepting a slope of 300 feet in length), by perpendicular walls, which add to the recoil of the sea within, this is not to be wondered at. Besides this evil, it is liable to become partially sanded up, probably from the effects of the river running against the projection of the south pier, beyond the projection of the north pier; the removal of this sand has been attended with some cost and trouble.

Casks used for Floating Large Stones.

"*Description of the Casks used for Floating Large Stones, to construct Sea Walls in Deep Water.*" By James Bremner, M. Inst. C. E.

The ordinary mode of conveying stones for harbour work, is by means of two large boats, with baulks of timber lashed across them, from which rope tackles are suspended. These tackles are hooked on to "lewises" inserted into the stones, and tightened at low water. When the tide flows the stone floats, and it can be conveyed to the spot where it is intended to be laid. Stones weighing 40 tons each have been thus transported several miles, without difficulty, in good weather; but it has been found, that the boats were soon strained and became leaky, and on an exposed coast, when bad weather came on, they were liable to be destroyed; the author therefore devised the plan described in the paper, as a substitute for the united boats.

About eight years ago, the author was consulted as to the improvement of the harbour of Banff, and the repairs of the sea slope of the north pier, the foundations of which had partially failed. He found, that the previous attempts at preventing the destruction of the pier, by laying down stones of from 2 tons to 4 tons in weight, brought from a quarry in the neighbourhood, had been quite ineffectual, as such materials could not withstand the force of the waves. He had observed along the shore, at several miles westward of the harbour, in almost inaccessible situations, ranges of large rough stones of hard quality, weighing from 25 tons to 40 tons each, and he determined to use them for the repairs of the work. It would have been almost impossible to get the boats near them, so he resolved to use casks for the purpose, as he had formerly done, under somewhat similar circumstances, at Pulteney-Town harbour.

There was but little novelty in the construction of the casks (Figs. 1 and 2), which were of fir timber; the ends had each two cross boards inside with four props fitted between them, and there was a slip feather at each joining of the end boards; there were also interior hoops of timber, strutted from the centre by spokes, like those of a wheel, in the situation of the

Fig. 1.

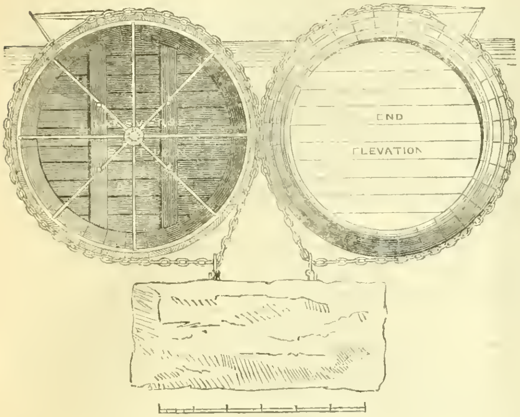
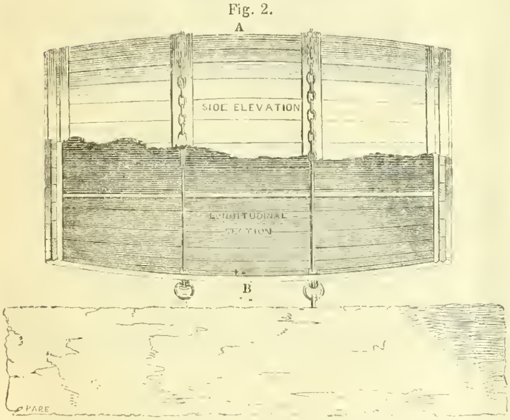


Fig. 2.



chains, by which the stone was borne; the whole was hooped outwardly with iron, and made in the strongest manner, consistent with lightness, to resist external pressure.

Where any of the stones were under low water, wooden frames were used in boring the holes for inserting the lewis. The casks were towed to the spot, and at low water were attached to the stone, by means of chains passing through the lewis rings and over the casks. At the top of each cask, the spindle of one end of the chain, was passed through the ring of the other, pulled tight, and fastened backward, by a small hempen line, to the chain. On the flowing of the tide, which rose at that spot from 10 feet to 15 feet, the casks and the stone floated together, and were towed away by means of a boat; the stone was then moored over the spot where it was intended to be laid, and at about half ebb, by means of a long-handled knife, the small lines, by which the chains were attached, were cut; the casks rose to the surface, and the stone, being guided into its position by boat-hooks, fell into its destined spot: the chains were then drawn away, and the casks were again fixed on, at low water, to the next stone to be floated.

The advantages gained by these means were obvious. The coast was too rugged and dangerous to admit of a crane-lighter being used, and if it could have been worked the stones were much too heavy to be lifted on deck, and even then, there would have been some difficulty in moving a lighter such a distance. The stone displacing its own bulk of water, left not quite 13 cwt. per ton for the casks to lift; the specific weight of water and of the stone being 36 cubic feet, and 13 cubic feet respectively to the ton. Each cask weighed 25 cwt., and displaced 145 cubic feet of water; so that two casks lifted a gross weight of $34\frac{1}{2}$ tons of stone, the displacement of water caused by which was equivalent to lifting $12\frac{1}{4}$ tons. When rough weather came on, the casks were easily disengaged, and were rolled to above high water-mark, without the least injury. Even in a heavy surf stones have been buoyed out, by means of a long towing-line fastened to the casks. The strength and tightness of the casks were very remarkable; after being used for 24 hours, scarcely a gallon of water was found in each cask. This must, in some measure, be attributed to the swelling of the wood.

Four casks were used, and with them a length of 400 feet of the foundation was effectually secured, in the course of a few months, and not a stone has since been removed.

To ensure still further the stability of the stones when laid, the author proposed to have a chain cable passed through a lewis in each stone, and permanently fastened to the pier, so as to connect the whole together.

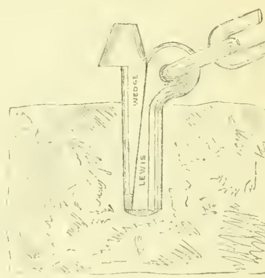
The application of these casks has not been confined to floating stones. In Banff, as well as in Macduff Harbour, great inconvenience was felt, from the want of a sufficient depth of water. In case of a vessel being fully loaded up in the harbour, and the depth of water being insufficient, four of these casks were attached, by means of chains previously passed under the vessel's keel; with the flowing tide, a lift equal to 44 tons, was given by the casks, which were afterwards easily disengaged, when the vessel was outside, in deep water. To a vessel of 100 tons register, a deficiency of 15 inches in her draught of water, has been supplied by these means, the want of which water would otherwise have occasioned detention and loss.

The author believes, that casks would be found equally efficacious, in removing stones from the beds of rivers, &c., as from dangerous and exposed parts of the sea-coast.

The cost of each of the casks was 8*l.*, ond they were not at all injured by the work they were used upon. The charge for labour, in making lewis-holes, fixing on the casks. and removing the stone three miles, was only 1*s.* 6*d.* per ton, which included lowering them into their proper places and towing back the casks; in short every expense, except that of finding casks and lewises.

The lewises used (Fig. 3), were of the simplest kind, the shank part inserted was 2 inches in diameter at the bottom, tapering to $1\frac{1}{4}$ inch at the

Fig. 3.



top, where a ring was welded into an eye; into this ring, the chains were fastened, before letting in the lewis, which was done by means of two guide rods of iron, close to the mouth of the jumper-hole; the wedge was then inserted, by means of a pair of long-handled tongs; a punch bar of iron being set on its top to hammer it down. Although the lewis-holes were perfectly cylindrical, not a single instance occurred of the lewis being drawn out, even when raising the heaviest stones.

The author thinks, that the slope of Banff Harbour, which is 3 horizontal to 1 perpendicular, is much too flat, as no superincumbent weight being added to the foundation course (on which the whole slope abutted), the stones were liable to be moved outward, by the heavy recoil of the receding waves, acting at low water on their surface and on the inner bed joints. This was the case with the new pier at Banff, which was designed by the late Mr Telford, and has also been found, in many other harbours, to be a cause of constant outlay for repairs. The author suggests, that a curved slope of 1 to 1, reckoning from the top of the parapet to the foundation, should be used, and he has found that even a less slope than 1 to 1 answers very well, even in very exposed situations, if the foundation can be let into the rock.

FAREHAM'S RAILWAY SWITCH.

A model was exhibited of Faram's Railway Switch.

The object of this invention was explained to be, that by means of an apparatus attached to the locomotive engine and under the command of the driver, the switches of the railway should be moved into such positions, as would be necessary to divert the train into the required direction, and thus render it unnecessary to have persons in attendance, to place the switches correctly for the next coming train. In the arrangements of this apparatus, care was taken to avoid too sudden contact between the switches and the projecting arm which caused the movement. It was stated, that if any objection existed to placing the control of the switches under the engine-driver, that part of the apparatus could be suppressed, and the switches could be worked by hand from the side of the railway as at present; but Mr. Faram stated that system to be less useful and certain than his plan.

March 19.—The President in the Chair.

Formation of the Town Lands of Musselburgh.

"*Description of the formation of the Town-lands of Musselburgh, on the Firth of Forth.*" By James Hay.

The author states, that the delta of low alluvial land at the mouth of the river Esk, which comprehends the town-lands of Musselburgh, to the extent of at least 400 acres had been gained from the sea, in the space of about three hundred years, by the gradual operations of nature, unassisted by art. If an excavation be made to the depth of a few feet, in ground that has not been previously disturbed, gravel and a few shells are found, the latter not fossilized, but in the same state in which they are found upon the beach at this time; and in cutting a drain to a depth of 7 feet in this deposit, at a quarter of a mile from the sea, the author found a piece of wrought-iron, which was surrounded by a concretion of shells and gravel, clearly proving that the sea had recently been there. He also mentions several facts, from ancient charters and leases, showing that the spot, where the present town-lands of Musselburgh exist, must formerly have been beneath the level of the sea. The causes which contribute towards producing these changes are, that the river Esk, when swollen by rain, brings down with its floods, the detritus of the hills through which it passes, which, with the soil washed from the banks of the low-lands, is arrested, when it meets the tide, and is thrown on the beach; then, by the action of the high north winds, the sand is carried up from the gravel, and raises the land several feet above the level of the sea, and in some places as much as 12 feet. Another cause is, that along the Firth of Forth, and particularly between Leith and Newhaven, the sea has made great encroachments, and about a mile west of Musselburgh many acres of land have been swept away, the lighter portions of which, are carried eastward by a current setting in that direction, and are lodged near the mouth of the Esk.

Hydraulic Traversing Machine.

"*Description of the Hydraulic Traversing Frame, at the Bristol Terminus of the Great Western Railway.*" By Arthur John Dodson, Assoc. Inst. C. E.

The object of this machine is to transport the railway carriages, from the arrival side of the terminus, to the departure side, or to any one of the several intermediate lines, without the use of turn-tables, which cannot always be conveniently or safely introduced, and also without any intersection or derangement of the rails. The apparatus consists of a wrought-iron frame, connected by cross and diagonal pieces, and supported upon eight cast-iron wheels. At the four corners of the frame, cast-iron hydraulic presses are fixed, and at one end of it, two force-pumps are placed, connected with the presses by copper pipes and gun-metal nozzles. Upon the wrought-iron plungers of the four presses, two additonal frames rest; these are attached to the lower frame, by four sets of parallel-motion bars, to ensure their rising perpendicularly. The action of the machine is described as follows:—An opening being made in the train, the apparatus is pushed on to the line of rails, and the carriage required to be moved is placed over it when the frame is quite down. As soon as the carriage is brought directly over the apparatus, a man works the larger pump acting upon the four hydraulic presses, which raises the frames until they are in contact with the axles of the carriage wheels; the smaller pump is then worked, until the flanges of the carriage wheels are clear of the rails. The whole apparatus, with the carriage suspended upon it, is then easily transported to any of the lines of rails, and by unscrewing the stopper, which allows the water to flow back from the presses into the cistern, the carriage is lowered on to the rails; it is then pushed back, and the apparatus is rolled over, ready for recommencing the operation, the whole transit not having occupied more than a minute and a half.

Mr. Dodson stated, in answer to questions from the President, that this hydraulic traversing frame had cost about 220*l.*: that it was the only one of the kind at present in use on the Great Western Railway, but that in consequence of its action being so much approved, several others were expected to be erected.

Mr. Brunel said, that the machine in question was made by Mr. A. Napier, of Lambeth; it was extremely well constructed, and he intended using others of the same kind. He expected they would be less expensive than the one described, which was the first that had been made.

Land Slip in the Ashley Cutting.

"*Account of the Land-Slip in Ashley Cutting, on the line of the Great Western Railway.*" By John Geale Thomson, Grad. Inst. C. E.

The object of the author of this paper is to show, that the land-slip which he describes, had its origin in a peculiarity of the geological position, and not in the nature of the ground in which it occurred. To explain this view, the formation of the oolitic district, so far as it relates to engineering purposes, is described generally, and a more particular account is given of the valley of the Box brook, in which this slip took place.

The Ashley cutting is situated about 5 miles on the London side of Bath, at the base of Kingsdown Hill, the level of the rails being about 23 feet above the level of the Box Brook.

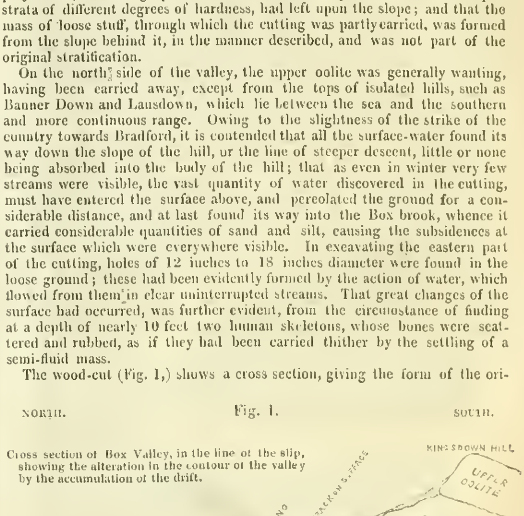
In Mr. Lonsdale's account of the oolitic district of Bath, the valley of the Box Brook is styled, a "denuded valley of the lias, or in other words, that the action of denudation has ploughed into, but not through, the lias, whereas it has completely eroded the superjacent strata. The valley is one of the two plains, which separate the parallel ridge of the great or upper oolite, which occupies, with few exceptions, the summits of the hills in that part of the country. The extreme height of the range of hills at Lansdown, its western extremity, is about 813 feet above the level of the sea. The summit of Kingsdown-hill, behind the cutting, is rather higher than Box-hill, over the tunnel; and from the several heights given by the author it appears, that the country slopes gradually from Kingsdown-hill to the railway, at the rate of 1 in 11, exposing a slope of 1000 feet in length, to the decomposing action of the atmosphere, and to the collection of water. From the appearances of this locality and other observations, the author contends that a considerable accumulation of drift from the high lands behind the cutting, had, in the course of time, settled at the base of the hill, whereby the original contour of the valley of denudation had been altered; that this had been caused by the unremitting action of water and the atmosphere smoothing down the projections, and filling up the cavities with the unequal effects of water upon strata of different degrees of hardness, had left upon the slope; and that the mass of loose stuff, through which the cutting was partly carried, was formed from the slope behind it, in the manner described, and was not part of the original stratification.

On the north side of the valley, the upper oolite was generally wanting, having been carried away, except from the tops of isolated hills, such as Banner Down and Lansdown, which lie between the sea and the southern and more continuous range. Owing to the slightness of the strike of the country towards Bradford, it is contended that all the surface-water found its way down the slope of the hill, or the line of steeper descent, little or none being absorbed into the body of the hill; that as even in winter very few streams were visible, the vast quantity of water discovered in the cutting, must have entered the surface above, and percolated the ground for a considerable distance, and at last found its way into the Box brook, whence it carried considerable quantities of sand and silt, causing the subsidences at the surface which were everywhere visible. In excavating the eastern part of the cutting, holes of 12 inches to 18 inches diameter were found in the loose ground; these had been evidently formed by the action of water, which flowed from them in clear uninterrupted streams. That great changes of the surface had occurred, was further evident, from the circumstance of finding at a depth of nearly 10 feet two human skeletons, whose bones were scattered and rubbed, as if they had been carried thither by the settling of a semi-fluid mass.

The wood-cut (Fig. 1,) shows a cross section, giving the form of the ori-

NORTH. Fig. 1. SOUTH.

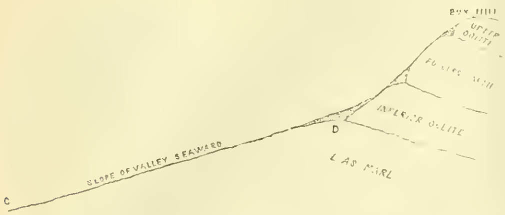
Cross section of Box Valley, in the line of the slip, showing the alteration in the contour of the valley by the accumulation of the drift.



ginal valley, the strike of the strata, the position of the cutting, the drift as supposed by the author, and the joints which traverse generally the secondary stratification. The position of the cutting with regard to these is shown as being partly in the lias marl, and partly in the drift. The author ascribes the movement of the ground, entirely to the weight of the saturated drift, either forming a joint in the marl, its tendency being down the slope AB, after the removal of the ground for the purposes of the railway, had destroyed its equilibrium, or acting upon a joint already in existence, so as to detach the mass, and force it towards the brook.

In Fig. 2 is seen a section of the valley at right angles to Fig. 1, with the dip of the same strata, and the direction of the valley towards the sea. From a joint consideration of these two sections, it will be seen, that the drift in which the cutting is situated, is based upon the slopes AB Fig. 1, and CD Fig. 2. It was in a direction, compounded of these two, that the ground was observed to move, and it was accordingly attributed to a sliding motion of the drift, upon the surface of the marl, which idea appeared the more feasible, as the first indication of the movement, was the separation of an immense unbroken mass from the side of the hill, and not of a gradual breaking back of the ground, as generally happens, where the slip is attributable to a want of consistency in the stuff itself. Subsequent examination

EAST. Fig. 2. WEST.

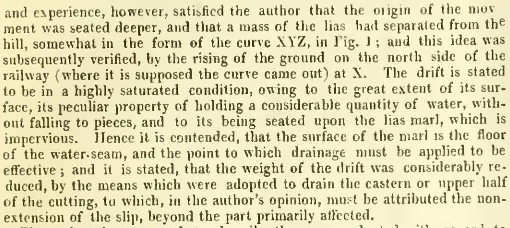


and experience, however, satisfied the author that the origin of the movement was seated deeper, and that a mass of the lias had separated from the hill, somewhat in the form of the curve XYZ, in Fig. 1; and this idea was subsequently verified, by the rising of the ground on the north side of the railway (where it is supposed the curve came out) at X. The drift is stated to be in a highly saturated condition, owing to the great extent of its surface, its peculiar property of holding a considerable quantity of water, without falling to pieces, and to its being seated upon the lias marl, which is impervious. Hence it is contended, that the surface of the marl is the floor of the water-seam, and the point to which drainage must be applied to be effective; and it is stated, that the weight of the drift was considerably reduced, by the means which were adopted to drain the eastern or upper half of the cutting, to which, in the author's opinion, must be attributed the non-extension of the slip, beyond the part primarily affected.

The author then proceeds to describe the means adopted with regard to the moving ground, as well as the precautions taken afterwards, to prevent a similar disaster taking place, where the ground was still firm. He states that the removal of the broken ground, to a slope of $4\frac{1}{2}$ to 1, was finally had recourse to, laying bare the slope AB, Figs. 1 & 3, for a considerable distance, and that all efforts to draw off the water from the drift, after it had broken up, proved totally useless. Drains filled with rubble stone or faggots were used; but in most cases without effect, as they soon became choked by the movement of the ground; the further causes of their failure are commented upon in detail, as well as the benefit derived from the experience which they afforded, in pointing out the proper mode of treatment to be pursued in future. The mode of proceeding which was at last adopted, and which is stated to have been perfectly successful, is shown in Fig. 3.

NORTH. Fig. 3. SOUTH.

Cross section, east of the slip, higher up the valley, showing the headings, shafts, and benchings.



It consisted, first, in removing a considerable portion of the drift, from the area occupied by the cross section of the cutting, before the marl at its bottom was touched; and, secondly, in driving headings from the valley into the hill, and connecting them by shafts sunk to meet them, from the high ground south of the line of railway, which in their progress downwards, necessarily pierced the water-bearing strata. These shafts and headings were afterwards connected, by headings driven on the surface of the marl, parallel to the railway, and thus the water was by degrees drawn off from the drift, and its quantity sensibly decreased. Upon the eastern part of the cutting, three benchings were cut, so as to bring the general line of the slope of the cutting, within the point B on the ridge, which is formed by the valley slope and the strata, and hereby, it was thought, a firmer base would be obtained.

Upwards of 1,500 yards of shafts and headings were driven, at an average cost of about thirty shillings per yard forward. The drift is stated to stand at present at a slope of 2 to 1, which is assumed by the author as a confirmation of his opinion, that the ground was radically favourable for railway operations, but that it was affected by local peculiarities, which it was originally impossible to have foreseen.

The necessity of attending to geology, as connected with engineering, is insisted upon, as the author contends, that in almost all instances, the actual surface of the country forms but a poor criterion, for judging of its original formation. The paper concludes, with examination into the effects of water upon clay, when in the ground and under pressure, and when exposed to the action of the atmosphere. The author attributes the disintegration of the clay by water, in the latter case, solely to the degree of pressure it is subject to, and cites some instances which came under his observation, in support of this opinion.

The account embraces a record of the work, extending over a space of more than two years, so that it is impracticable within the limits of an abstract to give more than an outline of it.

Mr. Lowe remarked, that the paper which had been read showed how intimately the science of geology was connected with that of civil engineering, and of what essential asistance the study was. This could not be too strongly insisted upon, and it was very desirable that resident engineers on railways should communicate to the Institution plain, but detailed accounts of the events which occurred daily under their notice, and which, when illustrated by drawings like that which accompanied Mr. Thomson's paper, would form invaluable records.

Mr. Sopwith said, that the detailed account given by Mr. Thomson, derived additional interest from the circumstance of its relating to the district, and to the same series of rocks which first led to the examination and arrangement of the strata of the British Isles, by Mr. Smith, who had been justly named the father of geology.

The vast masses of drift which frequently covered the regular stratification, had only recently become a subject of investigation: and Mr. Thomson had not only described the extent, nature, and effects of drift in this instance, but he had also investigated with care the sources whence it originated. This would often be found a study of practical value, as throwing a light on the nature of the material to be dealt with. Mr. Sopwith instanced the drift near the mouth of the river Tyne, which contained limestone brought from a distance of full thirty miles, and granite from more than seventy miles. The effect of masses of granite in displacing the stratified rocks was also shown on the banks of the river Tyne, where the front of a quay that was nearly perpendicular when built, was now, by the effects of the superincumbent gravel of a ballast-hill, in a nearly horizontal position. The fact, that the surface contour of a mass of drift, bore no relation to that of the harder rocks beneath, was now well known: and in the locality described by Mr. Thomson, rocks reposed, in what was called "unconformable position," upon the local strata. The paper just read, was a striking illustration of the value of the railway sections, lately collected and placed in the Museum of Economic Geology.

Mr. Slate said, that there were some remarkable deposits of drift in the Staffordshire coal-field. They had completely filled the spaces, which must have been left, when the great down-throws or faults occurred. Between Dudley and Birmingham, the coal and all the other strata had been thrown down vertically nearly 100 yards, and yet there was not any appearance of irregularity on the surface of the ground.

March 26.—The President in the Chair.

Railway Cuttings and Embankments.

"*On Railway Cuttings and Embankments; with an account of some Slips in the London Clay on the line of the London and Croydon Railway.*" By Charles Hutton Gregory, Grad. Inst. C. E.

The formation of railways involving usually the excavation, removal, and employment of large quantities of earth, requires particular attention to the practical geology of the soils used; and the skill of the railway engineer is tested by the application of his knowledge of the subject, to the safe and proper forms and proportions, of cuttings and embankments.

The material nature of every soil, assigns to it some particular slope, at which it will remain in repose; and this is not only as variable as the soil itself, but it is also modified by every variety of circumstance to which it is exposed. The principal change, however, for which provision is to be made, is the influence of the alternations of weather, which will seriously diminish the durability of a material, possessing in itself, considerable statical strength and tenacity.

All unstratified rocks, which are equal in their substance and free from faults, may be excavated, so as to leave the sides of the cutting perpendicular or nearly so, and the material excavated may form an embankment, nearly approximating to the form of a rubble wall. In some such cases a tunnel may be formed, by merely driving a heading through the rock, without the protection of an arch of masonry. Many stones, whose strength and texture would enable them to stand at any slope, are still affected in their durability by moisture, and especially by frost; with these, provision must always be made for exfoliation to take place, without injury or obstruction to the works, by leaving a full margin at the foot of the slopes, trimming them back at a greater inclination, or forming steps or benches, upon which the falling materials may rest.

Stratified rocks, whose beds are horizontal, admit of a slope next in steepness to the unstratified; but in working through dipping strata and through the shaly beds, which frequently lie above solid rock, care is necessary, not to leave the soil in an unstable equilibrium, which the presence of water will readily destroy.

Chalk is a material, which, in those parts where it first crops out, that is, at the top of the stratum, has frequently given much trouble, from its inequality and the frequency of pot-holes of loose gravel, which, when unduly charged with water, have at times broken away the surrounding chalk, when near the edge of a cutting; lower down, where it is more compact, chalk will stand at a very steep slope, allowance being still necessary for the effect of weather. The fear sometimes felt, of deep chalk cuttings, is one for which there would appear to be but slight cause, the very fact of their depth, usually involving their greater solidity. There is nothing in the nature of pure chalk, which should render it liable to heavy falls, excepting where it is exposed, unprotected, to some constantly undermining action, such as that of the sea breaking at the foot of cliffs.

The diluvial strata are, from their nature, the least compact, and therefore require the greatest slopes in excavations and embankments; the alteration, too, in their position which at some remote period of time has uplifted and distorted the original horizontal strata, renders them more liable to further change of form by facilitating the operation of water the element to which they owe their original deposition, and to whose continued action they seem peculiarly susceptible. Of these strata, the most solid are gravel and sand, in which, when strong and clean, the slopes of excavations may be left steep, while their binding and unsubsiding qualities render them the most suitable materials for ballasting the permanent way. The other soils of this class are extremely variable; some of the clays are firm and tenacious; others, of a marly character, are subject to slips, while quicksands and peat are soils of a proverbially treacherous character.

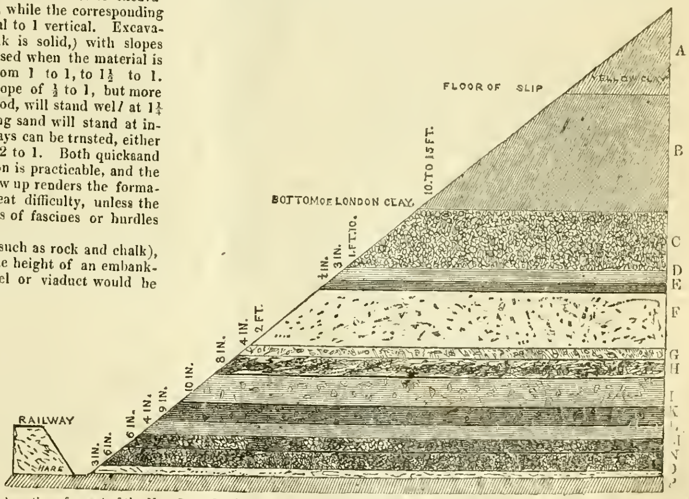
The nature of the soil, while it regulates the proper inclination for slopes, limits also the height of embankments and the depth of cuttings. It would be impossible, however, in a general sketch to give any definite rules for either, as they depend on minute differences of soil, as well as the various concomitant circumstances of the case.

In rock cuttings, many instances may be adduced of the sides of excavations, differing very slightly from the perpendicular, while the corresponding embankment, may have slopes of about ¾ horizontal to 1 vertical. Excavations in chalk are commonly made (when the chalk is solid,) with slopes varying from ¼ to 1 to ⅙ to 1, the slope being increased when the material is loose. Embankments in chalk may have slopes from 1 to 1, to 1½ to 1. Excavations in gravel will stand sometimes at a slope of ½ to 1, but more frequently at 1 to 1. Embankments of gravel, if good, will stand well at 1¼ or 1½ to 1. Excavations and embankments in strong sand will stand at inclinations rather greater than in gravel. Very few clays can be trusted, either in excavation or embankment, at a less slope than 2 to 1. Both quicksand and peat require the aid of draining before excavation is practicable, and the great quantity of earth which they invariably swallow up renders the formation of an embankment upon either a work of great difficulty, unless the surface to be covered is previously prepared by means of fascines or hurdles to support the superincumbent mass.

In materials of a rigid and unyielding character (such as rock and chalk), the practical limit to the depth of a cutting, or to the height of an embankment, goes far beyond that point, at which a tunnel or viaduct would be more economical. In such materials, too, it does not become necessary to augment the inclination of the slopes, with an increased height of embankment, or depth of cutting; a step which is essential in soils of a yielding character, and becomes more necessary in proportion as the rigidity diminishes. In yielding soils there is a limit of safety, in the height of embankments and the depth of cuttings. The reason of this is obvious; the rigidity of an unyielding soil, will admit of mass lying upon mass, like a wall, until the height becomes so great as to crush the base by the superincumbent weight; while a yielding soil has not sufficient tenacity to support its own weight, to any great height, but sinks down bodily and spreads out at the sides. Gravel or sand will not, in general, permit with perfect safety a cutting of much above 70 feet to 80 feet in depth, or an embankment much exceeding 50 feet or 60 feet in height; and in clay the limits of safety are far more contracted. In some cases, an embankment may be carried to a much greater height than it otherwise could, by forming it in several lifts above each other, and thereby allowing time for the weight to settle gradually, and to distribute itself equally over the base. The speading of the foot of the embankment may be frequently prevented by cutting steps in a portion of the subsoil, and punning up a footing of some more rigid soil, in the form of a revetment.

The consideration of the variable law, which regulates the slopes required, in yielding materials, according to the depth of the cutting, or the height of an embankment (increased height or depth requiring increased inclination of slopes), may, perhaps, fairly lead to the conclusion, that where the height or depth is considerable, the inclination of the slopes should not be in a regular straight line, but rather in a curve, so as to have the greatest inclination at the bottom, where there is the greatest pressure, and the least at the top. This system would approach nearest to the analogy of nature, where rigid angular lines are found only in the unyielding rocky crags, while all the slopes of the more yielding soils are undulating.

In partial illustration of these preliminary remarks, the author then proceeds to give the result of his observations on the soils upon the Croydon



		Ft.	in.
A	Yellow clay.		
B	Blue clay....10 ft. to	15	0
C	Rolled flint shingle	1	10
D	Fine sand	0	3
E	Lignite	0	0¼
F	Fine sand	2	0
G	Ferruginous sand with fossils	0	4
H	Loose grey sand with fossils	0	8
I	Strong blue clay	0	10
K	Black clay and sand with fossils	0	9
L	Black dirty sand	0	4
M	Dark sand with fossils, oysters, &c.	0	6
N	Stone with fossils	0	6
O	Decomposed stone and sand with fossils	0	3
P	Plastic clay.		

Fig. 1.—Geological section of a part of the New Cross Cutting, London and Croydon Railway.

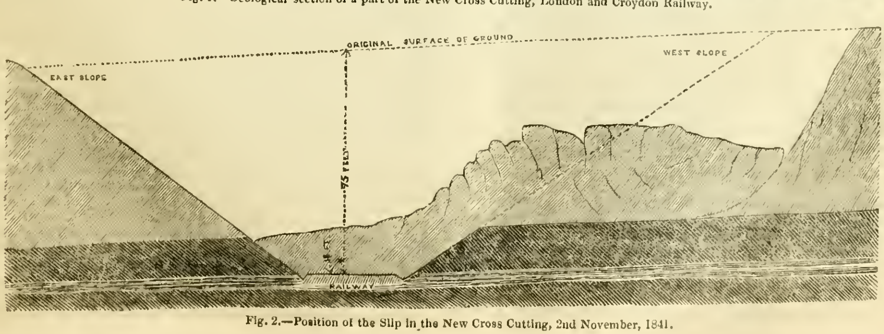


Fig. 2.—Position of the Slip in the New Cross Cutting, 2nd November, 1841.

railway, and also to place upon record, some account of the slips which have occurred on that line.

The formation of the London and Croydon railway, has laid open a complete section of the London clay, down to its junction with the plastic clay (Fig. 1). The line commences, at the London end, upon the more recent alluvial formations, with a considerable depth of peat. The first embankment, after leaving the Greenwich railway, lies upon the peat, which is there about 10 feet in thickness, and beneath it are 4 feet of loose silt, and 4 feet of shingle on the top of loose chalk, the whole full of water, to within 3 feet of the surface. The greatest height of the embankment is about 25 feet, and in widening it during the past year, for the junction of the Bricklayers' Arms branch railway, it was found necessary to cut the old bank into benches, and to pound up a strong footing, to prevent lateral spreading of the new work.

Although the railway has been opened more than four years, this embankment is continually subsiding, and the amount of 'packing' required, is about double what is needed on any other equal length of the line.

Passing the New Cross station, the line enters a cutting rather more than two miles in length, through clay, which material continues in variable qualities, until a short distance from Croydon, where the gravel appears.

Immediately beyond the New Cross station, the cutting (Fig. 2) deepens, and at a distance of about a quarter of a mile, its depth, at the centre line, is about 75 feet, giving, however, a depth of upwards of 80 feet to the western side, from the ground rising rapidly in that direction.

The permanent way lies upon the top of the plastic clay, and is nearly level with the bands of stone, sand, shells, and shingle, which immediately cover that stratum. Above this, again, is the strong blue London clay for a depth of 15 feet to 20 feet, and at the top is a yellow clay of a silty character, intersected with strata of septaria, and abounding in soapy earths and various mineral salts, rendering it extremely pervious to water, and more easily affected by its action than almost any other soil.

On Tuesday the 2nd of November, 1841, at about 8 o'clock, P.M., a movement was observed in the highest or western slope of this cutting, which is on the inside of a curve: some of the clay, washed by the continuous heavy rain of that season into a semi-fluid, crept down towards the rails from the side of the slope, which had previously been subject to frequent surface slipping. It was soon seen that the stratum of yellow clay was in motion from top to bottom, and in the course of four hours, a mass containing about 50,000 cubic yards of clay, had separated itself from the hill, and had sunk down, so that the back of the slip rested in a self-formed basin in the slope, while the front had slipped forward on the glass-like surface of the blue clay and had overwhelmed the line of railway for a length of 120 yards and a depth of 10 feet or 12 feet, while large detached blocks of blue and yellow clay, had been forced up from below, and beetled over the lower part of the slip, ready to follow it (Fig. 2).

In the removal of this slip, the exigency of the case required that economy of work should, in many respects, give way to expedition. Stages were erected at each end of the slip, sufficiently high to allow the earth wagons to run under them and to advance gradually into the slip, as a way was made for them, by working a "gullet" down to the rails. The wagons were then filled, partly from the gullets, partly by casting from the slope, and partly by barrow roads leading to the stages. Two sets were thus employed at the north end of the slip, and the earth was conveyed by locomotives, to the sides of the nearest embankment, while two other sets drawn by horses, worked the clay from the south end of the slip, to a distance of about a quarter of a mile, where it was wheeled out to the spoil-bank. The work of removal was continued by a large force, day and night, and on November 18th, both lines of railway were cleared. On the night of the 22nd of November, the large mass of slip, still remaining on the floor, travelled forward and again covered both lines of rail. On the night of the 26th of November, a heavy movement took place on the east slope, which had meanwhile been subject to a considerable sloughing. The large mass in motion came down over the rails, and the line was not cleared until December 23rd, when the trains again ran through. On the morning of the 7th of January, 1842, the line was again obstructed by an extension of the slip on the west side (in a southerly direction), and as it was found that a still greater quantity of earth was pressing forward from behind, a temporary bridge, of timber, was constructed across the line, at the south end of the slip, in order to carry away the top weight to an adjoining spoil-bank. During the whole of this time, relays of men had been unceasingly at work, day and night, in the clearing of the railway, which was at length effected, and after the 10th of February, 1842, the trains ran through regularly.

The sudden and extensive failure of so large a quantity of earth, in works constructed with every appearance of solidity, and in which, previous slips had been confined to the surface, without giving any indication in the mass itself, was naturally a subject of great interest; and a careful study of the character of the soil was necessary to throw a light upon the operations of nature in this instance.

The slopes having generally remained for some time in a stable condition, at the inclination at which they were formed, it may be inferred, that some fresh action must have been developed, by which the equilibrium was destroyed. In most cases of slipping, this action is found to arise from the solvent property or statical force of water; and to this cause principally must, in the author's opinion, be attributed the change of form undergone by the soil of the New Cross cutting.

The main body of the excavation is in two different sorts of clay; the blue clay at the bottom is stiff and insoluble, homogeneous in its character, and impenetrable by water; the yellow clay above, is separated from the blue, by a clearly defined line, excepting occasionally, where masses of the blue clay of an imperfect and mixed character run up into it. The yellow clay is extremely unequal in texture, mixed up in all directions with silt, ochre, fuller's earth, iron, lime, and bands of septaria; it is also intercepted by innumerable faults or breaks, running in all angles, from the top to the bottom; through these breaks, and the soluble particles of the earth, water had gradually found its way, owing to the imperfect drainage of the adjoining fields, and an unusually wet autumn and winter, and had saturated the whole mass, until it became overcharged with moisture; the greatest quantity of water accumulating on the top of the blue clay, through which it found no outlet.

This saturation had, doubtless, been much assisted by the alternating effect of succeeding summers and winters; the soil being charged with moisture must, during each winter, have expanded materially in bulk, and this expansion taking place laterally, had probably caused a gradual and indefinitely small movement towards the unresisting opening left by the railway cutting; the warmth of the succeeding summer, while it dried much of the saturated mass, could not bring the particles back into their former position, and thus additional cracks would be formed, admitting greater quantities of water, so that year by year the evil would become greater, and the tendency to slip gradually increase. Again, the clay, which, in a dry state, is comparatively tenacious, becomes when wet almost a semifluid, and would thus be unable to support its own weight, or to maintain itself in slopes so steep and so high as in its natural state. These two causes combined, would leave the whole material in a very unstable equilibrium, shaking by every passing train, until at length the balance was destroyed, perhaps, by the hydrostatic pressure of the water, which percolated through cracks at the back, or under some of the larger strata of septaria, and the mass, aided by its gravitating powers, sank down and travelled forward on the top of the blue clay, where the accumulation of water had formed a highly lubricated surface, and aided its descent.

In the case of the first slip at New Cross, this movement was materially assisted by the natural dip of the strata from west to east, and by the fact of the western slope being on the inside of the curve, thus leaving the slope less supported laterally.

This slip has been ascribed, in some degree, to chemical action, which, although not the only cause, nor, it is presumed, the most effective one, may probably have assisted the action of water. The lower part of the yellow clay and the upper part of the blue clay abound in iron pyrites; this is decomposed by the action of the weather, and the sulphuric acid disengaged, enters into combination with the carbonate of lime, which is found with septaria, thus forming crystals of selenite which here exist in great quantities.

The act of crystallization, while it alters the bulk of the component materials, may be supposed, in a measure, to assist the separation of the clay; in fact the innumerable breaks or faults in this soil are found to be covered with the crystals, in minute flakes or spiculæ, between which the water would have a clear passage.

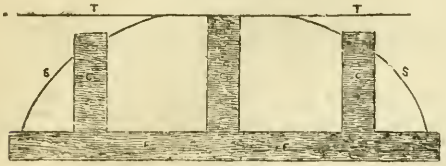
From this consideration of the causes of the movement, and the account of the manner and extent of the slips themselves, the author proceeds to notice the various modes of treatment which have been adopted, both at New Cross and elsewhere, under the instructions of Mr. Cubitt (V.P. Inst. C.E.), the consulting engineer of the Croydon railway.

Since the slip of November, 1841, above 250,000 cubic yards of clay have been removed from the two sides of the New Cross cutting, at the precise place where the slips took place. By the aid of the Inspector-General of Railways, the Company has been enabled, by obtaining possession of the necessary ground above, to trim back the slopes to what is considered a safe position. This has been done in the form of benches and intermediate slopes; on the west side the slope is divided into four parts by three benches, and on the east, into three parts by two benches. These benches vary in dimensions up to 65 feet in breadth, and are so arranged that they leave the least heights of slope at the bottom, near the railway, and the greatest heights near the top; these slopes being generally at an inclination of about 2 to 1. This arrangement, although not a curve, brings the general form of the whole slope into accordance with the conditions previously alluded to. Drains are formed in the benches and slopes to carry off the surface water, and although some slight slips have taken place, there is now no further symptom of greatly extended movements.

The same nature of clay in which this slip took place is found in all the cuttings on the Croydon railway; in some places it is of a more solid character, while in others, as at Forest Hill, it is very silty and untractable. So pervious, indeed, is the soil at Forest Hill, that after much rain it runs into mud; and after in vain attempting a complete system of under-drainage or soughing, by means of horizontal drains round and through the bottom of the slip to the face, and vertical drains from the top down to the back drains, a wide bench was cleared, about 20 feet up the slope, and varying up to 70 feet wide by running upwards of 100,000 yards of clay to spoil; and at the back of the benching a retaining wall of gravel, varying from 5 feet or 6 feet, up to 10 feet or 12 feet in height, and nearly double the same dimensions in width was formed, with a good footing into the solid earth below, to support the slipping earth behind. The clay taken out to form this wall, was thrown up in front of it for additional weight; and although the earth is still in some degree slipping away at the top, the foot has remained firm, excepting once, when a slight movement was perceived and was immediately stopped by building in two gravel buttresses 12 feet wide, from the weak point down to the bottom of the slope.

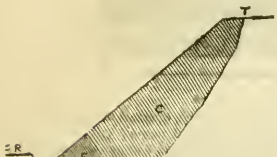
Other slips have occurred in the cuttings and embankments, the greater number of which were treated in the following manner (Figs. 3 and 4.) Parallel trenches were cut completely through the slip from

Fig. 3.



Elevation of Gravel counterforts, and footing, introduced into a Slip.
G. Gravel counterforts. F. Gravel footing. R. Level of rails.
T. Top of slope. S. Back of slip.

Fig. 4.



Section of Gravel counterfort, and footing, introduced into a Slip.

top to bottom, finishing in the solid earth behind, care being taken to cut footings in the soil perpendicular to the face of the slope. The opening thus prepared, was filled with gravel rammed in tight, and in some cases with gravel and clay mixed, a rubble or bush drain being previously laid in from the back to the front. The thickness of this gravel buttress (G) was from 6 feet to 12 feet, according to the size of the slip, and the same circumstance regulated the distance between the buttresses, which were united and mutually supported at the foot by a retaining wall or footing of gravel (F) running the whole length of the slip; the top of the slip was pounded tight, and the face trimmed off. This plan has been perfectly effective, at once supporting and draining the slip, while it was a far less expensive method than removing the slip and trimming back the slope, and avoided the necessity of so many obstructions to the traffic of the railway, which would have occurred in removing the spoil along the main line.

Water in these and most other cases appeared to be the ultimate cause of all the slips; the drainage, therefore, of the slopes, as recommended by the author, in both cuttings and embankments, is a consideration of the utmost importance, and where, as in the system above-named, it can be united with a means of opposing weight to weight, it may fairly be presumed that the cure is permanent and complete.

(*To be continued.*)

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Dec. 2.—J. B. Papworth, Esq., V. P., in the chair.

This was the opening meeting of the session. B. Green, Esq., of Newcastle-upon-Tyne, was elected a fellow; and prizes (books) were presented to Messrs. Baker and Deane, students to the Institute, for the best Architectural compositions, and for the best series of sketches, on subjects proposed by the council.

Some beautiful drawings were exhibited illustrative of the painted decorations in the church of S. Francesco di Assisi, and a description was read communicated by C. H. Wilson, Esq., with some observations on the polychromatic decorations of the early Italian churches in general. The church at Assisi was the work of Jacopo l'Alemanno, father of the more celebrated Arnolfo da Lupo, and is remarkable as one of the most perfect examples of an architectural monument of that age, completed by the painter. The entire church, withinside, is covered with color, the work partly of Greek artists, and partly that of Cimabuë, Giotto, Giottino, and Guinta Pisano, and their assistants, constituting it a most precious monument of the art of those early times. The importance and merit of these works by Cimabuë, have been recognized by all the writers on art. The fervour of Italian art, had given vitality to the inanimate forms of the Greeks, and the figures introduced are greatly superior in style, although the arabesque decorations with which they are combined, are altogether Byzantine in character, and decidedly inferior to those of earlier date in St. Mark's, at Venice. In the ornaments of Giotto and his school in the Scovigni, and Chapel of St. George, at Padua, in those of Spinello Aretino, in St Miniato, at Florence, and elsewhere, and in the works of Fra Beato Angelico, we have indications of a more refined taste and of progress.

Dec. 16.—J. B. Papworth, Esq., V. P., in the chair.

James Walker, Esq., F.R.S., President of the Institute of Civil Engineers, was elected an Honorary Member.

A model and drawings were exhibited of the mode adopted by Mr. Murray in moving the lighthouse at Sunderland.

A paper was read by Mr. J. J. Scoles, Fellow, '*On the Monuments existing in the Valley of Jehosophat near Jerusalem.*' These monuments might possess little interest if viewed merely with regard to their dimensions or architectural merits, but as they are almost the only buildings of any antiquity remaining in or about Jerusalem, and as tradition has invested them with the names of Absalom and Zachariah, it becomes an object of some interest to the archæologist to ascertain, if possible, the period at which they were really executed. In style, they are strangly mixed, the Greek orders being blended with the Egyptian character and form. The most remarkable, "the Pillar of Absalom," exhibits engaged columns of the Ionic order, Doric frieze, an Egyptian cavetto cornice, and a high conical roof, the whole being excavated and detached from the solid rock. "The Tomb of Zachariah" is of the same general character, but less decorated, and surmounted by a pyramid. There are several other tombs, but their features are less peculiar. One excavation, however, exhibits a pediment decorated with foliage of Greek character. On reviewing the architectural details, Mr. Scoles was of opinion that they are to be referred to the period of the Roman dominion in Syria and Egypt. The pyramidal form was very frequently used by the Romans in monumental structures.

ROYAL ACADEMY OF ARTS.

On Tuesday, December 10, being the anniversary of the foundation of this national institution, the usual meeting was held in the evening, for the purpose of distributing the premiums to the students for the works performed by them within the walls of the academy during the past year. The present is the distribution of what is called "the intermediate year," the grand distribution, which includes premiums for original composition, being "biennial." About 9 o'clock the President (Sir M. A. Shee), accompanied by the principal members of the Royal Academy, entered the large exhibition-room; having assumed the chair, he, in a few prefatory remarks, complimented the students generally on the exertions they had made, and the ability they had evinced in the competition. At the same time, he regretted to say, that in some classes a proper zeal had not been manifested. In the class of painting there were but two competitors; in that of modelling from the antique, but two also; while in the class of die-sinking there was no candidate at all. He exhorted the students to exert themselves in the competition in the intermediate year, as well as in the more important award of prizes which took place every two years. They should recollect that mediocrity in art was nothing. There was no medium in the fine arts between admiration and contempt; and the well-known sentiment of the poet on this subject was founded in truth and observation of nature:—

"Of all vain fools, with coxcomb talents curst,
"Bad poets and bad painters are the worst."

The premiums were then distributed in the following manner:—

To Mr. W. Gale, for the best copy in the school of painting, a silver medal and the lectures of Professors Barry, Opie, and Fuseli.

To Mr. Healing, for the next best copy, a silver medal.

To Mr. W. Gale (the gentleman mentioned above), a silver medal for the best drawing from the living model.

To Mr. A. Gatley, a silver medal for the best model from the life.

To Mr. G. Lowe, a silver medal, for the best architectural drawing of St. Mary's, Woolnoth.

To Mr. W. Dean, a silver medal, for the second best drawing of the same.

To Mr. Healy, a silver medal, for the best chalk drawing from the antique.

To Mr. Roan, a silver medal, for the second best drawing.

To Mr. A. Brown, a silver medal, for the best model from the antique.

After the distribution the President addressed a few words to the students, again urging them to continued exertion in their art. To them, the rising generation of artists, he observed, the country looked for the maintenance of its character in the world of art. It could not now (he continued) be said that opportunity was wanting to stimulate and encourage the exertions of the artists of this country. The Royal Commission of the Fine Arts was about to complete what it had so well begun, and it was not to be supposed but that the artists of Britain would respond to the advances of the Government, and by their works reflect credit on themselves and honour on their country.

The meeting then separated.

In consequence of the great merit of the copies in the painting school and of the architectural drawings, two medals instead of one were awarded in each of these classes.—*Standard.*

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

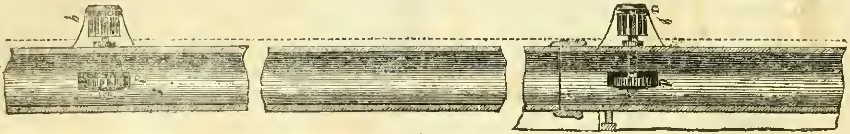
PILBROW'S ATMOSPHERIC RAILWAY AND CANAL PROPULSION.

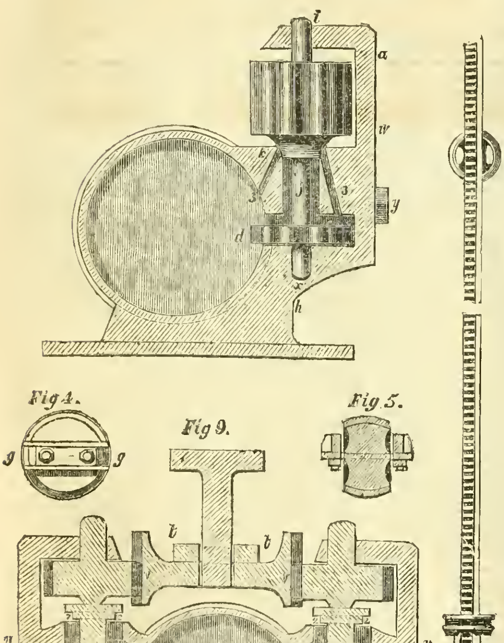
JAMES PILBROW, of Tottenham, civil engineer, for "*Certain improvements in the machinery for, or a new method of propelling carriages on railways and common roads, and vessels on rivers and canals.*"—Granted May 17; enrolled November, 1844.

We are indebted for the following description to a pamphlet just issued by Mr. Pilbrow; the invention is one of great importance, and appears to be very ingeniously contrived, and as such it deserves attentive consideration.

Mr. Pilbrow observes that his system has the following advantages over the present system.* In having no discontinuance of the "main," and therefore no "section valves," at crossings of roads, lanes, &c., or any necessity for bridges for cross lines, roads, lanes, &c. In having fewer engine establishments, one to every 10 miles being sufficient, instead of one to every 3 miles, thus saving 23 engines, &c., out of 34 in 100 miles. The reason why a less number will be required on this plan than the other is, that there being no long valve the leakage will be so diminished that it will amount to less in 10 miles than now in one; it is estimated that now the leakage equals five-horse power per mile, and therefore should there be but one engine to 10 miles of main, 50-horse power out of the 100 would be lost for leakage alone, so it is found absolutely necessary to have one engine every 3 miles, thus reducing the loss to 15-horse power out of the 100. Why the pinion-valves as proposed will not leak so much as the long valve is, first, because the surfaces are ground truly, and are pressed together by the weight and fall of the pinion, (and the more used the better they will stop); and, secondly, on account of the small quantity of surface or space that can leak, the proportion being as 1 to 20 between the two systems, for the pinion-valve or sea

Fig. 1.



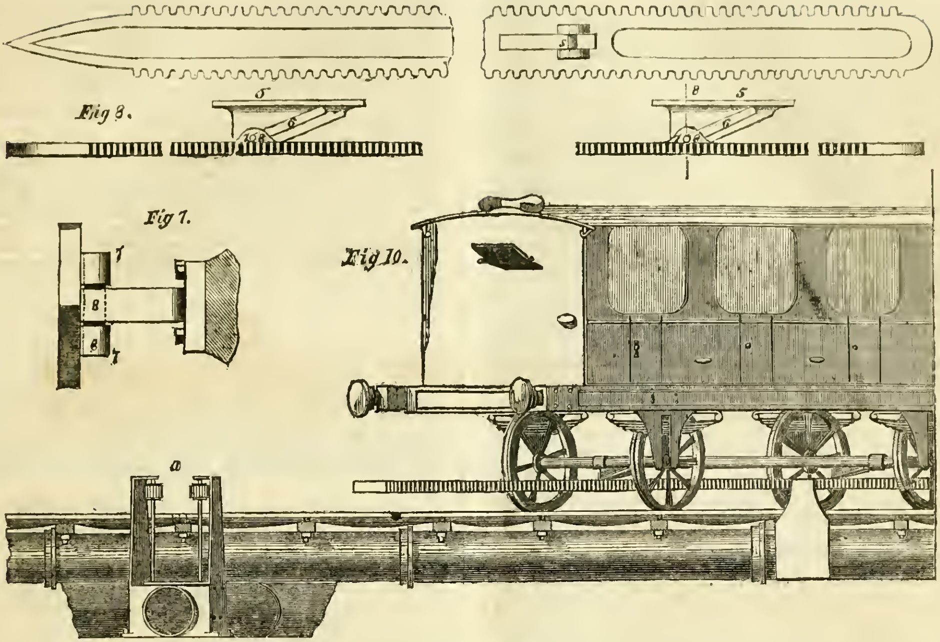


being but about 9 inches in circumference at the aperture where the air is admitted, and being only two of them to every 30 feet of main = 1 5 feet; whereas, the present long valve would be the whole 30 feet exposed and liable to leakage; hence, even were the pinion-valves to leak as much as the long valve, surface for surface, this plan would only leak 2½-horse power instead of 50-horse power, in 10 miles!

In having no necessity for "cranes," or elevated rails, for the taking on and off carriages. as that would be done in the usual manner, &c., and this arrangement will permit of the "main" being varied in its diameter at different parts of a long line, to suit any irregularity in the general level or gradients, or traffic, which is often greater at one part than at another.

Description.—Fig. 1 represents part of a pipe or tube (in section) supposed to be lying along a railway between the rails, similar to the tube as well known in the various plans hitherto devised for the propelling of carriages or trains on the "atmospheric principle;" but here it is proposed it shall lie in a hollow or channel dug in the earth, and fastened also in any convenient manner to the sleepers. At intervals (say at 30 feet or nearer) along this tube there are affixed pinions or small cogged wheels, as shown at *c*, and *d*. Fig. 2 made or cast in one solid piece of iron, the upper portion *c*, having cogs or teeth around it, and the lower portion *d*, being made the same, so that the cogs may correspond in both. The tube has a projection cast or otherwise made upon it, at the required places proposed to place these pinions, and also has an opening in it to allow of the lower portion of the pinion *d*, to enter and project a short distance into the hollow of the tube, as shown at *d*, the upper and lower end of the spindle, or the pivots of the pinion working in holes or bearings made for that purpose in this projecting case or box, as at *h i*, the box having a support carried up as *a*; but that part of the spindle or axis between the toothed portions does not touch, but passes through a hole or passage made in the tube and "box," which is larger than the spindle, as at *j*; but there is a flat or conical part, as at *k*, which is allowed to touch, as will be explained hereafter. These pinions, therefore, are free to turn, when acted upon in any proper manner for that purpose, and are partly inside the tube and partly out. It is proposed that a piston be made, to fit as nearly air-tight as possible into this tube, and having attached to it behind a long bar, or piece or pieces of iron, or other suitable material, having cogs along its edge or edges, to correspond and fit the cogs of the pinions. Fig. 3 is a side view of such a piston and appendage; *l*, is the piston head, and from thence to *m*, the line of cogs; *n*, is a wheel or roller placed near the centre of the rack, to support it in its proper place, and to obviate friction in its progression. Fig. 4 represents the end front view of the piston, and fig. 5 a section of the rack portion. The cogs do not pass quite through or entirely down, but along the lower part there is a plain piece as shown at *o*, *o*, which at the piston end declines or approaches the bottom, forming a small inclined plane as shown at *d d*, fig. 3, there being no cogs at the commencement; this "piston rack" is to be sufficiently long to reach two or more of the pinions in the tube, that it may never be entirely free, that is, will touch one before it leaves another; the pinions then being so arranged that they project at about the middle or horizontal diameter of the tube, and the rack being arranged in the same position as to the piston, so that when the piston is placed in or allowed to pass along the tube, the "rack" or cogged edges will act upon, and be in gear with that part of the

* We are indebted to the Editor of the "Mechanic's Magazine," for the use of the wood engravings.



pinion at *d*, and if a vacuum be formed by pumping out, or exhausting the air from the front of the piston in the usual and well known manner by air pumps worked by steam engines or otherwise, the pressure of the natural atmosphere will urge this piston onwards towards the vacuum, if permitted to do so, and consequently the rack with it, and that being in gear with the pinions, cannot advance without turning them as it passes, and also therefore that portion of them which is *outside* the tube, as at *q*, *q*, Fig. 1. There may be pinions on each side of the tube, opposite each other, as shown in the enlarged section fig. 9, if advisable, which will render it necessary that the "rack" should be double, or cogged on both edges as shown; and hereafter I shall describe and consider this to be the case throughout the following description, as being the most comprehensive form, although *single* "racks" and "pinions" may be found generally the better plan in practice, when the difference is merely the use of one pinion instead of two, as before described, and the "racks" being *cogged* only on *one* side, the "carriage rack" in such case must have a guide to keep it to the pinion, which guide may be a plain upright, or a plain or uncogged pinion, in the place of the pinion so removed.

To the under part of a railway carriage, in any convenient manner will be attached a similar "rack" to the "piston rack," (but without the piston or plain part as at *o*, *o*, in fig. 3,) which is called the "carriage rack," such a rack is shown in the annexed figure, fig. 6, the front end is tapered or pointed to render easy its entrance between the pinions, and fig. 7, a front view, and fig. 8 a side view; *s*, is one of the places where it is attached to the carriage. The rack is made precisely to correspond with the internal or "piston-rack," and will be the exact width the pinions are apart, so as to be in gear like the "piston rack," with the two opposite pinions at one and the same time; this rack also is the length of the other, so that it may reach two or more of the pinions or pairs of pinions at once. Fig. 9 is a transverse section of the tube, with opposite pinions, showing also a section of the carriage rack *t*, *t*, and a section of the "piston-rack" at *u*, both racks being in gear respectively with the pinions v,v,v,v. The boxes or projections, *w*, which contain the lower part of the pinions, will have a hollow or chamber, to permit the said piniun to revolve freely, but to be made and put on to the tube air-tight, having but one opening into the inner part or chamber, viz. at *j*. (Figs. 2 and 9) through which the spindle of the pinion passes. To admit of the pinion being put into its place, the box must be made to separate and go together at a vertical joint above *x*, and by bolts *y*. and air-tight. To make the passage of the spindle from the exterior to the interior of the tube air-tight, to be so, upon the spindle of the pinion (below the upper cogged part) is a flat shoulder, or a conical or bevelled one, at an angle of about 45°, as shown at *k*, (Fig. 2) and the upper edge of the passage through which the spindle passes, *j*. is also bevelled, and both truly ground, so that when the spindle is down in its place, the conical part of the spindle fits and becomes air-tight, in the manner of the common valve known by the name of the "spindle or conical valve," and thus prevents the passage of air through or by this passage; or, instead of making the part conical, make a simple *flat* shoulder ground true to the edges (horizontally) of the upper part of the passage, Another method is a combination of these two, as shown by fig. 9, where, instead of the flat shoulder, is a flat plate or disc, through which the spindle passes, having a conical part ground to a corresponding surface in the plate, as at *z*. This modification is for the purpose of preventing much friction, when the passage is required to be large, in case of the pinions turning round when pressure is upon them, thus permitting the smaller circumference of the two (the conical) turning instead of the larger flat one at its outer edges, where it will lie upon the "pinion box." That the pinions may be lifted up, and therefore the valve part also from its seat, (as shown by the pinions in fig. 9) the pivots are made long enough and the "chamber" in the tube and "box" large enough to permit of it. When the pinions are lifted up, a free passage is allowed for the ingress of air into the tube; and to make this passage under these circumstances as large and free as possible, several side passages may be made also, as shown at 3, fig. 9. when the "piston rack" is within the tube in its desired situation, and the cogs of the pinions in gear with those of the rack, the lower surface or end of the pinion cogs 4, will rest upon the plain piece (before explained) on the "piston rack," which makes a kind of shelf or ledge for the cogs or teeth; and thus, if this rack be so arranged as to move in a line rather higher than the pinions are placed when down, (as in fig. 2) it will cause them to be lifted up when it passes them, so avoiding the friction of the air-tight shoulders, and permitting air to enter into the tube during this action as may be essential to the efficacy of the apparatus, as will be hereafter explained.

The "carriage rack" may be attached to the under part of any railway carriage (the first carriage of a train) by any suitable means; but the inventor prefers the following mode of doing it, which will be understood by reference to figs. 6, 7, and 8, the two parts 5, 5, are firmly fastened to the under part of the carriage, or to a piece of timber supported by and suitably attached to the axles of the carriage; in the under part of these supports is formed a groove or slot, 6, 6, and upon the rack are fixed suitable projections, 7, 7, through which bolts, 8, 8, are passed, going also through the slot in the support. These bolts, then, resting at the bottom of the slots, support the rack in the horizontal position shown, a little lateral play being allowed; by this arrangement the rack, if meeting with any resistance suddenly in any of the pinions in passing them, (the momentum of the carriage urging it on), would cause the rack to be pushed up these slots, and thereby getting above the pinions, (if made sufficiently effective for this purpose) and so enabling it to pass the obstruction without concussion to any part of the apparatus outside the tube.

The operation of this invention, or manner of its working, is as follows. A pipe or tube, as before described, of sufficient diameter, being laid along in a hollow between the rails of a railway, and being exhausted of air by suitable means, as are well known, and having the pinions arranged as described at intervals throughout its length; the piston with its rack attached is placed in this tube in the manner before explained at the farther end from where the air has been, or is being exhausted or withdrawn, the piston rack being in gear with the pinions *inside the tube*; a railway carriage, having a carriage rack attached to it, as described, being placed upon the rails, as shown in fig. 10, this carriage rack being also in gear correspondingly with the upper part of the same pinions, that is to say, the relative position of each rack being the same, the piston rack being precisely under, and matching end to end with the carriage rack, (unless, as in the latter plan, the piston rack being longer than the other is a little in advance of it), the one rack cannot then move backwards or forwards without turning the pinions, and these being also in gear with the other rack, that must move also, and in the same direction. Therefore, if the vacuum has such an effect upon the piston that it advances, then will the rack upon the carriage be affected in the same way by and through the medium of the pinions, and will advance also and keep its relative situation exactly with the other, the racks being long enough to reach as described at least two pairs of pinions at one time, the next in advance is acted upon before the one acting has ceased, and therefore as long as the power applied continues, and the piston advances, the carriage will do the same to the end of the tube, neither arriving before or after the other, but together, as they cannot separate, nor can one move or stop without the other.

As it is necessary and important that the atmosphere should be admitted as nearly behind the piston as possible, the pinions are lifted up by the advance of the piston rack or the carriage rack, and the air will enter through the space allowed by the lifting of the conical or flat portion of the arbor or axis of the pinion, as described; thus would there always be at least two or more such passages open, as the rack acts upon the one before it leaves the other. After the rack has passed by, the pinions by their own weight fall into their places, and thus make an air-tight tube ready for the next exhaustion, when, if an air pump be set to work at the other end, and the *direction* of the piston and rack changed, and placed again as before into proper gear, the carriage would *return* in like manner.

Fig. 10 represents a perspective view of a portion of an atmospheric railway of this description, crossed, *on a level*, by a roadway, and another line of atmospheric railway, by which it will be seen that there is plenty of space between the pairs of pinions for the crossing, and that the mains being sunk beneath the surface of the ground, or under the sleepers of the rails, they are entirely out of the way, the carriage rack passing on from one pinion to another over such roads, without interfering—showing also, that where it may happen that two tubes are required to cross each other, one will pass beneath the other, the upper one keeping its level course, the lower one taking a gradual descent or dip under it, the pinions keeping their necessary level at the upper part by being lengthened, at such a locality, in the axes and supports, as shown at *a*. The first or "rack carriage," of a train, is shown advancing upon this cross line as it would appear just previously to its taking the pinions at *a*.

As there will not be on this plan, even in a single line of rails, any discontinuance of the main tube but at a place arranged for trains to meet and cross, which will always be at a *station*, (and for general purposes not less than twenty miles apart) it will be only at such places that the main will require any kind of valve to close its open end. The end of the main would simply require a disc of iron or wood placed against the open end, with a little composition to make an air-tight joint when the vacuum is to be made by the air pump, the disc or valve will fall or be pushed aside when the piston arrives at the end, and will require no more attention, excepting being replaced, or closed by the time this engine is again required to work.

The piston would, when it arrives here, either partially or wholly leave the tube, after displacing the disc or door by its remaining momentum, and the train with the "carriage rack" will pass on, and take one of the sidings and be stopped by the attendants by breaks as usual; but the operations of the stopping would have been begun before arriving here, the train now only moving slowly and with sufficient momentum to carry it to th place required, or middle of the siding. When the piston and rack reach the end of the main, and are out or withdrawn, it is proposed that there shall be placed at each of the two ends of the mains, a receptacle or trough mounted upon four wheels or rollers, so that the piston coming on to it, could be immediately removed for inspection, &c., and another piston newly greased, &c., brought and placed with its head in the tube ready for the next returning train. The trains having both arrived, each train would be urged on to the commencement of the opposite "main," where the fresh pistons having been already inserted, and the vacuum formed, the carriage rack coming into gear with the first pair of pinions, and the piston released, the train would start on its journey. Thus the pistons would never leave the main, or enter another but at a very slow pace, and at a place for stopping; and also that the same piston is not required to go on the whole journey, but a fresh one every twenty miles, leaving the other to be examined.

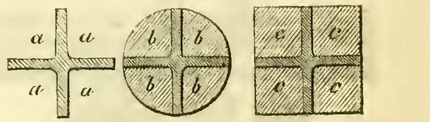
When this method of propulsion is used upon common roads, the tube will be sunk or buried along the side or centre of the road, and its operation would be as before described, there merely being the absence of the rails.

When used as a means of propulsion upon rivers or canals, the tube may be smaller, and laid either at the edge of the water, or upon piles or posts along its centre, the "rack" being affixed to the bows or side of the vessel to be propelled, to which may be attached any others that are intended to be drawn with it, thus making as it were a train of vessels: the general operation in other respects would be the same as described for carriages upon railways.

RAILWAY AXLES.

Edward Hill, of Harts Hill, Dudley, in the county of Worcester, ironmaster, for "*Improvements in the manufacture of railway and other axles, shafts, and bars.*"—Granted May 14; Enrolled Nov. 14, 1844.—*Reported in the London Journal.*

The improvements consist in forming the central parts of such articles of bars, which exhibit in their tranverse section the figure of a cross, as shown in the annexed engraving, at fig. 1. The spaces *a*, *a*, are to be filled with

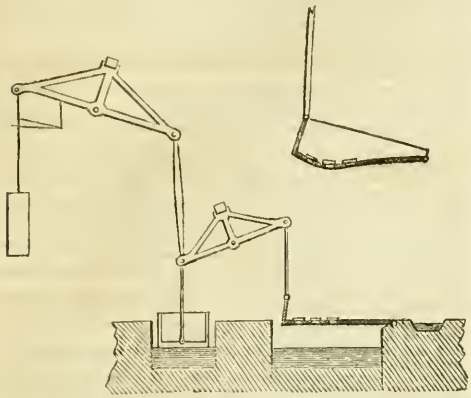


other bars *b*, *b*, fig. 2, if the shaft is to be cylindrical, or with the bars c, c. fig. 3. if the shaft is to be square, and the whole is then welded together. By using filling-pieces of various shapes, shafts of any desired form may be produced; and instead of only one filling-piece, two or more filling-pieces (of smaller dimensions) may be inserted into each space *a*. Instead of filling-pieces of iron, steel may be used, in combination with iron, either in forming the centre bar or filling-pieces. It is not necessary that the bars *b*, c, should fill the spaces *a*, as they may be formed suitably for leaving the parts near the centre hollow. In some cases, the shaft or axle may consist of the centre bar alone, the spaces *a*, being only filled in at those parts where the axle turns in bearings; or the centre bar may be made strong enough to admit of those parts being turned which are to work in bearings, without any filling-pieces being required. The patentee does not claim the rolling of bars of angle iron, each offering in its transverse section the form of a cross, that having been done before, for other purposes. But he claims the mode of manufacturing railway and other axles, shafts, and bars, by applying, as the central part thereof, bars, each offering the figure of a cross in its transverse section, as above described.

ENGINE AND MACHINERY FOR DRAINING

John Taylor, of Duke Street, Adelphi, in the county of Middlesex, gentleman, for "*certain new mechanical combinations by means of which economy of power and of fuel are obtained in the use of the steam engine.*"—Granted May 26; Enrolled Nov. 2, 1844. (Being a communication.)

These new mechanical combinations consist in the application of a double acting steam engine, in combination with two or more "scoops," to the purpose of draining or irrigating lands, or for raising water for other purposes from one elevation to another. The principal features in this invention consist in the peculiar arrangement of the various parts of the machinery or apparatus employed, viz. the beam of the steam engine is made of a triangular form, the base of the triangle forming the beam, and at the top or apex of the triangle there is a heavy counterbalance weight, which is situate above and in centre of the beam and may be termed an inverted pendulum, the object of this weight is said to be to counteract the inertia of the moving parts of the engine and the other parts of the machinery at the commencement of the stroke, the engine in this case being worked with steam of very great pressure, which is to be cut off at an early part of the stroke and afterwards worked expansively; the beam of this engine is provided with a connecting rod as in those of ordinary construction; the lower end of which is attached to the end of another beam similar to that above described, and having an inverted pendulum or counterbalance weight, and to each end of this last-mentioned beam there is attached by a pin joint a vertical rod, the lower ends of which are attached in a similar manner to the "scoops" which are intended to raise the water from one elevation to another. These scoops consist of a



trough which may be made with a flat or curvilinear bottom, and somewhat deeper at one end than the other, that end which is the deepest being attached to the vertical rods which are in connection with the working beams, the opposite end of the troughs being attached, by means of axes, (upon which they move,) in any convenient manner to the embankment, the height or level of which is equal to that at which the water is intended to be raised; at the bottom of these troughs and at the outer end thereof there are a number of valves opening inwards. From this description it will be seen that at each stroke of the engine one end of each of these troughs will be raised and lowered alternately, in such manner that when the engine is at or near the end of its stroke the end of one of the troughs or scoops will be immersed in the water intended to be raised, which will pass through the valves and into the scoop, the engine being provided with an hydrostatic catch or cataract, the object of which is to keep the engine and other apparatus, for a certain period, in a quiescent state at the termination of each stroke, for the purpose of allowing the scoops sufficient time to fill and empty with water. From what has already been stated, it will be clearly understood that during every stroke of the engine one end of each of these scoops will be lowered for the purpose of filling with water, which as the scoop is raised or turned upon its axis flows out at the opposite end of the scoop, and over the embankment into a trough or canal to be conveyed to the place desired.

This invention, therefore, consists in the application of two or more scoops working alternately, in combination with a double acting engine working expansively and provided with counterbalance weights in the manner above described, together with the application of the hydrostatic catches or cataracts for preventing the recoil of the piston immediately upon its terminating the stroke.

ALLOYS OF METALS.

James Fenton, of Manchester, engineer, for *"an Improved combination or alloy or improved combinations or alloys of metals, applicable to various purposes for which brass and copper are usually employed in the construction of machinery."*—Granted May 30; Enrolled November 30, 1844.

The improved combinations or alloys of metals are intended to be used in the construction of machinery in general in those places and situations where brass and copper are usually employed, and is designed as a substitute for such metal in consequence of not being liable to heat and other destructive results caused by friction and ordinary wear and tear, also by greatly decreasing the consumption of oil or grease, and being of much lighter weight in the same bulk of metal. All these advantages will be sufficiently evident to the practical engineer and mechanic, as well as the great variety of purposes for which this improved combination or alloy of metals may be employed in the construction of machinery, such as steps, bearings, pedestals, journals, bushes, axle boxes, connecting rod ends, cocks, taps, &c., and also as a substitute for the more elementary parts of machinery, (formerly made of brass or copper,) such as rollers for calico and other printers, bowls, &c.

The inventor describes the manner of carrying the same into practical effect in the manner following.

Firstly, take 32 parts of copper, 15 parts of block tin, and one part of sheet brass, and mix or combine them in the following manner—fuse or melt the copper in a crucible or other suitable vessel or furnace, add to it the sheet brass and afterwards the block tin, then pour off the alloy in ingots. This alloy forms what the inventor calls "*hardening metal.*" He claims this nove and peculiar use of these metals to form his "hardening metal," but the quantities may be varied to give the alloy any required degree of hardness, or various other metals may be added in small quantities to effect the same purpose, but he likewise claims the use of these in connection with copper and block tin.

The above constitutes the first part of the process he employs in the manufacture of his ultimate alloys.

Secondly, take two parts of the hardening metal previously described, 19 parts of zinc or spelter (or so many parts of calamine as shall be equal to the said zinc or spelter,) and 3 parts of block tin, and mix or combine these in the following manner—fuse or melt the zinc, spelter, or calamine in a crucible or other suitable vessel or furnace, which must be sufficiently large to contain along with the zinc or spelter the hardening metal previously described, and the block tin last specified. The hardening metal may be fused or melted in a separate crucible or other suitable vessel or furnace and then mixed or combined with the zinc, spelter, or calamine, the alloy must be well stirred with a suitable implement, in order to render the combination of these two metals or semi-metals as complete as possible, then add the block tin in order to give the ultimate alloy or alloys the requisite degree of ductility or toughness, the whole must again be well stirred with a suitable implement in order to render the combination of this the ultimate alloy or alloys as complete as possible. It may then be cast or employed in the usual manner in the various forms required for the construction of machinery. While the zinc or spelter is being fused or melted the surface of it should be well covered with a coating of powdered charcoal, in order to prevent the volatilty of the semi-metal.

The inventor claims the use of these metals and semi-metals above described to form his ultimate alloy or alloys, but the proportions may be varied to suit particular cases, and a variety of other metals may be added in small quantities, the use of which he also claims, though not absolutely necessary to form his ultimate alloy or alloys. He further claims the use of the semi-metal zinc, spelter, or calamine, as the basis of his ultimate alloy or alloys, and although he has found the manner of combination above described the most effective in preparing the alloy or alloys, which he substitutes for brass and copper in the construction of machinery, he claims the use of the said alloy or alloys although combined in any other manner or proportions, whatever such combination or alloy, being made either in the exact proportions herein set forth, or in any other within such limits as are substantially the same and will produce a like result.

COATING OF IRON WITH TIN, &c.

Edmund Morewood, of Thornbridge, in the county of Derby, merchant, and George Rodgers, of Stearndale, in the same county, gentleman, for *"Improvements in coating iron with other metals."*—Granted June 8; Enrolled Dec. 7, 1844.

The first part of these improvements relates to a mode of coating articles of cast iron with tin or other metal. This part of the invention is confined to the combined process of casting iron in metal moulds and then coating such articles with molten metal, the process being conducted by first cleansing the surfaces in the ordinary manner, and then coating them in a manner hereinafter to be described.

The second improvement relates to a mode of treating articles of iron before submitting them to the melted metal to be coated. In carrying out this part of the invention, the patentees provide an iron box or trough, about 7 ft. long and of sufficient width to contain the plates of metal to be coated; this box is provided with a number of ribs or bars so as to prevent the plates from touching one another; in the bottom of this box is placed sal ammoniac to the depth of 3 or 4 inches, a fire is then lighted under the box, the heat of which causes the sal ammoniac to give off vapour to such a degree as to exclude all atmospheric air; after this process the sheets or articles of iron may be immersed in melted metal for the purpose of coating them in any convenient manner.

The third part relates to a mode of treating tin which has become injured in the process of tinning. In coating iron with tin by the ordinary process there is considerable waste owing to its passing through the oil or tallow employed in the tin bath; this part of the invention, therefore, consists in submitting the waste or spoiled tin to a red heat, and then allowing it to cool after which it is to be placed in an earthenware vessel and covered with muriatic acid of commerce, which in an ordinary temperature must remain about two days, at which time the acid will have become sufficiently neutralized, and may then be drawn off; by this means the inventors obtain chloride of tin which they employ in the process of tinning metal.

The fourth improvement relates to a mode of coating sheets of iron with lead, or alloys of lead and tin, the latter being in the proportion of (not exceeding) 15 per cent., by means of a flux containing sal ammoniac and chloride of zinc without the aid of tallow. In carrying out this part of the invention the patentees prefer to use a flux composed of 3 parts of sal ammoniac and one part of chloride of zinc, without any oil or other fatty matter; the sheets of iron may be dipped in the bath of molten metal in the ordinary manner.

The last part of these improvements relates to an after coating of lead or alloy of lead, that is to say, coating articles which may have received a previous coating of zinc or alloy of zinc. In the case of iron which has received a previous coating of tin or some other metal, and afterwards to receive a coating of zinc, the inventor proceeds by melting the metal in an iron pot and then covering its surface with a suitable flux, which may be composed of two parts of chloride of zinc and about one part of oil or tallow; the articles to be coated are then to be immersed in the metal and allowed to remain until they become the same heat as the metal, (care being taken that the metal is not too hot so as to melt the previous coatings,) they are then withdrawn, and shortly afterwards dipped into water, and then brushed with sawdust to remove the flux,

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THE ANCIENT FRESCOES IN EAST WICKHAM CHURCH.—The churchwardens have entirely destroyed these interesting remains. Great efforts were made by the British Archæological Association to preserve them, and letters on their behalf were forwarded, by order of the Association when at Canterbury, to Archdeacon King and the Bishop of Rochester, but the result has proved the inefficiency of the Association's exertions. It was urged by the churchwardens and the ecclesiastical authorities that the paintings were not worth saving; but several eminent artists had pronounced them to be fine examples of church decorations of the 13th century, and it was hoped that least the better preserved portion would be spared, and that other paintings in the church, from which the whitewash had not been removed, would have been examined.

THE TOPOSCOPE.—A curious instrument, the invention of M. Schwilgué (the mechanist of the far-famed clock of Strasburg cathedral,) is about to be established on the platform of the same edifice; its object being to determine, during the night, the true position of lighted objects in the distance, false impressions on the subject being often of disastrous effect, as, for example, in the case of conflagration. The apparatus in question, to which the inventor has given the name of Toposcope, is composed, according to the description, of two graduated circles, with sub-divisions marked by an infinity of numbers. These circles, by their rotatory movement in inverse directions, furnish a multitude of numerical combinations. A telescope, moving with the upper circle, is fitted to the apparatus; and on directing this to the place of the disaster, the instrument itself furnishes, in measured numbers, its distance from Strasburg cathedral.

SINGULAR DISCOVERY.—On Thursday morning, Dec. 12, as some men were employed digging for the purpose of forming a new sewer in the New North-road, Hoxton, they discovered, at a depth of about 20 feet below the surface of the ground, a remarkable Roman structure. The first presentiment they had of approaching something wonderful was to find themselves standing upon a hard flat surface, instead of the usual rough earth and stone. The fact was immediately communicated to the surveyor, who, in company with about a dozen men, repaired to the spot. After some little delay, it was determined that the tiles, &c., should be taken up, and for that purpose six men were selected to descend, who, after some considerable delay, succeeded in raising several large pieces of stone and tile, underneath which was discovered a small cellar or vault, the dimensions of which were 3 feet in length by 2½ feet in width, and 3 feet 7 inches in depth, strongly tiled throughout. Several small vessels of earthenware were found, as also a small urn, supposed to be of gold. The excavation was immediately covered over, and men placed to guard it until this day, when it is expected some determination will be come to by the parochial authorities. A more wonderful specimen of ancient Roman architecture has never been discovered, and a view would amply repay the exertion of a journey thither.—'Times.'

BRITISH ENTERPRISE.—Some curious particulars are given in a Montevideo journal, of a British enterprise, one of whose remarkable features is a ship sailing on a level of 18,000 feet above the sea. In 1826, says the account in question, Messrs. Rundell and Bridge, the London jewellers, purchased the gold mines of Tipuani, and the emerald mines of Illimani, and sent over Mr. Page as their agent. These mines are situate on the banks of the Lake Chiquito, 238 English miles long, 150 in breadth, and hitherto unfathomed in many parts. In the neighbourhood of Tipuani, are other productive mines, belonging to General O'Brien and an Englishman of the name of Begg. The only vegetable produce of the district is a species of red potato called chusma, and a few nutritious plants; but to the east of the Lake, at Copacasana and in the vallies of the Bolivia, are cultivated maize, barley, and fruit-bearing trees. The difficulty of feeding, from their own scanty region, the large body of Indians working in the mines suggested the idea of building a vessel for the navigation of the lake; and General O'Brien, and Messrs. Page and Begg determined to make the attempt. Mr. Page purchased an old brig, in the port of Arica, stripped her of her anchors, sails, and rigging; and succeeded, with extreme difficulty, in conveying the hull to the mouth of the Apolobambo, whose waters fall into the Chiquito Lake. Thither he brought workmen from Arica, built stocks, and after two years of painful and unceasing labour, succeeded in launching his vessel on the Lake, and opening a regular communication with the produce of the vallies of the Bolivia. The brig is well found in all things—save for her want of anchors, which it has been impossible to carry to such a height. General O'Brien and Mr. Begg are reported to have executed other works of a boldness not less surprising. They have transported a steam-engine across the Cordilleras—dug, through the metalliferous hills of Lacaycota, a canal 2,000 feet in length, traversed by nine locks, and laid down a railroad at its extremity, for the conveyance of their ore. In this Lake Chiquito is the island of Titicaca, assigned by tradition as the cradle of the earliest Peruvian civilization, and the sacred burial-place of the ancient kings of the country.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM NOVEMBER 25, TO DECEMBER 21, 1844.

Six Months allowed for Enrolment, unless otherwise expressed.

John Barker Anderson, of Great Suffolk-street, Surrey, for "Improvements in the manufacture of soap."—Sealed November 25.

William Clarke, of Nottingham, lace manufacturer, for "Improvements in the manufacture of ornamental lace or net."—November 25.

Benjamin Baillie, of Henry-street, Middlesex, glazier, for "Improvements in regulating the ventilation of buildings."—November 25.

Ebenezer May Dorr, of Ludgate-hill, for "Improvements in the manufacture of horse shoe nails." (Partly a communication.)—November 25.

John William Buckle Reynolds, of Lymington, engineer, for "Improvements in obtaining motive power for working locomotive carriages and other machinery."—November 25.

George Millichap, of Birmingham, for "Improvements in the construction of axletrees."—November 25.

William Oxley English, of Kingston-upon-Hull, distiller, for "Improvements in the distilling of turpentine and tar, and rectifying volatile spirits and oils.—November 25.

William Alsop, of Tabernacle-walk, weaver, and Thomas Forster, of Streatham, manufacturer of India-rubber fabrics, for "Improvements in the manufacture of elastic fabrics, and in making articles from elastic fabrics, and for weaving fabrics for the driving bands of machinery, and for other uses."—November 25.

Narcisse Leray, of Paris, merchant for "Improvements in covering the tops of bottles jars, and other vessels." (Communication.)—November 28.

Louis Antoine Ritterbandt, of Gerrard-street, Soho, doctor of medicine, for certain "Improvements in preventing and removing incrustation in steam-boilers and steam-generators."—December 2.

James Wrigglesworth, of Bedford-street, Strand, chemist, for an "Improvement or Improvements in steel pens."—December 2.

William Henry James, of Clement's-lane civil engineer, for certain "Improvements in carriages for the conveyance of passengers and goods, and in the means of working the same."—December 2.

James Winter, senior, of Wardour-street, Soho, upholsterer, James Winter, junior, of the same place, upholsterer, and William Lane, of Bedford-place, Russell-square, Middlesex, gentleman, for an "Improved scaffold or mode of scaffolding, applicable also as a fire-escape for life and property."—December 2.

James Nasmyth, of Patricroft, Lancaster, civil engineer, for certain "Improvements in machinery or apparatus for hewing, dressing, splitting, breaking, stamping, crushing, and pressing stone or other materials."—December 2.

Rene Joseph le Comte du Colombier, of Chancery-lane, London for "Improvements in machinery for splitting and cutting skins and hides."—December 2.

John Jeremiah Rubery, of Birmingham, umbrella manufacturer, for "Improvements in the manufacture of umbrellas and parasols."—December 2.

Josias Christopher Gamble, of St. Helen's, Lancaster, manufacturing chemist for "Improvements in the manufacture of sulphuric acid."—December 4.

Benjamin Seebohm, of Horton Grange, York, merchant, for an "Improved mode of manufacturing certain descriptions of chains."—December 4.

John Ronald, of Glasgow, merchant, for an "Apparatus for boiling sugar-cane juice and other liquids."—December 5.

John Ryan, of Liverpool-street, surgeon, for certain "Improvements applicable to, or in the construction of, casks, barrels, or other vessels intended to contain wine, beer, fermented liquors, or other liquids or substances which are liable to fermentation or decomposition, from exposure to the action of the atmosphere."—December 7.

James Smith, of Cross Keys Hotel, Wood-street, engineer, for "Improvements in printing or ornamenting various fabrics."—December 7.

William Wood, of High Holborn, manufacturer, for "Improvements in printing, dyeing, staining, or producing marks or patterns in or upon woven, felted, or other fabrics."—December 7.

Thomas Metcalfe, of Eaton-square, Pimlico, brushmaker, for "Improvements in the manufacture of brooms, brushes, or other similar articles."—December 7.

Alphonse le Mire de Normandy, of Dalston, gentleman, for "Improvements in purifying lac, and in converting lac into shellac."—December 7.

John Fisher, the younger, of Radford Works, Nottingham, gentleman, and James Gibbons, of New Radford, merchant, for "certain Improvements in the manufacture of figured or ornamented lace or net and other fabrics."—December 7.

William Willcocks Heigh, of St. James's-square, M. D., for "his Invention of the hydro-mechanic apparatus, which by a certain combination of hydraulic and mechanical apparatus and well-known philosophical principles, is intended to supersede the use of fire and steam in working and propelling all kinds of machinery and engines."—Dec. 7.

Charles Louis Felix Franchot, of Paris, Engineer, for "Improvements in engines to be worked by air or gases."—December 12.

Joseph Weiger, of Vienna, Doctor of medicine, for "Improvements in the amalgamation, alloying, and soldering of certain metals."—December 12.

William Kenworthy, of Blackburn, Lancaster, cotton spinner, for "Improvements in looms for weaving."—December 12.

William Malins, of Mansion House-place, ironmaster, for "Improvements in constructing roofs and other parts of buildings of iron or other metals, and in the preparation of the materials of which the same are or may be constructed."—December 12.

Sebastian Mercier of Paris, manufacturer of piano-fortes, for "Improvements in piano-fortes."—December 12.

Robert Heath, of Kidsgrove, Stafford, coal agent, for "Improvements in heating ovens and kilns used in the manufacture of china, bricks, tiles, and other articles of earthenware."—December 12.

Joseph Lockett, of Manchester, engraver, for "Improvements in apparatus for preparing to be engraved or turned, such copper or other metal cylinders or rollers as are to be used for printing or embossing or calendering calico or other fabrics."—December 12.

John Perry, of Leicester, wool comb manufacturer, for "Improvements in combing wool."—December 12.

Moses Poole, of the Patent Office, gentleman, for "Improvements in the construction of fids for ship's masts, and in the means of setting up ship's rigging." (Being a communication.)—December 12.

George Fergusson Wilson, of Belmont, Vauxhall, gentleman, George Gwynne, of Cavendish-square, gentleman, and James Pellans Wilson, of Belmont aforesaid, gentleman, for "Improvements in treating fatty and oily matters, and in the manufacture of candles."—December 12.

Warren de la Rue, of Bunhill-row, manufacturer, for "Improvements in covering the surfaces of paper and other materials with colour and other substances."—December 12.

Robert Walker, of Saint Helens, Lancaster, colliery agent, for "Improvements in apparatus for riddling coals at collieries."—December 18.

Robert Knowles Waller, of Manchester, candle-wick manfacturer, for "Improvements in the manufacture of platted wicks, and in the manufacture of candles."—December 18.

John Wheeley, of Stafford, manufacturer of iron, for "Improvements in the manufacture of iron spoons."—December 18.

Nathaniel Fortescue Taylor, of Vauxhall, engineer, for "Improvements in apparatus for measuring gas."—December 18.

Arthur Wall, of Bisterne-place, Poplar, surgeon, for "certain Improvements in the manufacture of steel, copper, and other metals."—December 18.

Edward Hammond Bentall, of Heybridge, Essex, iron-founder, for "Improvements in implements or apparatus for sowing or depositing seed or grain."—December 18.

James Thompson, of Cornwall-road, Lambeth, baker, for "certain Improvements in the preparation and application of various farinaceous products, and for machinery used in manufacturing the same."—December 20.

Benjamin Biram, of Wentworth, in the county of York, gentleman, for certain Improvements in oscillating engines, worked by steam, water, or other fluids, which are also applicable to the raising or propelling of fluids."—December 21.

Charles Johnstone, of Saint Helen's, Jersey, engineer, for "certain Improved arrangements for raising ships' anchors, and other purposes."—December 21.

OUR MODERN MONUMENTAL BUILDINGS, AND THE NEW ROYAL EXCHANGE.

So many changes have already been rung in the newspapers on the subject of the Royal Exchange that we seem to come limping a day, or rather weeks, after the fair, or else to be attempting to collect cream from "thrice skimmed sky-blue." That the newspapers got the start of us is not to be denied, yet what they chiefly helped themselves to was rather the mere froth than the cream of the matter,—fussy reports of the fuss and fussiness attending what, by strange misnomer, was called the "Opening" of the Exchange, for after that grand and solemn house-warming the building was shut up again—even sealed hermetically—in order to be completed, an indispensable process, albeit it seems to have been forgotten during the vast hurry and eagerness of civic loyalty. However, the citizens took good care to convince her Majesty that however unfinished some other parts of their edifice might be, its *cuisine* was complete. All the nine-days'-wonder interest of the inauguration affair is now entirely evaporated, therefore we shall not think of bestowing other admiration upon it than we have just expressed as to the haste with which it was got up. Neither shall we touch upon any of those staler matters which the newspapers rummaged out and furbished up as being *àpropos* to the occasion. Of Sir Thomas Gresham all we say is *requiescat in pace*, we are not going to resuscitate, *alias* biographize, that worthy; nor shall we trespass upon the province of the Illustrated News by giving a view of Holt School as an illustration of Mr. Tite's Royal Exchange. Nay, we shall not even so much as enter into the pedigree and family history of the predecessors of the present structure, leaving them to the Dr. Dryasdusts who haunt the British Museum, and contenting ourselves with remarking that both its grandpapa and papa went out of the world in a blaze and that not a merely poetical and figurative, but a literal and good earnest one;—in other words, they were carried off by those sudden and violent inflammations of the bowels which gentlemen of their species are so liable to.

Such was the splendid fate, *à la Semele*, of the literally *feu* Houses of Parliament, which, thanks to the imperturbable composure evinced by Mrs. Wright on the occasion, made a most glorious flare-up. What a woman that same Mrs. Wright! she deserves to have a statue erected to her in the New Palace of Westminster, if not at the public expense, at that of the architect himself, as being his greatest benefactor. Had not that most worthy dame resisted the apprehensive hints and precautions her nose might have suggested to her, the fire might have been timely detected before it broke out, and comparatively very little damage would have been done. As good luck would have it—and we challenge Charles Barry to contradict us—it was as it was, otherwise we should still have been looking at James Wyatt's gothic, almost twin brother to that of the front of Guildhall. As to fresco painting, that would never have been so much as dreamed of had the old "Houses" remained *in statu quo;* what an impulse then has been given to art—if merely as regards the talking about it—and what results may eventually be produced, all in consequence of a little laudable indiscretion and want of vigilance. Laudable, no doubt, in the opinion of architects, whom we take to be fire-worshippers at heart, and Vulcanists in secret, except when they happen to be of the pontificial order—pontifices *alias* bridge-builders—because the aquatic structures of these latter are not at all liable to fall a prey to the flames, no one having as yet succeeded in setting the Thames on fire, often as the attempt has been made.

After this opening *àpropos*, we come to our professed subject, and shall enter into the heart of it at once, without repeating what is sufficiently well known already, the newspapers having taken the trouble of description off our hands,—in saying which we also acknowledge that the descriptions of Mr. Tite's edifice which appeared in the *Times* and *Morning Herald* were most satisfactorily drawn up, and most unusually circumstantial. Under any other circumstances, they would, we suspect, have been considered by far too minute and tedious, but the royal visit cast a nimbus over the building itself and all belonging to it. For ourselves we prefer contemplating it in a less glaring light, and considering it soberly with regard to its own intrinsic interest and merits alone, and as matter for critical opinion and speculation. Well! the new Royal Exchange is for a certainty no Parthenon, not even a bit of it—no make-believe Greek Doric temple after the fashion of the notable "Durham Testimonial" lately erected on Painshaw Hill—a curosity, by the bye, in its way, it being not only according to such architectural type, but also according to that of a "shocking bad hat," viz. one without a crown to it, the Durham Doric affair having no roof at all to it, although it has a pediment at each end! Neither is our London Exchange such a piece of classicality as the Parisian Bourse—that architectural compound of the veritable modern and pseudo-antique, produced by *pallisading* a building full of arched doors and windows all around with Corinthian columns, whereby the latter look as if they had been added afterwards to what was never intended to enact Corinthianism, and support the character of a Grecian peristylos. Nor is it such another piece of be-Corinthianized quakerism as is that other building in Albemarle Street, which is similarly dignified by the epithet "Royal." For what it is *not* let us then be grateful; grateful, too, for what it *is*, since it turns out to be very much better than we had reason at first to expect, and so very much superior to any other public edifice that has been erected in the metropolis from the commencement of the present century. Among those of late date scarcely one is really monumental in character, or noble in expression. Even magnitude is in many instances made to strike as littleness, owing to littleness of manner, while embellishment is so niggardly and awkwardly applied as to produce a more naked and starved appearance than there would be without any at all. As a piece of architecture, the Mint is of the most common-place design and humdrum quality, and is so totally devoid of any indication of its purpose that it might pass for anything save what it is. Ditto, with regard to quality, may be said of the Custom House, which, notwithstanding that there is plenty of it, is marked by nothing so much as insignificance, feebleness, and even paltriness of style. Wretched as the original design was,—wholly unworthy of the occasion and opportunity, there was at least some sort of physiognomy in the river façade, whose centre, consisting of a single row of nine lofty arched windows, at least plainly enough indicated that there was the "Long Room," but when after its falling down that portion of the structure was be-doctered, it was altogether deprived of such expression, and the design patched up as we now behold it, when the best that can be said of it is, that it is consistently insignificant and insipid throughout. Of course anything of such size will pass with the vulgar for grand, and may even aspire to obtain the epithet of magnificent from those critics who are in the habit of flinging about their high-flown terms of admiration so freely and so much at random that their praise is mere brummagem. What most forcibly strikes the observer is that the building seems to have been executed altogether as a mere job, with just the kind of taste, and as much of it, as was to be had by "contract;" beyond that, not a soul, neither the architect nor any one else, appears to have cared for anything, so long as the "material" purpose of the structure was answered. Of one thing alone is it characteristic, namely the easy and short-sighted indifference as to matters of architecture and art which prevailed at the time of its being erected. With the example of Dublin to stimulate to emulation —unless the noble pile on the banks of the Liffey happened just then to be utterly forgotten—London was content that its Custom House should yield undisputed architectural precedence to that of the sister capital. The latter city, however, exhibits in its Post-office a sad falling off from the general beauty and excellence of its public buildings. Francis Johnston was an estimable man, quite as munificent as old Soane, although his munificence was of a less trumpeting and fussy sort, for he erected in his life time, at his own private expense, the building for the Royal Hibernian Academy, but he showed himself, as we are sorry, yet as truth and regard for art compel us, to say, little better than a mere botcher in architecture when he applied a *macrostyle* Ionic order—one, moreover, affecting a a very unusual degree of decoration, even the frieze being enriched—to what is quite an ordinary house front, thereby producing a sadly tasteless jumble of full-dress costume and dishabille—of the would-be poetical and the veritable prosaic. Were all the rest knocked down and the portico alone left standing, we might then give the architect credit for a fine feature in what we should presume had been equally dignified in all other respects; which remark applies to a great many other buildings, and to not a few in our own metropolis. The India House for one, is in pretty much the same predicament as the Dublin Post-office; there likewise, we behold an hexastyle Ionic, which for sumptuousness of character and prodigality of decoration may be called unique, it being the only thing of the kind we have where sculpture has been applied to the same extent. Taken by itself, apart from what is alongside of and immediately behind it, the external elevation of the portico is *fully* enriched—almost to overflowing—both frieze and pediment are sculptured, and groups of statuary crown the acroteria of the latter; yet all this pomp of architecture shows itself but as a splendidly embroidered *pinafore* upon a very homely dress. In sad and sober truth it must be confessed that modern porticos are seldom other than so many architectural pinafores, consisting of only a single range of columns—let them be four, six, or any other number—attached *to* the front of a building, but not *of* it, on the contrary frequently contrasting with it so oddly and so harshly as to show utter disregard of all keeping and consistency of character, with a parading display of cheap classicality—now almost vulgarized by being hackneyed *ad nauseam*

Notwithstanding, that as treated by them, the idea of a portico almost excludes all idea of design, composition or combination, most architects are apt to pique themselves chiefly upon such borrowed and second-hand feature, and upon that kind of taste and correctness in regard to it which is altogether mechanical. However, we seem content to accept the negative merit of accuracy in lieu of either inventive talent or artistic feeling; and further, to accept a portico, and nothing but a portico, as equivalent to an entire structure. Were not such the case, hardly would its portico have obtained for the Post-office the reputation it has done; because, although it is certainly a superior thing of its kind, and one of the largest in town, the building itself is anything but worthy of that appendage to it, which, to say the truth, cause it to cut much such a figure as a jackdaw with a solitary peacock's feather in its tail. All the rest of the building can be described only by negatives. Even were its façade some degress better, and all of a piece in itself, still the whole would be but a very one-sided sort of affair, because although every side is to be seen, the posterior one and all, the architect seems to have relied upon obtaining for them the loan of Gyges' ring, and accordingly gave himself no further concern about their nakeduess.

In that respect, it must be confessed the Post-office does not stand alone, there being many other public buildings of that half-breed wherein, instead of being uniformly kept up and carried out, architectural pretension is either greatly abated or renounced altogether for such parts of the exterior as are not immediately in sight. This is the case for instance, in what would else be one of the most imposing masses of architecture in the metropolis: so long as Wellington-street and Waterloo-bridge were not in existence nor even contemplated, it mattered not in how slovenly dishabille the back of the westernmost range of the buildings of Somerset-place were left, they being at the time totally shut out from view, consequently it is no reproach to Sir William Chambers that he did not make fit to be seen what it was then impossible should be seen at all. Whereas now, in consequence of its being completely and most conspicuously exposed to view, that side has been turned out from its original concealment,—converted from a *back* into a *front*—not indeed nominally such, most assuredly no façade, nevertheless a front *de facto*, and as to situation. The consequence is, its present condition greatly weakens the impression which the river front is calculated to produce of itself, quite destroys all illusion, and causes that which should be "imposing" to appear little better than an imposition. There, indeed, we behold a splendid architectural *face*, but it is impossible to entertain the idea of a magnificent architectural *mass* and ensemble, when we also perceive of what rude, misshapen, mean and vulgar kind the rest of the mass is. And perceive it we needs must, because that miserable West side comes immediately in contact with the principal façade, and is not only seen in combination with it—there being no other land view to be obtained of that part of the building, than from the South-west,—but it shows itself the more distinctly and in full face, of the two. Hence monumental character is entirely forfeited where it might have been—or to speak more accurately, where it might be most forcibly expressed, whereas so long as that West side shall be suffered to remain in its present state, it is a gross deformity in itself, and a glaring contradiction to the architectural pomp affected for such other parts of the general exterior of the buildings as are visible. The immediate proximity of Waterloo Bridge only serves to render matters all the worse, inasmuch as strangers cannot go to view that monument without being struck by the unfinished beggarly appearance of the other. For our own part, we think that the architectural reputation of the British capital would be better consulted by completing such a pile of building as Somerset Place, than it is by sticking up dowdy York and Nelson columns, as if in evidence of bankrupt imagination.

A much-wanted lesson for some other public buildings may be taken from one which albeit by no means to be commended for its design, or held up as a model of refined taste, has nevertheless one merit in which they are deficient, namely that of architectural consistency—of being all of one texture throughout, and not a patchwork dress of embroidery in front and "filthy dowlas" behind. Although it faces what is so narrow as to be a mere passage rather than a lane, the South side of the Mansion House presents an elevation conformable in its design with the others, and of the same material, therefore it is at least stamped by integrity of architectural character. So far it is irreproachable,—free from that contamination of grudging meanness which so frequently causes what is meant for grandeur to appear little better than hypocritical pretence, and finery concealing sluttishness and rags. Besides the so-much-abused Mansion House—to which people seem determined to allow no merit at all,—we have very few buildings exhibiting the consistency and completeness which are almost essential to all structures of a monumental class. So few indeed are they that they amount to scarcely a handful, since they may all be reckoned up upon fewer than five fingers, viz., St. Paul's, the Mansion House, and the Bank, and there our catalogue would terminate, could we not now add to it the new Royal Exchange.

Here then we are arrived again at that edifice, after our long, and tortuous—some may call it tortoise-paced, prolegomena.—The Exchange does exhibit—and that, too, in a very striking manner,—what is generally more or less disregarded, notwithstanding its very great importance, namely, well-regulated architectural economy in regard to keeping, and the duly apportioning decoration over the whole. Equal care has been bestowed upon all the elevations, and, although with some variation as to design, the same character prevails throughout three of them, while the remaining one is differently treated for the purpose of distinguishing it as a portal façade to the edifice. Of course all the designs for the Exchange conformed with the conditions of the site, and whichever had been adopted, we should have had an insulated building of just the same extent as the present one, and showing four architectural elevations. Yet though as far as those circumstances alone go, no particular merit can be claimed for Mr. Tite, we think that he has availed himself of them more happily than was done by others. Unless our memory deceives us at this distance of time, in most of the other designs the chief architectural pretension was thrown into the West front and confined to that part so that there was more or less of falling off in the rest, the other sides being made quite subordinate and of little interest in themselves. Most certainly we should have been exceedingly sorry to see adopted for execution that design of all others to which the three professional gentlemen who were called in to act as umpires in the first competition, assigned the highest premium, although upon what grounds we cannot conceive, for if any reasons were alleged in support of such choice, they were not suffered to transpire, consequently we and the rest of the public went without the instruction we might have derived from a well drawn up report, clearly setting forth the peculiar recommendations of the design so especially singled out. Its merits—we cannot say its beauties—were of such an occult nature as greatly to need having some light thrown upon them, but professional men are apt to be very reserved and very shy of enlightening the public upon matters relative to their art, and some of them growl because "literary idlers" like ourselves presume to fill up the ranks that they desert, by dealing in architectural criticism.

However, instead of conjecturing what could have been proposed in favour of the design alluded to, let us be thankful for having escaped it, and by no means unthankful for having got so noble a structure as Mr. Tite has produced. Our apprehensions as to one point are now removed: it was matter of doubt with us whether the peculiar form of the plan—the obliquity of the sides to the ends,—would not be attended with an awkward effect, but now find that as far as the exterior is concerned, that circumstance proves no disadvantage; on the contrary, it is, perhaps, highly favourable in one respect, because bad the West end been as wide as the East end, it would probably have been treated just like the others, and there would have been no portico at all, or if portico there had been, it would have shown itself very differently from what it does now when it projects from what is just a sufficient mass behind it to serve as a quiet background to it, and give it relief; whereas greater extent of that front might have occasioned the intrusion of shops on each side of the portico—at least of windows, whereby composition and character would have been very dissimilar from what they now are, and would have partaken of that standard modern-antique physiognomy whose leading trait is a portico applied to rather than combined with a line of front behind it. We admit that the edifice would have been more homogeneous—would have been stamped by singleness of character and uniformity of design throughout, had the West front been treated similarly to the others; but then unless the plan had been rectangular, not only would the obliquity of the sides have been rendered more manifest, and disagreeably so, but that front the most exposed of them all, and so for principal as to situation, would have looked insignificant in comparison with the others. Some distinction and importance might, indeed, have been given it by placing the tower at that end, had which been done, besides overshadowing the Merchant's Area, by excluding from it the afternoon's sun, the campanile would, we suspect, have had a very unfavourable effect upon the Bank, if brought into such immediate proximity with it. At all events we should then not have had the additional piece of architecture we have now obtained,—the portico façade, which if it does not strictly accord in expression with the other fronts, neither interferes with nor is interfered with by them.

In its ensemble this portico may be termed unique, inasmuch as it is decidedly distinct from all previous specimens of the kind in the metropolis, and furthermore distinguished from them by qualities and circumstances of powerful effect. We do not say that it displays any great invention; we do not deny that it bears a general and absolutely inevitable resemblance to all other examples ancient and modern, because all alike agree in consisting of a colonnade crowned by a pediment, except in those very rare instances where the semicircular plan is adopted, as in the two porticos of St. Paul's transepts—by far the most tasteful pieces of composition Wren ever produced, and the most noble in style. Resemblance of that sort is, however, a very different thing from either actual likeness or mere repetition. However diversified in other respects, all architectural features of the same kind must have something in common, let the style be what it may. One spire, for instance, will bear a generic similarity to other spires, otherwise it would be something quite different from a spire, and would not answer to such name. No doubt some other arrangement of columns than that of a portico might have been adopted,—one at any rate more novel, perhaps quite equal—not to say superior in effect: that is very easily said, but those who start invidious objections of the kind seem to have themselves no idea of what that something should be, else they would probably give their ideas some intelligible shape. Dismissing all such unsubstantial, vague, and indefinite "*might-be's*," and "*might-have-been's*," our purpose is to consider the portico as it is, and without claiming for it originality, we are nevertheless disposed to hail it as a welcome novelty of its kind. We grant that it keeps in the usual track, but then it advances very much further in it than usual,—far beyond the point at which other architects have stood still. What has been done now for the first time—in this country at least, might certainly have been done over and over again, before: the only cause for surprise is that it should not have been done,—that our architects should have gone on contentedly, giving us little more than so many external semblances and mere shadows of porticos,—things which proclaim their own inefficiency of purpose, and renounce even the appearance of utility, being generally so shallow as quite to contradict the idea of shelter, and being sometimes so tastelessly—not to say barbarously applied, as to look more like unmeaning and cumbersome excrescences than organized and integral parts of the buildings they belong to: they have the unhappy look of being intruders where there is little or no room for them, and where they are accordingly squeezed up as much as possible in order to be no more in the way than can be helped.

In discussing the merits of the Royal Exchange portico, we shall not lay much stress upon the superiority to others, which it derives from greater amplitude of dimensions: it is sufficiently obvious that *cæteris paribus*, columns forty-one feet high will make a more commanding appearance than such as are only thirty or five and thirty feet;—that an octastyle—or eight columns in front, beneath a pediment, produces a richer and more majestic appearance than an hexastyle, or what has only six columns so disposed. Though circumstances of that sort have their weight and influence, and add to the aggregate impression, they would not of themselves excite our admiration,—very possibly might even increase our dissatisfaction, did we find the grandeur intended to be so produced maimed or nullified by inherent ignobleness of style and vulgarity of ideas, in other respects. Had the portico in question little other excellence than that of its external elevation and imposing scale, a foot rule would serve nearly as well as a pen to describe its beauties. Our admiration, therefore would have been considerably less had this part of the structure been executed according to the architect's first designs. By a most miraculous piece of good fortune—one exceedingly rare indeed in architectural history, instead of being required to prune and pare down his original ideas, Mr. Tite was very liberally allowed to develope and expand them, and so to amplify his portico as to render it, although still the same in front as at first, of markedly different and highly improved character. Whether the alteration was suggested *to*, or *by* Mr. Tite, or whether it was at all in consequence of the pretty general and strong approbation that had been expressed in favour of Mr. Donaldson's design, on account of the classical character of its portico,—we know not, but, although in its present form the portico does greatly resemble the one proposed by the latter gentleman, more especially in those peculiarities which so eminently distinguish it from what we have hitherto been accustomed to, the likeness does not afford any charge of plagiarism, since the other idea was only founded upon the example of the Roman Pantheon. It would be a difficult matter to establish and protect by patent any property of ideas in architectural design,—or could it be accomplished, it would be well that the profession should be restrained by severe pains and penalties from pirating Sir Robert Smirke's ideas of classical taste and Grecian style.

However derived, it is quite sufficient for us that we have at last got such an example as the portico of the new Exchange,—one whose *interior*, a part generally treated as if of no account, and at the best little more than a blank as to decoration, is strikingly replete with picturesque effect, with varied combinations and play of perspective, and is further set off by brilliant contrast of light and shade. We here perceive something of the poetry of architecture,—certainly of its pictorial quality, since this interior would be an admirable subject for the pencil, were it not also one that quite baffles its powers of representation.[1] For very much of this character the portico is indebted to the inner columns, which although only two in number tell for a very great deal by their value in the design. By their position, these columns distinctly mark out the plan into three divisions, the centre one of which is wider than the others, and of greater extent as to length, the portico being there recessed within the general line of its background, and through the open arched portal the inner quadrangle, or Merchants' Area, shows itself in the distance, which vista produces a very unusual species and degree of scenic effect. The inner columns, and all the other circumstances of plan and arrangement which we have mentioned, give to this portico the charm of apparent intricacy combined with perfect regularity, and of architectural uniformity without formality. Nor is this all, for we should leave one remarkable feature of its design and embellishment unnoticed were we not to point out for admiration the richly coffered vaulting of the ceiling. This last is qui e as much a novelty in its way as anything else in the design, for it exhibits a degree of finish and sumptuousness of character that in direct, almost might we say startling, contrast to the sort of apology for or pretence to coffering—any thing but Corinthian in taste—in the ceiling of the portico of the National Gallery, which has only very shallow coffers, without even so much as a moulding of any kind to them, and the look of beggary and blankness thus occasioned is further increased by the ceiling being so very low, that it is almost on a level with the soffits of the architraves, or the tops of the capitals of the columns. Finish was certainly not Wilkins' forte, and microscopic as was his taste in some respects it seems to have concerned itself chiefly about columns and intercolumniation, to the neglect of nearly all besides in design.

To return to the Exchange; it may be thought strange that where there is so much richness and decoration in other respects, the architect should have bestowed rather less of the latter than is now usual upon his columns, their shafts being left unfluted. Fluting, however, is not indispensable, not essential to completeness, nor does the omission of it occasion the appearance of positive nakedness and want of finish. Although left quite plain, the shafts of columns will always tell in a building, because of themselves they amount to decoration; and in a climate like ours and in a London atmosphere they show themselves, perhaps, with greater relief and breadth of effect when they are not, than they do when they are fluted. At any rate, whenever such further enrichment is applied to the columns, a corresponding or even increased degree of it should be applied to entablatures also. If the one are to be fluted, the mouldings of the others ought to be carved, and the soffits of their architraves embellished. It would further follow, from analogy and from regard to due proportion and distribution of decoration, that if an extra degree of ornamental finish be bestowed on the shafts of the former, it should be extended also to the corresponding division of the entablature, whence we should lay it down as a general principle that fluted columns require a sculptured frieze,—at any rate such ornate finish in the collective entablature as will render the entire order of a piece, by *proportioning* the character of one of its main divisions to that of the other. Such, at least, is our doctrine—fully supported, as we think, by the fundamental and almost instinctive principles of taste; and let whatever may be thought of it, it cannot be called the mere repetition and dressing-up again of what is inculcated as matter of course by the initiatory precepts of the art. No such broad theoretical maxims are laid down in architectural treatises, much less in the application of them shown in architectural practice. Nevertheless, the latter supports and confirms them by making manifest, sometimes even painfully so, the ill consequences of not attending to what is so obvious in itself, that almost the least disciplined notions of architectural consistency might inculcate it spontaneously, without precepts or authority of any kind. Of late years it has become almost the universal and ordinary practice to display almost the very two extremes of character in what are intended to constitute conjointly one consistent *order* and uniform whole, for while all the decoration they are susceptible of is bestowed upon columns, the very parts which least of all need extra embellishment, all that is above them is treated as if meant to be be in contradiction to them, plain architrave mouldings, naked friezes, stunted and otherwise mean looking cornices, and blank pediments being exhibited as

[1] Even the most correct perspective of the portico externally can but very inadequately express, or rather only hint at the design of the interior, therefore hardly need we say that the general views published of the building—apparently one and all made from the very same sketch, convey no idea whatever of the characteristic peculiarities of this example. In a geometrical elevation, again they disappear; the inner columns are completely concealed by those in front, the vaulting and its enrichments cannot be seen, and the whole is shown in a state of rigid lifelessness.

the entablature and complementary portion of fluted-columned order. For an instance of such order—although there is hardly occasion for pointing to any one in particular when they are, unfortunately, so numerous,—we may again refer to the portico of the National Gallery, in which the richness aimed at by the columns and the close intercolumniation, is neutralized by the general poverty of the entablature. The latter may be very well in itself, and suitable enough where plainness would be a propriety, and in accordance with the rest of the design, but placed as it is in juxta-position with elaborate ornateness, its plainness becomes offensive meanness, and the whole composition little better than a discordant jumble of conflicting qualities. Almost might it be imagined that Wilkins never saw the portico to which his columns originally belonged,—we mean that of Carlton House, an example which of all others then existing here we could least afford to spare, it being by very far the most complete, the most perfectly finished up in every respect, (with a highly enriched frieze and cornice,) and being strikingly majestic and grandiose in its *ensemble*, not a little picturesque withal in its plan, and further distinguished by having inner columns, very differently disposed, however, from those within the portico of the Exchange, they being so placed as to divide off that part of the plan which was recessed within the building—and which rendered the whole portico very nearly as deep as it was wide —as a sort of pronaos or inner loggia, whose floor was on a higher level, there being a flight of steps up to it, which last circumstance contributed not a little to picturesque variety. Still, one sad drawback there was, upon all this assemblage of architectural pomp and beauty, one, however, which did not accuse Holland of either negligence or want of taste, it arising solely from architectural correctness being made to give way to convenience, for in order to render the portico "*practicable*" for carriages, instead of its being made triprostyle, or with three intercolumns on its flanks, as it else would have been of course, two of the intercolumni were laid into one, thereby producing the disagreeable appearance of a wide gap, as if a column had actually been taken away from each of those sides. The convenience was undoubtedly very great, yet dearly purchased; and the only thing that could reconcile the eye to such defect, was that the interior of the portico was more exposed to view. After all, the portico of Carlton House—though hardly ever mentioned, while that of St. Martin's church continues to be cried up, even at the present day, as a sort of prodigy, at least as perfection—was the finest example of its kind we had,[2] unrivalled, until now in some respects surpassed by that of the new Royal Exchange.

Resuming our remarks upon this last, we venture to give it as our opinion that it would not have been amiss to try the effect of a little polychromatic decoration within the portico, if only by way of experiment, and at first with colours that might have been easily expunged in case of the result proving unsatisfactory. Painting of the kind in that situation would be equally protected from the weather, and stand just as well as within the ambulatories around the open area. Introduced into the portico[3]—not that we wish to have seen it there—after just the same fashion, and to the same extent and degree, polychromy would have been a more decided novelty in itself, and also appropriately characteristic of the particular building, as announcing in the principal entrance to it the style of decoration adopted for the public part of the interior. Nay, the effect of colour within the portico might be tried with the greatest facility and without the slightest hazard there being a model of that part of the building upon a sufficiently large scale for an experiment of the kind, or a still larger one might, if necessary, be prepared for the purpose. It would be a futile objection to say that it is now altogether too late to think of such additional finish to the portico, since it is of a kind that might still be applied, should previous experiment justify its being attempted, the only other consideration being that of extra cost, an exceedingly trifling one with the citizens, if we may judge by the alacrity with which they expended their money upon temporary decorations, and the fittings-up for one day that were meant to be pullings-down the next.

All that we desiderate further for the exterior of the portico is two statues for the pedestals that close the ends of the flight of steps. So placed, they also would be a novelty, for we know of no instance in this country where figures of the kind are introduced after that manner as accompaniments to a portico, and so far more effectively than when placed on the acroteria of a pediment, where as statues they cannot be properly seen, but show little better than so many oddly shaped pinnacles. Put in advance of the portico, statues would increase the general stateliness of its appearance, and combining in perspective with the columns would produce a very unusual degree of picturesque richness. Of the portico we may now at length take our leave, with the remark that the sculpture is of more value as an accessory to and filling up of the architecture, than for any particular merit as a work of art.

The other elevations of the exterior will not detain us so long, for instead of speaking of them separately, we shall make a few general observations suffice for all. And looking at them we cannot but regret that it was deemed expedient to incorporate shops with such a structure,—a regret in which the architect himself, no doubt, sincerely joins us. We do not so much object to them on the score of their being shops for retail business, and in such capacity beneath the dignity of a Palace of Commerce, as because they cut up the architecture, destroy all breadth and repose, cause the lower part of the structure to appear too slender and weak, and the upper to look more massive and heavy than it otherwise would, and all the more so because the shop fronts are, almost of necessity, in a light and what may almost be called a fragile style. We think, therefore, that the building showed itself rather to advantage than not, in the interim between the scaffolding being taken down and the hoardings removed, when only the upper half was visible. There is hardly any appearance of piers at all to the arches, merely strips on each side between the arcades and the pilasters, consequently the whole of the lower part has the look of being crowded and squeezed up, more so, perhaps, than would have been the case had the pilasters been omitted and the piers unencumbered. Had it been possible not only to get rid of the shops, but to dispense with windows altogether on the ground floor, making the lower parts solid masonry with jointed rustics,—as is actually done in the Royal Exchange at Dublin, the general character of these elevations would have been incomparably superior to what it is at present, and withal, markedly distinct from anything we now have. At all events, shop windows might surely have been omitted in those curved portions of the exterior which connect the north and south sides with the east end; for arches on a curved plan have anything but an agreeable effect or appearance of strength.

If these strictures amount to rather serious dissatisfaction we cannot help it; our censure must be taken along with our praise, or if the latter be not worth having the other may stand for nothing. As soon, however, as we get *over* the shops, we can resume our benignity, and speak in favour of the upper portions of the elevations, without going against the grain of our critical conscience. Here there is certainly no lack of ornament, for it is indulged in even to profusion as regards the windows; but when we say "to profusion," we do not therefore mean to faulty excess. It is something to find that windows can be made to take a far more decided and important part in architectural design than they have hitherto been allowed to do; and that instead of being made to look as if they were ashamed of showing themselves at all they here display themselves in peculiar "bravery." We have heard them compared to picture frames—one of that cheap sort of comparisons which are employed from lack of critical argument—but we have yet to learn what it is that constitutes that particular, and of course very discreditable resemblance. If we are to judge by comparisons and resemblances, we might with quite as much truth and propriety say of the windows which our ultra-Greek architects exhibit, that they too resemble frames—not indeed picture frames, but the straining frames on which picture canvasses are stretched, they being about as plain and free from all ornament. The windows of the Royal Exchange manifest considerable study of detail, ability of invention, and diversity of design, far more of them all three than one of the *notables* in the profession has expended upon all the buildings he has erected, and they are surprisingly many, when we consider how small his practice would have been had it depended chiefly upon his talent, which has procured for him no more flattering distinction than the epithets of "Machine" and "Milk-and-Water," the ideal of respectable and intolerable mediocrity. We wish that *he* could be *exchanged*—for any body else, or if for nothing it would still be a bargain.

We own that the windows, and some of the other decorations of the Exchange, are calculated to horrify architectural precisians and puritans,—those who eschew all innovation as contagion, and denounce as illegitimate whatever deviates from their own formal rules for producing frigid insipidity. We leave to others to enter into logomachics as fierce as they are finical about mere names and words, for we are always ready to accept as legitimate in art that which is meritorious and satisfactory in itself, and if it comes to us without producing a licence from precedent, we welcome it all the more as an

2 We might seem to be altogether ignorant of the existence of such an acquisition to the portico class as is that of the Fitzwilliam Museum, Cambridge,—so capacious in its interior, and picturesque in its arrangement,—were we to pass it by entirely, but this mere mention of it thus in a corner must suffice on the present occasion.

3 We have seen it mentioned that the frescoes within the colonnade of the Berlin Museum were "inaugurated" on the 15th of October last, but without the slightest remark as to the effect produced by them, on the architecture, or to inform us whether the range of Ionic columns in front is at all improved or not in appearance by such pictorial background to them.

entirely new acquisition. As to the edifice we are speaking of, we admit that its style cannot be called pure, and that it may without injustice be termed heavy, but if without injustice so also without reproach, for of heaviness it has no more than befits its character; or if that term must be exclusively employed as one of censure, substitute "boldness" and "massiveness" in lieu of it. Perhaps we could find no more expressive and appropriate epithet than what we chanced to hear applied by a person who, after looking at the building for some time, addressed his companion with the exclamation of "Well, now that's what I call a JOLLY style!" Jolly it certainly does look in comparison with the meagre, starved-visaged buildings we are accustomed to behold. There is an expression of both stateliness and sumptuousness—qualities which we do not meet with so very often as to have to complain of being surfeited with them. Affluence there is, too,—exuberance of ornament, and much of it may be said to be exaggerated; yet even such excess becomes quite a merit in comparison with the opposite faults of feebleness and nakedness.

Simplicity, or what has been so called—and a plausible name goes a good way in such matters—has been greatly overrated by us, and the affectation of it has led to the adoption of what cannot so properly be called a style, as an extinction of all style, patched here and there, perhaps, with a few broken bits of Grecian and Roman. It is full time to have done with that; and we not only hope but think that the new Royal Exchange will help to banish it henceforth from our public buildings at least, and such others as make any pretension to architectural display.

Concerning the interior of the Exchange we cannot speak as yet so fully as we could wish, nor can we now speak of it so fully as it would be in our power to do, were we not apprehensive of being thought to claim too much space for our remarks, wherefore we must confine them to that part of the interior which is of chief architectural interest, and to which alone the public will have access. The Merchants' Area of course constitutes the Exchange properly so called; yet although it is so far, the very body of the plan, and heart of the building, its architecture is *external*, the place being only an open cortile or piazza surrounded below by arcades forming spacious ambulatories. Somewhat strange it certainly is that the merchants should not have availed themselves for their new edifice of the opportunity of rendering that part of it where they assemble for business more commodious than the former one by roofing it in so as to protect the whole of it from the weather, as might have been done without converting it into what would have resembled merely a spacious room or interior of the usual kind. There would not have been any necessity for deviating from or disturbing the present design, since the four elevations might have been just the same, excepting that there might be required to have been added to them a clerestory with open unglazed arches, which together with skylights or open glazed compartments would, we think, have afforded quite as much light and ventilation. There was not very far to seek for a practical instance and test: Hungerford Market supplies one. That holds out a sufficiently suitable idea for a Merchants' Hall, and might have removed whatever apprehensions were entertained that by being covered in the area of the Exchange would be too much darkened.

However, we shall not pass censure on the merchants for adhering to the plan of their former building,—the only one, perhaps, according with their notions of an exchange, and therefore not to be exchanged for any other. The inconvenience attending it,—if it be not an entirely imaginary one fancied by us—will be felt by them, not by ourselves, who are very well content to behold what is a much greater architectural rarity here than a spacious covered-in room of any kind would be, namely, an open *cortile* of uniform design and entirely closed in on all its sides. We can not call to recollection any thing that we have at all similar in character, for even the inner court or quadrangle of the British Museum is of quite a different one, and still would be so were it just in the same style, and precisely in the same taste, instead of being in those respects the very reverse of the other.[4] The inner court of the Museum is very far more spacious than that of the Exchange, its area being no less than nine times greater, from which many would at once infer that the effect must be about nine times grander, whereas it is really just an inverse ratio. Beyond certain limits, increased extent of space diminishes the effect of the architecture around it, unless the latter be augmented in the same proportion; contracted space, on the contrary, enhances its effect. Thus, the cortile within the Exchange has the proportions of a lofty hall, and architectural character predominates in it; but in the other case, the proportions become those of a very low room, the architecture loses much of its consequence, impressiveness of ensemble is greatly weakened if not destroyed, and the general appearance differs but little from that of so many distinct though uniform buildings ranged on the sides of an open space. Difficult as it is for us to express our meaning clearly, we may perhaps illustrate it—though somewhat fancifully—by saying that the Exchange cortile has a certain peculiar and rich architectural flavour—a choice and peregrine relish almost unknown among us.

Spacious as it would be for a room, the Merchant's Area is small—we do not say too small—as a court, for although the entire plan, including the arcades or ambulatories, is 168 feet by 111, the court itself or open part does not exceed 116 by 60 feet. It is accordingly treated differently from the exterior, for a single large order, as in the latter, would have taken off from its apparent size, and have been rather overpowering; wherefore the elevations are made to consist of two, the lower one Doric, the upper Ionic, and we hardly need add, of Italian character. Here, too, there has been a considerable deviation from and improvement upon the original design, it being at first intended to leave the lower order quite open without any arches between the columns, in which case, besides that the colonnades would have had a poor and stragging effect in themselves, unless the intercolumniation could have been reduced by increasing the number of the columns, there would have been a most disagreeable expression of weakness in the whole of the lower part in comparison with that above it, which expression would have been any thing but mitigated by the very unusual depth of the ambulatories within. The columns being attached to piers, and, thus contracted, the openings converted into arches, the whole has now an air of adequate substantiality and compactness, and the ambulatories themselves are less exposed to the weather. We should however have liked to see moulded archivolts to the arches, as such a degree of finish seems wanting in order to bring them more into keeping with the very ornate character of the other features. Ornateness to an unusual degree—such as may be called even floridness, certainly prevails in the upper order, whose windows are even still more remarkable as composition, than any of those on the exterior; each window occupying the plafond *(plat fond)* or back of a large niche-like recess, coved and panelled. The window itself has rich dressings, and is surmounted by a pediment; and the arch over it has a sculptured keystone in the form of a cartouche. Thus the general composition of the upper order presents a series of arched compartments between the columns, corresponding with the open arcades below. Decoration has been applied with ungrudging hand, and such is the variety and complexity of details that repeated examination is requisite for noting all its particulars. In many of the other designs which were sent, the interior court was, on the contrary, marked by excessive plainness, as if appearance was there of no moment. Such, if we mistake not, was the character of Mr. Donaldson's, and if such really was the case, it would have formed a more striking than happy contrast to his splendid portico. In the edifice actually erected there is, fortunately, no such anti-climax,—no falling off in point of richness. However high expectation may be raised by the portico, there is no danger of disappointment being felt on entering the cortile, whose effect is considerably enhanced by its not coming immediately into full view, on passing from the other, but being approached through an intermediate space, in comparison with which it forms a wide and brilliant expanse,—brilliant certainly in polychromic embellishment, to quite an unprecedented degree, &c.,—we were going to say surpassing every thing else of its kind, but we have at present nothing else of the kind, except it be in the Temple church. We are aware that Mr. Sang's decorative encaustic painting in the ambulatories does not satisfy every one, nor can it be considered more than mere decoration, without pretension to pictorial art: still it serves to shed a glow of warmth and splendour over the place; and it is highly creditable to the committee that they should have shown themselves willing to adopt improvements and additions both in this and a variety of other respects, so very far exceeding what was originally contemplated. One strong proof of their desire to render their edifice complete at all points, in decoration, was the introduction of tessellated pavement for the flooring of the area,—which was tasteful and classic in design, and no doubt singular, striking, and superb in effect. But, alas, ! that was but a transitory gleam of splendour, no other trace of which is left than an engraved delineation of it upon paper. Whether or no the mischief is at all to be attributed to the hurried-on 'Inauguration' and to its being then trodden upon by a concourse of persons, before the cement had had time to harden, it was found necessary to take up the tessellated pavement again, and replace it by one of asphalte. This *solemn* failure is greatly to be regretted, not only on account of the Exchange itself, which has thereby

[4] That any architectural character or finish at all should have been bestowed upon a part of the Museum, which is all but entirely shut out from notice, seems to us somewhat at variance with that economy which has considered bare brick walls sufficiently ornamental and dignified for the whole of the exterior except the South front—the smart pinafore to an uncouth mass of meanness if not of positive ugliness. The columns, antæ, &c., now secluded from view, within that court, would have just sufficed to decorate and face with stone eleven hundred feet of the exterior, or rather more than both the East and West sides!—Surely this does not indicate the most judicious management.

been despoiled of a magnificent piece of decoration, but because it is likely to prejudice against, and deter from, again attempting tesselated flooring—at least upon anything like the same scale.

We have not yet taken our readers over the whole edifice, but, although much that is highly attractive and worthy of notice remains to be spoken of,—viz., the apartments constituting what is called 'Lloyds', which are unusually spacious, and in some respects of novel character also,—we must be excused from conducting them upstairs, lest the Editor's patience should be exhausted, and he kick us and our article down stairs without any ceremony. So instead of looking at those rooms, it behoves us to look to ourselves, and to see that our paper, does not grow to such dimensions that no room can be found for it, but it must be exchanged for some other, which sort of Exchange we most assuredly should not admire at all, nor should we call it a Royal one, though made by Regina herself.

ON THE OILS HITHERTO USED IN PAINTING;

AND THE NATURAL AS WELL AS REQUIRED PROPERTIES OF ALL OILS FOR ITS USES.

No. II.

Lanzi[1] might well say, "Much will he do for the Art who can tell us with what gums, with what mixtures these Greeks painted;" and as justly assert, after all his indefatigable enquiries, "Correggio's vehicle is lost and inimitable;" for, after years of labour, I came to the conclusion, that no one oil, no one agent, as a vehicle,[2] could effect the desired end; and, therefore, by combining the elementary principles of the best terebinthinaties, so as to dry without the rising of oil and thereby prevent lowering and yellow horn, I gained as far as I could judge, the chief desideratum of the Art, and subsequently joined to this the powers of glassa, which I saw clearly had been used by Correggio and Rubens so as to glaze with that splendid, ever-flowing power, which I honestly believe no other earthly agent at all approaches; but the difficulties of the subject in its enforcement, no man can possibly conceive. I have now before me six quart bottles of the same agency, varied to suit first one caprice, then another, until nothing short of the most minute diary could have prevented confusion and loss of first principles, and this only between the dates 1841 and 1844, and two of the finest elementary matters were actually rejected, one to please a colourman's[3] caprice because of its colour, the other because of its smell, in defiance of all my experience and assertions; although, I am now prepared to prove by the living testimony of an artist of no ordinary[4] qualifications, that an Italian experimentalist of note now living, extracted the one from an accredited picture of Correggio, which my friend saw, first in the state of powder, next after evaporation of its solution *in its original form*; and that in searching the public archives he found evidence of the expenditure for glassa, &c. And further that my friend under his instruction learned to overcome its difficulties,[5] used it, and continues to use it with unquestionable effect; nay more, the employers of Corrgegio,[6] paid for similar articles for Correggio's use; and three powerful agents out of five, acquired by me from sheer thought, labour and cost, in a word from practical deduction, were proved, to my conviction at least, to have been actually used by this hitherto inimitable painter; and that with one alone a mere dauber could have produced impasta and luminosity which Reynolds tried in vain to achieve. But, to return systematically to my last paper.

Oils, I have said, must not be tampered with. A simple, pure, vegetable oil such as linseed or poppy, bleached,[7] if you please to bleach at all, in defiance of my experience, by the sun alone, (although in this climate you never can gain the state called by Cennini *baked*—a state quite opposite to that of *boiled* oil.) A simple oil, I say, joined with a pure resinous vehicle, a proper dryer for this climate, and such a glazing will defy time; and, I repeat, with these, good flake or Kremnitz white is *more permanent than ultramarine in ordinary oils and Macgelps*: for the one will not change, as a white, while the other does, in effect, change as a blue (however permanent in itself), when covered by an acquired yellow.

It becomes clear therefore, painters who love their Art and look for fame, for I do not address such vulgar drivellers as said the other day publicly, "he cared not, so long as his pictures outlived the exhibition and brought him the price, if they died away the next day;" and some months ago to another—"what care I, they will stand my time"—such beings are too grovelling, too heartless to feel the lash, or I would broadly give the "local habitation and the name." Painters who seek the laurel wreath of posterity must dash off their ancient prejudices—spurn idle empirics who advertise this and that colour or mixture, and inverse their ideas of permanence, choose simple pigments few in number, torture less with the brush, depend wholly and solely on vehicle, and use less oil and that simple and pure, heedless of shop limpidity—use a proper dryer with every lead or tender colour as well as with lakes or blacks, and cease to be deluded by body, however convenient it may be. They must cast aside all Macgelps sold in the shops, however puffed off, and make their own of copal or glassa, which is infinitely better, and remember the empirical addition of copal to brighten colours, however learnedly vaunted by Merimée, only betrays a total ignorance of all practical desiderata and the simple principles of permanence. Their oil will then not retrograde, as it now does, by an unerring law of nature, and their pictures will not die away or crack, but remain gloriously steadfast, rich, flowing and fresh.

I have alluded, in my last paper, to the non-use of dryers except where a lake or black required forcing, let them remember lead requires forcing also, simply because it wants also fixing as rapidly as possible, and so with vermilion, &c., or its gravity assists the oil in rising, which it does into cups or vallies from which the skin radiates, and this skin which Fernbach mistakes for an oleate of the pigment contains *no* pigment at all, it is a mere film or artificial caoutchouc (or Indian rubber) and the pigment is always found beneath after rubbing it off with pumice, beautifully pure but full of vallies. Fernbach in fact rides a silly hobby,[8] that of theoretic chemistry from a bad school, with nomenclature for a vest and his saddle a sort of Liebig skin. I am amply disposed, however, to "render unto Cæsar the things which are Cæsar's, and unto God the things which are his." M. Fernbach is said to possess some secret vehicle on which he sets a high value, and that the book, therefore, he has ushered into the world contains it not, but that this vehicle smells strongly of the copaiba balsam—here the enquirer has shaken Liebig's nonsensical elementary science off, and gained a grand point. Copaiba was used by me twenty years ago, and every other natural balsam and gum resin, not only known to modern medicine, but many which modern medicine scarcely knows the name of.[9] Copaiba was recurred to again by me four years ago. With copaiba, *as one agent*, I had a landscape painted by a Mr. Birch[10] two years ago; and two quarts now stand as refuse in Soho Square. Copaiba I first used twenty years ago with an essential oil to imitate a balsam long forgotten, but of great solvent powers, viz. the beautiful Balm of Gilead (*Balsamum Gileadensis*) of which I possessed a brilliant specimen from the cabinet of the late Dr. William Marris, the well-known bibliomaniac. Copaiba was used by Sir Joshua Reynolds, as I see by his diary; and whoever possesses at this moment Sir Joshua's portrait of Goldsmith can amply test my experience, if painted, as he states in the diary, with copaivi, as he calls it, and lead, it will be found the hand has the colour good, impasta fair, but *too fixed*, too solid, that is not floating as if fixable but not fixed—and finally, full of cracks,—this will surely be if the

1 Lanzi, Vol. I.

2 So little do varnish makers know or even colourmen what a vehicle requires, I am now compelled to retrace my steps, and the vehicle is now precisely what my landscape by Birch was painted with, and insert those agents in 1845 which in 1842 Messrs. Newman's rejected.

3 That is a necessary caprice of trade; the tradesman keeps what will sell—what the majority demands, and he considers such demands his desiderata.

4 Mr. Salter, the painter of the Waterloo Banquet, of 56, Pall Mall, who knows more of vehicle than any man I have met with in thirty years.

5 He who found the agent (1827), from an ancient book, was taught by him who discovered it by analysis of a piece of a real Correggio 'to use it.' Mark the similitude of our labours and circumstances—a practised painter could not use it well until taught by the philosopher; a colourman and amateur painter rejected mine first as too dark, second as of a bad smell; Mr. Birch's brushes stuck fast in my landscape two years ago, as too fiercely drying; Mr. Eastlake could not get his first specimen to 'dry at all'—yet do we agree.

6 This will be better given in full and 'formally' by my valuable friend in a communication to the Royal Commission of the Fine Arts, and in deference to whose "equal right to fame" I use the now obsolete term "glassa," (which I take to have been a trading term synonymous with what was termed gutta succina), the pure gum fornis of the Monk Theophilus, which Merimée, as a crotchet, identified with copal,—but which no more referred to an absolute "gum" than the old name of catechu, a vegetable extract, viz., Terra Japonica—referred to any earth.—I would neither forestall my own "past" communication to the Secretary of the Royal Commission of the Fine Arts, nor any my friend may intend to make, for this is a second advent of painting, an absolute resurrection of the vehicle of Correggio,

7 See further of Mr. Salter's beautiful alcoholic treatment in the sequel.

8 And Salter has profited by not following the same path. Let a painter be well read and versed in the nature and history of what he uses, but never a chemist (affected to he), nor ever trust the oxygen and hydrogen gentry of the mere teacher's chair, these men are incubi and ignes fatui, out of their sphere they laugh at your folly while you quote their trash. Obviously they are theorists,—practically know nothing. The worst physicians, toxicologists, painters, and farmers I ever knew, were these amphibiæ of science.

9 Not one in every thousand ever heard of some common dispensatories not five hundred years old. I could prescribe with 8 or 10 synonymes and medicines the majority never heard of; and I name it only to exemplify the fact that modern chemistry, byenamed philosophy, is the owl on the donkey of Pope's Dunciad, and its motto "nil desperandum."

10 Of Brewer Street, Golden Square.

lead were used in powder or ground in oil, but no excess thereof; this terebinthinate being a grand preserver of lead, simply by a resinous shield preventing the rising of the oil. Copaiba was used by me in some specimens given by me to Sir Martin Archer Shee, but I fancy thrown away, two years ago in pure detestation of the classics of his art, and what he emphatically termed "black pictures of the greatest fools upon earth, the connoisseurs." Finally, copaiba *was* used by Correggio, which, as I before said, was one of the three agencies used by me, and is the only good diluent, in delicate proportions to be gained only by practice, of solutions of glassa, which again the varnish makers know nothing of—their only method of treating it being by ordinary practice which destroys its chief and strictly characteristic traits; nor can any living artist, except my friend Mr. Salter, use its solution without being taught from the results of practice. This glassa was my rejected article for "colour"—copaiba for its "smell," which greatly to my cost I mixed and modelled, steamed and distilled in vain, to please the colourman. Copaiba, however, can only be used in certain given proportions; first, because it begets tack; secondly, because containing extractive it is disposed to turn *brown* by light, whereas the painter requires, if possible, such agent or such quantity as shall bleach by light. Copaiba proves the concluding portion of my last paper, which Reynolds was ignorant of, viz. an "*inversed law of drying*," for it is *naturally* a bad dryer, and yet *with lead alone* cracks more than most of the hardest gums.

The mere varnish maker would reject this, as he would *all soft* gums (as they are called), but he knows nothing of vehicle, in which it cannot be too soft. And, the glorious property of glassa next to its "*flow*," which the innocent colourman rejects, however beautiful in working, almost as inveterately as he does its dark colour, at the very moment he recommends Macgelp with much *more colour*, because "it does flow," will not stand out or stand up. Now, in the first place, every true artist knows Macgelp is infinitely more valuable for its "bearing out" (for a time only), than for its "standing out," though useful. And these genii of the shop little know that this *inherent flow* of glassa, this inimitable resemblance of molten glass can be checked at our pleasure, and stand out in the highest pile upon pile, the finest imitation of muslin threads or crystal ramifications.[11] Still has the use of glassa its obvious limits; it cannot be used empirically; it has no preservative power *with lead*, and has also some disposition to brown; and flowing surpassingly would—with oil—dispose it to rise because of this flow, if not modified by the dictates of practice.

I had intended to trace the various oils used in painting from Plutarch's day to that of Pliny, from Apelles to Andreas Rico, and the gradual changes from the "cera Punica in oleo liquefacta" to wax, oil and resin.—Oil and resin with lesser quantities of wax, until solutions of resin in oleo de sasso, or spirituous vehicle made the picture a mass of sheer brittleness, as in the Rico picture of the Museo Mediceo described by Lanzi and Tambroni; or the pupil of Georgione examined by me, which picture, though evidently painted with oil as the vehicle, was a mass of resin, as mentioned before, and blackened considerably from the action of a very slight absorbent and bad gesso ground; and ultimately, as the zenith of vehicular progress, to Correggio's resinous vehicle combined with glassa glazing and splendid imperishability; but as I know Mr. C. L. Eastlake, with one of the best artistic libraries in England at command, great artistic powers and experience, and a brain infinitely better adapted to special research, and moreover a better linguist, has it in hand or in perspective, I retire gladly to what I am more *au fait* in giving, mere practical experience.

I have made more than five hundred distinct experiments on panel during the last year, and can preserve lead as I please. I have used every artificial precipitated silicate, (not to be confounded with the impostures *called* silica and glass media, mere trash conglomerated during the borax mania, a large parcel of which I analyzed for a gentleman three years ago,) and I must here defend Mr. Field against the flippant remarks borrowed by Mrs. Merrifield from the Davy and Merimée and Taylor school. Soft glass containing lead I have detected in several pictures; in others pumice and burned bones; and as Cennino Cennini used, and almost every other great painter of whom we have any record, this glass in grinding, as a separater of particles, it is almost impossible, in such a day of close experience and personal manipulation, that the powers of this vitreous silicate as a fine dryer should have been neglected; besides, we have incontestible evidence that it *was* used for another purpose, viz. to produce rough and sparkling particles in the middle painting. Ground lead glass with an artificial silicate most assuredly preserves and bleaches lead *in oil*, and prevents by fixation the rising thereof.

Strass, or paste for Paris diamonds, flint glass alone, every sort of flint in common, Brazil crystal, aqua-marine, and diamond dust, I caused to be levigated with much labour three years ago, and found *none* possessed of this power in the manner and quantity of artistic painting; if, therefore, the allegations of certain house painters and their colour makers be true, with reference to flint and green bottle glass after calcination, it must be from the greater quantity used in the one and mixed with *more boiled oil*, and in the other the probable presence of iron and manganese both quite incompatible with artistic use.

Oil, I have again and again asserted, must not be tampered with; and I have shewn the fallacy of bleached oil, and if corroboration were wanted I have given enough in pointing to Leonardo da Vinci,[12] whose oil was beautiful, but he neither produced Correggio nor Anselmi nor Rubens's general effect, neither the combined impasta and permanence of the one, nor beauty and permanence of the other. I have shewn the fallacy of chlorine bleaching, though elegant and creditable to the bleachers; I am bound, however, to give an apparent exception to my own rule—Mr. Salter by a peculiar alcoholic action does good, not in bleaching, but in the abstraction of dirty mucilage and water, and although I have used some hundreds of agents and nitric ether among them, I cannot recollect I ever used alcohol, and his judgment, tact, and manly perseverance, in using that which gibes and jeers had turned many a man from, redounds to his credit. In two centuries will his pictures be such as Wilkie's are not now, and in fifty years will be less.—Ere that time they will be, on the contrary, a crackling memento of genius in decay, for Wilkie tried the trick of the Flemish school, viz. to produce by asphaltum and Macgelp an imitation of this flow and brilliance.

The empty assertions which blemish Mrs. Merrifield's translation of Cennino Cennini, borrowed from the theoretic schools, I trust in another edition she will erase,—such as "*We know ultramarine can preserve other colours*," when it cannot preserve itself (in oil); "soda *has great preservative power*," because, forsooth, soda exists in ultramarine, in which she forgets soda, as in glass, is a *vis inertiæ* of matter, so much so, fluoric acid sooner attacks its silex than its soda; and if it were not, if it were free, that is active, it would be a filthy, destructive, efflorescing, baneful agent, the curse of the Art. And if it could *preserve* any green, dependent on alkaline agency, in the same proportion would it *destroy* all other pigments, more especially those dependant on acid agents for their tones.

But enough, alkaline lixiviæ *never were used* in oil painting at all; they were used after a certain period of wax painting and during the transition of the Art *to oil*, more as a remanet of old practice than anything else, and when olive oil was actually used, the grease of which it *did* somewhat subdue; but a soap picture does not now exist, nor did such exist at the time Andreas Rico, the Cretan, painted in Candia with oil surcharged with olibanum thus, or some other gum resin, and certainly not since, without Mr. Pyne has painted one in the borax vehicle and plaster of Paris to astound the world; I never saw one, however, and his good sense has perhaps retouched his pictures in plaster and Macgelp[13] to secure them from human eye, for like the cheeks of a female mummy they would assuredly blush to be seen by man.

Cennini had observed, like da Vinci, the rising of oil, and recommends the use of ultramarine with all white; this was wise, just what a practical man might be supposed to teach—not because it could preserve the lead, but because it would cover its yellow as the laundress's powder blue does the visible change of her linen vests.

Let us now take cause and effect in juxta-position: let us see the sources of permanence in various pictures, of various styles; and, the obvious sources of modern failure.

The Causes of Permanence in Ancient Pictures.

1. Better grounds, as the result of hard labour, much thought, keen observance of cause and effect, and by necessity a better adaptation to the style and tempera or vehicle used thereupon.
2. Fewer colours, and less of that which Cennini calls "torturing with the brush."
3. More transparent colours.[14] Aye, and if less vivid, more faithful; for, less changeable in themselves, not having been alchemically changed or brightened, they could not retrograde.
4. Resinous preservation the *sine qua non* of the Art.

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[11] Aye, or as Mr. Salter says, a "bundle of lighted matches, solid, firm, distinct, and tual 'strips of wood,' with drops of fiery, flowing, liquid brimstone!"

[12] Whose method of preparing it, mentioned in my last, was found in his own handwriting, vide general edition of his works by C. Amoretti, Milan, 1804. Whether Regaw's old translation, (so scarce, I have not seen one for many years,) contains the account I know not.

[13] How the talented editor of the Art Union can have permitted such absurdities, crudities, and empiricisms to have stamped them "fame" in his ink I know not. Corregio produce impasta in Macgelp and plaster of Paris! Heaven and earth! can fluidity be shown by fixidity? Can yellow-horned plaster look the transparent beauty of his deepest, darkest shade? Fie! oh fie!

[14] Old La Porte laughed at me, in 1828, over a picture of Dominicheno of S. Berger, Esq's., at Hackney, in asserting this obvious fact.

5. Sun dried oil, the real antipodes of boiled oil.
6. Sun dried varnish, bringing the picture to juxta-position with modern japanning.
7. The well recommended practice of Cennini, of mixing ultramarine with all lead white.
8. The rapid fixing of the leads and oxides, before their action on oil became detrimental, from difference of climate.
9. The use of soft or lead glass, first used to divide the colours in grinding only, but subsequently, *ex necessitate rei*, as a dryer, and by inferior masters pumice instead.
10. A perfect superiority of the glassa varnish over all others, from the very qualities a modern varnish maker would laugh at: Correggio and Rubens as the proofs, not forgetting Michael Angelo Anselmi.

Together with the casual aid gained, by the same means as in water, from density of mass, as in Chinese painting, Chilian pictures, Egyptian mural decoration, &c., and as exemplified in the famous early picture by Andreas Rico, now preserved in the Museo Mediceo, in which little or no blending appears, poor composition and defective drawing, but a mighty purity and imperishable splendour of colouring as to permanence alone; and which picture chips off in scales, precisely as the landscape painted for me by Mr. Birch does now, only two years after date. And some little gained empirically, at times, in Cennini's day, by using different tempras in the same picture, a practice however not advisable; and, permanence, again, in the mixed style of water painting glazed in oil; all of which I consider *casual*, because not inherent in, or necessary to legitimate oil painting; and, excepting the pictures of Correggio or his pupils, or Anselmi (Michael Angelo), we have no examples of such an accumulation of so *many* causes of permanence.

Let us now turn to the moderns—for, in defiance of the actual degree of brightness and permanence of the school of Van Eyck, and the absurd encomiums frittered away by triflers over his own accredited pictures, I broadly assert that no one picture exists of the Flemish school to be compared with Correggio's, they are dross to pure gold; and Rubens, with all his beauty, with all the taking splendour of his style, has no permanence but what the poor German clock makers of the Black Forest, however rudely, very *nearly approach*. A pure white ground, a brilliant and universal light from within, a *thin* resinous vehicle, and a glaze of glassa, will give permanence to any lake, either vegetable or animal, if that lake be not, in itself, in defiance of nature's laws, that which it should not be—that is to say, if a cochineal lake, as Gay Lusac and Morveau made it were purple toned, whereas no vehicle can perpetuate the gossamer tint and yellow tone of the beauty certainly, but deceptive syren scarlet lake; hence the error into which even Mr. Field and many other valuable men have fallen, whose names I mention only with respect, namely, that cochineal lakes are inferior to kermes, lac, or madder, from some inherent defect in the cochinellin. Bleached oil will yellow; bleached linen will deteriorate from the same cause and by the same rule, to which the painter adds a dozen auxiliary causes, but we will examine them in the same tabular form.

The Causes of Failure in Modern Pictures.

1. Inferior painting grounds, made for show and sale, to suit the caprices of the worst of painters and worst of judges, by men totally ignorant of the real requirements of the Art, and who actually laugh at the demands of the minority—those qualified men who, by years of labour and enquiry, know what they *ought* to have—men who consider any ground, even though it yellows before the month is out, will do, if it can but leave the shop and be daubed over.
2. An infinity of colours which, tortured into each other without any knowledge of what Bacon would have called their sympathies and antipathies, become a muddled conglomerite.
3. A mania for body, as if one dense dab could imitate the cloud which is almost black and yet transparent; a fine example of which is seen in the moons of what are ycleped moonlights, and the so called moonlights of what no more resembles light than chalk resembles cheese. Nature has no body colours, neither in an Italian sunrise nor when, in northern forests—

> "The western waves of ebbing day
> Roll o'er the glen their level way,
> Each purple peak, each flinty spire ——"

4. The miserable abuse of boiled oil and Macgelp, dryers and oxides, which increase the disposition to skin, yellow, and horn, the fine bleached oil of the quack, of which Wilkie will be, like Reynolds, a sad proof. His abuse of Macgelp and asphaltum will leave his pictures, in a few years, like the Algerine pile of sculls, the crumbling memento of human genius in decay.
5. A total ignorance of that manipulation which taught the grand secrets of the Art.
6. A bad atmosphere; often the worst of lights, and therefore demanding the more knowledge of the true source of permanence; and the prevalence of coal fires.
7. An absurd reliance on alleged permanence of colour, in defiance of palpable examples in pictures abounding in lead, and of bleached oils.
8. Varnishing too early by half. And finally, a reliance on the so-called chemists; as if the teacher of the elements of chemistry knew a particle, practically, of what the painter requires.

W. Marris Dinsdale.

January 10th, 1845.

SIR JOSHUA REYNOLDS.

Sir,—I enclose some further memoranda, from Sir Joshua's book.

1767.—Lord Townsend, prima con Macgylp, poi olio, poi verniciata con vermilion.

Dr. Armstrong, painted first in olio, poi verniciato, poi cera solo, poi cera e vernicio.

Speaker—the face colori in olio, mesticato con Macgylp, poi verniciato.

Cielo (sky), con Macgilp e poi per tutto verniciato con colori in pulvere (in powder), senza olio o Macgylp. (Delicious.—B. R. H.)

Master Burk, finito con vern. senza olio o cera, carmine.

Dutchess of Ancaster, prima Macgylp, secunda olio, terza olio.

Lady Amelia Carpenter, Mrs. Cholmondely, with Macgylp senz', olio.

This dry rubbing in of colour in *powder*, over a sky whilst it was tacky and gummy, produced a gemmy splendour as if sprinkled with gold dust. Sir George Beaumont told me, once when Sir Joshua had placed a woman's portrait by the fire to warm, some soot fell down on the fire, splashed out and sprinkled the neck all over, Sir Joshua on turning it round and seeing the condition said "It will make a capital half tint," and immediately rubbed the whole into the neck, and turned it into an exquisite tint.

The following extracts are selected, and not regular.

April 29, 1776.—Mr. Basset—Asphaltum and verm. solo glazed and retouched.

May 3.—Naples—cinnabar—red lead, Cologne earth and black.

(These two above remarks are crossed out by Sir Joshua.)

June, '76.—Blue, light red, verm. white, perhaps black.

Duke of Dorset, finito con cera solamente poi vernicato con cera e turp. Venetia.

1778, } Hope, cera solamente.
} La melia maniera, con cera mesticato con turp. di Venetia—Justitia, ma di panni cera solamente.

Strawberry Girl, cera sol.

Doctor Barnard—1, black and white; 2, verm. and white (*dry*); 3, varnished and retouched.

Further irregular extracts.

Samuel + red, flesh glazed with gambo. and verm. Drap. gamboge and lake, sky retouched with orpiment.

Appresso Perino del Vago—Saint Joseph depinto con verm. e nero velato con gamboge e lacca, e asphaltum, poco di turchino nella barba, panni turchino e lacca.

My own Picture sent to Plimpton, cera, poi vernicato, senza olio, colori, Cologne earth, verm. white and blue, on a common colourman's cloth, first varnished over with copal varnish.

(This very fine head Wilkie and I saw in the Town-hall at Plimpton, 1809, *in perfect preservation.* Would any man of taste believe that this portrait, given by Sir Joshua, as a mark of respect, to the corporation of his native place, for having elected him mayor, *was actually sold*, brought to town, offered to the National Gallery and *refused*, and what is now become of it nobody on earth knows!

Everybody concerned in this transaction ought to lose *one ear!*—B. R. H.)

Miss Molesworth—Drapery painted with oil colour first, after cera alone.

Miss Ridge, ditto.

Lady Granby, ditto.

Præcepe—on raw cloth senza olio, Venice turp. et cera. (Seen by Sir George the year before it was burnt at Belvoir, and said by him to be perfect.—B. R. H.)

Aug. 1779.—Hope—My own copy, first oil, then Venice t. e cera, verm. white and black, poi varnisht with Venice e cera—light red and black.

1781.—Dido, oil. (In beautiful condition.—B. R. H.) Manner—colours to be used, Indian red, light ditto, blue and black, finisht with varnish without oil, poi ritoccato con giallo.

Thus end the extracts, and a more interesting collection can hardly be imagined.

They shew Sir Joshua's eagerness for improvement, and the restless uncertainty of his mind. Whilst he used every gum, and every spirit, and every oil, which earth produces, to get the brilliant body of Titian's colour, Titian had gone on quietly on one species of white ground, viz. calcined pipe-clay and chalk (*vide* Haquin's report on removing Pietro Martyre from the wood), had never used anything but *linseed oil*; all that gemmy splendour, which Reynolds aimed at immediately, was owing in Titian to the simple use of the simplest material, guided by his exquisite feeling for tone, and leaving time to settle and consolidate his surface, substance, and touch.

I earnestly hope these extracts will not induce one student to cease drawing hands and feet, head and body, or proceeding to master the skeleton, muscles and construction, which great and solid principles may now be said to have taken root all over England, and that they will never indulge in such tricks and schemes till they can do so on the firm foundation of drawing, and when that element is mastered they may indulge in the wildest flights with security, and perhaps honour.

B. R. Haydon.

ON THE EMPLOYMENT OF MILITARY ENGINEERS ON ARCHITECTURAL WORKS.

Sir,—In the letter by "A Civilian" which appeared in your Journal for May, 1841, after alluding to military engineers in the Ordnance and Admiralty departments, mention is made of "an humble, ill paid individual, usually emanating from the carpenter's bench, and rising through the grade of Foreman to what is called Clerk of Works."

Happening to know something of the internal arrangements of the engineering branches of the public service, it may be as well, for the information of those who are studying the several branches of the building profession, to state what were a few years ago, and what are now, the regulations in regard to the "civil" branch. Formerly, a gentleman who was candidate for the situation of Clerk of Works was required to possess qualifications which could only be possessed by a well educated architect. That profession, like others, has overgrown, and many men of talent were tempted to enter the service, under prospects held out to them of future preferment and reward. The engineering branch of the service progressed in intelligence, from the description of persons by whom the situation of clerk of works was filled; but whether the military branch of it found they could not mould men of talent and education to their purposes, and drive and insult them as they pleased, or whether they had recourse to that change in the mode of admission to the department, which was made on the recommendation of a committee, such as usually manages these matters, for the purpose of obtaining the valuable services of any of our professional brethren that might be compelled by untoward circumstances to enter their department, at a less rate of pay, it is hard to determine, for the greatest acts of meanness and injustice are daily and hourly committed, by those who preside over the management (God save the mark!) of that ill paid and insulted branch of her Majesty's service.

Let any one acquainted with the minutiæ and detail of the architect and surveyor's profession go into the engineering office, at an extensive station, and there inspect the work performed by that abused and ill paid public servant; let him watch the deep feeling of disgust with which he performs his laborious duties, goaded by the annoyances of those who (receiving seven or eight times the clerk of works' daily pay), know little or nothing of the work to be performed, or one half the mental labour to prepare those documents to which they affix their names, and which, from ignorance of the time and attention requisite to bestow on matters involving not only theoretical but practical knowledge of an honourable and highly intellectual profession, are hurried on with that precipitation which renders the duty of the working part of the department one of the most perfect slavery. The public work is thereby performed without proper consideration; and if any censure is to be attached to the parties who execute such works, the poor clerk of works is made the scape goat; if any praise, the military engineer will take care he has that. But this is not all, perhaps certain features of a design are agreed on, the affair is then given to a clerk of works, or perhaps a poor, humble foreman of works at 6s. per diem!! who has to prepare his designs, specification, working drawings, and detailed estimate, and superintend and measure the work; and all this, which involves knowledge of a first-rate order, for 6s. or perhaps 7s. 6d. per diem!! Let us hear no more of the government patronage of the fine arts, when such dirty shifts as these are resorted to for raising public edifices. The public, or the profession, little dream of the insult and degradation men of first rate talent are often fated to endure; and who having embarked in a service, the nature of which they were utterly ignorant of, are compelled to remain in it, not from any liking to it, but from having quitted the walks of that profession in which they were brought up, and having, by an *ignus fatuus*, been led to enter the public service. True, indeed, is it that worldly minded motives influence the English people, to the exclusion of all others, and this is the cause why they so shamefully neglect men of genius and talent, and prefer those in whom worldly-mindedness is the ruling principle of character. Many a man, whom the world applauds and honours, gains his distinction from the position in which fortune has placed him in society or office, and is indebted for the foundation of his fame and fortune to another of more genius but less knowledge of the world. This is a sad state of things, but it is too true; and those of rank, fortune, and power, it is much to be lamented, are ever ready to countenance not only apathy, but total indifference, to the sufferings and privations of men of known professional talent.

There are many highly estimable men who have direction of the engineering department of the public service, but there are also those who have called down the curses of their fellow men on their heads. It was once related that a certain —— was so obnoxious, from the tyranny and oppression exercised towards those under him, that four individuals absolutely went on their knees and called down the most horrid curses from Him, whom nature shudders at addressing as any other than a God of peace and love. This is, indeed, an awful picture of any branch of her Majesty's service, and in a country laying claim to civilization, but it is nevertheless a true one.

The statement of "Civilian" in your Journal of May, 1841, is one which every man acquainted with the working of that branch of the service to which he alludes must admit to be faithfully drawn; and "Veritas," who replies to him in June following, might have saved himself the trouble of showing out his figure, which there is little difficulty in discerning to be warlike, although he states he is a "Civil Engineer."

Personal abuse ought never be resorted to, and it is with no wish to wound the feelings of any individual that these statements are made, but from a wish that the profession, of which the writer is an humble member, should know how matters are managed in the engineer branch of the service, and that they should serve as a beacon to those who may make wreck not only of all worldly comfort, but of that happiness and peace of mind compared with which all the honours, riches, and enjoyments of this world are as nothing.

Bills are brought into parliament to emancipate black slaves, and twenty millions of money given from the pockets of the country for that purpose! The poor labouring classes of the United Kingdom, who work so many hours with their hands, and are subjected to such pain and privation have very justly attracted the sympathies and interest of the country. Are men whom their God has endowed with a higher order of intellect than either of these classes, (who are bound in the worst state of slavery, that which enchains the very heart's best feelings, and renders them beings of that degraded and subservient character to their fellow men, that they begin to doubt whether those who thus goad them be not something below the sphere of that mortal whom the God and Father of all has endowed with the faculty of reason,) to drag on a wretched existence in the service of their country, without one cheering consolation, not even that which long and faithful service ought to secure to every good servant—comfort and peace of mind in his declining years? There is One who will exact from us submission to his laws; not only that we should render him perfect love and obedience, but that our fellow men should receive at our hands ample justice, and kind and charitable consideration in every relation of life.

ZOPHORUS.

January 1, 1845.

ON SLIPS IN CUTTINGS AND EMBANKMENTS.

(From the Minutes of the Institution of Civil Engineers.)

(*Continued from page* 27.)

Mr. Cowper said, that he should be inclined to attribute the slips to the expansion of the clay, from the action of water. He had recently examined the retaining walls, on the London and Birmingham Railway, in the cutting near the Euston Square station, and had found they were, in several places, forced forwards, apparently by some action behind them. This action was irregular, for its effects appeared indiscriminately at the top, at the bottom, and in the middle of the retaining walls, which were built of brick, generally about 5 feet 6 inches thick at the bottom, and 2 feet 6 inches at the top, with a curved face. Wherever the wall had been removed, for the purpose of rebuilding it, the face of the clay behind appeared to stand quite straight, without any fissure. He was therefore induced to think that water descended to various depths, according to the degree of permeability of the clay, and as far as its action extended, expansion took place. If the whole mass had expanded, from having been exposed to the action of air, before the face was covered with brickwork, the entire wall would have been moved forward, which was not the case.

General Pasley said, that from his observation of the usual character of slips, he was induced to think, that the slopes were generally too steep; 2 to 1 had been considered sufficient for almost all kinds of earth, although Sir Henry Parnell, in his Treatise on Roads, said, "When it is necessary to make a deep cutting through a hill, the slopes of the banks should never be less, except in passing through stone, than 2 feet horizontal to 1 foot perpendicular; for although several kinds of earth will stand at steeper inclinations, a slope of 2 to 1 is necessary, for admitting the sun and wind to reach the road." The same authority stated, "in the London and plastic clay formations, it will not be safe to make the slopes of embankments or cuttings, that exceed 4 feet in height, with a steeper slope than 3 feet horizontal to 1 foot perpendicular. In cuttings in chalk, and chalk marl, the slopes will stand at 1 to 1. In sandstone, if it be solid, hard, and uniform, the slopes will stand at ½ to 1, or nearly perpendicular." "There are many instances of slips in sandstone and marl strata alternating (when the line of road is parallel to the line of the bearing of the strata), where the slopes are as much as 4 to 1."

General Pasley had arrived at the conclusion, that 3 or 4 to 1 ought to be given, in order to insure good work; he had, therefore, authorized the railway companies to take possession of land, to increase the inclination of their slopes. It was remarkable that the slips rarely occurred during, or immediately after, the formation of the cuttings; it would appear therefore probable, that the movement was caused by the combined action of the air upon the surface, and that of water, which had percolated through the upper strata and acting behind it, forced the earth forwards in the line of least resistance. He believed, that a series of gravel counterforts, with a revetment at the foot, was the most effectual method of preventing slips. On the South Western Railway, hard chalk had been used with good effect, instead of gravel, for that purpose. The perfect drainage both of the surface of the ground, on either side of the cuttings, and of the slopes themselves, was of the utmost importance. On the Eastern Counties Railway, shafts had been sunk at intervals in the slopes, and filled up with dry rubble; from their bottoms, iron pipes proceeded to the face of the cutting (fig. 6); these had proved effective in draining away the water. With regard to embankments, he was of opinion, that if more attention was paid to forming them only in propitious weather, placing the material in thinner layers, in a concave form, and draining them well, as the work proceeded, the result would be more satisfactory, and less expensive, not only in the first cost, but in subsequently avoiding slips. He thought, that in situations of difficulty, advantage would arise from the employment of wooden stages, like those which had been used by Mr. John Braithwaite at the Colchester embankment; the traffic of the railway was there carried on, over the wooden viaduct, until the subsidence of the earth had ceased, when the timber work was either cut off, or drawn out, as the contractor found least expensive.

Mr. Bruff remarked, that the timber viaduct at the Colchester embankment, was only adopted in consequence of the extreme subsidence of the material, which had assumed a slope of 6 to 1; he had seen the same material, which was plastic clay, stand well at a slope of 2 to 1. If an embankment was formed with that material in a wet state, it would inevitably spread at the foot. The cuttings of the Eastern Counties Railway had remained open for 2½ years, but owing to the nature of the soil, the water would not drain from them.

Eastern Counties Railway.

Mr. Phipps corroborated the statement, relative to the use of the timber viaduct on the Eastern Counties Railway; it was only an expedient to enable the railway to be opened, at an earlier period than it could otherwise have been, in consequence of the subsdence of the embankment, which however now stood very well. He approved of the formation of embankments, by depositing the material in thin layers, and by several lifts; the embankment was by that means rendered sounder and less liable to slip. Dry shafts and gravel counterforts had prevented many slips, but he thought that sufficient time had not elapsed since their adoption, to enable an unqualified approval of them to be given. The pipes which had been inserted into the clay slopes, did not appear at present to draw away much water.

Mr. Braithwaite said, it should be remembered, that the soil at Brentwood Hill, was very different from that on the Croydon Railway. The Brentwood sand was so full of water, that when it was opened it appeared semifluid, like a quicksand; the gravel counterforts, which had been effectual in stopping the movement of the London clay, would have but little effect in sand of such a quality as he had described.

He had seen much of the London clay in sinking wells, and it was notorious to well-sinkers, that even in the absence of moisture, if the London clay was left exposed to the air for a few hours, expansion took place, and the surface of the cutting began to fall away: by this expansion the walls of wells were frequently fractured, unless allowance was made for it.

He could not agree with Mr. Cowper, as to the cause he had assigned for the partial action upon the walls of the Euston Square cutting. The London clay was impervious to water, therefore it could not arrive at the different parts of the wall, unless the line of junction between that clay and the pervious superstrata, was very irregular in its course, as compared with the inclination of the railway.

General Pasley coincided in the opinion, of the difficulty of working a material like the Brentwood sand, which was mixed with silt and quicksand, and demanded more than ordinary care; he thought that such ground should not be worked upon at all in wet seasons. He believed, that in many cases, slips had occurred in consequence of the too great proximity of side cuttings, by which the ground between them and the foot of the embankment, was too much weakened. He had in some cases recommended, that the side cuttings should be filled up in order to consolidate the embankment.

Croydon Railway.

Mr. Gregory believed, that the expansion of the clay was in some degree (but not entirely), the cause of slips. The blue clay was impervious to water; the yellow clay permitted the water to traverse it freely, by the natural joints and fissures in it, and also by those which were formed by the drying action of the air upon its surface. When the face of the bed of the blue clay was softened by the action of water, and its surface became lubricated, there was not any longer sufficient friction between the strata, to retain the weight of the superposed yellow clay, the mass of which, on the slightest impetus being given by expansion, travelled forward down the inclined strata, which in the case of the New Cross cutting, was towards the railway.

He had tried the insertion of pipes into the sides of cuttings, and almost every other kind of drainage, without effect, and he was of opinion, that the general saturation of the mass, was the cause of the slip in the New Cross cutting.

Mr. Hoof said, he had executed the greatest portion of the works on the Croydon Railway; his experience induced him to agree with Mr. Gregory in the statements contained in the paper, and in the reasons he had assigned for the causes of the New Cross slip.

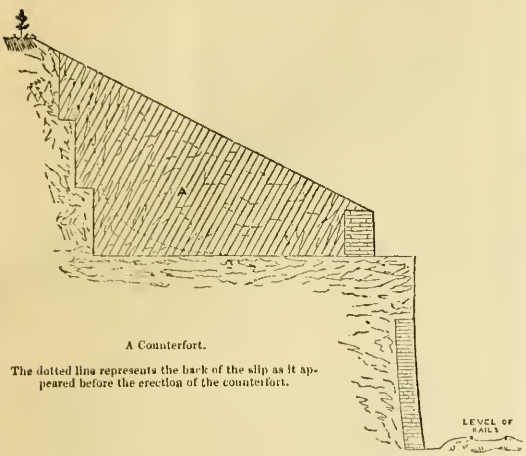
London and Birmingham Railway.

Mr. Dockray doubted the advantage of the benches in the face of the slopes; he thought, that they not only caught and absorbed all the rain, but also a great portion of the water, from the drains of the upper part of the cuttings; a well-drained slope, at a regular angle from the top to the bottom, would, in his opinion, act better.

He had observed, that the slips on the London and Birmingham Railway generally commenced, either in the line of the fence ditch, or in that of a catch-water drain, or at some natural or artificial obstruction, which prevented the free passage of the water, over the surface of the slope, into the ballast drains. He considered it of great importance that the surface water should be carried off as rapidly as possible, and that it should not be permitted to lodge on the slopes, or in the drains; from whence it could only escape, either by evaporation, or by absorption into the ground: it was to the gradual operation of this latter cause, that he attributed most of the slips in clay cuttings.

In repairing such slips Mr. Robert Stephenson had used a plan, (fig. 1,) which had hitherto proved very successful. He regarded the slip simply as a mass moving down an inclined plane, by its gravity, and he proposed to counteract that tendency by friction. This was effected by dividing the

Fig. 1.



Section of the Slope in the Blisworth Cutting, London and Birmingham Railway.

slipping mass into vertical sections, by excavating perpendicular chases, 5 feet wide, and passing completely through the slip, down into the solid clay below; these chases were 15 feet apart, and were filled up with rubble masonry, or with chalk or gravel, well rammed down, so as to form a solid immoveable mass. Thus the slip was divided into a number of isolated portions, of comparatively small dimensions, each side of which came in contact with the side of a counterfort, and the friction between the masses had, in every case, proved sufficient to retain the slip from further movement.

This mode of repair was first adopted about 5 years ago, and had since been extensively used, in repairing the numerous slips, in the slopes of the cuttings of the London and Birmingham Railway.

Mr. GREGORY stated, that similar counterforts, with a revetment of gravel along the foot, (Figs 3 and 4, January number) had been tried with good effect, on the Croydon Railway. He had understood, from military engineers, that thin revetments with long deep counterforts, bore a heavy fire better than thick revetments without them. He was well aware, that slips were frequently occasioned by catch-water drains on the face, or at the top of slopes; on that account, his attention was constantly directed, to uninterruptedly keeping up the surface drainage of the earth-works under his charge.

Geological, Chemical, and Mechanical Action of Water.

Mr. TAYLOR believed, that the mechanical action of water, produced many of the effects which had been mentioned, but the chemical action upon clays, and even upon solid rocks, must not be overlooked. He would instance, particularly, the well-known action of the air upon shale, which although so tough and hard under ground, as to require the agency of gunpowder for its excavation, became, after a few weeks' exposure to the air, thoroughly decomposed.—Decomposed granite, called by miners 'pot grawen,' was extremely troublesome in mines; it consisted principally of feltspar and potash, and was the China clay (Kaolin) so much used in potteries. This substance would appear to have been formed, by the decomposing action of the air, or of chemically-formed oxygen.—Pyrites, which appeared to have abounded in the strata of the New Cross cutting, not only had a natural tendency to decomposition, when exposed to the action of air, but also affected every thing with which it was in contact.

It had become fashionable to account for all changes, by attributing them to the agency of electricity, and since the interesting researches of Mr. Fox, of Falmouth, there was much reason for believing, that electricity was capable of producing these wonderful changes. It was easy to understand, that as soon as chemical action began, electricity might be generated; its flow would be conducted through the fissures and veins of mineral substances; decomposition of the existing material proceeded, and other forms were assumed; this action could not be continued, without a corresponding alteration of the bulk of the mass, and when it reposed on an inclined bed, of which the surface was covered with a semifluid film, such as the London clay was described to be reduced to, by the solvent effects of water, the slightest expansion or contraction would suffice to set the whole superstratum in motion, and to produce the slips.

Primary rocks were subject to the same effects, and in sinking through porphyritic rocks, fissures were frequently found, filled with foreign matter, which swelled and forced in the sides of the shafts, when such an event was least expected; such occurrences could not be guarded against, as the direction of these fissures was usually parallel with that of the shaft.

Mr. TAYLOR agreed in the necessity for the precautions which had been mentioned, in cuttings and other railway works, and that it was generally only in such strata as clay-slate, granite, or other primary rocks, that works could be left without artificial protection. He had driven, on the line of the Tavistock canal, a tunnel of $1\frac{3}{4}$ mile long, through clay-slate, and granite, which stood perfectly without any internal arching.

Mr. SMITH said, that although he had but little experience in the formation of cuttings or embankments, he had devoted much attention to surface drainage. He had been surprised at the visible want of the precautions, which he conceived necessary, to prevent the saturation of the slopes, and their consequent degradation. The back drains, which were frequently carried along the top of cuttings, were objectionable, and were likely to cause slips.—Slips were also, probably, caused by the alternate contraction and expansion of the clay, under exposure to changes of weather. From experiment it was ascertained, that clay occupied $\frac{1}{7}$th or $\frac{1}{8}$th less space when dried, than when in situ. It could be imagined, that during the summer, the combined effect of the sun and the wind, formed cracks on the surface; the crumbling of the edges of these fissures partially filled them: the rain which fell in the winter, or was brought by the catch-drains from the neighbouring land, tended to restore the clay to its original bulk, but the fissures being prevented from closing, by the crumbled clay within them, which also swelled from the wet, the whole mass expanded in the line of least resistance, which was towards the cutting. This process being repeated, during several succeeding winters, would at length cause a slip. The best method of prevention would, he thought, be a greater attention to surface drainage in the line of the slope, so as to carry off the water very rapidly. This had been attempted, by working the surface into parallel furrows and ridges, from the top to the bottom of the slopes; but neither those, nor the covered drains were alone effectual. The latter were not deep enough, they should be 5 feet or 6 feet beneath the surface at the bottom, and 3 feet at the top of the slope, and not more than 16 feet apart, so as to be sufficiently close together, to collect and to carry off all the water that was not conducted down the slopes, by the furrows on the surface.—The gravel counterforts formed drains, and thus, he conceived, were more beneficial, that by increasing the friction between the masses, which could have but little effect, when once the mass of material was thoroughly saturated.—If embankments could be formed in very thin concave layers, equally spread and beaten down, in dry weather, while the clay was in hard lumps, leaving interstices, which, for a long time, would permit any water falling upon it to traverse freely, until the whole mass was consolidated, there would be but little subsidence. He was aware that this plan was too expensive, but the nearer it could be approached, with due regard to economy, the better would be the effect; whereas, by the present system of making embankments in all weathers, when frequently the whole mass was so thoroughly saturated, that it could never dry, nothing but failures could be expected.

General PASLEY said, that he always supposed the gravel counterforts were intended to act as drains, at the same time that they gave increased friction, and broke the continuity of the mass of earth, limiting any slip that might occur, to the extent of space between two counterforts.

Mr. HAWKSHAW thought, that arbitrary limits could not be assigned for slopes in given strata; the different conditions under which the same strata appeared, in different localities, precluded any general law. Clay, which in a wet situation required a slope of 3 to 1, would in another position, stand well at 2 to 1. In the Andes (South America), he had seen granite in such a decomposed state, that it would have been very unsafe to have left perpendicular sides in a cutting through it. The drift formation of Lancashire might also be instanced. Sand was found, on the line of the Manchester and Bolton Railway, which stood well in slopes of 30 feet high, at an inclination of 2 to 1. These slopes were kept perfectly dry by drains, running at intervals from the top, down to the bottom of their faces.—In mining operations, the expansion of clay was well understood. The floors of old mines were always expected to swell up. In the tunnel on the Manchester and Bolton Railway, the timbers were frequently broken by the expansion of the clay, although it appeared quite dry.

Mr. SOPWITH instanced the 'creep' in collieries, which had been attributed to this expansive action, but he rather thought, that the complete closing of old mines, was owing to the weight of the superincumbent rocks, which acting upon the pillars and walls, forced up the floor. The subsiding of the surface, which was so frequent in mining districts, corroborated this view.

Beneath the village of Wallsend, there was a tract of coal, which the late Mr. Buddle hesitated to get, but at last he decided upon continuing the working in that direction, and the whole village had subsided nearly 2 feet vertically; but by care in the workings, it had occurred without materially damaging any of the buildings.

Mr. FORSTER said, although it was well known, that in mines which were carried to a considerable depth, the 'creep' would occur, and the floor of undisturbed clay appeared to rise, he believed it to be an erroneous idea, and that in consequence of the partially supported weight of the strata above, the roof sunk down, causing the centre of the floor to form a 'horse-back,' as it was termed by the miners. When some old mines, in which this had occurred, were entered and worked after a lapse of years, the indurated clay of the floor had supported the roof, while the coal, which had been formerly left as pillars, was subsequently cut away.

It was true, that when the floor was soft, it would swell. In the Primrose Hill, and the Kilsby tunnels, if the cutting was left for a few days, without completing the brick arching, the timbers were broken. The expansion appeared to be nearly the same, whether it was caused by the air, as in the former case, or by the water, as in the latter instance.

Mr. Thomson remarked, that in the Box Tunnel, it was usual to allow 6 inches for expansion, between the face of the work and the timbers, and that space was scarcely sufficient.

Mr. Buck said, that in the Heaton Norris cutting, which was chiefly through sand, containing much water, he had completely drained the slopes, and had stopped the running of the sand, by building at the foot, a retaining wall about 4 feet in height and from 2 feet to 3 feet thick, with a backing of 2 feet in thickness of cinders. He was induced to do this by observing, that cinders were constantly used in the neighbourhood, for forming drains, and he had generally found, that from careful observation of local habits, valuable hints might be gained.

Mr. Simpson, had devoted much attention to embankments and cuttings in the London clay, and had found it very treacherous and difficult to manage; he believed that an inclination of 4 to 1 was not too much for a slope of any considerable height.

He remembered the embankments of a reservoir near London, which had been originally constructed with insufficient slopes; within a few months after they were finished large masses slipped down, and it was feared, that the whole must have been destroyed. At first, attempts were made to repair the slips with mingled gravel and sand, but although the slopes were then formed, at an inclination of about 3 to 1, they did not stand; after 3 years, they were made up with gravel and clay, mixed with materials from the dust-yards of the metropolis, containing a mixture of all kinds of substances; this was of a dry, porous nature, and the slopes had stood well since, although they were subjected to very variable pressure, sometimes having a head of water of 20 feet upon them, and the next day much less.

In constructing embankments, it was his custom to have a footing of brickwork, resting against a toe of concrete, and with careful attention to the drainage, he found this plan always successful.

He attributed the first motion of slips in railway cuttings, to the action of water, and unless the water was diverted by complete back drainage, and that on the surface and within the slopes, was carried rapidly away, the slopes would never stand, even at the inclinations which had been mentioned.

The expansion of the London clay was certainly very remarkable; he had seen at Richmond, a well of 4 feet diameter, completely closed in one night, by the swelling up of the bottom, although there was not any water in it.

Mr. Clutterbuck observed, that slips in railway cuttings appeared to be caused, sometimes by the geological condition of the soil, when acted upon by water, and sometimes by what might be termed its chemical condition; the latter was produced by the air, causing such a disintegration, as rendered it more pervious to water, and consequently more liable to be acted upon by its mechanical force.—All railways passing from London must, more or less, intersect the London and plastic clays; the sand beds of the latter formation rested upon the chalk, and if those sands were washed away or shaken, a slip of the superstratum would necessarily follow. The plastic clay above the sand beds, was deposited in layers, in which a certain order of superposition might be traced; he had recognized a striking similarity between those beds under London, and at the outcrop near Watford: the distinct layers were known, and names were given to them, by those persons who sunk shafts for getting the sand; it was understood, that their security in working the sand, depended on the thickness and strength of some of the beds; to their inequality of strength, might probably be attributed some of the slips that occurred in that formation.

The plastic clays were usually covered by a stratum or bed of silt, containing shells, sharks' teeth, &c., and upon the silt rested the strong blue London clay; the most inveterate slips that he had observed on the London and Birmingham Railway, occurred in those localities, where the silt was covered by a thin outcropping bed of the London clay, not sufficiently thick to resist the infiltration of water; the silt thus became saturated with water, and slid from the surface of the tenacious plastic clay lying beneath it.

The cutting at Brentwood passed through strata, which he believed to be silt, covered by beds, or layers of loam, sand, and gravel, all more or less pervious to water; thus causing slips, which were attributable to the geological condition of the soil.

In the London clay, where there was no superficial deposit of gravel, the slips, he thought, might be traced to its chemical condition. A distinction was often made, between the yellow clay on the surface, and the blue clay beneath; this difference of colour, was caused by the state in which the iron existed in the soil; when excluded from the action of the air, it was found as a protoxide; and in the upper beds, when subject to that action, it became a peroxide; hence, the difference of the colour and, as he conceived, the cause of a certain amount of disintegration. The air was admitted, by the cracks formed in the clay in drying, or by the roots of trees or plants (whose course might be traced by the difference of colour in the clay); by the working of the earthworm, and by other causes. The water which fell on the surface, carried particles of sand and other substances into the fissures, rendering the clay, in some measure, permanently pervious to water: it was to this percolation of water, through the upper or yellow beds of the London clay, that slips, such as that as New Cross might, be conceived, be attributed.

It was the practice, on many railways, to cut a back ditch between the boundary railing and the quickset fence; this appeared to have caused many slips. The bottom of the ditches being exposed to the action of the air would, when they received a flush of water, permit its infiltration below the top of the slope; he had remarked, that many slips occurred, about 1 foot or 2 feet below the bottom of these ditches, which was about the angle, at which the water would drain towards the face of the cuttings.

In some cuttings, apparently with the object of economizing space, the slope was carried to the edge of the quickset fence; where that was done, the slips seemed more frequent, than where the ditch was further removed from the edge of the slope.

Sir Henry Delabeche said, that he viewed railway works with great interest, as opening a large field for the economic geologist. The causes of the slips, which had so frequently occurred in cuttings, deserved careful investigation, and great benefits would result, not only to the scientific world, but in the practice of engineering, if those who had charge of such works, carefully watched and recorded every event connected with their progress; such as the nature and position of the strata, their amount of natural drainage, the effect of weather, and all other points calculated to produce any changes.

With respect to the origin of slips in general, but more particularly of those in the London clay, Mr. Clutterbuck had treated the subject so well, and his remarks contained so much truth, that there remained but little to be said.

Whether the attention was turned to cliffs on the sea coast, to mountain cuttings, or to artificial embankments, it would be seen, that in the majority of cases, the slips were caused by the action of water. Wherever there existed a soft vein, beneath strata with fissures which enabled the water to percolate, the substratum became mud, and being squeezed out by the superposed weight, caused the whole mass to slip.

There were many instances of this kind in the oolitic escarpments near Bath. They were extremely interesting, from being the scene of the labours of Mr. Smith, who had justly been styled the father of geology in England. In that district, Mr. Smith had cured and also prevented many threatening slips, by introducing a system of surface drainage, at the same time tunnelling into the face of the escarpment, to drain the beds, and to prevent the water from reaching the softer strata beneath.

At Lyme Regis, the strata, having a certain degree of inclination, became saturated with water, the softened mass was forced out from the lower parts, and caused the slips which so frequently occurred on that coast.

It was evident, that the various angles at which different earths would stand, depended, in a great measure, upon the relative tendency of the materials to form mud.

The Directors of the Eastern Counties Railway had requested him to visit the Brentwood cutting with Mr. John Braithwaite, their engineer. The strata in that locality were nearly horizontal, and although the material cut through, would have been easily set in motion on an inclination, he was of opinion, that the banks would stand well, if they were perfectly drained. The ground was, however, very full of water; it was also of a very tenacious nature; but he had observed much water running out from beneath the upper and dryer beds. A good system of drainage was the only preventive or cure; Mr. Braithwaite was so well convinced of that fact, that he planned and executed the dry shafts which had been mentioned: the credit of all the good they had produced must be given to Mr. Braithwaite.

Sir Henry Delabèche did not attribute much advantage to the friction of the gravel buttresses; their weight, force, and friction, might retard a slip for a time, but unless the buttresses entered the water-bearing strata, and served as perpetual drains, they would not be efficacious.

The London clay was not homogeneous in its nature; it was more or less pervious, and abounded with fissures in all directions; many of these were filled with a slimy substance, which was easily converted into mud by the percolation of water, and hence slips so frequently occurred, where cuttings were made through the dip of the London clay, as at New Cross. Surface-drainage was not sufficient for such strata; the main springs must be tapped, and regular drainage be established, otherwise slips would be of constant occurrence.

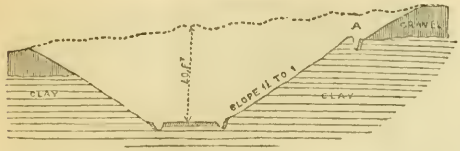
The rocks of Rossberg (Switzerland) and the Undercliff at the back of the Isle of Wight, might also be quoted, as instances of the same action of water, in converting the lower beds into mud, upon which the superstratum slipped, in spite of all attempts to restrain it.

Captain Moorsom had seen several instances where, in forming embankments of gravel upon a clay bottom, the wet substratum had been squeezed out, and had caused the foot to spread, until it was stopped by weighting it, and thus re-establishing the equilibrium.

He thought, that back-drainage was essential, and he had rarely found it unsuccessful, if it was commenced far enough from the edge of the cutting. It should be so contrived, so as to allow the surface-water to flow rapidly and freely away. He had repeatedly found tapping and under-draining ineffectual, unless the surface-drainage was thoroughly completed.

He had used benching with good effect, where an overlay of wet gravel rested on clay; the method he adopted was to remove the gravel in the upper part of the slope, sufficiently to enable a good catch-water drain to be formed, along the bench in the clay, as shown at A, Fig. 2.

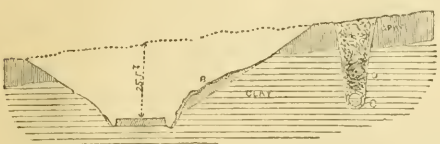
Fig. 2.



This plan he considered very effectual in certain positions, as a means of preventing slips. Slopes of 1½ to 1 for a maximum height of 40 feet, which had been so constructed, had stood well for upwards of 5 years.

In other situations, after slips had occurred, he had used back-draining with good effect, where tapping and leading-drains had failed. The method pursued, (Fig. 3) was to cut a drain at the back of the slip, (B,) so as to intercept the water which flowed thither, either from springs or by infiltration.

Fig. 3.



At the bottom of the drain was placed a round pot drain (C,) covered with a thickness of brushwood, (D,) and the remaining depth was filled in with gravel or rubble. For positions where it was practicable to cut the back-drain, he recommended this system.

With reference to the depth of cuttings and the angle of slopes, in various materials and under different conditions, he thought that each case must be regulated by the particular nature of the soil, the facilities for drainage, and the means adopted, besides many other local considerations, so that it was nearly impossible to lay down any arbitrary rules on the subject.

In one situation, he had seen a cutting through gravel and sand, stand excellently at an inclination of 1½ to 1, although the cutting was 86 feet deep, and on one side was placed a spoil-bank of 21 feet in height, making 110 feet in all, forming a regular slope. In another position, he had made a cutting of 57 feet in depth, through gravel, which stood well at a slope of 1 to 1.

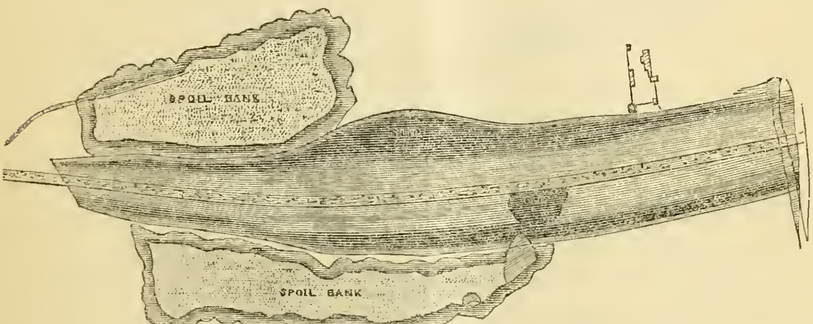
Eastern Counties Railway.

Mr. Bruff stated, that the timber staging erected on some of the Eastern Counties Railway embankments, had not been resorted to for obviating the formation of the clay banks in wet weather, but was merely contrived for expediting the work, so as to admit of the railway being opened to the public at an earlier period than would have been possible had solid embankments been first formed. The timber staging was erected on three embankments, which could not be completed in time, and on another where the nature of the material, in its then wet state, would not admit of its being formed to more than half its height; all these embankments had, however, since been filled up to the regular level.

The cutting through Brentwood Hill, presented some features in the execution, different from those on the Croydon Railway; he presented to the Institution a copy of the contract plan of the Eastern Counties Railway, with such amendments and additions as were considered desirable, during the progress of the works, and since their completion.

The drawing gave a ground plan, (Fig. 4,) exhibiting the position of the cutting, spoil-banks, &c., with longitudinal and transverse sections (Figs. 5 and 6) of the cutting, showing the extent of the excavation and the slopes, the benchings, culverts, wells, drain-pipes, and gravel counterforts.

Fig. 4.



Brentwood Hill Cutting. Eastern Counties Railway.

The nature of the material of the cutting was sand, sand with loam, gravel, and silt.

The great difficulty experienced in draining the slopes, had arisen from the slimy nature of the silt, from which the water could not be separated. Its power of holding water might be imagined, from the fact of a face of nearly 50 feet of slope, being exposed during 2 years, without producing any sensible effect in the drainage of the material.

The silt had a constant tendency to flow away with the water, and great attention was directed to that point, in order to prevent the slopes from being injured.

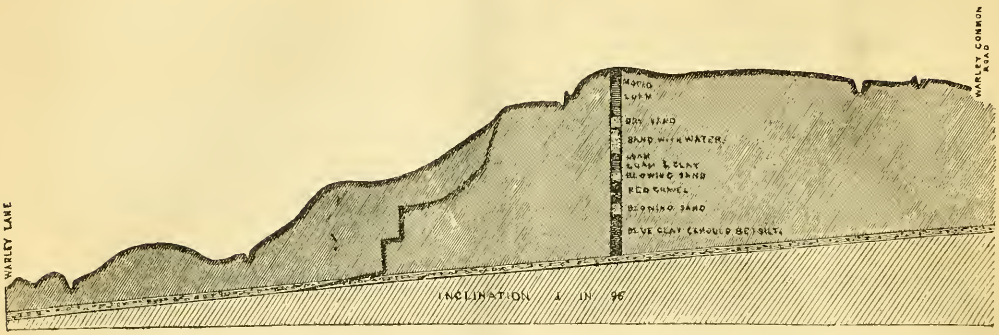
The provision for upholding and draining the slopes comprised in the contract, consisted of a fence ditch at the top of the cutting, a benching 10 feet wide, half way down, and the ordinary side drains at the foot, with drain pipes, running in various directions, along the face of the slopes. To this was subsequently added a culvert, on the benching on each side, with proper outfalls; then the wells (Fig. 10,) were adopted, and lastly gravel counterforts. The wells were not placed with any regularity, but were sunk at the wettest parts of the slope; they were steined as in the ordinary well work, until within a distance of about 3 feet from the bottom, where an inner ring of brickwork 4½ inches thick, was built in cement. The bottoms of the wells were not bricked, but each had an outlet pipe of about 2 inches diameter, into the open drain below it. There were twenty of these wells, in the upper port of the north slope, ranging in depth from 15 feet to 20 feet, and 3¼ feet in diameter. In the lower part of the same slope, there were twenty-five wells of the same diameter, but only 10 feet deep. In the same slope, seven gravel counterforts of a prismoidal shape were afterwards added; they were formed by cutting out the requisite cavity, and barrowing in dry gravel from above, without pounding.

Neither wells nor counterforts had been adopted on the south slope, which was on the lower side; the cutting being through ground slightly inclined to the south.

These plans for draining the cutting were, Mr. Bruff believed, all designed by Mr. John Braithwaite.

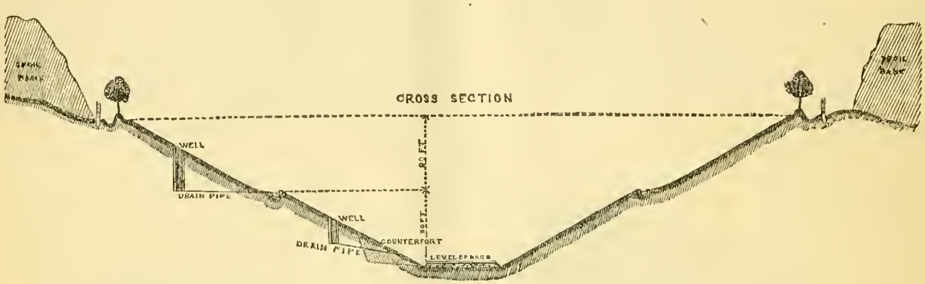
Mr. Phipps had tried a somewhat different plan. A narrow trench was cut along the wettest part of the slope, as deep as it could be excavated, without much shoring of the sides; a small culvert was laid in the bottom,

Fig. 5.



Longitudinal Section.

Fig. 6.



Transverse Section.—Brentwood Hill Cutting.

having an outfall into the open drain at each end. On the lower side a puddle wall was raised, and at its back, a dry rubble wall with straw above it, to prevent the sand and loam from washing into and choking the interstices. This plan was simple and inexpensive, and was stated to have answered its intended purpose. With respect to the general question of slips in cuttings, Mr. Bruff was convinced, that want of thorough drainage was the proximate cause. In the Brentwood cutting there had been two slips, which, in his opinion, arose from the surface water being checked by the spoil-banks, and being allowed to soak through the surface down to the slopes. In most cases where slips occurred in side-lying ground, it would be observed, that the upper slope almost invariably gave way first. In embankments on side-lying ground, slips generally occurred first on the lower side, which might be ascribed to want of friction, as well as to the agency of water. The effect of a drain above and near to a slope, in an excavation, had not hitherto been sufficiently attended to; in inclined ground, a rubble catch-water drain should, in his opinion, be formed parallel to the whole length of the cutting, at a distance from the upper edge of the slopes, varying with the depth and nature of their material; in a depth of 20 feet, he thought that it should be set back at least the length of a chain. Spoil-banks placed near to the slopes of cuttings, also appeared to him to be injudicious; in the cases of the Croydon and the Blisworth slips, which had been mentioned, he had no doubt, that the spoil-banks contributed as much to produce slips, by checking the drainage, and by the increased quantity of surface-water they threw into the slopes, as they did by their great superposed weight on the edge of the banks. It was a curious fact, which he deemed worthy of notice, that serious slips seldom occurred, until 2 or 3 years after the completion of the earthwork; the large sums usually left by contractors, to cover one year's risk of maintenance, might therefore, he conceived, be dispensed with.

Cuttings and Embankments—Great Western Railway.

Mr. Colthurst exhibited and described, three sections of the embankment across the valley of the Brent, at Hanwell, on the line of the Great Western Railway, (Figs. 7, 8 and 9.) The embankment, which was formed of gravel was 54 feet in height; it rested on vegetable soil, beneath which was a thickness of 4 feet of alluvial clay; then occurred a bed of gravel, varying from 3 feet to 10 feet in thickness, resting upon the London clay, which was traversed in all directions by slimy beds or joints. The surface of the country sloped gradually towards the Brent, which was at a level of about 20 feet below the south side of the embankment. The subsidence of the embankment commenced during the night of the 21st of May, 1837; the next morning the foundation was discovered to have given way, and a mass of earth, 50 feet in length by 15 feet in width, was forced from beneath the north or lower side of the embankment, towards the Brent. For four months this protruded mass increased in dimensions, and the subsidence of the embankment continued, until the surface assumed an undulating outline, which, on being cut through, showed that the subjacent beds corresponded accurately with the curvatures produced at the surface by the disturbance. The state of the seams or strata beneath the surface, was ascertained by sinking trenches at right angles to the embankment, to the full depth shown in the sections, Figs. 8 and 9.

The symptoms of failure in the embankment, at this period, were confined to a subsidence of about 15 feet, with a fissure extending all along the top of the south slope, at the side opposite to where the foundation had yielded. From the dip of that fissure, Mr. Colthurst inferred the nature and inclination of a rupture of the ground under the embankment, as shown in the sections, Figs. 8 and 9.

Immediately on the commencement of the slip, Mr. Brunel directed a terrace to be formed, on the swollen surface, at the north foot of the embankment; the weight of the mass thus placed, succeeded effectually in stopping the further progress of the subsidence, which up to that period had exceeded 30 feet. The swollen ground extended over nearly 400 feet in length, by about 80 feet in width, and was elevated nearly 10 feet, with a horizontal movement of about 15 feet. The general disturbance ranged to a distance of 220 feet from the foot of the slope, towards the river Brent, the south bank of which was forced forward about 5 feet.

The section, Fig. 7, showed the position of the strata, at the time of the forming of the embankment.

The section, Fig. 8, showed the state of the strata, when the slip or swollen ground was being covered by the terrace on the north side.

Fig. 7.

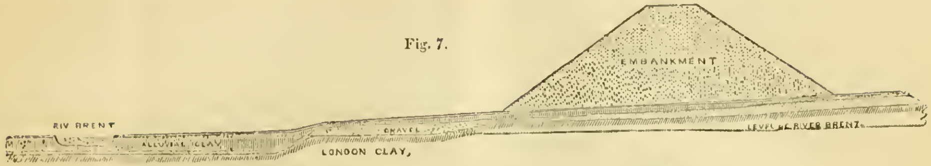


Fig. 8.

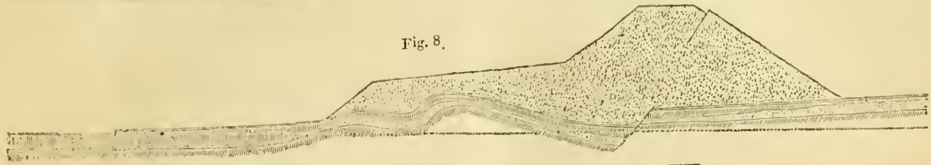
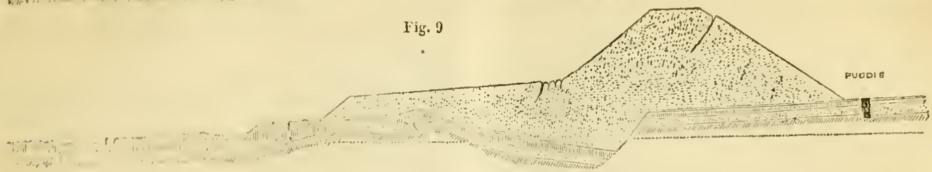


Fig. 9



Brent Embankment at Hanwell, Great Western Railway.

The section, Fig. 9, gave the form of the terrace, and of the ground beneath it during the further subsidence; but all under the embankment in Figs. 8 and 9, must be considered as inferential from the appearances above. The rupture of the ground beneath the embankment, was indicated by the crack near the upper part of the south slope.

In a letter received recently from Mr. Bertram, one of the engineers on the Great Western Railway, it was stated, that the Brent embankment had subsided very little for several years; indeed from the nature of the material there was naturally less sinking than in loosely formed clay embankments; a coating of ballast from 6 inches to 9 inches in thickness, applied once a year, was found sufficient for all purposes. The slips which occurred in embankments formed of clay, occasioned trouble at first, by their immediate effect on the road above, and the difficulty of adding material to them. Mr. Bertram had found in many such instances, in the London clay district, that a temporary measure, of forming the softened mass which had slipped down, into large raised beds or ridges from 8 feet to 12 feet wide, by dressing with the spade, surface punning, &c., had the effect of keeping rain-water out, allowing the raised parts to dry, and retaining the mass in its place, until better weather and matured arrangements, permitted the more permanent proceeding, of forming an extended footing and working up the mass with additional material, so as to fill up the space with an increased slope.

When the Acton cutting slipped about three years since, Mr. Bertram was induced (from the difficulty of bringing gravel to the spot, and the quantity of surplus stuff in the cutting), to try burnt clay for the drains, for forming an open backing to collect water, and also for mixing with the soft clay in punning up again; from what he then saw, he gave a decided preference to that material, over any kind of gravel, for mixing with clay, to retain it in its place. When gravel was used, there was generally a slight subsidence and opening at the top, but with burnt clay neither occurred. The usual system pursued, was to form with that mixed material, continuous abutments and revetments, upon the original face, and in all cases to make sure of thorough drainage from the back.

He had always been able to trace an immediate connexion between the courses of septaria and the slips at Acton. Those courses were not sufficiently open to act as natural drains: he had made many surface and deep drains leading from them, but the quantity of water drawn off, was not equal to that which was obtained by the means before described.

At Ruscombe, he had removed the gravel stratum from the top, laying bare and well draining the surface of the clay, using the gravel as a footing or buttress below, at such portions of the cutting as had been forced up by previous slips; when there was under drainage from longitudinal culverts, that plan answered very well.

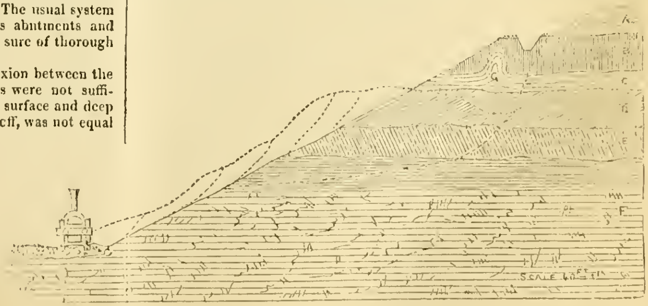
At that portion of the Sonning cutting, which slipped so suddenly 2 years ago, the stratum of gravel was found to be broken into, by an upraised bank or dam of clay, at G (Fig. 10), which after much wet weather, kept a reservoir of water penned back, until it broke out the mass of clay, down to the next stratum at D, and so out at E; the dam G had been cut across at different points in the slope for the purpose of drainage, and when that was done, all that portion of the cutting became particularly dry. A drain was led from the back of the dam G in dressing off the slip. That continued to bring away a great deal of water, which previously had some other outlet, over the lowest point of the bank.

Mr. Sibley thought, the causes of the subsidence of the Hanwell embankment were very obvious. In laying out the foundations of the Lunatic Asylum, in that immediate vicinity, and in the formation of a deep sewer, with a soil pit 20 feet in diameter, and 20 feet in depth, at the side of the Brent, he had ample opportunity for examining the strata, and it appeared to him, that had a trench been made in the direction of, and at the foot of the embankment, the marshy piece of land where it was situated, would have been sufficiently drained, to enable it to carry the weight of the mass laid upon it.

The trustees of the Uxbridge road had their great store of gravel in fields to the west of this embankment, and excavations had been going on there for about half a century. The springs in that neighbourhood, accumulated in a

Fig. 10.

A, Spoil bank.
B, Gravel.
C, Clay.
D, Brick-earth, with loamy sand.
E, Clay variegated with water-marks.
F, Dark coloured clay.
G, Upraised bank or dam of clay.



Transverse Section of Sonning Cutting, Great Western Railway.—The dotted lines show the form of the slip.]

reservoir, which was formed by an escarpment of clay, skirting the river Brent; part of the waste water, together with the percolation from the reservoir, was permitted to traverse the site of the embankment, rendering the ground marshy, even in the driest seasons. The late Mr. M'Intosh had frequently told him, that a larger quantity of material was used in maintaining, than in constructing the Hanwell embankment.

Mr. Colthurst, in answer to questions from members, explained, that the fissures shown in the clay, beneath the embankment, were assumed from the form of the depressions of the surface. The sections of the ground were taken weekly, during the whole time of the susidence, so that he contended, the form of the substratum might be assumed as being correct. The spreading of the lower side of the embankment, displaced the bank of the river Brent for some distance.

Sir Henry Delabeche remarked, that if the sections (Figs. 8 and 9), which were exhibited, approximated to truth, it would appear, that the embankment was formed upon a fault of greater magnitude than usual. The consequences were inevitable; when the fault yielded, the embankment sunk, and continued to subside, until the mass was stopped by weighting the foot, and thus restoring the equilibrium.

Mr. Colthurst said, that the slimy beds, and the fissures, which ran in all directions in the clay, were most difficult to be guarded against, and they were, he believed, the principal causes of slips and subsidences.

Mr. Braithwaite said, that from the observations of Sir Henry Delabèche, it might be inferred, that slips and other movements of earth, were more frequently due to mechanical, than to chemical action, although in the case of the New Cross slip, the latter cause had been much insisted upon.

Mr. John Braithwaite gladly availed himself of the geological knowledge of Sir Henry Delabèche, and his approbation of the measures pursued was highly gratifying to him.

With respect to the Brentwood cutting, although the strata were nearly horizontal, and it might have been imagined, that there would be little tendency to slip, yet from the ground being so full of water, more than ordinary attention to its drainage was required, for it was so retentive of moisture, that a drain had but little influence at a few yards from it.

The draining shafts which were sunk, had operated well, to the extent to which they were carried, and he believed that generally, the mode of treating the Brentwood cutting was considered successful.

He had understood, that the trenches which had been alluded to, had not been extensively used.

Mr. Phipps explained, that the trenches and the wall with dry backing, were tried under his direction merely as an experiment, prior to the examination of the ground by Sir Henry Delabèche. The dry shafts were subsequently sunk, and the only doubt he entertained was, whether there was a sufficient number of them to drain the bank effectually.

Sir Henry Delabeche said, there could not be any doubt of the ground being completely drained, if a sufficient number of shafts were sunk to intercept the water, but then the question of their cost must be considered.

Mr. J. Green, in answer to questions from the President, stated, that his experience did not enable him to lay down any rule for the prevention of slips in cuttings or embankments. They were generally to be attributed to the presence and pressure of water, acting upon the substratum; the method of discharging the water must depend on the direction and the nature of the strata; in all ordinary cases, he conceived, that with proper application of the known methods of drainage, successful results might be attained.—He had not made any particular observations, as to the relative duration of the tendency to slip, exhibited by the slopes of embankments and cuttings, in canals and railways; but he conceived, that in a canal, the weight of the water acted as a support to the internal slopes, and tended also to counteract the upward pressure of water in the substrata. He had frequently observed this in cuttings, with embankments on the sides; while the canal was full of water, the banks stood well, but when the water was drawn off, the banks subsided, and the bottom of the canal rose up.—A curious instance occurred, in forming part of the Exeter ship-canal, through mud lands in the estuary of the Exe. The embankments on the sides of the cutting, remained firm, so long as their weight only just balanced the upward tendency of the water, in the substratum of the bed of the canal; but when the increased weight of the mass, destroyed the equilibrium, the embankments sunk down, and the bottom of the canal was forced up in proportion.—This occurred in several places, even after the works had preserved a perfect section for some months, but the canal had not then been filled with water. It was found on examination, that at a few feet only below the bottom of the canal, there existed a bed of peat, which, although capable of resisting the weight of the banks for a considerable time, at length gave way; thus the embankments sunk down, the bottom of the canal rose up, and it became necessary to drive strong piles in the line of the bottom of the canal, on each side, in a lateral direction, and to support these piles by rough inverted arches of stone, at intervals of about 20 feet, for a considerable distance, after which the banks being slowly raised, stood well.

The President said, it must have been observed by all engineers, that in the embankments and cuttings of canals, the slips generally occurred, within the first 6 or 8 months after the works were completed; but in railway works, the slips constantly occurred even after years had elapsed. He observed on many of the railways, upon which he travelled habitually, that the slopes were almost as frequently under repair, after being open for many years, as they were within a few months of the first opening. He was decidedly of opinion, that although water might be the primary cause of the slips, the vibration caused by the passage of the trains, was the more immediate cause.

When, as had been so ably explained, the lower beds became converted into mud, and the adhesion of the particles was destroyed, the mass only required a slight impulsive force, such as the vibration consequent on the passage of an unusually fast or a very heavy train, to set it all in motion and to cause a slip.

Some of the methods proposed for the formation of embankments, such as only constructing them during suitable weather, and with thin layers of material, regularly laid and pounded, &c., might be used in the construction of reservoirs for retaining water; but they were not compatible with the manner in which extensive works required to be carried on, independent of the extra cost they would occasion. Experience had shown him, that the best method of constructing a heavy embankment was, to run forward two tips, parallel with each other, forming the outsides of the bank, and leaving a void in the centre, which was subsequently filled up. The greatest amount of pressure, was thus brought to act vertically upon the material, and the two sides having become somewhat consolidated, were better able to resist the pressure, and they had not any tendency to slip away. This method had been ably treated by Mr. J. B. Hartley, in a paper read before the Institution in 1841.

He had not found any difficulty in inducing contractors to adopt that method; when proper precautions were taken to insure thorough drainage, he believed, that embankments would generally stand well, although made in the wettest weather. Moisture would only cause the mass to become more consolidated, and when once that was the case, but little water would subsequently percolate.

He concurred in the opinion, that the gravel counterforts acted rather as drains, than as supporting buttresses; for he believed, that they stood generally at a steeper angle, than the slopes which they were supposed to support.

Mr. Clutterbuck said, in confirmation of the President's opinion, he had been told by the persons who worked in the sand-pits, under the plastic clay, near the London and Birmingham Railway, that they were afraid to remain under ground, during the passage of the heavy luggage trains, on account of the extreme vibration of the earth.

Mr. Green was convinced of the correctness of the President's opinion, as to the effect of vibration upon banks saturated with water. He had seen instances even in canal embankments, where, at the head of locks, the vibration arising from the sudden and careless closing of the lock-gates had produced slips.

He did not think any commensurate benefit would result, from the extra expense of pounding the earth in embankments, as had been suggested. The degree to which earth might be safely consolidated by pounding, could only be determined by great attention to the nature of the material, and to the circumstances under which it was used. He had known much injury caused by the earth-backing for walls, being too much pounded, when, from defective drainage, the expansion of the earth had subsequently thrown the walls down.

Mr. Hughes presented a specimen of Watson's drain pipes, described in the Journal, Vol. VII., page 49.

RAISING SHIPS.

"*An Account of the Plan employed for raising the 'Innisfail' Steamer, sunk in the river Lee, near Cork.*" By George Preston White, Assoc. Inst. C. E. (*From the Minutes of the Proceedings of the Institution of Civil Engineers.*)

The "Innisfail," a steamer of 400 tons burthen, and 180 h. p., sunk in the river Lee, in consequence of having run foul of an anchor, with such force as to tear a plank of 64 feet in length, and varying from 8 inches to 10 inches in breadth, out of the bottom close to the keel. As the vessel lay right athwart a narrow part of the channel, it was necessary to take immediate steps for its removal. The Directors of the St. George Steam Packet Company being aware that Mr. William Preston White, the Harbour Master of Cork, had succeeded in raising several large vessels, solicited his assistance to remove their steamer. The method he had adopted on former occasions, was that of slinging or weighing, which is done in the following manner:—After the position of the sunken ship has been ascertained, a chain cable is passed round it by means of two vessels, which are placed near the bow, with the cable suspended between them, so that its centre shall sweep the ground, and it is moved to and fro until it comes in contact with the stem of the sunken ship. The two vessels are then moved astern, the ends of the chain are brought together, and passed through an elliptical ring, which is loaded, in order that it may fall close to the stern, and the ends are secured to the vessels. The main chain being secured in its position, bridle chains are affixed to it at intermediate distances; these being attached to other vessels alongside, all the chains are strained at low water and as the tide flows, the sunken vessel is raised from its bed, and is brought to shore. If the vessel cannot be left high and dry at low water, the operation is repeated as often as circumstances may require.

In this way Mr. White has succeeded in raising four sailing vessels and three steamers, besides numerous smaller craft. This plan, however, did not succeed in the case of the Innisfail, owing to the narrowness of the channel, which prevented the employment of ships of sufficient tonnage for weighing. At the suggestion of Mr. A. S. Deane, a cofferdam was constructed at the side of the vessel which had received the injury, and to prevent any leakage at the other side, a few loads of clay ballast were deposited. The cofferdam was formed of deal planks 12 feet long by 3 inches thick, secured by wales and cross-pieces. On examining the bottom, after the water had been pumped out, it was found necessary to excavate to a depth of about 2 feet, in order to arrive at the leak; as the excavation proceeded, the vessel was shored up and when the spot was discovered, elm planks of 1 inch thick and 12 inches in breadth were nailed over the whole length of the leak, first covering the hole with strips of flannel, soaked in tar, in order to make the patch water-tight. By this means the vessel was raised in the course of ten tides, and it was floated and steamed down to Passage, a distance of about 7 miles, in order to undergo a thorough repair: the total expense of the work, including the cofferdam, was £350.

SUNDERLAND LIGHTHOUSE.

"*An Account of the removal of the Light-house at Sunderland.*"* By John Murray, M. Inst. C.E. *(From the Minutes of the Institution of Civil Engineers.)*

Sunderland is rated the fourth port in the United Kingdom, as respects the aggregate amount of its tonnage. The shipment of coal, which is the principal business of the place, amounts annually to about 1,300,000 tons. Lime is also extensively shipped for Yorkshire and Scotland. There are various manufactories in the town and neighbourhood, and the building of ships is carried on to a great extent. The population of the united towns of Sunderland, Bishopwearmouth, and Monkwearmouth, amounted, according to the census of 1841, to 57,057, including about 4000 seamen.

The harbour has been, since the reign of George I., under the control and jurisdiction of Commissioners, appointed by Parliament. For some years past, the average revenue, arising principally from the shipment of coal, has amounted to about £16,000 per annum. The funds so collected, have been expended in deepening the shoals, removing rocks and other obstructions and building piers at the mouth of the river. These piers, having been originally executed in a superficial manner, soon showed symptoms of decay, and it was found necessary to rebuild the eastern or seaward portion of them.

The late Mr. John Rennie was consulted and his advice was, that the piers should be prolonged with solid masonry into deeper water. The South pier has, in consequence, been rebuilt in a substantial manner with ashlar masonry, in blocks of stone, varying from 5 to 7 tons in weight, properly backed with a glacis of rubble stone. The eastern part of the north pier, during the last ten years, has been taken down, under the author's superintendence; a new pier has also been built, in the direction suggested by Mr. Rennie, and approved by his son, Sir John Rennie. This pier has been executed in the strongest manner and with excellent materials, forming altogether a handsome and substantial piece of masonry. The most beneficial effects have been produced by the adoption of these plans; the channel to sea has been straightened and deepened by dredging, and the bar has been lowered and kept in a stationary position, so as to give 4 feet of water upon it during low water, or 18½ feet at high water of ordinary spring tides.

Near the termination of the north pier, there was built, in 1802, by Mr. Pickernell, then engineer to the Commissioners, an octagonal Light-house of polished stone. Its height was 60 feet 2 inches from the base to the cornice, terminating with a lantern, the cupola of which was 16 feet above the cornice, making a total elevation of 76 feet 2 inches above the pier. Its breadth was 15 feet at the base and 8 feet 6 inches at the cornice, having a spiral staircase up the centre of the building. It was subsequently lighted with coal gas from nine patent burners with parabolic reflectors.

In the beginning of the year 1841, before the works at the north pier head were terminated, an alarming breach was made by the sea in the projecting part of the old pier (Fig. 1), on which this Light-house stood, and it became imperative, either to take down the building immediately, or to repair the pier in an expensive manner.

On the 7th of April, 1841, the advantages of having a new Light-house on the high ground near the fort, on the south side of the river, and the difficulties of removing the present one from its then critical situation, were discussed at the Board of Commissioners. The result was, that the author received directions to prepare the materials necessary for carrying into effect the project he had suggested, of removing the building in an entire state, on a cradle of timber, to the eastern extremity of the new pier.

In consequence of the breach before alluded to, it was necessary to remove the Light-house in a northerly direction, on to the new pier, before it could be taken to the eastward and its axis required to be turned, in order to make it correspond, or be parallel with the altered direction, east and west of the new pier. The raised platform of the new pier head, where the building was proposed to be placed, being 1 foot 7 inches higher than the original site of the Light-house, it became necessary, in providing a proper height for the entrance doorway, either to descend a few steps from the platform, or to lift the base, and consequently the whole building, to the proper level. It was deemed advisable to adopt the latter course.

The first of these operations was to take the building northward. On the 15th of June, the masons began to cut apertures on the north and south sides of the building, for the reception of the cradle or platform of timber (Figs. 2 and 3); the two middle balks were threaded through consecutively and the apertures were made no larger than absolutely necessary for that purpose. The upper course of stones below the torus moulding was not disturbed, and the bottom of this course was made to rest immediately upon the cradle timbers. The upper surfaces of the beams, where they were in contact with the masonry, were covered with thin sheet lead, to equalise the pressure. When the timbers were threaded through the building, screws were applied beneath them, until they were closely pressed to the course of masonry, and uprights of timber were then inserted and firmly wedged up, which allowed the screws to be removed. Less difficulty was experienced in inserting the next timbers, which were parallel to the other pair, and supported the external masonry; they were covered with lead like the others, screwed up and shored with timber uprights and wedges in a similar way. Care was taken to place all these shores in such positions, that they should not interfere with the insertion of the lower transverse tier of timbers.

An aperture was next cut on the eastern side of the base (the entrance door on the west side not requiring any), to admit the two transverse beams, which were firmly screwed up underneath the beams previously inserted, and then shored with uprights and wedges to relieve the screws. Other timbers were next inserted and shored up in pairs, in a similar way to the others, and when all these were secured, other apertures were cut through the building to admit the upper timbers. The next operation was the insertion of the timbers, with rails fixed upon them. The centre timbers immediately below the upper beams were fixed first. These were firmly bedded on the stone pavement of the pier and upon the solid masonry of the new work. The sheave balks to each, were then threaded threaded through the building and firmly wedged to the timbers above, and to the rails below, by a series of wedges. The other rail and sheave balks were placed in a similar manner, underneath each upper timber and in the order in which they were inserted in the building. Finally, when all these wheels were brought to their bearing, the small portions of the original masonry, left in the four corners of the building, were cut away at one time and the two remaining intermediate upper timbers were threaded through and secured.

While these works were in operation, the octagonal shaft was tied together in the following manner. Two planks, 44 feet in length and 3 inches in thickness, were suspended from the cornice at each angle of the shaft and then lashed closely to the masonry by ropes and wedges. Five horizontal tiers of iron straps, 2½ inches broad, and ⅞ths inch thick, were made to embrace the building, and these were drawn closely up by screws to the above-mentioned planks and filling-in pieces. Immediately above the cornice and on a level with the light-room floor, eight apertures were made through the walls (which were here only 10 inches in thickness), and pieces of timber were pushed through the apertures from the inside and drawn back again till they met in the centre. Strong plates of malleable iron covered the joints above and below the timbers and screwed bolts passed through the whole. This upper platform was connected with the cradle below by a large chain, passing round a strong bar of iron at the top of the platform, and round a similar bar of iron on the lower side of the cradle, and the chain was drawn tight by a large screw.

The upper platform was further connected externally with the cradle, by eight main uprights of timber, 12 inches square, tenoned into the horizontal timbers at the cornice, and brought close to the masonry of the building at the base, and secured to the cradle and upper platform by stirrup-straps and bolts. The uprights were united together by three tiers of chock-pieces. Three iron straps, 3½ inches broad, and 1 inch thick, passed round the chock-pieces and uprights, and the whole was drawn closely to the building by screws. The raking braces were next erected and their feet passed between the timbers of the cradle and cill-beams fixed thereon, so that the whole framing could be firmly bound together (Fig. 4.) The four diagonal beams and ledges, fixed to the raking braces, further prevented any of the timbers from springing or twisting.

Up each angle of the building, above the cornice, battens, 2½ inches thick, were fixed, with two tiers of horizontal junction pieces, kept together by binding screw straps. The dome of the building, which is of iron, covered with lead, was fastened by chains passing round the summit and the upper cornice, and continued down to the projecting timber of the upper platform, each chain being tightened by screws. The large plates of glass of the light-room were taken out, and window sashes, with ordinary crown glass, were put in their place. The light, however, was exhibited nightly, as usual, during all the operations of removal; a lead pipe, lengthened as required, being connected with the gas-works on the pier.

On the 2nd of August everything was prepared for drawing the building northward. For this purpose, five pulling screws were strongly fixed to the glacis of the pier, north of the building and chains were attached to them and to the cradle upon which the Light-house rested. These screws were worked by twenty-four men. Four forcing screws, worked by three men to each, were applied behind the cradle, to assist in propelling it. The total number of men employed on the occasion was forty. The cradle was supported on one hundred and forty-four wheels, which travelled on eight parallel lines of rails, but the extreme ends of the cradle were supported and

* Some account of the removal of this Lighthouse appeared in the Journal, Vol. IV. 1841, page 243, 325, and 378, together with a view of the Lighthouse.

moved on slide balks only. The operations for the removal northward were commenced at half-past 3 P.M. and at a few minutes after 8 P.M. it was safely landed on the new pier. The distance travelled was 20 feet 5 inches.

On the 7th of August the building was drawn, in a similar manner, to a further distance northward of 8 feet 1 inch. The cradle was then shored with timber uprights, which allowed the railway and sheave balks to be withdrawn and reversed, for the purpose of taking the building to the eastward. It is unnecessary to describe the process of placing these railway and sheave bulks in a direction bearing east and west, as it is merely a repetition of the same operations previously mentioned. Some difficulty was experienced in taking the building round the curve, which was a portion of a circle of 647 feet radius.

The rails on this curve were laid level, to the point at which the tangential lines of the rails commenced and from that point, to the new pier-head, they had a gradual inclination of 1 in about 225, making a total rise of 1 foot 7 inches above the original base of the building. This was accomplished, on the raised platform, by different heights of timber beams and on the unfinished part of the pier, between the platform and the coping, by large stones set in mortar, on which the railway beams were solidly fixed.

The series of wedges in the sheave balks not only allowed them to be removed when required, but were otherwise of great use, for by slackening the wedges on the east side and tightening those on the west, the building was retained in a perpendicular position, when the rails were on the inclined plane.

On one portion of the raised platform of the pier the pavement was completed with large Yorkshire landings, from 6 inches to 8 inches in thickness. It was questionable whether they would be able to bear the great pressure of the building; but it was determined to try it, as the stones had been laid with the greatest care on a proper bed of rubble stone, and the joints run with pozzolana mortar. As a precaution, planks were laid upon the pavement, to equalise the pressure, and particular attention was paid to have the rail balks securely and thickly wedged upon the planks. Under the great load of the building very little impression was made upon the paving; in some few instances the joints of the mortar were cracked, but no stone whatever was broken. This is particularly noticed, because every practical man who inspected the pier was of opinion that the stones would not bear the pressure.

The cradle was supported on what are termed by ship-builders sliding balks; that is, the lower side of the travelling beam was convex, fitting into and sliding along the concave surface of the lower beam, which was solidly fixed upon the pier. These beams were greased with a mixture of soft soap and black lead, to diminish the friction. The sliding beams were connected with the cradle by a framing of timber, which formed part of the moving mass, with the view of saving expense, as it avoided the necessity of raising the surface of the pier to the level of the railway beams. The principal weight of the building was, however, thrown upon the railways, and, comparatively, nothing of any consequence on the sliding balks.

Immediately underneath the area of the building the cradle wheels were placed close together, but outside the area of the building they were separated from each other (Fig. 3.) Each of the wheel plate castings had the under surface covered with a piece of felt dipped in tallow, and it was then secured to the sheave balk by a tapering wedge (Figs. 5, 6, and 7.) By so doing, the timber was not injured with bolt holes, and the casting could at any time be easily taken out and replaced with another, had any accident happened to it. The spindles of the sheaves were very accurately turned, and the sheaves were likewise thrned, to take off all irregularities from their surface. The rails were secured to the timbers by short spikes, formed with a head turned at right angles with the body, which allowed them to be easily drawn without much injury to the timber, when the rail had to be removed.

Fig.5. —Elevation.

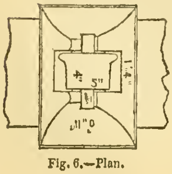


Fig. 6.—Plan.

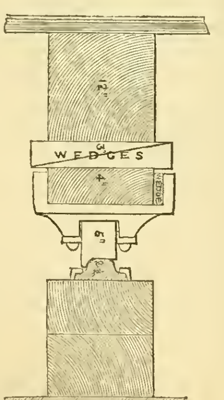


Fig. 7.—Section.

The cradle beams were all squared and planed, to distribute the pressure over the whole surface. They were of American oak, which is a very solid wood, and, as it could be procured straight in long lengths, it was preferred to any other timber. The rest of the timber employed was Memel red and yellow pine. During the latter part of the operations the cast-iron rails were laid upon a plank of African oak, 1½ inch thick, fixed upon the railway beams, as it was feared that the great weight would press the rails into the Memel timber.

The method employed in taking the building to the eastward, was different from that which was first attempted in moving it northward. The slow process of drawing the cradle forward by screws, was abandoned, and recourse had to three ordinary winches. Each was worked by six men, with one man to hold on the tail-rope, which before arriving at the winch, passed through a twofold and threefold sheave block. The total number of men employed at the handles of the winches was eighteen, and the power of them when so applied, may be reckoned at 562½ lb. The radius of the handles of the winches being 14 inches, worked a cog-wheel of 4½ inches diameter, turning a spur-wheel of 30 inches diameter, and a barrel of 10 inches diameter. The additional power of the twofold and threefold sheave blocks makes the whole power of the eighteen men, applied in the manner stated, to be 52,480 lb. The gross weight moved was calculated to be 757,120 lb., or 338 tons. The distances traversed were determined by the various lengths of the railway beams, which were taken up and relaid forward, to save expense, but which of course prolonged the time of taking the building to its destination. The greatest speed with which the mass moved, was at the rate of about 84 feet per hour, the winches being advantageously placed; but the average actual rate was 33⅓ feet per hour. The greatest distance accomplished at one time was 40 feet 7 inches; the average distance being about 28 feet. The actual time employed in moving the building to the eastward was 13 hours 24 minutes; that distance being 447 feet 1 inch, to which, if 28 feet 6 inches be added, what it was taken north, will make the total distance traversed 475 feet 7 inches.

DATE. 1841.	Mean Distance Traversed.		Time of Moving, including Stoppages at the Winches, &c.	Actual Time of Moving.	Remarks.
	Ft. In.	Ft. In.	Minutes.	Minutes.	
2 August, Northward	20 5				
7 " "	8 1				
		28 6			
30 August, Eastward	25 2	—	70	70	On the curve.
31 " "	20 3	—	124	70	
3 September "	20 0	—	95	75	
13 " "	33 0	—	110	110	
14 " "	32 6	—	75	60	
15 " "	32 6	—	90	90	
16 " "	31 0	—	35	35	
17 " "	32 8	—	26	26	
18 " "	32 1	—	23	23	Greatest speed.
21 " "	40 7	—	45	45	
23 " "	35 4	—	50	40	
27 " "	30 0	—	50	45	
28 " "	20 0	—	25	20	
1 October, "	22 6	—	—	20	
2 " "	22 6	—	—	30	
4 " "	17 0	—	—	45	Delay on the pier-head.
Total Eastward .		447 1	—	804 or	13 hrs. 24 min.
Total distance traversed		475 7			

On one occasion, an experiment was tried with only two winches at work; it was found, that, with twelve men at the handles, the cradle could be drawn forward, but at a slower velocity than ordinary, and the men were much fatigued with their exertions.

The Americans have been successful in moving houses to a considerable distance, but the weight was generally distributed over a large area of the foundations, which allowed the cradle to run upon slide balks, and saved the expense of wheels and railways. Those who had seen the operation in the United States strongly advised the adoption of the same principle. The great weight of the light-house at Sunderland, however, concentrated into an area of 162 square feet, caused a contrary decision. If reliance had been placed solely on the sliding balks, it is very probable the attempt to move the mass would have proved a failure; inasmuch as even with the internal railways and wheels, it sometimes required the utmost exertions of the men at the

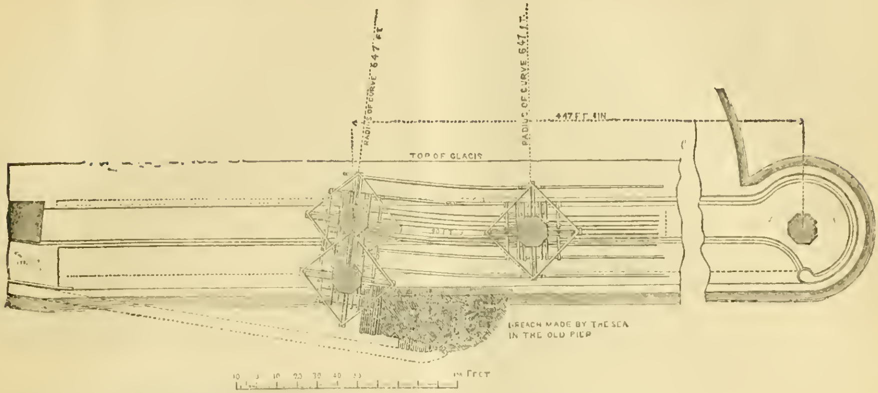


Fig. 1.—Plan of the North Pier of Sunderland Harbour, showing the different situations of the Light-house.

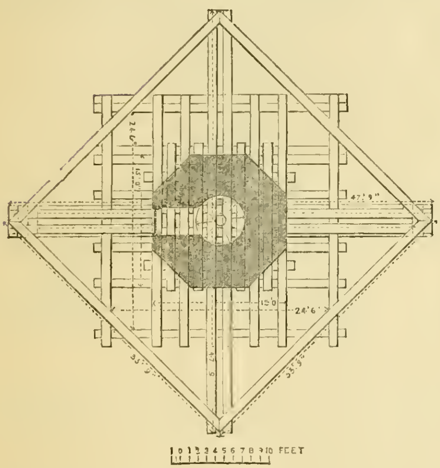


Fig. 3.—Plan.

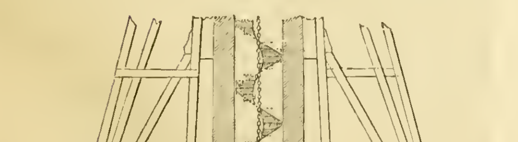


Fig 2.—Light-house on the Cradle.

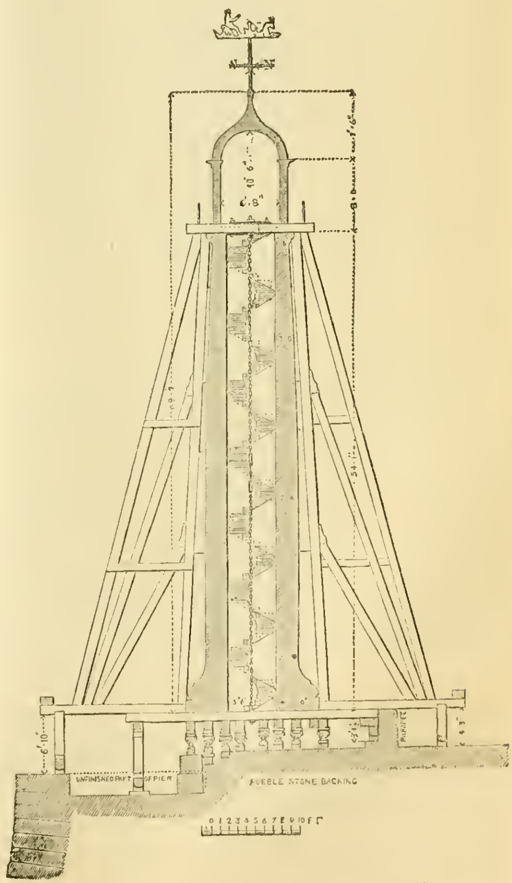


Fig. 4. Section of the Light-house, showing the Rail-balks, &c.

winches to pull the cradle forward. The outer part of the cradle, which bore the weight of the raking braces, was, to save expense, supported on sliding balks. On one occasion, when the ropes were tightly stretched, a few blows given to these sliding balks caused the cradle, with its enormous weight, to start suddenly forward a distance of nearly two feet. In consequence, they were always tapped afterwards, whenever the cradle encountered any obstacle to its motion. M. le Bas experienced the same difficulty in moving the Luxor obelisk, both in Egypt and at Paris, where a great force was employed to drag it forward. The huge rock of the statue of Peter the Great at St. Petersburgh was moved on balls of brass, turned very accurately, and running in brass channels; yet they frequently stuck fast, and required the attention of a man to each, with an iron rod, to keep them in motion and equidistant from each other. The use of railways, with wheels moving in carriages fixed to the cradle, undoubtedly saved trouble and expense, and, to a certain degree, reduced the friction.

At the time of building the new pier, preparations were made for the site of a light-house, by piling an area of about 20 feet square in the centre of the head, founding upon the piles, and bringing up along with the other work, a mass of masonry, in large blocks, properly squared, and bedded solidly in pozzolana mortar. The foundation was therefore in readiness for the reception of the building. On the 4th of October it was brought to its destination. Timber uprights were immediately wedged up under the cradle, which permitted the different sheaves and railway balks to be withdrawn. Upon this being done, the masons commenced operations by building on the foundations above alluded to, pillars of stones, with retreating courses, striking the shores, from time to time, as these pillars took their bearing under the original masonry.

The mortar used was made from blue lias lime, with a mixture of sand and pozzolana, and was laid in very thin joints. The chief difficulty arose in making good the last course, as the joint had to be made rather thicker than usual, for the admission of the masonry. The stones of the course, before insertion in the building, had their upper surface covered with thin sheet lead, firmly beat down and lapped for a breadth of two inches over the back part of the stone. This was done to equalize the pressure, and to prevent the external masonry from being flushed by the weight of the building it had to sustain. The joints were run with grout through the funnel of a tube, carried up a few feet in height, to give additional pressure. They were previously closed all round with Roman cement, excepting a few apertures left on purpose for the air to escape, and which allowed the grout completely to fill the joint. Great care was taken to make the masonry sound and perfect, by properly bonding the joints, both internally and externally, by which means there is not any indication of the building having ever been displaced. The masonry was completed on the 12th of November.

Before cutting into the light-house for the insertion of the cradle, the different corners of the base were accurately levelled with an instrument and trial was made whether the building was exactly perpendicular by a plummet. From time to time, as the building was moved forward, other trials were made for the like purpose and also after it had been brought to its destination on the new pier head. In all cases it was found to be as at first. No settlement was ever perceptible, even where the new masonry was placed, on withdrawing the cradle; nor has the slightest crack appeared since, in any part of the building.

The timbers and the chief part of the other materials employed, were used in other works, then carrying on by the Harbour Commissioners, and the men who worked at the winches, when they had accomplished their task, were taken off to other work connected with the building of the pier. The cost of carrying the work in question into execution, amounted to £827. The building was erected in 1802, at an expense of upwards of £1400. If to £827 be added £280, the estimated cost of a light-keeper's dwelling, gas-house, and other apparatus, it would have made £1107 as the total expenditure of this department. The estimated cost of building a new light-house on the high ground near the Fort, with a tide light on the north pier, dwellings, and other contingencies, amounted to £2000; consequently, by adopting the removal of the building, as is above mentioned, there was a saving of £893, and no inconvenience was experienced from the want of a harbour-light.

Since the completion of this undertaking, the author has had the honour to receive the thanks of the Board of Commissioners for his exertions; and a piece of plate of the value of £100 has been unanimously voted to him as a further acknowledgment of his services on that occasion.

ENGINEERING IN EGYPT.—Mehemet Ali's great dock at Alexandria has, after a labour of eight years, and a cost of half a million sterling, been opened;—to the great satisfaction of the Pasha, who came from Cairo for the occasion, and caused the inauguration to be accompanied with great ceremonial. The engineer, M. Mongel, a Frenchman, has, it is said, received from Mehemet Ali directions to take all necessary measures for the one other great work which that prince has so much at heart—the construction of the barrage of the Nile. The site now fixed upon is the point of junction of the Rosetta and Damietta branches of the river—about ten miles below Cairo. The work will consist of two bridges, one over each branch, joining each other at the extreme point of the Delta. One arch of each bridge will be made with a lock, for the purpose of navigation. In the centre of the Delta, and on the sides of the bridges, will be opened several canals, to which the water of the Nile will be allowed ingress, as may be required. It is stated, as an example of the saving to be effected by this barrage—that of the 50,000 sakiahs, or Persian water-wheels employed in Lower Egypt, and worked by not less than 150,000 bullocks, not more than 10,000 will be required to irrigate the lands situate at a great distance from the canals or above their level.

IMPROVED LEVEL.

Some Account of Levelling Instruments, with Description of one of an Improved Form.

By THOMAS STEVENSON, Civil Engineer, Edinburgh.

The improved spirit-level about to be described, was made for me in 1840 by Mr. Adie, and afterwards described in a letter to the Institution of Civil Engineers (*see* Journal, Vol. IV., pp. 357 and 373.)

Since then I have had two levels of the common construction altered to the new form. On a late occasion these instruments were exhibited to the Royal Scottish Society of Arts; and as no drawings had been laid before the public, that Society requested me to prepare a description with diagrams, that these might be published in their Transactions. In accordance with their request, therefore, I have drawn up the present description; and have also consulted many early writers, to ascertain, as well as I could, the history of one of the most important of geodetical and engineering instruments.

There unfortunately exists a great deal of conflicting evidence regarding the true inventors of the different parts of the spirit-level. Indeed, there are hardly two authorities who agree upon the subject. The original form seems to have been[1] that of a plummet, and is described as "instrumentum quo plumbo à filo et gnomone pendente, rectio, sive obliquitas operis perpenditur."[2]

The great Huygens appears to have been the first to *apply the telescope to a level* of his, which was constructed on the principle of the plummet. This is noticed, in the life prefixed to his works,[3] in the following terms:—"Ibi" (Lutetiæ) "vixit ab anno 1666 ad annum 1681. Durante hoc tempore pulcherrima subtilissimaque multa in mathematicis detexit, veriaque ex iis operibus conscripsit, quæ nunc in unum corpus collecta, quid in variis Matheseos partibus præstiterit, sub oculis ponunt. Præter ipsius jam memorata inventa præclara, inter alia duo insigni usu eminent. *Libellam telescopio munitam* ita construxit ut ipsi præ ceteris. fides haberi possit," &c.

The honour of having first applied the *air-bubble* to the determination of horizontality seems to be due to that universal genius Dr. Hooke. From all that I can gather, it appears that his invention must have been made subsequent to 25th March, 1674, and prior to the year 1675, as, in his "Attempt to prove the Motion of the Earth by Observations," by date 25th March, 1674, he describes a new method of *stilling the plummet* by immersion in water. While in his "Animadversions,"[4] published also in 1674, after fully describing his invention of the air-bubble confined in a tube, he speaks of its peculiar advantages, and great delicacy of movement, and remarks,—"This can hardly be performed by the ordinary way of plummets, without hanging from a vast height, which is not practically to be performed without almost infinite trouble, expense, and difficulty," &c.

Hutton, in his Mathematical Dictionary, remarks, that the applications of the air-bubble to the level "is said to be due to M. Thevenot;" but with what justice I cannot say, having been unable to meet with any reference to this instrument in the writings of that author. Thevenot was born in 1621, and he died in 1692.

I have been unable to discover who was the inventor of the *circular level*, which I imagined had been of recent date; but Switzer, at page 91 of his Treatise on Water works, which was published in 1734, remarks, that the circular level was then employed in the construction of the surveying instrument called a Plane-table.

According to Sir John Herschel, *the cross-hair*, which gives so much accuracy to all astronomical as well as levelling instruments, was the invention of Gascoigne, a young Englishman, who used it in 1640. He was killed at the age of 23, at the battle of Marston Moor.

M. Le Bion[5] appears to have been the first to *conjoin the telescope of Huygens with the air-bubble* of Dr. Hooke; and this must have been subsequent to the year 1684, as such an instrument is not shown in De La Hire's edition of Picard's Treatise on Levelling.[6]

But it was not till Sisson's improvements that the level could be considered as in any way an accurate or philosophic instrument. All that were made previously to his time were coarse instruments, adjusted by a ball and socket, and in other respects resembling the common perambulatory survey-level, which, from the nature of the construction, can be levelled in only one direction, and cannot be reversed, or moved even in the slightest degree, without requiring readjustment. Sisson may, therefore, be considered as the inventor of the instrument in common use. The main feature in his improvements

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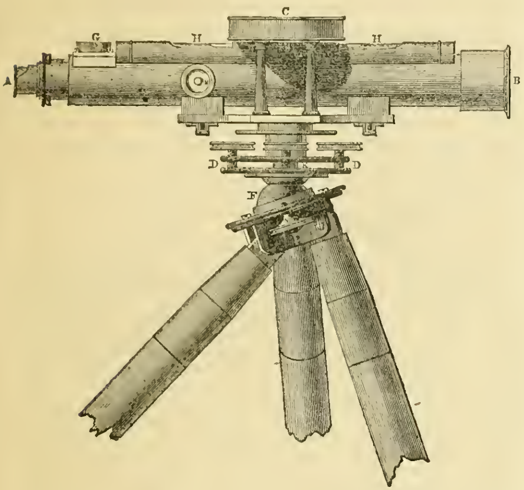
1 Plin. Lib. 7.
2 Polydori Virgilii de Rerum Inventoribus Libri Octo. 12mo, p. 258. Urbini, 1590.
3 Christ. Hugenii Op. Var. Lugd. Batav. 1724.
4 Animadversions on the first part of the Machina cœlestis of the Hon., learned, and deservedly famous Astron. Johannes Hevelius, Consul of Dantzick, together with an explication of some instruments made by Rob. Hooke, Prof. Geom. in Gresh. Coll., and F.R.S. Lond. 1674, p. 61, 'et seq.'
5 Traité de la Construction et des Principaux usages des Instrumens de Mathematique. Par N. Le Bion, Ingénieur du Roi pour les Instrumens de Math. Nouv. Edit. A La Haye, 1723.
6 Traité du Nivellement Par M. Picard, mis en lumière par les soins de M. De La Hire, 12mo. A Paris, 1684.

was the introduction of the four screws called *the parallel plate-screws* (D, in the Diagram). I have been unable to find out the date of Sisson's improvement; and, indeed, the only notice I can find of him is the following in Switzer's System of Water-works: "The invention" (alluding to the instrument with parallel plate-screws) "as I take it (for I am not as yet well acquainted with that gentleman), of William Sisson, at the corner of Beaufort Buildings, in the Strand."[7]

Since the time of Sisson, the celebrated Ramsden introduced a tangent-screw and clamp, for moving the instrument with accuracy through small distances in an azimuthal direction. Messrs. Troughton and Simms also made several improvements in the arrangement of the various parts of the instrument; and Mr. Gravatt has of late years added a cross-bubble for facilitating the *rough-setting* of the instrument—or that adjustment which is made with the legs of the tripod; and an enlargement of the diameter of the object-glass, so as, by the admission of a greater number of rays of light, to allow of the telescope being shortened, without impairing its optical powers.

A B is the telescope.—C C the compass-box.—M the screw for adjusting the focus.—H H, the tubular spirit-level.—G, the spherical or circular level.—D D D, the parallel plate-screws of Sisson.—K, the old ball and socket motion.—F, the new ball and socket motion.—N, clamping-screw for ditto.



Having thus endeavoured to describe the successive changes which the level has undergone, I shall now proceed to notice the nature of the present improvements.

The first of these is the substitution of a circular, or to speak more correctly, a *spherical* level (G), sluggish in its motions, instead of the small cross level, which was introduced by Mr. Gravatt. The advantage of the circular level over the common form, is its peculiarity in at once showing the deviation of the instrument from horizontality in both directions, instead of only one.

Before describing the next improvement, it may be proper to state, that the clumsiness of the common level consists in its being at all dependent on the setting of the legs. This arises from the circumstance of the ball and socket motion (K) being controlled in its action by the parallel plate-screws of Sisson (D), the consequence of which is, that, in using the common level, care must be taken to set the instrument very nearly level *by the eye*, so as to be within the range of the parallel plate screws (D), otherwise it is impossible to adjust the instrument. And although to the practical man, the trouble attending this may be comparatively small, still he will admit that it is one of the most irksome parts of the whole operation of levelling; to say nothing of the time that is lost in adjusting the instrument afterwards with the parallel plate-screws. What appeared to be wanting was a motion for the preliminary, or *rough-setting*, intermediate in nicety between those of the parallel plate-screws and of the legs. In order to gain this end, a ball and socket motion (F), having a clamp (N), is introduced in addition to the ball and socket (K), whose action is limited by Sisson's parallel plate-screws (D); *so that my improved level has two ball and socket movements.*

[7] An Universal System of Water and Waterworks. By Stephen Switzer, 2 vols. 4to. Lond. 1734.

With the instrument thus improved, the observer is made quite independent of the level of the ground where he sets the legs of his instrument, and may place them without regard to the inclination of the telescope to the horizon. Looking first to the circular level (G), and releasing the clamp (N) of the ball and socket (F), he, with one hand, moves the head of the instrument till the bubble is in the centre of the circle, an operation which is done almost instantaneously.[8] The socket-screw (N) is then clamped, and the telescope bubble (HH) is brought to the *absolute* level by a slight touch of the parallel plate-screws (D). In this way the legs of the tripod never need to be moved after the instrument has been placed on the ground, and the parallel plate-screws have almost nothing to do—advantages which all who are accustomed to levelling will fully appreciate.

In levelling over mountainous districts, it very often happens that it is desirable to select a station where the ground is so rugged and precipitous as to render it difficult, if not impossible, to find three points for the extremities of the legs of the instrument to rest on, which shall be on such levels as to bring the telescope within the range of the parallel plate-screws; *but wherever the instrument can be made to stand with safety, the bubble of the improved level can be adjusted, and adjusted in exactly the same time, and with exactly the same ease, as if the instrument were placed on level ground.*

Another advantage of these improvements is the removal of a great practical difficulty which is often experienced on sloping ground. The instrument being set and properly adjusted, the observer, on looking through the telescope, may discover that he is not within the range of the levelling staff; in other words, he has chosen a station too high or too low to admit of his seeing any part of the staff within the field of the object-glass. The only remedy for this is to choose a new station where the instrument must be again set up and levelled, at a great expense of time and trouble. In order to remedy this, it was my intention at one time to have fixed on the telescope a French level, on the principle of the plummet, in order speedily to discover before making the adjustments, whether the intended station were within the range of the staff or not. But the instrument can be roughly set with so much quickness by means of the additional ball and socket, that the French plummet may be considered as being now scarcely necessary.

In my letter to the Secretary of the Institution of Civil Engineers, I pointed out the advantages which would result to the surveyor were the theodolite provided with a second ball and socket motion; but no opportunity of trying this has as yet occurred.

Edinburgh, 1844.

[8] In the annexed plan the instrument is shown off the level, so that neither the air-bubble of the circular level (G) is in the centre of the circle; nor does the air-bubble in the tube (H H) correspond with the file marks made on the glass.

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

CONSTRUCTION OF HARBOURS, &c.

James Bremner, of Poultney Town, in the county of Caithness, civil engineer, for "*certain arrangements for constructing harbours, piers and buildings in water, for cleansing harbours and for raising sunken vessels.*"—Granted May 22, Enrolled Nov. 22, 1844.

One part of the invention consists in certain arrrangements whereby a wall or other structure may be built near a quarry or other convenient spot, and floated to a distance, and placed in the site in which it is to remain permanently. For this purpose a floating structure or vessel is built in compartments of two distinct kinds, whereof one set is intended to contain the wall and the other set to afford the buoyancy requisite for sustaining and floating the wall or the other structure so as to admit of its being transferred from the place at which it is built to the place in which it is to be deposited. The set of compartments for giving buoyancy or floatation to the vessel is generally arranged around the interior of the vessel, so as to surround the compartments for containing the wall; they may be of any convenient number and size, each is to be furnished with the means of letting in the water when required, and at other times to be perfectly water tight. The total aggregate contents of the compartments of floatation, must be varied accordingly to the weight of the wall or other structure which is to be transported, the principles upon which the requisite sustaining power is to be obtained being well understood by engineers. The compartment of the vessel containing the wall or other structure has a moveable bottom, which during the building of the wall and the floating of it out to the proposed site is sustained and kept close to the vessel by chains, and caulked or rendered water tight by any of the various methods well known to shipwrights; upon this bottom, which is called a slip bottom, the wall or other structure is built. The construction of the slip bottom may vary according to the nature of the structure and of the site upon which it is to be placed. This structure being complete the vessel is floated out to the spot at which the wall is to be deposited; the surface of the ground upon which the structure is to rest having been carefully levelled and prepared in the usual manner so as to correspond with the slip bottom upon which the structure has been built, the float is brought over the site and sunk by admitting the water into the compartments of floatation, or into such of the compartments employed for giving buoyancy to and sustaining the load as may be necessary. The float having been sunk into the required position, so as to place the bottom sustaining the wall or other structure upon the prepared site, the chains or other means by which the slip bottom was retained in its place during the building of the wall or other structure being released, the wall is left deposited on its permanent foundation and the float rises immediately to the surface. The vessel or float just described may be constructed with rounded ends, and finished, both as regards the exterior and interior of the compartments of floatation, according to the most improved method of ship building. The nature of this part of the invention is farther explained by the engravings in Plate 4.

Fig. 1 shows a transverse section of the vessel or float, with a set of wall built in it, also the plan of attaching the chains to the transverse beams and screw bolts for the slip bottom beam ends, which are all to be detached as soon as the vessel is settled and the wall set on its foundation; the vessel being then relieved is ready to be employed again for a similar purpose. Fig. 5 shows the deck or surface of the vessel, fig. 1, for carrying out a wall to be founded in water, or on sand where the water dries. Fig. 2 shows a transverse section of both walls, finished with beams, chains and hearting inserted. A higher parapet may be built at pleasure. Fig. 6 shows one of the vessels hauled stern on to the end of a portion of the wall formerly built, and is moored with seven chains and anchors, and in the act of depositing another length of the wall. The chasms in the bottom of the river are first made level by depositing rubble. Fig. 3 is a transverse section of a vessel, having the compartments for buoying out both walls as represented, and leaving cross beams of two feet at bottom, by which means two feet of masonry is allowed to rest on the foundation. and then a beam which runs several feet on each side, into which screw bolts are screwed into the outside vessels to keep them together as well as the chains to the top beams until the vessel has made the foundation, when all is scuttled and detached, and the outside relieved and hauled off; the longitudinal beams and cross beams are all bolted and chained together, which makes it to a certain extent as one solid rock, and calculated to resist the most exposed situations or heaviest sea. Fig. 4 is a transverse section of the above, finished off and hearted in with the extra batter above low water; when the action of the sea is more powerful than below, the parapet may be made any necessary height and more batter to the sea wall if required.

Another part of the invention consists in the application of a vessel constructed in compartments as already described to cleansing harbours. It is evident that a large quantity of water may be transferred to the place at which its scouring effects are required, and confined until low water and the slip bottom being let go the water may be suddenly discharged so as to produce an excellent scourer for cleansing the harbour.

Another part of the invention consists in certain arrangements for driving the piles occasionally required in constructing buildings in water or lighthouses on sand banks.

Another part of the invention consists in the application of the float or vessel above described to raising sunken ships or barges. The float (similar to fig. 6), is brought immediately over the ship or barge to be raised, so that the masts may come up through the centre compartment of the float, the ship's bottom being altogether sea over, where chains are placed about the sunken ship and made fast to the float.

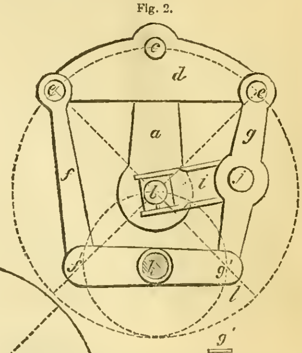
The Patentee does not claim the exclusive use of any of the several parts or arrangements described, except when they are employed for the purpose of his invention which he declares to consist in the application of the arrangements before described for the purpose of constructing buildings in water, cleansing harbours and raising sunken vessels.

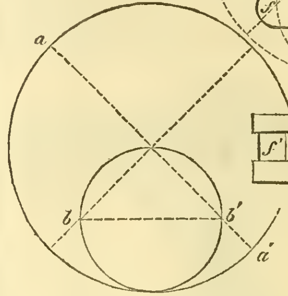
CONNECTING CRANK.

ELIJAH GALLOWAY, of Nelson Square, Blackfriars's Road, in the county of Surrey, for "*Machinery for connecting axes or shafts, whereby when in motion they revolve at different velocities.*"—Granted June 12; Enrolled Dec. 9, 1844.

This machinery or apparatus for connecting two shafts so as to cause the same to revolve at different velocities is illustrated somewhat in the following manner. Let *a*, *b*, fig. 1 represent the pitch-line of two wheels, the wheel *a* being twice the diameter of the wheel *b*; then for every revolution of the wheel *a* the wheel *b* will make two revolutions, and if a tracing point be attached at *b'* it will describe the straight line *a a'* upon the face of the larger wheel, and if another tracing point be attached at the opposite side of the small wheel *b* such points will describe straight lines at right angles to one another during the revolution of such wheels.

Fig. 2.





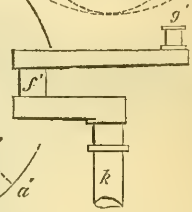


Fig. 1. Fig. 3.

In fig. 2 is shown an elevation of the arrangement of levers for connecting two shafts together so that they may revolve at different velocities. Fig. 3 is a plan of one of the shafts which is provided with a crank forming a portion of the apparatus. In fig. 2 *a* is a crank, fixed upon the end of a shaft *b*, supported by suitable bearings; *c* is the crank pin which supports the triangular arm *d*, through each end of which there are pins *e c*, in the same plane with the aforesaid shaft. these pins support two connecting rods *f*, *g*, the lower end of the connecting rod *f* being attached to the crank *f'* shewn in the plan, the lower end of the connecting rod *g* being attached to the crank pin *g'* of the plan; *b* is a pin fixed into the end of the shaft which carries one end of the connecting link *i*, the opposite end being attached to the centre or middle of the connecting rod *c* by the pin *j*; *k* is the axis of the shaft which is to receive motion from the shaft *b*, or *vice versâ*; consequently, if *g* be double the length of the connecting link *i* the point *g'* will describe a straight line *l l*, and if we suppose *g* to be attached at its lower end to the crank pin *g'*, and also the rod *f* to the crank pin *f'*, and that the axes *b* and *k* revolve in suitable bearings, *k* will make two revolutions whilst *b* makes one revolution.

There are other modifications of the above apparatus shown, for which the inventor claims machinery described for connecting axes or shafts to revolve in connection at different velocities.

IMPROVEMENTS IN IRON.

THOMAS LEVER RUSHTON, of Bolton-le-Moors, Lancaster, iron manufacturer, for "*certain Improvements in the manufacture of iron.*"—Granted June 21; Enrolled December 21, 1844.

The invention consists of improvements in the manufacture of malleable iron in reverberatory furnaces, and the manner in which the same are to be carried into effect is fully described and ascertained in the following statement.

In the manufacture of malleable iron from pig or refined iron it has long been the custom to throw hammer slack, roll scale, red ore, calcined iron stone, or other suitable material, consisting principally of oxide of iron, into the puddling furnace for the purpose of protecting the sides and bottom thereof, and with a view to feed or add to the weight of the product, owing to the decomposition of their oxygen by the carbon contained in the pig iron. The additional yield has however hitherto been only partially effected owing to the small quantity of carbon contained in the pig iron generally used for the purpose. The patentee's improvement in this respect consists in mixing the hammer slack, roll scale, red ore, calcined iron stone, or other oxide in a finely pulverized state, with a proportion of finely pulverized charcoal, coke, or other suitable carbonaceous matter, (which should be as free as possible from sulphur) and introducing the mixture into the furnace before, or along with, or immediately after the charge of pig or refined iron.

The mixture of ore and carbonaceous matter is from time to time turned over till the iron is melted, and both are then worked together in the usual way. The process is similar to that described by Mr. William Neale Clay, in the specification of his patent for improvements in the manufacture of iron, enrolled the 30th September, 1840, but the proportions I use vary from 17 up to (but not including) 28 per cent. in weight of carbonaceous matter to the ore or oxide, according to circumstances, whilst his invention is confined to combining carbonaceous matters in quantities not less than 28 per cent. by weight of the iron ores employed.

The proportionate weights of carbonaceous matter and ore or oxide which within the limits above named, the inventor uses, depend upon the quantity of carbon or oxygen they respectively contain, the description of pig iron used with them, and the relative proportions of pig iron to the mixture; he has found the following proportions give very excellent quality and yield of iron—to 480 lb. of No. 4 pig iron, the inventor adds 84 lb. of Lancashire hematite ore pulverized, and mixed with 20 lb. of powdered coke.

If No. 1 pig iron be used a still less proportion of carbonaceous matter will suffice, but if the charge of pig No. 4 be reduced to 420, and the ore increased to 180 lb., the coke should be 48 lb. The inventor does not limit himself to the definite quantities, nor the precise proportions of iron, carbonaceous matter, and oxide here given, as they will necessarily differ according to circumstances, but as a general principle, if the pig iron to be used be of a very fluid or highly carburetted description, such as is generally designated as No. 1 in the trade, then the proportion of carbonaceous matter to roll scale, red ore, or other oxide of iron, should be proportially less than if white or plate iron be employed, and the proportion of carbonaceous matter should vary according to the relative proportion of ore or oxide used with the pig iron, it being advisable to use a larger relative quantity of carbonaceous matter with the ore or oxide when the pig is comparatively reduced in weight than when more pig is used; it may also be added that when the mixture amounts in weight to one-fourth of the weight of pig iron charged, the mixture should be introduced into the furnace sooner than the pig iron, and turned over until it begins to adhere to the workman's "rabble" or tool, when the pig may be charged, but smaller proportions charged with the pig iron will generally come round by the time it is melted. The inventor does not prefer in any case introducing the mixture after the pig iron. The second improvement consists in the addition of clay, argillaceous ironstone, or other substance containing alumina to those ores or oxides which manufactured by the aid of carbonaceous matter into malleable iron in reverberatory furnaces, produce iron of the quality usually denominated red-short. The clay or other substance to be used should, like the ores and carbonaceous matter, be ground fine and dried before mixing, and a larger relative proportion of carbonaceous matter to a given quantity of ore should be employed than if no clay were added, as the clay in addition to its capability when fused, of taking up some of the carbon, will by diminishing the contact of the carbonaceous matter with the ore or oxide, prevent so complete a decomposition as would otherwise take place, so that generally more than 28 per cent. of carbonaceous matter will be required to the ore when clay is used. The proportion of clay to be used will vary with the nature of the ores employed, but from 4 to 10 per cent. in weight of the ore employed will suffice with the Lancashire hematite ores. If too large a quantity of clay be used the tap cinder will be very sluggish, and that ball when under the hammer will emit continued showers of darkish red cinder sparks, and if too little be added the iron will retain some of its red-short quality. The inventor has found the ground-fire clay from Worsley, near Leeds, very suitable as a substance for effecting this improvement. The last improvement consists in combining a portion of the tap or flue cinder of puddling or ball furnaces with a portion of clay, chalk, carbonaceous matter, and rich iron ore, or some of these substances, and manufacturing them either with or without pig or refined iron, in reverberating furnaces, into malleable iron. The same process of pulverizing, drying, and mixing the several materials, as well as their treatment in the furnace, as before described, must in this case be pursued.

To 150 lb. of tap cinder containing 71 per cent. of protoxide of iron, add 150 lb. of Lancashire hematite ore, 20 lb. of ground Worsley fire clay, 20 lb. of chalk, and 100 lb. of coke dust.

The inventor does not however limit himself to these or to any proportions of the constituents, when tap or flue cinder are employed as above, nor does he necessarily use iron ore with the cinder, though it is more advantageous to do so.

The inventor does not claim to have discovered the manufacture of malleable iron in reverberatory furnaces, either with or without a portion of pig, or scrap, or refined iron, nor the advantage of pulverizing the ores and carbonaceous matter, but he claims as his first improvement the manufacture in reverberatory furnaces in manner hereinbefore mentioned of malleable iron, by means of ores and carbonaceous matter mixed in proportions, limited as before, defined and combined with a portion of pig or refined iron.

In his second improvement he does not claim to have discovered the advantage of using a portion of clay or argillaceous iron stone in the manufacture of iron, from certain ores, that having long been done in the manufacture of pig iron from such ores, but he claims the use of clay as an ingredient to be employed in a pulverized state, mixed with certain ores and carbonaceous matter, also pulverized for the manufacture, both with and without pig or refined iron, of malleable iron in reverberatory furnaces.

In his last improvement he does not claim to have first applied a portion of tap or flue cinder, or other silicate of oxide of iron with lime or carbonate of lime and rich iron ore, clay, and carbonaceous matter, all these have been long used in the manufacture of pig iron, but he claims the manufacture of malleable iron from the combination of those substances, pulverized (both with and without pig or refined iron in reverberatory furnaces) as before described.

ELECTRIC TELEGRAPH.

Henry Heighton, of Rugby, Warwick, Master of Arts, Clerk, for "*certain Improvements in electric telegraphs.*"—Granted July 10, 1844; Enrolled Jan. 10, 1845.

The object of the invention is to adapt a system of telegraphing to common or frictional electricity. For this purpose the inventor uses an Armstrong's hydro-electric or other powerful electric machine, and with it charges a Leyden battery. He employs an instrument, different modifications of which are described in the specification, and which regulates the number of discharges sent, the intervals of time at which they are sent, and the nature of the discharge, that is to say, positive or negative. He shows that in 10 discharges any one of a number of more than 16,000 signals may be made, or in 30 discharges any one of more than 1000 millions if necessary.

The method of observing the signals at the place to which they are sent is by means of two wires, the one communicating with the place from which the signals are made and the other with the earth, which are placed perpendicularly to a sheet of paper or similar substance, which is moved along by clock work, so that each discharge shall pass over the surface and through the substance of the paper, making a hole close to the wire from which the negative electricity proceeds. This paper is coloured with chromate of lead, which is easily decomposed by the electric spark, and moistened, if necessary, with sulphuric acid to facilitate the passage of the spark. Thus the sparks leave on the paper a kind of printed register of the signals which have been made. Other methods of observing and registering the signals are described, where the electricity, after having traversed a great distance, is too weak to produce the effects just described.

GOLD PAINT.

Henry Bessemer, of Baxter House, St. Pancras, in the county of Middlesex, engineer, for "*a new pigment or paint, and the method of preparing the same; part of which method is also applicable to the preparing and treating of oils, turpentine, varnishes, and gold size, when employed to fix metallic particles and metal leaf, or as a means of protecting the same.*"—Granted Jan. 13; Enrolled July, 13, 1844.—(Reported in the *London Journal.*)

The new paint, which constitutes the chief part of this invention, is made by mixing metallic powders, (known as bronze powder,) with gum-resins, oil, and turpentine, in such proportions as to form a fluid, capable of being used in the same way as oil paint.

The following is the mode of preparing the paint:—Into a copper or other vessel placed over a brisk fire, 8 pounds of gum copal are thrown, and the heat is so regulated that the gum will fuse in about 20 minutes. An addition is then made of 2½ gallons of drying linseed oil, heated to nearly the boiling point; the oil being introduced in small quantities, and the mixture well stirred up. The mixture is now boiled for about two hours (skimming off any impurities that may arise); after which it is allowed to cool to 150° Fahr., and 25 gallons of turpentine, heated to 150° Fahr., are slowly introduced, and thoroughly incorporated with the mixture, by stirring; 1 gallon of slaked lime, or other alkaline matter, is then added, and the mixture allowed to rest for three days. When this time has expired, the fluid portion of the mixture is drawn off from the lime, which will have subsided, and is then mixed with the metallic powder, in the proportion of five parts, by weight, of fluid, to four parts of powder. The metallic powders preferred by the patentee, are those manufactured by the process for which he obtained a previous patent.

That part of this invention which is "applicable to the preparing and treating of oils, turpentine, varnishes, and gold size, when employed to fix metallic particles and metal leaf, or as a means of protecting the same," consists in neutralizing the acids that are combined with those materials, by the use of lime or other suitable alkaline matter.

The acids in gold size, and such varnishes as are employed to fix metallic powders and metal leaf in japanning, paper staining, painting, &c., are neutralized in the following manner:—One pound of slaked lime is ground, by means of a mullar, with as much of the gold size or varnish as will reduce it to the consistence of ordinary oil paint, and this mixture is added to the gold size or varnish, in suitable proportions for neutralizing the acids contained therein. In treating oils, turpentine, or such varnishes as may be used to protect the metallic powders or metal leaf, the lime, or other alkaline matter, which is added to them (for the purpose of neutralizing the acid), must be subsequently separated by filtration; but if any of the oils or varnishes should not be sufficiently fluid to pass through a filter, they are made so, by the addition of spirits of turpentine, which is afterwards separated from them by evaporation.

The patentee claims, as his invention, firstly, a pigment or paint, consisting of bright metallic particles, combined with purified gums, oils, or spirits, in such manner, and in such proportions, as to form a painting fluid. Secondly, the method, hereinbefore described, of preparing a fluid for the purpose of mixing with metallic particles or powder (known as bronze powder), and forming thereby a pigment or paint. Thirdly, the combination of lime, or other suitable alkaline matter, with such gold size or varnish as may be used in fixing metallic powders and metal leaf. Fourthly, the use of lime, or other suitable alkaline matter, for the purpose of neutralizing the acid contained in such turpentine, oil, or varnish, as may be used as a covering or protection to metallic powders and metal leaf, and the means, hereinbefore described, of effecting the same.

IMPROVED STEAM BOILER.

WILLIAM FAIRBAIRN and JOHN HETHERINGTON, of Manchester, Engineers, for "*certain Improvements in stationary steam boilers, and in the furnaces and flues connected therewith*."—Granted April 30; Enrolled October 30, 1844.—(*With Engravings, Plate V.*)

The engravings Plate V. shows an improved boiler, by Mr. Fairbairn of Manchester, wherein is embodied many important qualities, both as regards the economy of fuel, and what is almost of equal importance, the prevention of smoke. It is perfectly cylindrical, and contains two circular tubes or flues, varying from 2 ft. 6 in. to 2 ft. 9 in. diameter, which extends from the front to the further extremity of the boiler. For a distance of 6 or 7 feet from the front, the flues are made elliptical in order to receive the furnace and grate bars, and to give room not only for space over the fire, but to increase the capacity of the ash pit, and to admit a sufficient supply of air under the bars. On this principle of construction, it will be observed that each furnace is surrounded by water in every direction, and to prevent injury to the plates, the water spaces are in no instance less than 5 to 5½ inches wide. These water spaces are of considerable value, as the flues from their curvilinear form recede from each other at the line of the horizontal centres, and by these means the water spaces are enlarged above and below the furnaces, and much greater security afforded both as regards the durability and wear and tear of the parts.

Another advantage is the facility with which the sedimentary deposits take place, and as these deposits are not immediately over the furnace, but close to the discharge cock, where the temperature is lowest, it follows that less risk is incurred, and greater security afforded than could possibly be attained in the old construction. These advantages are peculiar to this construction, and on reference to the engravings Plate V,, it will be seen that these deposits can never be injurious, as exclusive of the cock, which is placed at the lowest point in front, for discharging the sediment as it settles. There is in addition a manhole for cleansing and thoroughly securing the interior as often as accumulation takes place.

Another feature in this construction, is the perfectly cylindrical form of every part, which (with the exception of the two furnaces being slightly elliptic,) gives the strongest form, and thus ensures safety under any pressure, not exceeding 40lb. on the square inch.

This appears to be a great improvement over the square and wagon shaped boilers, which, with the same thickness of plate, cannot be worked with safety above 10 lb., without the introduction of heavy stays to resist the pressure and retain the boiler in shape.

Objections have been taken to the cylindrical boilers with internal furnace and large single flue, as constructed in Cornwall. It has been alleged that the boilers are insecure, from the small quantity of water which they contain; it is, however, well known that the security does not depend upon the cubical contents of water contained in the boiler, but from the depth and area of its surface over the flues. If for example a wagon boiler is taken (having an interior flue,) 24 feet long, and 6 ft. 6 in. wide at the water line, with 9 inches depth of water over the flue; and again, if we contrast with this a boiler of the circular form of equal evaporating powers, of the same dimensions at the water line, and with equal depths of water over the flue, it is evident that in case of neglect or injury to the feed pumps that the rate at which the water will be reduced will be the same. This is easily proved by the quantity of water evaporated, which in both cases, being equal to $24 \times 6{\cdot}5 \times {\cdot}75 = 117$ cubic feet. 117 cubic feet of water must, therefore be evaporated in both cases before the surface of the flues is uncovered. In fact the only advantage gained even in this respect is, the wagon or square boiler being less subjected to danger arising to the plates from the fire not being in the flue, as the heat in this case is considerably reduced before it reaches that part, but this is more than compensated by the increased powers of evaporation, which are so strikingly exemplified in the circular boiler from the rotundity of the flues, which in the event of accident or neglect expose much less surface of dry plate to the action of the fire.

As the evaporative powers of a boiler depend upon the quantity of flue surface which it contains, we may probably venture in this place to trace the comparative merits and peculiar advantages belonging to the old and new forms. In this enquiry it is not our intention to enter upon a strict analysis of principles, but simply to enquire into facts, and by comparison to ascertain the best and most economical form of construction. It is well known, practically and experimentally, that the evaporative powers of a boiler follow a certain ratio as compared with the amount of flue surface exposed to the action of the fire, and also as respects the relative area of grate bar surface in evaporating a given quantity of water and producing a certain effect Now, if we take as the maximum quantity 12 square feet of flue, and 100 square inches of grate bar surface to the horse power, we shall then have the comparative values of the wagon boilers and that now under consideration.

Taking boilers of the same dimensions as before, we shall have for the wagon boiler 502 square feet of flue surface, and for the improved circular boiler 529 feet. This gives an excess of 27 feet, which taken at 12 square feet to the horse power gives 41·8 for the wagon, and 44 horse for the cylindrical boiler. But this is not the only advantage of the improved form, as the position of the flues are much more favourable in the latter as an absorbent than in the former, where a great proportion or the whole of the side flues are vertical, and in a less favourable position as recipients of heat.

In this comparison it is assumed that the area of grate bar surface is the same. Having stated this much, it will be necessary first to describe the drawings, and subsequently to state the process by which the results already noticed are obtained.

DESCRIPTION.—*Reference to Engravings.*—Fig. 1 represents a plan and longitudinal section of the boiler with double flues and double furnaces, and figs. 2 and 3 a transverse section and end view. In these representations it will be seen that the gases emitted from the furnaces *a*, *a x*, are conducted along the internal tubes into the return flue *b*; from *b* they cross under the boiler below the ash-pit into the flue *c*, and from thence along the opposite side of the boiler into the main flue *d*, which communicates with the chimney. From this description it will be observed that the gases do not unite until they have reached *e e*, at the end of the boiler. At this point a change immediately takes place in the gaseous products, and that from one of two causes, as follows. Suppose the furnace *a x* to be newly fired, and the fuel in furnace *a* in a perfectly incandescent state, it then follows that the gases passing from *a* will not only be different in their constituents to those from *a x*, but they are at a much higher temperature, and both furnaces having received air as a constant quantity through the fixed apertures *f f*, it will be seen that in the event of a surcharge of air on one side and a diminished supply on the other that their extremes are neutralized by the excess of oxygen, and the increased temperature which effects ignition at the point *e*, where combustion takes place. All that is therefore necessary is to replenish the fires alternately every 20 minutes, in order to effect the combustion of the gases without the least appearance of smoke. These, and the increased recipient surface, are the leading properties of this boiler, which compared with others having single flues, is found to be greatly superior, either as regards the combustion or the economy of fuel.

BORING APPARATUS.

ROBERT BEART, of Godmanchester, Huntingdonshire, gentleman, for "*Improvements in apparatus for boring in the earth and in stone*."—Granted July 12, 1844; Enrolled Jan. 1845.

This invention has for its object the so arranging of apparatus used when boring in the earth and in stone, that the parts cut or moved by the boring tools may be constantly removed by a flow of water. It is well known that when boring in the earth that the tools and apparatus employed are constantly being raised, in order to bring up the soil or matters cut or moved by the tools, which renders the practice of boring very expensive; and the inventor has discovered that in many cases he can employ a current of water to bring up the soil or matters cut or moved by the tools, by which the work of boring may be carried on for a great length of time without lifting the apparatus and tools, and the only cases in which his invention is not applicable are where the soil through which the boring is desired to take place will not retain water, so as to allow of a constant current being kept to flow upwards in the boring: for this purpose the patentee has an apparatus for boring in the earth. An excavation is first dug, which during the boring is kept constantly full of water, the boring is made by any suitable tool fixed at the lower end of a tube acting as the bar for giving rotary motion to the tool, and at the same time it acts as one of the limbs of a syphon, through which there will be caused a constant rising current of water to carry up the soil and matters cut or moved by the tool below. The tube is made square, on the outer surface a bar is fixed at any part, by which manual or other power may be applied to turn it. The tube is composed of many pieces, which are successively added, as the boring is increased in depth, by screw joints, in such manner that the turning of the tube when at work tends to lighten the screw joints. At the upper end of the tube there is a pump in order to fill the tube with water before starting to work; as the means of giving motion to the tool or cutter used, the upper end of the tube is suspended by means of the bar which embraces it, such bar being supported by chains passing over pulleys and having weights applied thereto. Connected to the upper part of the tube is the descending limb of a syphon, made with a water tight joint so that it can rise and fall to accommodate itself to the descent of the tube. The descending leg of the syphon apparatus enters into a reservoir, into which the current of water passing through the tube and descending limb of the syphon enters constantly, carrying with it any soil or matters which have been cut or moved by the tool or cutter; and there will be a constant flow of water through the tube so long as the water stands in the excavation at the top of the tube at a higher level than in the reservoir, and it is by having a constant current of water down the boring outside of the tube that the earth and matters cut and moved are carried up; and it will only be desirable further to remark in respect to this part of the invention, that the direction of the currents may be reversed by any suitable supply being constantly caused to descend down the tube and ascend up the cutting, but he believes the means of obtaining a constant flow herein described to be the best for carrying out this invention.

EXPOSITION OF FRANCE, 1844.

(With Engravings, Plate III.)

We continue our account of the recent Exposition at Paris, but we must observe that we do not hold ourselves responsible either for the originality or utility of the inventions described. The descriptions will, however, be of interest to our readers, as illustrating the progress and present state of engineering in France.

M. Stoltz's Engine.

This engine is of great simplicity; it has neither cocks nor valves. The cylinder oscillates upon an axis fixed or the lower end of the cylinder, in the bottom of which are openings for the admittance of the steam and exhaust passage, which opens and closes with the oscillation of the cylinder. Fig. 1, Plate IV., represents an elevation of the cylinder, and fig. 2 the expansion valve gearing.

M. Legendre's Oscillating Engine.

M. Legendre exhibited an engine on a new plan; instead of the cylinder oscillating it is the piston rod only, this arrangement very much simplifies the moving parts. In 1836, Mr. Francis Humphrey, in England, applied an oscillating piston rod, which vibrated in a trunk that was attached on the top of the piston and moved through a stuffing-box in the lid of the cylinder, *(See Journal*, vol. 3, 1840, p. 142), as applied on board the *Dartford* steam boat; one great objection to this system was on account of the large area on the top of the piston occupied by the trunk being rendered ineffective, and consequently the pressure of the steam on the two sides of the piston was unequal, and caused an irregularity in the movement of the engine.

In M. Legendre's engine the piston rod is articulated to the crank and the other end to the top of the piston by a vibrating joint, which enables the power to be transmitted direct from the piston to the crank. In the cover of the cylinder there is an opening or slot of sufficient size to allow the piston rod to vibrate freely, but this opening is closed by a ball and socket joint being attached to a sliding plate, transversely in the thickness of the cover in grooves or guides; the radial movement of the rod is secured by the ball and socket stuffing-box, which is connected by two small steel axes to the traversing plate; this allows sufficient play for the piston rod to move the crank freely.

It is stated that one of these engines was constructed in 1843, and that it has proved there is not the least escape of steam in the traversing plate or the ball joint stuffing-box, although the pressure of the steam has been from one to five atmospheres. When the vacuum was produced under the piston the pressure of the steam against the plate was sufficient to make a perfect joint, and when over the piston the packing in the stuffing-box kept the plate in perfect contact with the underside of the cover.

The engravings show an engine of 10 to 12 h. p. to which the system has been applied. The engine it appears is well adapted for steam boats, as a steam vessel with engines of this description of 200 h. p. has been lately constructed for the King of Naples.

M. Legendre took out a French *brevet* for this engine Jan. 3. 1842, and in consequence of some additional improvements he took out another *brevet* Jan. 23, 1844; Mr. John Harvey has also taken out a patent in England and Mr. Parkyn in America for the same engine.

Reference to Engravings, Figs. 1 *and* 2, *Plate IV.*

A, piston rod; B, stuffing-box with a ball and socket joint, E; C, plate under the cover sliding in a groove, I and I′; C, C′ small plate of bell metal covering the opening in the cover, to prevent dust or dirt getting in; H, H′, piston with metallic packing; J, steam chest; and L, steam valves.

Bourdon's Expansive Gearing.

M. E. Bourdon's expansive valve differs from those already described, *(See Journal*, vol. vii., 1844, p. 326,) by the disposition of the parts forming the steam passages, so that the admission of the steam will be instantaneously cut off on entering the cylinder, the engravings figs. 1 and 2 will sufficiently explain its construction. Fig. 1 is a section through the middle of the valves and passages, and fig. 2 a view of the face of the valves with the plates for closing the steam passages. A, is the cylinder with the passages; B, valve box; C, slide valve pierced with four orifices in pairs; D, D, small plates for closing the orifices, turning on axes of steel; E, a regulator, the extremities of which are terminated by pallets, it oscillates on a conical axle, which passes through the outside of the steam box, and is then attached to a small lever for the purpose of regulating it by hand or by apparatus attached to the working parts of the steam engine; F, F, two stops, the length of which determines the opening of the orifices for the introduction of the steam at each stroke; G, steam pipe. The movement of this apparatus is very simple; if the regulator, E, be inclined one way so that the pallets do not come in contact with the moveable plates, D, D, the steam will enter during the whole stroke of the piston, and if inclined in the opposite direction the orifice will be closed: the closing of the orifices will take place more quickly when the pallets are made to come in contact with the plates, D, D. By these means the expansion can be regulated so that the steam can be cut off from $\frac{1}{20}$ to $\frac{1}{2}$ the stroke of the piston. When it is requisite to expand from five to seven-tenths, for example, it is sufficient to employ an eccentric cam regulated so as to permit the steam to enter during those limits.

Farcot's Engine.

This engine, figs. 1 and 2, Plate III., was one of the most remarkable exhibited by M. Farcot. It was in the form of a hollow column, possessing the properties of simplicity and stability. This hollow framing, cast in a single piece, gives a greater degree of firmness than is to be found in framing with four pillars. It is one of the best plans for engines where the shaft is above, and susceptible of many applications, and particularly for engines of a few horse power. It would, however, be desirable to adopt for the machinery an arrangement more accessible, for it is often necessary to get at the machinery, and the interruptions should be as short as possible.

HISTORY OF ARCHITECTURE.

A Brief View of the General History of Architecture, from the Earliest Periods of Egyptian Art to the Middle of the XVI. Century. By Thomas Leverton Donaldson. *(Read at the Royal Institute of British Architects,)*[1] *Monday, January* 13.

To those, who devote themselves to the profession of architecture with a real love for the pursuit, instigated by a passion to follow out a noble study from the delight it affords, whether considered as an art or a science, or from its intimate connection with the history of all periods of the world, and its illustration of the habits and feelings and intellectual developements of every nation, it is apparent, that the satisfaction derived from the contemplation of the individual monuments of those, who have preceded us, falls far short of all the interest with which those monuments are capable of being invested, unless we associate with those impressions other considerations connected with the purposes for which they were erected, with their history and with those elements, beauty and propriety, in an esthetic point of view, which give a finished charm to the majesty and proportions which they exhibit.

It is not my purpose at this time to follow out so vast a subject, but I am anxious to invite your attention to one part of it, and to ascer-

[1] [We are indebted to Professor Donaldson for the liberal use of his rough notes, the conclusion of which we shall present in our next number. In availing ourselves of this permission, we would urge upon the members of the Institute and the profession generally the propriety of following the laudable example of Mr. Donaldson, and by their labours contribute to the reputation and usefulness of the Institute. Few can plead the excuse of want of time or pressure of professional occupations so strongly as Mr. Donaldson, yet few are so ready to devote their time for the public advantage, and the interests of the profession to which they belong.]

tain your opinions upon some crude ideas, which have for some time been floating upon my mind as to the continuous stream of architectural history, by which, as it appears to me, an intimate connexion may be perceived to exist between the architecture of all countries and every period—a direct succession in which the monuments may be traced up to one common source, varied it is true by the taste and caprices of the several nations, but containing features and principles in common; monuments not owing their existence as works of art to chance principles and fortuitous combinations, but founded upon existing types modified by local circumstances.

The diagram by which I propose to illustrate this view of the subject is like a river with its various branches, ultimately swollen into an ample stream with a common exit. This you are aware is a common mode of illustrating historical facts, and has been partially adopted by M. de Caumont in his able work on Gothic architecture. In the present instance it will be more largely applied and by giving distinct tints to the styles of architecture of various countries and modified tones to those affected by confluent influences, we shall mark distinctly the gradual progress of our art from the earliest existing monuments to those of a recent era. On each side of this stream of architecture are columns containing dates, the one having the names of the leading characters in each century, who mark certain epochs in architecture, and the other some leading historical events having reference to the same leading subject.

Having thus alluded to the more prominent features of the sheet before you, we will now proceed to consider the subject in question.

The earliest authentic history of any ancient nation is that of the Jews; and from the reverence with which it must be regarded by all here, I need not insist upon the authenticity of the leading facts; but with regard to the dates much variety exists among chronologists. I shall not venture to enter upon such debateable ground, but shall assume at once the dates generally accepted. We shall, therefore first consider the corresponding epochs of Jewish history, and the computed dates of the existing monuments of Egypt, which are held indisputably as the earliest architectural remains, which the destructive hand of time has spared.

The Tower of Babel is supposed to have been built about 2247 B.C. or 100 years after the waters of the flood had retired and left the face of the ground dry. To the Great Pyramid is assigned the date of 2100 B. C., about 100 years before the death of Noah, which took place in 1998 B. C.

These are the three most striking events of the first period of our table. We find the descendants of the three sons of Noah so multiplied within 100 years as to be able to build a lofty tower of such magnitude as to excite the displeasure of the Almighty, from the presumptious imitation of the builders to make it reach even unto the heaven. This must have had a widely extended base, and was doubtless built in steps in order to afford facility of access to enable them to reach the top, and we learn also that it was built of burnt brick—a coincidence the more remarkable as we find that material mentioned in the Scriptures in reference to the occupation of the Jews under their hard task-masters in Egypt—and some of the less pyramids of Egypt and Nubia are built of the same form and materials. Canina leaves undecided the question as to the priority of Thebes or Memphis in regard to their origin, being unable to decide between conflicting authority of ancient authors.

Manethron records Tosorthrus or Sosorthus, the successor of Necherophes, the head of the third dynasty, as the discoverer of the art of sawing stones. The same writer also attributes to Saphis the erection of the prior pyramid, referred by Herodotus to Cheops.

The tombs of Beni Hassan seem to have been excavated 1000 years before the Trojan war (1180 B. C.), and they may be considered as the earliest types of the mystic styles which pervaded all the monuments of Upper as well as Lower Egypt. The Temple of Aboo Simbel is one step in advance upon the sepulchral avenues of Beri Hassan. Here the excavated chambers are enlarged and greater developement given to the antechamber; and again, the Temple of Guircheh is a still greater expansion of the primitive idea. The original tomb had subsequently added to it a fore court and a front pylon or entrance gate, which obtained in all the later temples of any note.

These three steps in Egyptian architecture mark the progression of the ideas of the people in that art. Their first construction, or as it may be rather called architectural formation, was a long and narrow passage with occasional enlargements to receive the embalmed remains of the dead. A mysterious and of itself an obscure abode of the departed. But the Egyptians did not stop short here, these were abodes of the departed, which might vie with the dwellings of the living. The pillars were left to uphold the roof, as in the excavations of our coal, gypsum, and stone quarries; the ceilings now flat, now curved, now inclined to a pitch, and the walls were covered with a profusion of sculptured incisions, painted in various brilliant colours and representing in splendid series the deeds of the king or hero, his judgment and glorification. These pillars were with the Egyptian the original types of their after columns—massive, short and simple in their parts. The same piers more profuse are at Aboo Simbel, and more embellished, having standing and attached figures of deities in front. The whole surfaces of the interior are covered with sunk sculptures, also enriched with dazzling tints, and the front rendered important and magnificent by the four gigantic sitting gods, who seemed to guard the portal of the sacred excavation, and to preside over the destinies of the river which flowed at their feet. The Temple of Guircheh seems by its propylon and fore court to keep the respectful worshipper still more remote from the fane, and to induce a preparation of mind ere he enters the hallowed mysteries of the place. We find the four colossal attached figures in front of Aboo Simbel removed here to the front of the propylon, detached and independent of the wall; and the solar ray, the emblem of their great divinity, embodied in the obelisk, an additional symbol in the round of mysterious devices in which the Egyptian priests enshrouded their theology.

In all the endless successive dynasties, and the dominion of varied conquerors, piles of gigantic dimensions, groups of enormous extent and colossal proportions, rose on the banks of the Nile; each ruler seemed ambitious to mark his reign by a stupendous monument of his glory, or to propitiate the favour of their cherished gods by successive additions to their vast temples, or by pompous accompaniments, such as propylon, courts, obelisks, colossi, and paved ways bordered with endless avenues of multiform sphinzes—Carnac and Luqsor, above a mile apart, were united by a stone platform of such a character, and other ways diverged from various parts of the precinct to the several quarters of Thebes. The square pillars of the caverns of Beni Hassan were gracefully rounded in the porches and halls of Carnac and Luqsor; at Thebes the Egyptians called in aid the elegant forms to be found in the plants of the Nile, or in the vegetable productions on its banks—the bud of the lotus and its developed flower gave features for the general outline of the capitals of the columns, and the palm tree and bundles of reeds occasionally suggested an idea for the shafts of the pillars.

I have been led to dwell somewhat at length upon these leading features of Egyptian art, as they seem to point out the original types of classical architecture.

REVIEWS.

Ancient and Modern Architecture. Edited by M. JULES GAILHABAUD. Series the Second. London: Firmin Didot. Parts 21 to 26.

We have so often had occasion to speak in praise of this useful and valuable serial, that we are almost inclined to fear that our readers may consider we award our approbation with little discrimination, or as a matter of course. We must however, again perform our duty, and express the pleasure we feel in its successful progress as testified by the parts before us. When the first series was completed we expressed our hopes that the work would not thus close; a new series has since been carried on, and we are pleased to find our hopes so fully realized. The present series contains so much matter of interest, and so much instruction that it would have been a subject of great regret had M. Jules Gailhabaud paused in his labours. The numbers now before us have many examples of early Italian works, which may be advantageously studied by the church architect, and there are also many other features of interest. We find the church of St. George at Valabro, a most ancient monument, given with many details; the Mosques El Moyed and Hassan, at Cairo; the ancient Greco-Italian church of San Miniato, near Florence, given very minutely; the Amphitheatre of Pola, and the Acropolis of Mycenæ.

The Basilica of St. George of the Velabro, being a very curious example, and illustrating many minute points in connection with ancient ecclesiastical and architectural practices, we have made some extracts from it.

"Between the Tiber and the Capitol, in a place formerly called *ad Velum aureum, ad Velum auri*, corrupted into *Velabrum* and *Velavrum*, in the midst of edifices which, from their architecture and general structure, must be attributed chiefly to the first ages of Rome, stands a little church, built in the seventh century by Pope Leo II., with materials taken from the ruins of the Civil Basilica, erected by Titus Sempronius, on the site previously occupied by the house of Scipio Africanus. This church was originally dedicated to St. Sebastian and St. George the Martyr, as we are informed by the librarian Anastatius, in his life of its founder: "*Hujus alumni pontificis jussu ecclesia juxta Velum aureum in honorem beati Sebastiani ædificata est, nec non in honorem Martiris Georgii.*" (Vita Sancti Leonis, papæ II. p. LVII.) "The church near the *Velum aureum* was built by the order of this venerable pontiff, in honour of St. Sebastian and St. George the Martyr." Vasi, Ugonio, Piazza, and Panvini, are of opinion, notwithstanding this positive assertion of the librarian, that the church was already in existence in the time of Gregory the Great, and that he made its name the title of a cardinal deacon, and had it renovated by the Abbé Mariniano.

In 745, Pope Zacharias, who was of Greek extraction, and professed great veneration for the patron saint of this church, made considerable repairs, and removed there, in solemn procession, the head, spear, and helmet of St. George, which had been found in the Latran Palace, accompanied by a Greek inscription stating their identity. These precious relics are still preserved in the church. At the beginning of the ninth century, the edifice having suffered greatly from the injuries of time, Pope Gregory IV. rebuilt the portico and ornamented it with paintings; the apsis also was repaired from the foundations, and the sanctuary was restored to its original state. The Pope Gregory, as the librarian informs us, in addition to these proofs of his munificence towards the Basilica, supplied it with sacerdotal vestments, and other decorations. Ugonio thinks the church must at some very early period have belonged to a Greek congregation, as in his time there were many Greek inscriptions on the pavement, but so effaced by the crowd of worshippers frequenting the church, as to be almost illegible. This opinion appears so much the more probable, from the fact that St. George, who was of Eastern origin, is held in great veneration by the Greeks, who entitle him "the Great Marshaller of Combatants," *των αθλητων ο μεγας ταξιαρχης*, and in all ages have raised the most magnificent temples to his honour. There was a ceremony performed every year in the church of the Velabrum, which shows that the Latins also attributed to him military functions, calling him "the Dispenser of Victory," *Victoriarum largitor*. On the 23rd of April, St. George's day, the gonfalonier of Rome, followed by the magistrates, used to carry the national standard in grand procession to the church, where it was blessed during the celebration of mass, and then carried back to the Capitol.

In the last century the church of St. George in Velabro belonged to the barefooted Augustines; Pius VII. afterwards gave it to the congregation of the children of *Sancta Maria in Pianto*, to which it still belongs.

The rich presents of Pope Gregory IV. have long since disappeared; and the church is now one of the poorest in Rome, but it has lost nothing of its interest as a religious edifice of the early times of Christianity, and as such we shall now proceed to describe it in detail.

The ground plan is in the form of the Latin basilicas, but not quite so long as usual; it presents on the southern side a defect of parallelism difficult to explain; divided into a nave and two side aisles, the nave alone is terminated at the eastern extremity by an apsis, or semi-circular tribune; a porch with four columns in front, and very wide openings on its north and south sides, precedes the edifice; on the north, it is supported, as is also the steeple, on one of the pillars of the little arch, which the goldsmiths of Rome erected to Septimus Severus.

The façade is surmounted by a pediment, supporting a cross. The roof, which has the same pitch as the pediment, was rebuilt about the middle of the fifteenth century, in the pontificate of Sixtus IV., by order of Cardinal Riario; below the pediment is a circular opening, or *oculus*, which lights the nave. The porch extends nearly the whole length of the façade; it is composed of four monolithic columns, with Ionic capitals passably executed, and of two large corner pillars crowned by mouldings and fragments of antique sculpture, forming a reticulated frieze. All this order stands on a plain, continuous stylobatum, which is interrupted only before the church door, and at the extremities of the porch. The entablature over the columns is rather heavy in its proportions. The architrave, crowned by a double moulding, bears an inscription. Under the soffits, between the capitals, a number of rings are still left, to which the curtains were suspended that used to hang in the intercolumniations, for the purpose of keeping the scorching rays of the sun off the penitents, who waited under the portico until they were allowed to enter the temple.

The frieze is plain, except at its extremities, which are decorated with two lions' heads, memorials of the ancient custom of administering justice at the church door, *inter leones*, between the lions. The upper cornice, consisting of bricks, marble mullions, and composition laid on burnt clay, is heavy, and with the frieze (which is too high) helps to give the whole a clumsy aspect, as we have already remarked. The porch is covered with a high roof, the wood-work of which is visible from the interior.

The present porch is not the one built and ornamented with paintings by Gregory IV.; the old one having fallen to decay, another was built in its place by one of the priors, named Stephen, who lived about the twelfth century, if we may judge by the form of the letters of an inscription then engraved on the architrave. *Stephanus ex stella cupiens captare superna.—Eloquio rarus, virtutum lumine clarus.—Expendens aurum studuit renovare pronaulum.—Sumptibus ex propriis te fecit, sancte Georgi.—Clericus hic cujus prior ecclesiæ fuit hujus.—Hic locus ad Velum prænomine dicitur auri.* This portico having become dilapidated, it was repaired by order of Clement IX.

As we have already said, in describing the plan, one of the angles of the porch stands on the arch of Septimus Severus; the steeple also stands on another part of the same arch, and from the close analogy between the cornices by which it is divided into five stories, and the cornice on the porch, it ought perhaps to be attributed to the same epoch. Most of the steeples in Rome were erected in the twelfth century, before which time they were but rarely seen; from these facts, we may therefore infer the date of the one added to this church. All the arches in the different stories are semi-circular; the lower limbs of those in the upper stories rest on marble columns with heavy capitals, in the style common to those executed at the date we think ourselves justified in assigning to this part of the church.

The porch of St. George in Velabro is paved in what is called *opus spicatum*; in the middle is a large door leading into the nave; the doorposts and lintel are three fine fragments of antique sculpture. The two leaves of the door are hung to a wooden frame. The body of the church contained originally a nave and two aisles, divided by sixteen columns, in two rows; only fourteen, however, are now visible, as by the erection of a steeple on one side, and a little vestry on the other, two of them are enclosed in the masonry. Ten of these columns are of gray granite, and four of Parian marble. The capitals are extremely irregular, being mostly Corinthian on the left, and Ionic on the right, of the nave; some of them being narrower than the wall they support, the lower limbs of part of the arches are bevelled off to the same width. Windows arranged symmetrically over the intercolumniation light the interior of the church; above them runs a plain cornice supporting a wooden ceiling, totally devoid of ornament. The side aisles are decorated with little altars in very bad taste. In the middle of the southern aisles is a door opening into a very narrow garden, used as a playground for the children of the congregation. The northern aisle had a similar door, which is now walled up. These two entrances, thus placed on the transversal axis of the building, confirm Ugonio's opinion alluded to above; and, in fact, this practice of having doorways in the sides is still very common in Greek churches.

The Composite capitals of the pilasters are of a style and execution very unusual. Between the two pilasters at the back and about two-thirds of their height, is a little square window with a very close lattice. All the intervals between the pilasters are filled with an elongated compartment extremely simple. A complete entablature without ornaments in its mouldings runs along the base of the semi-cupola above the pilasters, and is prolonged across the anterior face of the apsis to the side-walls of the nave.

Over the cornice and under the great vertical circle of the vault, there is a painted ornament tastefully composed and in perfect harmony with the rest of the decoration; it encloses a large religious subject, which occupies the whole of the hemispheric part. In the centre of this picture there is a colossal figure of Christ, with a cruciferous aureola about his head; his right hand is raised, and his left holds a scroll; his feet stand a terrestrial globe. On the right of Jesus, is the Virgin Mary; farther, on the same side, stands St. George, in warlike costume, holding his standard and leaning on his horse. On the left, is St. Peter, with the keys of Paradise in his hand; near him, on the outside of the picture, is St. Paul, begirt with a sword.

Though the church of St. George in Velabro has undergone many renovations in the long lapse of centuries since its erection, and some parts have even been built quite new, the primitive character of the edifice remains unimpaired. This uninterrupted adherence of successive artists to the Latin style in the erection of churches, is one of the most curious facts in the history of Christian architecture at Rome; especially when we reflect that, for more than six hundred years, all Europe has been covered with buildings in the Norman and pointed-arch style. But we shall often have occasion to repeat this observation when we come to describe the Christian edifices of Rome which were erected before the sixteenth century."

Ecclesiastical Architecture. Decorated Windows. Edited with descriptions, by Edmund Sharpe, M.A., Architect. London: Van Voorst. Part I.

This is one of the works we announced some time ago as forthcoming from Mr. Van Voorst's library, and calculated to be of some interest and utility. This opinion is not diminished by the appearance of the first part, which contains eight authentic examples of windows in the decorated style. The examples are well chosen, and have interest in themselves, and they are brought out with the finish which usually characterizes Mr. Van Voorst's works. We would, however, particularly call attention to some points of considerable importance, and which would greatly improve the series. We would suggest that at the bottom of the drawings the contour or section should be given of the mouldings, and that in the drawings, the jointings of the stones should be accurately marked. It is also desirable that the dimensions of the parts should be given, and not merely the rough measurement, of the opening of the windows. We do not perceive that Mr. Sharpe has in any case given the age of the churches from which the examples are taken.

A Thermometrical Table. By Alfred S. Taylor. London: Willats, 1845.

Mr. Taylor is lecturer on chemistry in Guy's Hospital, and he has published a table with accompanying description, which by inspection, gives the corresponding degrees of the scales of Fahrenheit and Reaumur and the Centigrade scale, at the same time that it exhibits a most copious list of the temperatures by which various substances are affected. It is calculated to be highly useful, is very elaborate, and from Mr. Taylor's high character, we have every reason to presume it is very accurate.

Papers on Subjects connected with the Corps of Royal Engineers. Vol. 7. London: Weale, 1845.

This work prospers under its editor, Captain Denison, and the present volume contains many valuable and practical papers, although it is to be observed that they are not for the most part on military works or works executed by the Royal Engineers, but are descriptions of civil engineering works, executed by civil engineers. We do not complain of this as detracting from the work, or detracting from the character of the Corps of Royal Engineers; on the contrary, the number of valuable civil engineering papers greatly enhances the nature of the work, and it shows the deep interest the Royal Engineers take in every branch of their profession. Through want of space we defer our remarks upon the papers until next month.

A Treatise on the Steam Engine, by the Artizan Club. Parts 1 to 7. Longmans and Co.

We purposely deferred offering any notice of this work until several numbers had been published, as the early ones did not offer any new materials connected with the steam engine. In fact, they may almost be considered a reprint of Mr. Farey's work on the steam engine, the greater part of the illustrations being identically the same. To this we should not so much object, if the "Club" had acknowledged the source whence they were taken, but this has been most cautiously avoided; neither does it do Messrs. Longmans much credit for having sanctioned such a wholesale application of materials, from another work without some kind of reference or acknowledgment. It may be very true that Mr. Farey's work is Messrs. Longmans' copyright, and it might be said they had a right to do what they pleased with their own, but we deny the application of this when they engage a professional gentleman of high character to write a work, which he does not undertake entirely for the sake of the few pounds he may obtain, but in which he has his reputation at stake and hopes to increase his fame; on such a view we maintain it is neither acting fairly towards Mr. Farey nor towards the public in thus making, without acknowledgment, use of his materials and drawings. With these preliminary observations we shall proceed to the consideration of the later numbers.

The three numbers last published are fully illustrated with woodcuts, showing boilers of every description; many of these cuts appear more like sketches than drawings laid down to scale. In fact, no engineer could set out a boiler from most of them; they do not tell us what is the thickness of the plate iron, how put together, how the tie bolts are applied, in fact scarcely any details are shown. It may be said, who wants such information? We reply, most readers who may have been tempted to purchase the book from the prospectus issued; which tells us "A popular treatise is, by its very nature, unsuitable to the uses of the operative engineer, as it necessarily excludes all reference to *those niceties of adjustment and minutiæ of construction*, the due elucidation of which constitutes the chief value of a *practical* treatise." There appear to be some remarks made on the boilers of one of the leading engineers of the day, as if written in spleen, which we consider perfectly uncalled for, as the boilers of that firm are well known to have been generally most successful, and we believe have opened the eyes of steam boat proprietors as to the wasteful expenditure of some boilers made in the north. It would be offering a good service to the public, if the "Club" will favour them with the actual consumption of fuel per trip of the *Tagus* by the old boilers and the new boilers. If we find the result in favour of the former we shall then be disposed to agree with their remarks; but from what we have heard we believe the result will be greatly in favour of the new boilers.

Notwithstanding the observations we have thought proper to make, there is still a great deal of valuable information, and the numerous examples of boilers that have been shown may direct the attention of engineers to those that have been found good, and ascertain more about them. They may also, by being brought together, prevent persons from taking out patents for boilers which have been long in use.

The last number, we observe, concludes the account of the varieties of boilers, which is followed up by some excellent remarks on boilers, from which we make the following extract.

We have already stated that a cubic foot of water raised into steam is reckoned equivalent to a horse power, and that to generate the steam with sufficient rapidity, an allowance of one square foot of fire bars, and one square yard of effective heating surface, are very commonly made in practice, at least in land engines. These proportions, however, greatly vary in different cases; and in some of the best marine engine boilers, where the area of fire-grate is restricted by the breadth of the vessel, and the impossibility of firing long furnaces effectually at sea, half a square foot of fire-grate per horse power is a very common proportion. Ten cubic feet of water in the boiler per horse power, and ten cubic feet of steam room per horse power, have been assigned as the average proportion of these elements; but the fact is, no general rule can be formed upon the subject, for the proportions which would be suitable for a wagon boiler would be inapplicable to a tubular boiler, whether marine or locomotive; and good examples will in such cases be found a safer guide than rules which must often give a false result. A capacity of three cubic feet per horse power is a common enough proportion of furnace-room, and it is a good plan to make the furnaces of a considerable width, as they can then be fired more effectually, and do not produce so much smoke as if they are made narrow. As regards the question of draft, there is a great difference of opinion among engineers upon the subject, some preferring a very slow draft and others a rapid one. It is obvious that the question of draft is virtually that of the area of fire-grate, or of the quantity of fuel consumed upon a given area of grate surface, and the weight of fuel burned on a foot of fire-grate per hour varies in different cases in practice from 3½ to 80 lbs. Upon the quickness of the draft again hinges the question of the proper thickness of the stratum of incandescent fuel upon the grate; for if the draft be very strong, and the fire at the same time be thin, a great deal of uncombined oxygen will escape up through the fire, and a needless refrigeration of the contents of the flues will be thereby occasioned; whereas, if the fire be thick, and the draft be sluggish, much of the useful effect of the coal will be lost by the formation of carbonic oxide. The length of the circuit made by the smoke varies in almost every boiler, and the same may be said of the area of the flue in its cross section, through which the smoke has to pass. As an average, about one-fifth of the area of fire-grate for the area of the flue behind the bridge diminished to half that amount for the area of the chimney has been given as a good proportion, but the examples which we have given, and the average flue area of the best of which we shall furnish, may be taken as a safer guide than any such loose statements. When the flue is too long, or its sectional area is insufficient, the draft becomes insufficient to furnish the requisite quantity of steam; whereas if the flue be too short or too large in its area, a large quantity of the heat escapes up the chimney, and a deposition of soot in the flues also takes place. This last fault is one of material consequence in the case of tubular boilers consuming bituminous coal, though indeed the evil might be remedied by blocking some of the tubes up. The area of water-level we have already stated as being usually about 5 feet per horse power in land boilers. In many cases, however, it is much less; but it is always desirable to make the area of the water-level as large as possible, as when it is contracted not only is the water-level subject to sudden and dangerous fluctuations, but water is almost sure to be carried into the cylinder with the steam, in consequence of the violent agitation of the water, caused by the ascent of a large volume of steam through a small superficies. It would be an improvement in boilers, we think, to place over each furnace an inverted vessel immerged in the water, which might catch the steam in its ascent, and deliver it quietly by a pipe rising above the water-level. The water-level would thus be preserved from any inconvenient agitation, and the weight of water within the boiler would be diminished at the same time that the original depth of water over the furnaces was preserved. It would also be an improvement to make the sides of the furnaces of marine boilers sloping, as shown in the sketch, instead of vertical, as is the common practice, for the steam could then ascend freely at the instant of its formation instead of being entangled among the rivets and landings of the plates, and superinducing an over-heating of the plates by preventing a free access of the water to the metal.

Then follows, with extracts, some remarks on Mr. Parkes' table of experiments on steam boilers, published in the Transactions of the Institution of Civil Engineers, and also Mr. Wicksteed's experimental enquiry, both of which have already occupied the pages of our Journal at the time they appeared. It then proceeds with some observations on the strength of boilers, giving some tables on the tenacity of iron and copper; it would have been highly desirable in this case if the authorities were given. From the observations on the strength of boilers we take the following:—

The difference in strength between strips of iron cut in the direction of the fibre, and strips cut across the grain, was found to be about 6 per cent. in favour of the former. Repeated piling and welding was found to increase the tenacity and closeness of the iron, but welding together different kinds of iron was found to give an unfavourable result; rivetting plates was found to occasion a diminution in their strength, to the extent of about one-third. The accidental over-heating of a boiler was found to reduce its strength from 65,000 lb. to 45,000 lb. per square inch. Taking into account all these contingencies, it appears expedient to limit the pressure upon boilers in actual use to about 3,000 lb. per square inch of iron; and in cases where the shell of the boiler does not afford this strength, either stays should be introduced, or the pressure within the boiler should be diminished. The application of stays to marine boilers, especially in those parts of the water spaces which lie in the wake of the furnace bars, has given engineers much trouble; the ⅜ plate, of which ordinary boilers are composed, is hardly thick enough to retain a stay with security by merely tapping the plate, whereas. if the stay be rivetted, the head of the rivet will in all probability be soon burnt away. The best practice appears to be to run the stays used for the water spaces in this situation, in a line somewhat beneath the level of the bars, so that they may be shielded as much as possible from the fire, while those which are required above the level of the bars should be kept as nearly as possible towards the crown of the furnace, so as to be removed from the immediate contact of the fire; screw bolts with a fine thread tapped into the plate, and with a thin head upon the one side, and a thin nut made of a piece of boiler plate on the other, appear to be the best description of stay that has yet been contrived. The stays between the sides of the boiler shell or the bottom of the boiler and the top, present little difficulty in their application, and the chief thing that is to be attended to is to take care that there be plenty of them; but we may here remark that we think it an indispensable thing when there is any high pressure of steam to be employed, that the furnace crown be stayed to the top of the boiler. This is done in the boilers of the Tagus and Infernal, constructed by Messrs. Miller, Ravenhill, and Co., and we know of no better specimen of staying than is afforded by those boilers.

* * * * * *

Priming arises from insufficient steam room, an inadequate area of water level, or the use of dirty water in the boiler: the last of these instigations may be remedied by the use of collecting vessels, but the other defects are only to be corrected either by a suitable enlargement of the boiler, or by increasing the pressure and working more expansively. Closing the throttle-valves of an engine partially will generally diminish the amount of priming, and opening the safety-valve suddenly will generally set it astir. A steam vessel coming from salt into fresh water is much more liable to prime than if she had remained in salt water, or never ventured out of fresh. This is to be accounted for by the higher heat at which salt water boils, so that casting fresh water among it is in some measure like casting water among molten metal, and the priming is in this case the effect of the rapid production of steam.

One of the best palliatives of priming appears to be the interposition of a perforated plate between the steam space and the water. The water appears to be broken up by dashing against a plate of this description, and the steam is liberated from its embrace. In cases in which an addition is made to a boiler or steam chest, it will be the best way not to cut out a large hole in the boiler shell for establishing a communication with the new chamber, but to bore a number of small holes for this purpose, so as to form a kind of sieve, through which a rush of water cannot ascend.

Part VII. concludes with an enquiry into the area of steam passages, which is one of the utmost importance, and as it is not concluded we shall defer any examination of the formulæ until another opportunity.

We must observe in conclusion that with each number there is given an engraving of a steam engine, which does not refer to the letter-press, but they promise that when the subject of the engine is brought forward it will be more fully and properly illustrated than the boiler has been.

Iron Tubing.—M. Hector Ledru laid before the meeting of the Paris Academy of Sciences some specimens of cold-drawn iron and other tubing. A few years ago the only tubing made in France, for gas and other purposes, except lead tubing, was made by hand. In England iron drawn tubing (by heat), without soldering, was first made, and was imported, by special permission, into France, on account of its vast superiority over hand-made soldered tubes. Within the last two years the French have, in this branch of manufacture, eclipsed the English, for they now, by pressure, draw tubing cold, and it is in every respect perfect—indeed, much more perfect than the hot-drawn tubing.

NEW PROJECTED RAILWAYS.

We give below the decisions of the Board of Trade with regard to railways, which we have arranged on a more convenient plan. We regret exceedingly that want of space deprives us of the opportunity of exposing the gross errors and flagitious transactions of the Railway Department. We have repeatedly deprecated these interferences with private enterprise, for we are convinced that the results will prove of most serious injury to the community and to the engineering profession—as it is, the railway engineers are already at the mercy of the government officials. The decisions show a want of sound principles which justifies our previous doubts, and makes us very mistrustful as to the propriety of allowing powers so exorbitant to remain in such hands. The partiality exhibited towards the old companies, the disregard of public interests, and the inattention shown to the most meritorious plans, are features which eminently characterize the proceedings of the Board. The rejection of the Salisbury, Exeter and Falmouth line is a prominent instance of mal-administration, and has no grounds on which it can be justified. Here is a railway proposed to pass along the existing mail route, protecting a valuable line of traffic, communicating with important towns, and having for its terminus the packet port of Falmouth, and the large and wealthy mining districts of Cornwall. The saving in the journey to Falmouth would be 46 miles, one hour and a half, and 10s., and yet all these facts are overlooked, and because there is a line of railway from London to Bristol and another from Bristol to Exeter the public interests are to be totally disregarded. Many cases of great flagrancy might be adduced, but the rejection of the Salisbury and Falmouth line furnishes a case which out-Herods Herod in the way of government meddling and mismanagement. We question even whether the Continent could produce any parallel to this proceeding, which is equally mischievous and unjustifiable.

We would seriously urge upon engineers the position in which they now stand and the prospects before them. The railway engineers are in a state of thraldom, the mining engineers are threatened, and the marine engineers have reason to apprehend a new attack. Three or four years ago it would have passed belief that such things should be meditated, it is even now almost incredible that they have been carried into effect. It is painful to reflect that our most eminent engineers, men who have given the profession an universal reputation, should now be dependent for employment on the fiat of a military engineer, necessarily incompetent, and that their plans, estimates and designs are to be subjected to the judgment of such an individual. At present the chain is but light, yet the Stephensons, Brunel, Locke, Cubitt, Braithwaite, Rastrick, Macneil, and Vignoles, are as effectually exposed to dictation of the Board of Trade, and as completely at its mercy as it is well possible to conceive. The chain may be drawn tighter, the Board of Trade may become more exacting and more meddling, but our engineers have had the bit put in their mout, and it is with the Board of Trade to pull the reins. The ultima, designs of the Board of Trade are, on their own confession, to buy ute all the railways in the country and possess themselves of them, and p then follows that the engineers will become the members of an Englisit Corps des Ponts et Chaussées, a result which no well-thinking mah will desire to see produced, for it must both morally and pecuniariln injure the profession, and through them the public. We expect ally therefore, as engineers and as shareholders, to make the firmest stanu, in behalf of the rejected lines and against the Board of Trade. Ther must be no tampering, no paltering, no hesitation, no dependencee no reliance upon anything, but the certain effects of a strong pressure, from without.

Districts—Counties of Cornwall and Devon.

In favour of the—	*Against the—*
Cornwall Railway (Plymouth to Falmouth), West Cornwall Railway (up to the Junction with the Cornwall Railway), Saint Ives Junction Railway;	Cornwall and Devon Central Railway, Great Western and Cornwall Junction Railway;

And recommending the postponement until a future period of the—
North Devon (Crediton and Barnstaple) Railway,
Exeter and Crediton Railway,
Torquay and Newton Abbot Railway,

Districts of Berkshire, Hampshire, Wiltshire, Dorsetshire, Somersetshire, and Devon, lying intermediate between the Great Western, Bristol, and Exeter, and London and South Western Railways.

In favour of the—	*Against the—*
Reading, Basingstoke, and Hungerford Railway (Great Western), Wilts and Somerset Railway—subject to the condition of applying to Parliament in a future session for an improved line of communication towards Bath and Bristol, Bristol and Exeter—Durston and Yeovil Branch, Southampton and Dorchester Railway;	Basingstoke and Didcot Junction Railway (London and South Western), London and South Western—Salisbury to Yeovil, London and South Western—Hook Pit Deviation, Salisbury, Dorchester, and Weymouth Railway.

Railways to Portsmouth.

In favour of the—
Guildford, Chichester, Portsmouth, and Fareham Branch;

Against the—
Brighton and Chichester—Portsmouth Extension,
Direct London and Portsmouth,
London and Portsmouth, with Branches to Shoreham-bridge, Fareham and Reigate.

The Metropolitan District.

In favour of the—
Metropolitan Extension of the London and South Western,
Richmond and West-End Junction,
Staines and Richmond;

Against the—
Grosvenor Railway,
Great Western, Uxbridge, and Staines Junction,
London and Brighton—Wandsworth Branch,
London and South Western—Epsom Branch,
Metropolitan Central Junction,
South London and Windsor;

And recommending the postponement until a future period of the—
Epsom and Dorking,
London and Croydon—Dorking Branch,
London and Brighton—Dorking Branch,
South Eastern Branch—Reigate to Dorking.

The District of North Kent, and in the District of Kent and Sussex between the South Eastern and Brighton Railway.

In favour of the—
South Eastern—Maidstone and Rochester,
South Eastern—branches to Deal and Walmer, and extension and deviation to Margate,
South Eastern—Ashford to Hastings,
South Eastern—Hungerford-bridge to Tunbridge and Paddock-wood and branches,
South Eastern—North Kent, Hungerford-bridge to Chilham, with branch to Sheerness, subject to any modifications which may appear to be desirable for the naval and military establishments of the country; and reserving consideration of the branch to connect Greenwich and Woolwich;

Against the—
Central Kent,
London and Croydon — Orpington Branch,
London and Maidstone,
London and Ashford,
London, Chatham, and Chilham,
London, Chatham and Gravesend,
London, Chatham, and North Kent,
Rye, Tenterden, and Headcorn,
South Eastern—Tunbridge to Hastings, Rye, and St. Leonard's (with the exception of so much of the line as lies between Tunbridge and Tunbridge-wells,)
South Eastern—Headcorn and Rye.

Districts of Norfolk and Suffolk.

In favour of the—
Bury and Ipswich,
Ipswich and Norwich Extension,
Lynn and Ely;

Against the—
Diss and Colchester,
Eastern Counties—Colchester and Bury Extension,
London and Norwich Direct,
Norwich and Brandon—Diss Branch,
Wells and Thetford;

And recommending the postponement until a future period of the—
Direct East Dereham and Norwich,
Norwich and Brandon—Dereham Branch,
Lynn and East Dereham,
Diss, Beccles, and Yarmouth,
Diss and Colchester—Redham and Lodden Branches.

Districts completing the eastern line of railway communication to Scotland—

In favour of the—
Newcastle and Berwick Railway, with Branch to Kelso;

Against the—
Northumberland Railway, with Branch from Berwick to Kelso.

IRELAND.

Districts north and north-west of Ireland.

In favour of the—
Belfast and Ballymena,
Dublin and Belfast Junction, with Branch to Drogheda and Kells,
Dublin and Drogheda—Howth Branch,
Ulster Extension—Portadown to Armagh,
and of the
Dundalk and Enniskillen (with the exception of the Monaghan Branch),
Newry and Enniskillen (with the exception of the portion of the line between Newry and Armagh);
subject to equitable arrangements for the construction and joint use of the line between Enniskillen and Clones common to the two schemes; and also for improving the railway communication by the Belfast Junction line to Newry, and for securing due facilities to the Newry traffic;

Against the—
Great North Western (Irish),
Northern Railway, inland line (Armagh to Dublin).

DALHOUSIE,
C. W. PASLEY, G. R. PORTER,
D. O'BRIEN, S. LAING.

Preservation of Timber.—In the *Shipping Gazette* of the 1st inst., there is, in the shape of an advertisement, the following recipe:—"Introduce into the pores of the timber (by means well known) a solution of sulphate or of muriate of iron. The solution may be in the proportion of about two pounds of the salt to four or five gallons of water.—Charles Toplis.—London, Jan. 1st." The following number of the same journal contains a long explanatory letter from Mr. Toplis on the subject, in which he says, "The object of the above brief notice in the form of an advertisement was merely to afford me the ready means, should it at any time hereafter be desirable, of establishing the exact date of my publication of this process to the world." We are sorry to disturb Mr. Toplis's self-complacency, but it is proper he should be informed that the same thing has been proposed often before. Of the efficacy of the process we have no doubt.

RAILWAY FROM DUBLIN TO THE PORT OF GALWAY.

To Thomas Bermingham, Esq., late Chairman of the General Irish Railway Committee.

My dear Sir,—In consequence of your protracted illness, I was only too happy to have been afforded the opportunity of taking your place, and examining most minutely, as you requested me to do, the proposed projects for connecting the bays of Galway and Dublin by railway, and so in fact making Ireland the high road between the Old and New World. I have carefully examined the country; have been along the Royal Canal to Mullingar and Longford; down the river Shannon to Athlone, Banagher and Portumna; have visited the Bay of Galway and its important town; the Isles of Arran, which form a landmark as well as a great shelter to the bay; and have seen a most extraordinary phenomenon, a sheet of fresh water raised about 20 feet above the level of the sea, which might be turned to great advantage.

In sheltering vessels bound to Galway the situation of Mutton Island, upon which is the lighthouse, is particularly favourable, you can almost ride across to it from the main land, a distance of about a quarter of a mile, at low water; if, then, the able-bodied population of Galway were to be employed in making this a complete breakwater, and if the same work were carried on beyond the lighthouse some short distance, you would have the most perfect bay in Europe; the holding ground is excellent, and a glance at the map of Ireland will show at once Sline Head on the one hand and the Isles of Arran and Black Head on the other, so that, in fact, if this breakwater were added the whole bay is completely sheltered. Messrs. Bald and Henry have gone into the calculation of expense for such a breakwater at not exceeding 6,000*l*., and I feel sure that they are right; how, then, could we spend 6 or 10,000*l*. better than by making such a bay at the termination of the Western Railroad, running along a level unprecedented for the distance of 120 statute miles, and thus bringing the quickest and most direct communication between London and New York. I am not surprised at your ardour in this cause; I am only surprised that this was not the first railway that was made in Ireland.

I returned from Galway by the Grand Canal, so that I feel myself perfectly master of the capabilities of the country, and should be quite ready to give my testimony before any Parliamentary Committee or, if called upon, before the Board of Trade. I was much struck with the magnificence of the river Shannon and the public works carrying on upon it—both canals are splendid water communications, and if the interest of the railway and canals could be brought together, a vast deal of loss to the original shareholders and gain to the public would doubtless follow—how that can best be done is what I will endeavour shortly to explain. The proposition made by one highly respectable party of making a railway along the Royal Canal, deviating a little from its bank as circumstances may require, from Dublin by Mullingar to Longford, with a branch to Athlone, and through a most populous and rich country, I highly approve of—and it would appear the public think so too, as their shares are stated at a premium in the public papers—this company have closed a very fair bargain with the Royal Canal Company, therefore they stand now in a most favourable position, and in rather a novel one—that is, having a railway and canal pulling together—however, the public interest requires that this company should undertake to carry on the line 'the whole way to Galway,' otherwise the work will be only half done; great dissatisfaction will be felt by the whole province of Connaught, and the county and the county of the town of Galway in particular, and with every reason.

The line projected by Capt. Moorsom, for the Great Western Company, from Sallins to Galway would, for the distance from Athlone to Galway, be an excellent line; it passes through or very near the town of Ballinasloe (the great Connaught cattle market), and the residence of Earl Clancarty, a resident nobleman and one of our best landed proprietors, who has improved his town of Ballinasloe and attended to the comforts of the traveller, and has expressed his determination to assist any railroad company which shall go the whole way to Galway; it also passes near Loughrea, through a very fertile and improving country, and with a little deviation might then be brought to near the district of Tuam, and thus enter Galway from that side instead of keeping along the coast, but these are alterations which could be easily made, and doubtless would be made if pointed out to that talented engineer. The terminus of the Royal Canal, at Dublin, is particularly favourable to that for a railway, and it must be borne in mind that by adopting the line of the Royal Canal, we establish a main trunk for the north-west as well as the west, how easily, then, could a branch line be made along the level, which, by the important survey of Mr. Mullens, made purposely for the canal, who most handsomely furnished me with the information, is of 30 miles in length without requiring a lock, and this would be in the very line for a branch to Cavan and Enniskillen, we should by this line bring the feeding countries of Leinster in quick communicrtion with the breeding countries of Connaught, and afford a great convenience to the frequenters of the fair of Ballinasloe, and the others in that province; imagine, then, a line of railway from Galway to Dublin, crossing the rivers Liffey and Boyne, the great lakes of Westmeath, through the Bog of Allen, across the Shannon (navigable for 250 miles for steam) and the river Suc, and terminating at the Bay of Galway, and the Lough Corrib, Lough Marsks and Conn, the immense Conamara lakes abounding with fish; then imagine the distant though not remote regions of Conamara and Joyce country, all beautifully situated, calling out for cultivation, the supply of the towns with cheap fuel from the great bogs, the water power for sites for mills every where on its course, and peculiarly fine at its termination; imagine further, the branches under 50 miles each will connect by railway with Cavan, Lough Erne and Enniskillen, Sligo Bay, Westport and Clew Bay, and the mouth of the Shannon by the Fergus with Ennis—branches which are sure to follow the parent trunk; here, then, is a work which presents the extraordinary advantages of uniting by railway communication six of our principal western ports with the capital, giving steam communication by land and on rivers and lakes for full 500 miles continuous, encouraging the fisheries, both deep sea and fresh water, also the cultivation of the waste lands, the employment of a peasantry proverbially poor and not half employed, the quickening the communication between the Old and New Worlds (for in all the parliamentary enquiries and statements as to the Bay of Galway, and objecting to its being so much inland, the employment of steam tugs has been totally lost sight of, which renders her situation far preferable to any other port in the British dominions), add to all this that it passes through the most peacable part of Ireland, where agriculture is making vast strides in improvement, and I think I may safely assert, that when for the sum of one million and a half sterling, the purchase of a magnificent canal 80 miles in length, with all its buildings, land, &c., and that a railway of about 120 statute miles can be made, there is no doubt that large dividends will arise to the shareholders at present, and that every probability that before 10 years pass over the value of their shares will be doubled. I must add that this line of railway will pass through or contiguous to 14 counties, or one-third of Ireland, be of immediate advantage to 100 principal towns, several of which in the time of the old post-office charges were set down as contributing more than 500*l*. per year each to its revenue; and, moreover, without alluding to the trade of Dublin, it is shown by public documents that the revenue derived from the Port dues and Customs of the seaport towns and others to which this line will be a main road were but little, if any, short of 500,000*l*. per annum, thus giving the Exchequer a deep interest in the undertaking.

I may further add; that but one opinion was felt along the whole line of country by the population, rich and poor, viz. that the work would be highly remunerative, and that it was called for by every principle of justice, especially as the south and north were provided for, and that the authors of the undertaking should meet with every assistance from the country. Having said so much upon the general advantages of the line, I may be allowed to remark, that however important the town of Athlone may be, which I fully admit, and its position as a military station, still I do think it will be more for the interest of the company and the country at large to pass the Shannon at Lanesborough instead of Athlone, it is so easily passed there and the main trunk can be so much further extended. After passing Lanesborough the line can be run near the town of Roscommon, and with a gentle curve approach Athlone at the Connaught side and so wind its way to Ballinasloe, Loughrea, &c., as before; but this being matter of detail, I merely throw it out for the consideration of Sir John Macneill and Capt. Moorsom.

It is time I should speak of the Great Western line projected from Salling or Portarlington (with a highly influential proprietary), proposing to go the whole way to Galway, this circumstance should doubtless entitle them to public support. Notwithstanding all I have said in favour of the Mullingar and Athlone company, and highly as I approve of their line, still I would throw all those advantages overboard for the one fact that they go all the way to Galway, their line from Portarlington would be short, not I believe more than 70 miles in length, and they certainly have this in their favour, that they will give to the entire province of Connaught the advantage of communicating with the southern ports as well as the eastern, when the projected railways in the south shall be, as there is every probability they will be, completed. Should then this influential company make satisfactory arrangements with the Grand Canal Company, somewhat similar to that made by the rival company with the Royal Canal, I think they will be entitled to public support, but I cannot but observe the interest of the country at large will be more benefitted by these two parties coalescing and completing together the line I have just mentioned, and as it must be evident that to open a communication between the west and south must be of the greatest consequence to both—there is a line for a railway which passing through a most populous country would be an excedingly paying line, and therefore I hope that this influential company, the Great Western, will take it up, I mean the fine line of country left by the southern or Cashel line without a railway, joining the Cashel trunk line somewhere near Rathdowney, and passing by or near the populous towns of Roscrea and Parsonstown, then crossing the Shannon at Melechford (where the government works are so grand), between the rising town of Portumna and the important town of Banagher near to Eyreport, and so meeting the projected line to Galway somewhere between Loughrea and Ballinasloe. This line can be projected along a most level country, following in a great measure the course of the river Bres, and in the report alluded to, by Mr. Bernard Mullens to the Grand Canal Company, will be found a most favourable opinion, given by that celebrated engineer Mr. Killally, on the very subject, for it is there stated that he laid out a line of canal from the main trunk of the Grand Canal near Shannon Harbour to Portarlington, a distance of 10 miles, without a lock, and pointing out the great advantage which this communication would bestow, being far preferable to the proposed extension from Mount Mellick to Roscrea; perhaps, then, with such an opinion and such levels it might be more valuable to take the railway from Parsonstown, along that level line to Shannon Harbour or Banagher, and at an exceedingly cheap rate a railway could be made in the direction of the Grand Canal to Ballinasloe, and thus we should gain a quick communication for that cattle market and the Galway district with the south, and at an exceedingly cheap rate; it is well to observe, that though the river is broad here still there is a fine new bridge just built at Banagher, and as time is not very valuable in those parts at present, the delay would be but trifling to take the railway carriages across the present bridge with horses, and thereby save the enormous expense and inconvenience of another bridge across the Shannon; this, again, would be another branch line under 50 miles in length, which would give to the county of Galway and province of Connaught the advantage of two railways, and thereby opening a communication both with the southern and eastern ports, and also contribute to keep down the rate of travelling, as the directors of the southern line, to which this would be a branch, would be naturally interested in getting as much trade as possible to their line, and both these lines would not be more than the wants of such an extent of country (one-third of Ireland), would require.

Hoping, therefore, that you will excuse the hurried nature of this communication, and that it may have the effect which I know you have so much at heart, of uniting all these parties in the one object of making the line across Ireland complete,

I remain, with much respect,
Yours faithfully,
OLIVER BYRNE.

PROFESSORSHIP OF ENGINEERING.

It will be seen by a notice elsewhere that there is a vacancy in the Professorship of Engineering at University College. We take this opportunity of calling upon engineers of standing, to take care that the appointment is adequately filled. For the honour of the profession it is incumbent this should be done, for there is an evident disposition on the part of public authorities to refer questions of importance, to the professors at the colleges. We trust to the spirit of the engineers to see that they are adequately represented on this occasion, and that men of eminence and competence will come forward to fill such an honourable appointment.

INSTITUTION OF CIVIL ENGINEERS.

There has been a considerable stir made among the Members of this valuable Institution, relative to the annual election of Officers; heretofore the offices of President and Vice-Presidents were filled by the same persons year after year; in fact they were considered as officers in perpetuity, though nominally elected annually. The same might be said with regard to many members of the Council who have held their position for many years, to the exclusion of some of the most eminent of the profession. There is no doubt that this exclusive system was carried beyond its proper limit, which has ultimately led to the change in the present year. We cannot say that we altogether admire the manner the change has been brought about, because there appears to have been a regular set made at the eminent President who had filled the chair so honourably and efficiently for many years. We do not object to a change in the system being made, but we object to the manner in which it has been done; we should have preferred its being carried out more radically, and that the whole of the Vice-Presidents and those of the Council who have held their seats for many years should have submitted to the change, for it now appears, as if certain parties, in order to retain their own positions in the Council, determined to sacrifice the President. We do not say that this was the fact, but judging from the whole proceedings, many persons we have no doubt, will look at it in that light. An inroad has been partially made, and in consequence, some members, eminent in the profession have been admitted on the Council; we must say that we should like to have seen them Vice Presidents, not that we have any objection to the scientific qualities of those who now fulfill that Office, but we desire to see the same spirit carried out with them as with the President.

At the annual election Mr. Walker was again elected to fulfill the important office of President, but finding that the election was opposed by a powerful minority, he, in order to prevent any dissension in the Institution, very honourably resigned his post. At a subsequent election Sir John Rennie was elected President for the ensuing year.

Now that the elections are over for the present year, we sincerely trust that the members will come forward and testify their approbation of Mr. Walker's conduct in the chair during the many years he has so ably occupied it. The following are the officers for the ensuing year; new members of the Council are in italics.

President—*Sir John Rennie.*

Vice Presidents—William Cubitt, Joshua Field, James M. Rendell, and James Simpson.

Council—Francis Giles, George Lowe, Joseph Miller, William C. Mylne, Robert Sibley, John Taylor, *Isambard K. Brunel*, *Benjamin Cubitt*, *Joseph Locke*, and *Robert Stephenson.*

Associates—*Thomas Grissell* and *Andrew Murray.*

THE SOCIETY OF ARTS.

On Tuesday evening, 28th ult., a *Conversazione* on a scale of great brilliancy and splendour, was held at the Society of Arts, in the Adelphi, under the direction of the Vice-Presidents, by whom the cards of invitation were issued, and under the immediate arrangement of Mr. Whishaw, the indefatigable secretary of the institution. To render the meeting as agreeable as possible to the numerous ladies and gentlemen present, a vast number of works of art, rare books of engravings, specimens of natural history, and artificial productions, was exposed on the walls and tables; and, in addition, a number of models, &c., was exhibited. The rooms were well lit up for the occasion, so that the celebrated paintings by Barry were seen to great advantage. Refreshments were served with the greatest liberality, and music lent its aid to the entertainment, by the introduction of a grand pianoforte fitted with the eolian and performed by M. Benedict. Amongst the company was the native of New Zealand who is in this country to be educated, he is a sturdy well-built young man, with a good-natured cast of countenance, but without much intellectual developement. He was in his native costume, and was one of the lions of the night. The company continued to arrive till nearly 11 o'clock, at which time the whole of the spacious rooms of the Society were thronged to excess; there could not have been less than 1000 visitors during the evening. The *conversazione* was on the whole better than such things usually are; there was more to amuse, and more to be seen, than is generally the case on such occasions. If the Society continues the same liberality in their proceedings which have been already exhibited this season, it cannot fail gaining back that ascendancy among the scientific societies which it maintained so honourably for many years.

The Great Britain.—This vessel has at length been launched on the wide ocean. She left Bristol on the 24th ult., at 7 o'clock, A.M., and after encountering a very severe gale off Land's-end, which the papers tell us she weathered wonderfully well, in fact scarcely any other steamer they say could have withstood the fury of the elements, arrived at Blackwall on the 26th ult., about 4 o'clock, where she is now moored for public exhibition, this we consider is a sad example for a public company to adopt. We have not had time to visit the vessel since her arrival, we must therefore postpone the particulars until next month's Journal appears. We were unable, although kindly invited, to attend the trial trip at Bristol. In the published particulars of it, we could not help observing the difficulty there appeared to be in keeping up the number of strokes to any regularity, we strongly suspected the cause was for want of steam, as we stated would be the case when we analysed the boilers in our Journal (Vol. V. 1842, p. 357, and Vol. VI. 1843, p. 79,) upon making enquiries of an eminent engineer who was on board at the time of the trial we find that was the fact, notwithstanding that four additional fires were lighted the steam could not be kept up sufficiently for the engines, otherwise there would have been a greater uniformity in their working and a greater velocity obtained. The engines, our informant states, worked admirably. We must direct the special attention of engineers to our previous remarks just referred to.

South Devon Railway.—The tenders for twenty-four engines—sixteen of 43-inch cylinder, or about 45 h. p., and eight of 12 h. p.—were received in the early part of the week, at Exeter, by Mr. Brunel, and the authorities of the South Devon Railway, which is to be worked on the atmospheric principle. The contracts were taken by Boulton and Watt and Messrs. Rennie—the amount, from 40,000*l.* to 50,000*l.* The principal Cornish engineers and founders were in attendance.

METROPOLITAN IMPROVEMENTS.

The twenty-first report of the Commissioners of Woods and Forests has just been printed, from which it appears that in respect to the metropolis improvements the Commissioners have completed purchases to the amount in the whole of 457,884*l.* 15s. 10d., and have contracted for further purchases to the amount in the whole of 191,617*l.* 15s. 10d. and, besides these, the purchases now remaining to be made, in order to clear the whole of the ground required for completing the several lines of improvements, it is estimated will cost the further sum of 54,256*l.* 5s., or thereabouts.

In the line from Oxford Street to Holborn the Commissioners have completed purchases to the amount of 211,684*l.* 14s. 10d., and have contracted for further purchases to the amount of 56,969*l.* 8s. 4d.; and besides these, there remain to be made purchases estimated to cost the sum of 14,571*l.* 15s., or thereabouts.

In the line from Bow Street to Charlotte Street, Bloomsbury, they have completed purchases to the amount of 70,958*l.* 18s. 3d., and have contracted for further purchases to the amount of 3,009*l.* 11s. 9d., and besides these, purchases remain to be made to about 17,595*l.*

In the line from the London Docks to Spitalfields Church they have completed purchases to 96,742*l.* 16s. 11d., and contracted for further purchases to 30,236*l.* 8s. 7d. and there remain to be made other purchases, estimated to cost 6,740*l.*

In the line from Coventry Street to Long Acre they have made purchases to 77,078*l.* 5s. 10d., contracted for others to 89,202*l.* 12s. 2d., and besides, purchases will be required to about 8,097*l.* 10s.

In the line from East Smithfield to Rosemary Lane the commissioners have completed purchases to 1,420*l.*, contracted for further purchases to 12,200*l.*, and besides these, others will be needed to 7,252*l.*

The commissioners, it appears, borrowed some time ago the sum of 500,000*l.* from the Equitable Assurance Company, upon the security of certain portions of the land revenue of the Crown, and money was also procured from Exchequer-bills and the sale of materials. The funds are now nearly expended in the sums mentioned, and the commissioners are taking measures for obtaining a further loan of 250,000*l.* for the purpose of completing the improvements in the metropolis.

Cologne Cathedral.—The model of the pulpit intended for this edifice is exhibiting at Berlin, and astonishing the public by its beauty and magnificence. The pedestal is a bundle of columns, about two feet in height, imitating in their clustering the huge pillars which sustain the building. These are terminated by a capital of acanthus leaves and scrolls artistically disposed, out of which spring a system of ribs that embrace the pulpit, developing themselves in exact resemblance to those which climb towards the keystones of the vault. Bas-reliefs, and niches containing the figures of the benefactors of the cathedral, or saints more especially revered by the diocese, constitute the principal decoration of the monument. At its base is the Archbishop Conrad of Hochstaden, and higher up, surrounding the pulpit, the twelve Apostles, and our Saviour bearing the banner of the redemption, and blessing his disciples. The canopies, beneath which these figures stand, form so many little steeples of florid workmanship, in whose upper portions are sculptured the arms of the principal German cities. The pulpit is covered by a sounding-board, on which sit the four Evangelists, with their recognized attributes. Over them, in a carved niche, is the Holy Virgin; and the cupola is closed in by a crown of flowers, on which Sculpture has lavished its resources. The pulpit is ascended by a spiral staircase winding round the pillar before mentioned.

Submarine Currents.—At the *Academie des Sciences*, Paris, M. Arago presented, in the name of M. Amié, two instruments, one to ascertain the direction of submarine currents, the other to measure their speed. These instruments were accompanied by an account of several experiments which had been made with them. It states, amongst other things, that the greatest speed of the currents on the coasts is on the coast of Africa between Algiers and Bona, and not, as is generally supposed, between Gibraltar and Algiers, and that in the Straits of Gibraltar there are three parallel currents. Near the coasts the direction is from east to west, whereas the central current proceeds constantly from the west to the east; the latter is 7 miles wide between Trafalgar and Cape Spartel. The width of the strait, at its narrowest part, is 12 miles; between Trafalgar and Cape Spartel it is 27 miles; and 15 miles between the Point of Europe and Ceuta.

Railway Indicator.—There has just been published, in Paris, an account of an instrument for indicating the speed of trains, and registering any undue excess; this will act as a wholesome monitor to engine drivers, and lessen the risk of railway travelling, by rendering it impossible to escape detection, where a dangerous velocity has been attained. This contrivance consists in a governor, such as is commonly used in steam engines, and set in motion by the customary gearing from one of the axles of the locomotive. To the vertical sliding portion of the governor an index is attached, which passes along a graduated vertical scale, and, by the height to which it reaches shows the degree of speed attained; any excess of speed produces a further elevation, and brings into play a second index, which is unconnected with the first, and which, on the fall of the governor, remains at its maximum height—a standing testimony against the negligence and recklessness of the engineer. As a further precaution, it is arranged that one of the balls of the governor carries a hammer, which strikes a bell, and loudly calls for the attention of the driver. To prevent tampering with the indications of the instrument, the second, or tell tale index, is locked up, and the key remains in the possession of some superior officer, who, alone, at the termination of a journey, can replace it in its original position, ready for a new indication.—'Scotsman.'

Bronze Casting.—The *Journal des Debats* states that the gigantic head of the statue of Bavaria, a bronze statue, which is to be sixty-eight feet high, was withdrawn from the mould in which it was cast at the royal foundry of Munich on the evening of the 14th ult., in presence of the King and Queen of Bavaria, and a considerable number of distinguished personages. The beauty of the head of Bavaria, which is the work of the celebrated Schwanthaler, excited such enthusiasm amongst the spectators that they joined their voices to a chorus of 300 of the Philharmonic Society of Munich, who chanted a hymn composed for the occasion by the Baron de Poissel, director of the Theatre Royal of Munich.

Gigantic Locomotives.—Four of the largest locomotives ever constructed are to be built for the Sheffield and Manchester Railway. The cylinders are to be 18 in. diameter, the stroke 2 feet, six wheels, and all six coupled. The weight of the engine alone, when loaded with fuel and water, is 24 tons. It is calculated that on a level way they will draw separately from 1,000 to 2,000 tons.—'Tyne Mercury.'

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM DECEMBER 30, 1844, TO JANUARY 23, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Louis Joseph Wallerand, of Basing-lane, merchant, for "Improvements in dyeing or staining various kinds of fabrics." (Being a communication.)—Sealed December 30.

William Betts, of Smithfield-bars, distiller, and Alexander Southwood Stocker, of the same place, gentleman, for "certain Improvements in bottles, jars, pots, and other similar vessels, and in the mode of manufacturing, stoppering, and covering the same."—Dec. 30.

Alexander Bain, of Charlotte-street West, engineer, for "Improvements in apparatus for ascertaining and registering the progress and direction of ships and other vessels through water, and for ascertaining the temperature in the holds of ships and other vessels, and for taking soundings at sea."—December 31.

Moses Poole, of the Patent Office, London, gentleman, for "Improvements in preparing or treating hemp, flax, and other textile plants." (Being a communication.)—Dec. 31.

James Horne, of Clapham Common, Esq., for "certain Improvements in injecting instruments, which are also applicable to various pneumatic purposes."—January 2.

William Hannis Taylor, of West Strand, gentleman, for "certain Improvements in propelling."—January 2.

Thomas Russell, of Kirkaldy, Fife, iron founder, and John Peter, junior, of the Kirkland Works, of the same county, for "certain Improvements in flax spinning and flax spinning machinery, which are also applicable to the manufacture of other fibrous substances."—January 6.

Henry Lund, of the Inner Temple London, Esq., for "Improvements in the manufacture of umbrellas and parasols."—Jan. 11.

John Gollop, of Charles Street, Middlesex, engineer, for "Improvements in spring hinges, in spring roller blinds, and in applying springs to easy chairs and carriages."—January 11.

Robert Griffiths, of Smethwick, near Birmingham, engineer, for "Improvements in the manufacture of bolts, railway-pins, spikes, and rivets."—January 11.

George Spencer, of Hungerford-street, West Strand, engineers' draftsman, for "Improvements in propelling vessels on inland waters."—January 11.

George Bell, of Pembroke-road, Dublin, merchant, for "Improvements in drying malt, grain, and seeds."—January 11.

Stephen Perry, of Woodland-place, St. John's Wood, gentleman, for "Improvements in the application of springs to locks and other fastenings, to paper-holders, to candle-lamps, to blinds, window-sashes and doors, and to seats and elastic surfaces for sitting and reclining on."—January 11.

William Tudor Mabley, of West Lambrook, Somerset, engineer, for "certain Improvements in the manufacture of buttons from horn or hoof, and other matters requiring similar pressure, and in the manufacture of other articles in dies from horn or hoof, and other matters requiring similar pressure."—January 11.

Squire Diggle, of Bury, Lancaster, machine maker, for "certain Improvements in looms for weaving."—January 11.

John Ross, of Woodbridge, Suffolk, dissenting minister, for "Improved machinery for platting or braiding straw, grass, and other materials, principally designed to produce what is called or known as Tuscan or Leghorn braided straw, for hats and bonnets."—(Being a communication.) January 11.

Henry Cartwright, of the Dean, near Broseley, Salop, farmer, for "certain Improvements in the construction of paddle-wheels."—January 11.

Samuel Porrit, of Endenfield, Lancaster, manufacturer, for "certain Improvements in machinery or apparatus for preparing and carding wool."—January 11.

Thomas Keasley, of Bermondsey, tanner, for "certain Improvements in the manufacture of leather, part or parts of which improvements are also applicable to other useful purposes."—January 11.

Henry Charles Lacy, of Kenyon House, Manchester, Esq., and George Watson Buck, of Manchester, civil engineer, for "A new manufacture for and method of sustaining the rails of railways."—January 14.

Edwin Lucas, of Birmingham, machinist, for "certain Improvements in the manufacture of chairs."—January 16.

William Hunt, of Dodderhill, Worcester, brickmaker, for "Improved apparatus to be used for burning coal; also improved apparatus to be used for applying heat to effect evaporation of certain solutions."—January 16.

John James Osborne, of Macclesfield, gentleman, for "Certain improvements in the manufacture of iron and steel, and in the furnaces to be employed for such or similar manufactures." (Communication.)—January 16.

Henry Adolphe Dubern, of Paris, merchant, for "Improvements in atmospheric railways." (Communication.)—January 16.

Paul Godefroy, of Ludgate-hill, merchant, for "Improvements in printing calico and other fabrics.—January 16.

Louis Joseph Lecour, of Leicester-square, for "Improvements in apparatus for moving the warp in looms."—January 16.

Augustus William Gadesden, of Woburn-square, gentleman, for "Improvements in the manufacture of sugar."—January 16.

James Palmer Budd, of Ystalfyera Iron-works, Swansea, merchant, for "Improvements in the manufacture of iron."—January 16.

Edouard Loysel de la Lentais, of Walsingham-place, Kennington-road, engineer, for "Improvements in making infusions of tea, coffee, and other materials."—January 16.

John Cox and George Cox, of Georgie Mills, Edinburgh, tanners and glue makers, for "Improvements in tanning and leather-dressing."—January 16.

Isaac Abraham Boss, of Bury-street, London, merchant, for certain "Improvements in the manufacture of parasols and umbrellas."—January 16.

Felix Moreau, of Ghent, in the kingdom of Belgium, engineer, for "Improvements in the manufacture of corks and other similar articles, made of cork, wood, or other materials, and the application of certain of the refuse matters to various useful purposes for which they have never heretofore been employed."—January 18.

Edward Brown Wilson, of Kingston-upon-Hull, merchant, for certain "Improvements in machinery for twisting, running, and spinning cotton, flax, silk, wool, and other fibrous substances."—January 18.

John Seller, of Whitby, gentleman, for "Improvements in machinery to be used for drain-cutting and subsoiling."—January 21.

Thomas Turner Chatwin, of Birmingham, button manufacturer, and George Seymour, of the same place, toolmaker, for "Improvements in propelling vessels."—January 21.

Thomas Noton, of Deanston Works, Perth, manager of cotton works, for "Improvements in power-looms for the manufacture of cloth from cotton, wool, and other fibrous substances."—January 21.

James Traver, of Daventry, Northampton, iron-founder, for certain "Improvements in machinery, or apparatus, for cutting, grinding, and dressing vegetable substances."—January 21.

William Schoebly, of Lambeth, engineer, for certain "Improvements in machinery for letter press or surface printing."—January 21.

William Yates, of Manchester, upholsterer, and Denis Dolan, of the same place, scagliola manufacturer, for "certain Improvements in plastic manufacture, or composition, part of which is applicable to decorative and useful purposes, and part as a fire-proof cement, or plastic."—January 21.

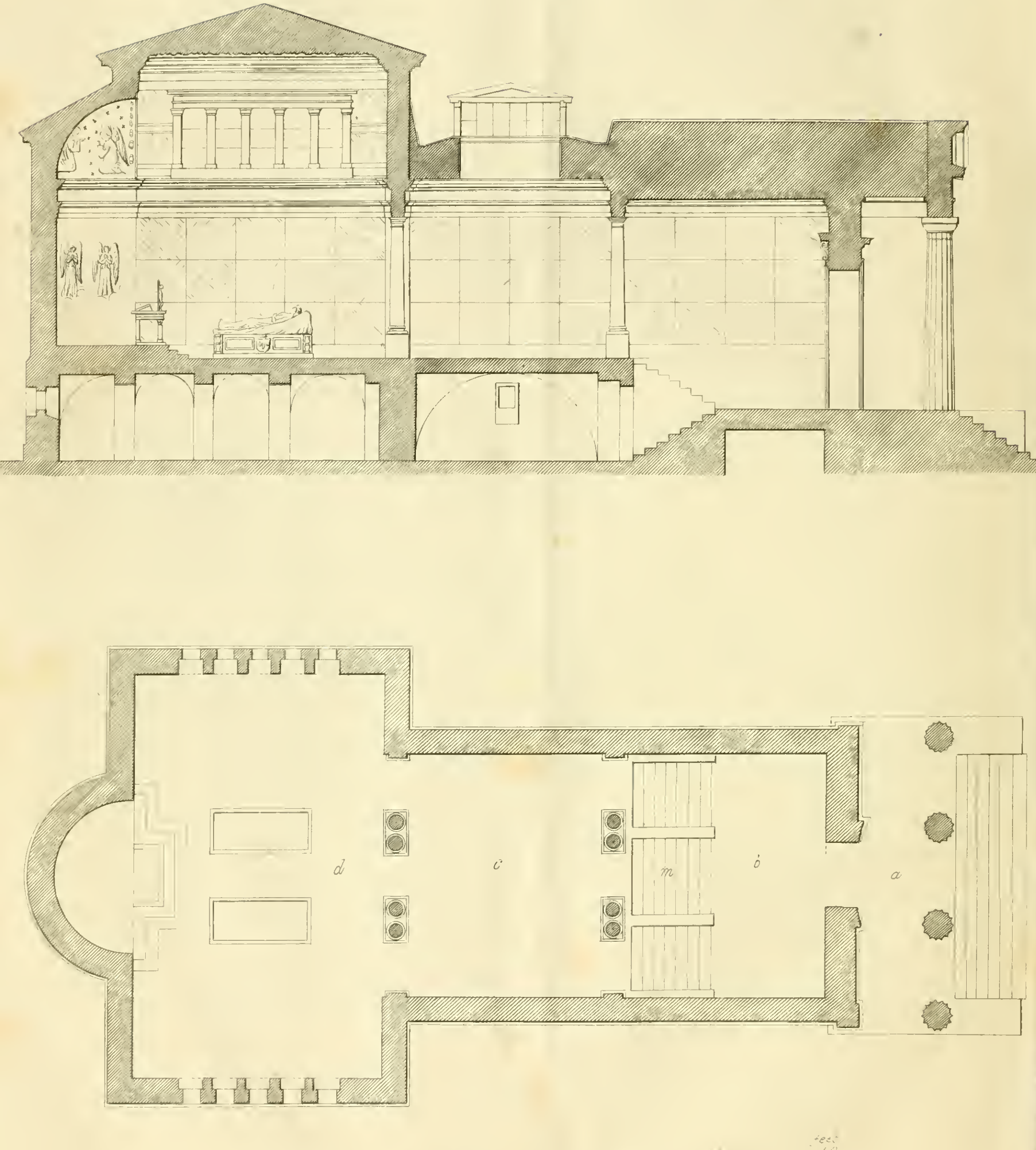
John Smith, of Highbury-grange, Islington, merchant, for "Improved means and apparatus for shaping hats." (Being a communication.)—January 21.

John Clay, of Edgeley, Chester, corn dealer, for "an Improved apparatus for consuming smoke."—January 23.

George Joseph Green, of Birmingham, manufacturer, for "a certain Improvement in, or addition to, harness, or harness-furniture."—January 23.

Peter Borrie, of Princes-square, St. George's-in-the-East, engineer, for "Improvements in the construction and fitting, or equipping, of ships or vessels."—January 23.

MAUSOLEUM AT CHARLOTTENBURGH.



MAUSOLEUM AT CHARLOTTENBURG.

(With an Engraving, Plate IV.)

The Royal Mausoleum in the park of Charlottenburg has long been an object of deep interest, both as testifying the conjugal piety of the late Frederic William III. of Prussia, and on account of its enshrining within its walls a masterpiece of modern sculpture, which if not perhaps the very finest production of Ranch's chisel, is the one which most impresses the feelings of the spectator—the exquisite recumbent statue of the lamented Louisa of Prussia. Thirty years after the death of his consort, died Frederic William (June, 1840), and according to his express directions was entombed in the same sepulchral chamber. In consequence of this, the present king ordered another sarcophagus to be erected similar in design to that of the queen, with a figure of the late monarch executed by the same artist, and further ordered the building itself to be enlarged by the addition of the chapel, *d*. The works were completed within about a year and a half, and the mausoleum solemnly opened again on the 7th June, 1843. The sarcophagus and figure of the king, however, were not then finished, therefore only a temporary plaster model of it was placed where the marble one is to stand—or perhaps now actually stands.

Who was the first architect of the Mausoleum we are not informed,—for almost everywhere alike, it would seem, an architect's name is of no importance or interest—but as the account which accompanies the plan, &c., proceeds from Bau-inspector Hesse of Berlin, we may take it for granted that he was the architect employed in enlarging and redecorating the structure, in which last respect it has undergone material change—at least great change of materials. The tetrastyle Grecian Doric portico, which was orignally of sandstone, is now entirely of highly polished granite, and each of the columns formed of a single piece, or rather all the four were cut out of a single block; and the doors within the portico are of bronze. The first space or vestibule portion of the plan, marked B, is 20 feet by 17 feet, and lower than the rest, up to which is an ascent by a flight of steps on each side, and between them a centre flight leading down to the crypt or vault. This difference of level contributes greatly to the striking effect of perspective, which is further enhanced by that of light falling down in the distance behind the columns. By this means also although the whole interior is disclosed on first entering, it is not fully revealed, but a well-defined interval is interposed between the body of the Mausoleum and the portico. The flights of steps are of Silesian marble, and the four columns in the space, c, (which is 20 feet by 16 feet within the columns,)are of a green and red marble, with white bases and capitals; and were brought hither from the royal chateau of Oranienburg. The other four columns, which divide *c* from *d*, are of Poldevere marble from quarries near Genoa, selected so as to be as nearly as possible of the same colour as the others. As is shown by the section, the division c of the interior is lighted from above. The darker parts of the section describe the original portions of the building, and those of a lighter tint the additional ones. The part *d*, (33 feet by 20 feet and 25 feet high,) is paved with black and white marble, has its walls encrusted with Silesian marble, veined with green and violet on a greyish ground, and is lighted by five windows in the upper part of the wall at each end. The walls are further adorned with a border of lapis lazuli, on which are inscribed suitable texts from scripture in letters of gilt bronze; and the tribune or recess is painted in fresco on a gold ground. Thus, notwithstanding that there is comparatively little to be shown in a mere outline section, there must be great richness and effect as to colour, as well as to perspective, and light and shade,—merits which the section alone would not convey an idea of, without some verbal explanation and description, whereas, aided by these it is now capable of affording a complete picture to the imagination.

As now altered, the structure it will be observed is just double its former size, the new portion, *d*, being equal to *b* and *c*, but placed transversely to it, and also loftier, both which circumstances very greatly improve the exterior, by producing variety and contrast of well-opposed masses, while at the same time sufficient simplicity—even to severity perhaps—is preserved. Nor is such disposition of the two main divisions of the plan less favourable to internal effect, inasmuch as the further part expands both sideways and upwards, and the combination of different heights as well as different levels is singularly effective and piquant. In fact, barren as the design looks at the first glance, it will be found upon inspection to contain the elements of a more than usually scenic piece of interior architecture.

CANDIDUS'S NOTE-BOOK.

FASCICULUS LXII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. 'Tis strange there should uniformly be so much gratuitous hypocrisy, and nauseously canting humbug respecting the *moral influence* of the fine arts. Fudge! and very silly and useless fudge, too! In the first place it amounts to an acknowledgment that art is not worth cultivating for its own sake; that the people of this country care nothing for art—have no relish for it, and can be brought to encourage it only by being persuaded of its innate "*goodness*" and moral efficacy; or else an appeal in behalf of it must be made to that very sensitive part of them—their pockets, and they must be convinced that art is capable of greatly increasing their commerce, by improving their manufactures, mammon being found to be here the most eloquent advocate for art. In the next place, the "moral influence" argument will not "hold water at all." History flatly gives the lie to it at once, because if such argument were at all more than mere moonshine, the court of Leo X. would have been the most moral court in the world—quite a pattern one, whereas it was notoriously the reverse, and so was that of the arch art-Mecænas, Louis XIV. Still that such should be the case does not afford, *è contra*, a positive argument *against* art—although it may after all be questionable whether art be particularly favourable to the "severe virtues." On which account, the more prudent course is not to provoke a too nice and sifting inquiry into the real influence of art, by crying it up as of marvellous efficacy for moral good. Let us have as much of art as we can get, and as little maudlin cant about it as possible. Of cant there is quite enough already served up to the public in every imaginable shape. Religious cant does not amount to a tenth part of it. There is your cant political, and your cant literary; there is your aristocratic cant and your utilitarian cant; the vulgarian cant of would-be gentility, and the hysterical cant of would-be benevolence. But, if we can preserve nothing else from it, let us at least endeavour to keep art intact from cant, and from the humiliating humbug of hollow, make-believe enthusiasm. Salvator Rosa's energetic satire, "La Pittura," does not say much for the so-much-talked-of moral influence of Art; at all events *he* was not addicted to humbug.

II. Nothing can be more truly impolitic than for professional men to sneer, as they are apt sometimes to do, at those who take up the study of architecture merely as an intellectual and æsthetic pursuit. Rather ought they to feel flattered by their art being looked upon in such light; and if they at all understood their own interest, not perhaps as individuals, but as a body, they would do all in their power to encourage such a taste, and to promote the diffusion of it as widely as possible. Nevertheless, they either are incapable of perceiving or else obstinately refuse to see the advantage that would hence result to them, unless just when they happen to feel the sad inconvenience that attends their being at the mercy of committees who are utterly unable to judge of architectural designs. Then, indeed, there is sad lamentation about the ignorance and utter incompetency of the judges who decide on such occasions; then a sort of glimmering comes across the professional mind, just enabling it to discern that it might be as well if the non-professionals who compose such committees, and accordingly possess great power and influence for either the advancement or retardment of the art, were capable of fully appreciating the drawings submitted to them, and no less willing than able to bestow upon them an impartial and patient examination. Yet what wonder is it that such persons—no matter what their rank in society—should be generally quite incompetent, if, as non-professionals, they have hardly any right to qualify themselves properly for the office they undertake. Instruct the public, and then there will be no great difficulty of finding sufficiently capable persons for committees at competitions; and the better instructed and more intelligent they are, the more impartial would they be likely to prove, and less liable to be swayed by sinister motives, because they would then be more earnest, and feel really interested in the best design being chosen. There would, besides, be far less danger than at present of having to encounter stupid obstinacy; the well-informed man knows his own deficiencies, knows where he ought to yield to the professional one, because he is capable of understanding, and is therefore ready to be convinced by his arguments, when they are well supported; whereas stupidity, which is generally accompanied by an equal degree of obstinacy, is not to be stirred by any argument or reasoning whatever. Yet, so far from hearing any cry of "Instruct the public in architecture," we may frequently detect a suppressed feeling of jealousy on the part of professional writers towards those who attempt to bring architectural topics more immediately before the general public, conveyed in a more attractive and popular shape than that of formal treatises and theories. Yet they cannot reasonably complain of ground being trespassed upon, which they themselves willingly abandon to all who choose to enter upon it. No doubt there is a great deal of absurdity —no small number of crude superficial opinions served up to the public in that fashion; and why? because however ignorant and superficial such writers may be, the public are still more ignorant, consequently unable to detect the shallowness of those who "set up for critics." This last phrase has been employed as one of peculiar reproach by a certain professional writer, who seems to hold all criticism illegal and contraband that does not bear the lawful professional mark, which is assuredly greatly overshooting the mark, and almost tantamount to interdicting criticism altogether. From whom do we get criticism on art at all, if not from those who voluntarily come forward and "set up as critics," without other licence for doing so than their own? Condemn and expose bad critics, but to rail at the whole race indiscriminately is extravagantly absurd, and also perfectly useless. It would seem that some are possessed with such a horror of criticism, that while they carefully abstain from it themselves, they will on no account tolerate it in others. Strange, then, that professional men should care at all for the good opinion of those who, if some among them are to be believed, are no better than pretenders, and whose praise ought therefore to be held as valueless as their censure. Yet somehow or other it happens that praise—even though it should come from a blockhead—is always acceptable, and will be received as legal tender without being very nicely examined. So long as he deals only in *that*, a man may pass for a very judicious and discerning critic; but when once he begins to censure, or even to qualify his praise by noting defects and imperfections also, his judgment is disputed.

III. As in a good many other things, *Nominalism* is the source of no little mischief, error, and humbug in architecture. It puts us off with mere delusions—words, names, and titles, instead of realities. Because the style which a building must be described as belonging to —for want of other means of indicating the mode it affects—is good in itself, it nominally ranks as being *of* it, although it may be a positive disgrace *to* it. Notwithstanding that the contrary opinion seems to prevail, there is no talismanic power in the name of a style. Grecian, Roman, Italian, Gothic, may be all alike rendered detestable, thoroughly mean and paltry; and when that is the case the excellence of the style adopted only renders failure in it the more ignominious, proving that he who has attempted to use it has neither understood it nor had the least feeling for it. The name of a style is of infinitely less importance than the manner in which it is treated. Instead of taking one that is good merely to emasculate, impoverish, and vulgarize it, it would be far better to make use at once of what is considered a poor one, and try to infuse some spirit and quality into it. It matters little what style an architect employs, if out of the very best he can only produce what is decidedly unsatisfactory. Before determining upon what style he shall select, an architect would do well to ask himself if he can treat any style at all with geniality. Unless he be content to be nothing more than a mere builder, geniality is a *sine qua non* prerequisite for him who would not unworthily write himself architect. Genius, indeed, we have no right to demand, because it cannot be commanded even by the most diligent and the most zealous, but geniality—intense relish for his pursuit, earnest and fond application to it, generous and enthusiastic devotion to it, may not unreasonably be looked for in him who enlists under the banners of Art, which is presumed to admit into its service only volunteers. A coward in a red coat is less pitiable and contemptible than he who enrols himself in the ranks of art, though conscious of his own disqualifications, and animated by no higher stimulus than the hope of pay and plunder.

IV. Onerous and odious as the window-tax may be, it cannot—as those who declaim against it would fain make us believe—be alleged against that it operates to the disadvantage of architecture. Absurdly anomalous it is, no doubt, there being no reason wherefore a special tax should be levied on those parts of a house more than any other—than on doors or fire-places, which are equally indispensable, and the number of which in a house afford just as good a criterion of its occupier's ability to pay accordingly. If tax of the kind there must be, it would be good policy to take it off from windows and clap it upon doors (double doors or folding doors reckoned as two), because were windows untaxed there could no longer be room for any sentimental lamentation about the inhumanity of making people pay for enjoying the "LIGHT OF NATURE, the enlivening, the pure, the holy light!"— In regard to which flourish of superfine sensibility, I may observe, that to so very prosaic a creature as myself, it seems that it depends upon a variety of other circumstances than the mere number of windows whether the said "holy light" be particularly "pure" and "enlivening" or not. Although one side of a room were made all window, there would be nothing particularly enlivening in having an uninterrupted prospect looking into a narrow, dismal, and stinking alley, into which fresh air never finds its way, though such gratification were attended with the additional delightfulness of a person's knowing that he was fully exposed to the constant surveillance, inspection, and sympathetic watchfulness of his opposite neighbour,—window-blinds and draperies being of course totally out of the question. If the poor are ever to enjoy them in their dwellings, light and fresh air must first of all be admitted into the places where such dwellings are now squeezed up and crammed together to the all but utter exclusion of both. The dismal lanes, and courts, and alleys inhabited by the poor, stand in need of thorough ventilation both physical and moral, nor is the latter kind of it that which is least of all needed; yet neither the one nor the other, it seems, is likely to be promoted by the Society for Improving the Condition of the Labouring Classes, and its model houses packed together within "blind" courts and alleys.—But there must always be a certain degree of humbug and cant afloat, and the cant which is just now uppermost with the public is that of providing a panacea for the poor by affording them light and ventilation in places so densely built that it is almost mockery to talk of their having either, unless such districts can be thoroughly *thinned out*—half the houses or more knocked down in order that the rest may get a little sunshine and fresh air. If a system of "thinning out" and dispersing the present horribly accumulated masses of poverty be impracticable, no effectual remedy for the evils complained of can be supplied.

V. If there be any justness in the preceding remarks, it further follows that even in houses of a superior kind, regard is to be had to the express situation, if a certain fixed proportion of light is to be admitted into all the rooms alike—as seems to be generally considered desirable. There is therefore something like quackery in the rules pretended to be laid down by some writers, for regulating the number and size of the windows of a room according to its cubic dimensions. Either there can be very little difference in the size and proportions of the several rooms or what would be proper for some of the rooms would not suit others. Besides which the scrupulous *secundum artem* nicety which is affected, is, after all, disregarded if a variety of other circumstances, be not also taken into account,—*imprimis*, external situation, for it surely makes some difference whether light be at all obstructed or even moderated by opposite buildings, or not; next, aspect, because if we are to come to such very nice calculation, windows of that size which suit an East aspect do not answer equally well for a West one; thirdly, the position of windows—whether at one end or along one side of a room,—whether on a level with the floor or raised only two or three feet above it, or in a lofty room placed high up over head, just beneath the entablature or cornice; again, whether they be in the side walls at all or in the ceiling as a lantern or dome skylight,—in which last shape a much smaller proportion of window aperture is required than in any other.

VI. So far from operating at all to the prejudice of architectural design, the window-tax is a most decided boon and blessing to it— that is, supposing it does ever cause fewer windows to be made in a front than otherwise would be. If—as seems to be the vulgar notion —"frequency" of windows and comparative narrowness of spaces between them be a merit in architecture, then are the "Terraces" in the Regent's Park, and other similarly genteel-named ranges of houses beskirting the metropolis, in better and more rational taste than Barry's and Basevi's Clubhouses, which are in comparison with them, of course very sulky-looking—not to say prison-like without, and dismal and gloomy within. Neither Reformers nor Conservatives seem to have any very inordinate affection for "the holy light"—for what Friend Joseph calls "God's eldest daughter." On the contrary, we might suppose them of the other sex, who, if they are not grossly belied, are led by instinctive policy to prefer artificial light to "the light of nature." The Conservatives' new building does not, indeed, look very much like a *conservatory*. There are comparatively few openings for daylight either in that or the Reform Clubhouse; and the buildings are in other respects far more massive and substantial than *light* in style. Nevertheless, in spite of their pronounced Italianism, which *ought*, according to some learned wiseacres, to disqualify them entirely for this tramontane, hyperborean climate of ours, they are not such exceedingly *owlish* places within as might, *à priori*, be imagined. The rooms are passably lightsome and cheerful "*considering*;" the atmosphere within them is not quite of the kind to bring on a fit of the blue-devils,—which is rather to be mortally regretted than not, because it is most mortifying to the solemn twaddlers whose puny theories it completely upsets. Pity! that a little more light cannot be admitted into some gentlemen's *Hattic* storeys!

HISTORY OF ARCHITECTURE.

A Brief View of the General History of Architecture, from the Earliest Periods of Egyptian Art to the Middle of the XVI. Century. By Thomas Leverton Donaldson, Fellow. (*Read at the Royal Institute of British Architects, Monday, January* 13.)

(*Continued from page* 58.)

We now quit the banks of the Nile, leaving its patient and laborious people, with whose power, magnificence, and intelligence all antiquity is filled; we quit its pyramids, its tombs, its temples and wondrous monuments, struck with a sense of their majesty, their overwhelming size and profuse embellishment, and considering the refinement to which their arts and manufactures were carried, and the extent to which their commerce penetrated, we might well deem (had not experience taught us the contrary), that human intelligence could not have risen to higher flights of imagination or more perfect productions of skill. But we learn that a people of much later origin, or at least of a much later date of civilization, caught from the Egyptians the first germs of art and science, and penetrated by their monuments were seized with a higher inspiration of the imaginative faculties, enunciated sounder precepts of wisdom, and throwing off the formal shackles of superstition and mysticism sought a new world of art and science in nature's self, and have been regarded as the masters of future generations in the canons of art, of letters, and of science.

You must feel that I allude to the wondrous Greeks. Yet although I am conscious that they owe most of the first elements of their future greatness to the lessons acquired by their philosophers, their artists and historians on the banks of the Nile, still we cannot but allow that they must have been influenced also by the arts and manufactures of other people of high antiquity, such as the Phœnicians, Assyrians, and other mercantile nations, whose ships oft sought the coasts of Greece in search of commercial wealth or as an asylum from the overgrowing population at home, or the tyranny of their rulers or predominant factions. But although we know how skilful those nations were in the arts of commerce and the useful productions of life, still we have no monuments of art now remaining to attest their genius in those finer productions of the human genius which raised the Egyptians, and subsequently the Greeks, to so high a scale in the intellectual world. 'Tis true we hear of the masses raised at Babylon, at Nineveh, and Sidon, and Tyre, but they are rather mentioned for their vastness and constructive skill than for their beauty as works of art—and they are quoted by the Greek writers rather upon the authority of other travellers, than described as monuments which they themselves saw and studied and described from actual inspection. It is true, that like Memphis and Thebes and all other great cities, Babylon and Nineveh were situate upon the banks of rivers, but the Euphrates and Tigris had not, like the Nile, their discharge in the Mediterranean, and consequently were not accessible to Greek commercial enterprise, it was only later, when Greek courage and Greek discipline rendered them the terror and admiration of the then known world, that their armies penetrated as conquerors or allies to inland regions, and brought home the refinements and luxuries of central Asia.

The earliest practisers of our art in Greece were the Pelasgi, whose origin is lost in the darker periods of Greek history. Their skill seems to have been principally applied to the construction of their city walls, the first object of necessity to tribes (if I may so call them), who were little better than hordes of robbers, constantly carrying their predatory incursions into each other's territories and plundering friend or foe—those nearest being the most dangerous.

Argos is generally first named as being founded by Phoroneus, son of Inacus, from whose son, Argos, it derived its name. Danaus travelling from Egypt rendered himself master of the throne of Argos and Sicyorn, founded by Egialeus a supposed other son of Inacus, usually mentioned by Greek chronologists as the earliest date of Greek civilization, and first notice in history as a people. Three hundred years afterwards the sacred rock of the Parthenon was selected by Cecrops for a city, called after him Cecropia and subsequently named Athens. He established laws and erected a court of judicature called Areopagus, after the models, as we are expressly told by Thucydides (lib. 2), of the tribunals of Egypt. The next striking event was the Argonautic expedition, headed by Jason, Castor, Pollux, Hercules, Telamon, and Orpheus, which visited many nations and enriched themselves by the experience gained in their visits to the cities of Asia Minor. Mycenæ now assumes an important place in Archaic history. Its Tyrant Euristheus compelled Hercules to undertake his twelve labours, in the performance of which he visited various foreign parts. In these remote times we find the origin of that distinct difference of character which pervaded Greek art in contradistinction to that of Egypt. The earliest temples were built of wood—the ignorance of their first artists, the poverty of the people, did not allow them to avail themselves of the stone and marble which are to be found throughout Greece; and at a period when some of the most glorious edifices of Memphis and Thebes had their propylea, obelisks, columns, and statues, the Greek worshipped his mountain god in a log built fane formed of the pines cut from the summit of Parnassus, Taygetus, or Œta. But under the Atridæ a great step was made, and solid masonry of horizontal courses was introduced.

Other cities had like treasuries, as that of Minyas at Archomenes, the first according to Pausanias erected for such a purpose, and probably erected by some artist who accompanied the colonists who came to Greece from Egypt and Asia Minor. We now learn for the first time the use of bronze, as those chambers were lined by that metal, and frequent mention is made of kings who hid themselves from their enemies in bronze chambers, which were probably of this form. Euristheus used almost always to hide himself in his bronze chamber whenever Hercules returned to Mycenæ after accomplishing one of his labours.

Mr. Donaldson then alluded to the Greek migration to Asia Minor, to the impulse given by the siege of Troy, to architecture and its state at the time of Homer. He then analysed the origin of the Greek Doric, as derived from timber construction, and the difference of its entablature, with architrave, frieze, and cornice from the Egyptian entablature.

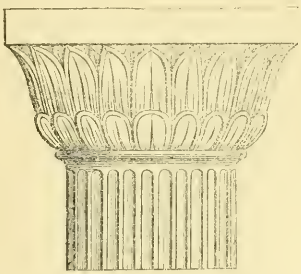
It seems to be certain from the evidence brought forward by Canina that the Ionic as well as the Doric was invented before the Persian invasion of Greece by Xerxes; and in fact the example at Samos, given in the works of the Dilettanti Society, so peculiar in its design, proves a very remote epoch, not a decline of a previously well-conceived and highly finished example but the first rude attempt at somewhat not yet matured and perfect in its conception. We may hence conclude that in the period between the Trojan war and the Persian invasion the Greeks, although distracted by internal wars, still pursued the art with perseverance, and following the right traces. They seem to have made a point of studying nature as the source to direct them in the principles of art; and as in those of painting and sculpture they sought in the finest forms of the Grecian youth and in the exquisite figures of the athletes and runners in the sacred games, the proportions of their heroes and their gods, so they recurred to the productions of the vegetable world and the parts of the log hut or wooden temple for the principle features of the orders and graceful details of the mouldings which gave a charm to, and relieved the heaviness of, their substantial constructions. We may assume as certain that the Corinthian order had not yet been discovered; for otherwise we should find it doubtless employed in those edifices, at least in some parts, erected immediately after the Persian invasion. Nor probably had the Ionic yet established its claims, as I said before, to be considered a perfect conception, for unless restrained by a superstitious veneration for antiquity, or an attachment to established forms, we might suppose that the Theseum and Parthenon would have been raised in all the sumptuousness of the more enriched parts of the Ionic. That the Doric was perfect in all its parts at the Persian invasion we may infer from the fragments of the large Doric order, whose blocks form part of the citadel walls of the Acropolis of Athens, and which seem with all reason to be the ruins of the original Parthenon destroyed by the Persians and worked up when the citadel was rebuilt. We may judge also from the fact that the temples of Sicily and Magna Grecia, which appear probably to have been erected soon after the settlement of those colonies, contain all the parts of the more refined productions of Ictinus, although of more massive proportions, of ruder workmanship, and with some greater crudity of detail. The Doric example at Corinth, apparently the prototype of the Sicilian and Magna Grecian temples, is the expression of a masculine and fierce sentiment; the Athenian models the emanation of a gentler and more refined feeling. This pervaded the entire of Attica, at Eleusis, Rhamnus, and the Promontory of Sunium, as the other did Syracuse, Girgenti, Selinus, Pestum, Metapontum.

Tracing then the development of the Grecian character from their state of barbarism, their gradual acquirement of the arts of civilization, their commerce and wars with other nations, we find them progressing in the cultivation of the arts of peace, creating two new original orders distinct in their original types and peculiar in sentiment, and all this before the Persian invasion, when most of the temples and other edifices in Attica were destroyed, and before the epoch of Pericles and Ictinus, whose productions are too often regarded as the first examples of those orders.

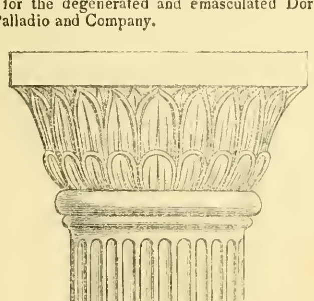
The conquest of the Persians driven from Greece, and the riches of which they were plundered, inspirited the Grecians to turn all their energies to produce those splendid and perfect works of art, the admiration of all succeeding ages. From that time there was a rapid and progressive improvement, the natural result of which, and of the desire for novelty, was the invention of the Corinthian order by Callimachus. It is, however, a remarkable circumstance, considering the beauty of this invention, that the ancient Greeks do not appear to have employed it as the principal order of any of their temples until the period of the Roman rule in Greece. The only perfect example which we have is that of the Choragic monument of Lysicrates, in which a playful fancy, as was natural in such a monument, had more scope than would have been allowable in a monument of a severer character. Scopas introduced it in the interior of the Temple of Minerva in Tegea; but no Corinthian edifice of a large scale remains at this time of the purer epochs of Greek art. The same may be said of the Ionic. The little Temple of the Ilissus, the moderately sized triple Temple of the Acropolis, the casual intruduction of the Ionic columns in the propylea of Athens and at Eleusis, do not announce a grand application, a hearty adoption of the Ionic order by the Greeks of Europe, whereas it was the prevailing order in the colonies of Asia Minor.

NEW ORDER OF ARCHITECTURE.

SIR,—To suggest a New Order of Architecture has long been a desideratum, particularly with those who seek after novelty. It is possible, but not probable, that an invention shall be realised which can compete with any of the three beautiful orders which we have already; perhaps, however, the accompanying sketch may be received as a variety not unsuitable on some occasions. It is not presented as altogether new, for the hint of the lotus-leaved capital is taken from the ornamental base of a column from the ruins of Persepolis, and it may also, in some measure, be considered as an attempt to Grecianise one of the Egyptian capitals.



The example will admit of the abacus and zocco being made either circular or square—thus differing in respect to the former from the Corinthian and the Ionic, and perhaps also the Doric order. With regard to massiveness, it is intended to occupy a place between the light Corinthian and Ionic and the more ponderous Doric; in short, as a substitute for the degenerated and emasculated Doric of Messrs. Vitruvius, Palladio and Company.



As it has been held that "the art is taught by Vitruvius and adorned by Palladio," we may trace to the reception of this doctrine all the enormities and bad taste exhibited in the productions of those who follow the anilities of these great masters. Both of them indeed professed to follow the principles which guided those who brougt the art to perfection; but the one appears to have attempted to describe what he never saw—and the other to have profitted nothing by what he did see: rejecting all that was good in the imperfect examples which were presented to him, he retained in his own productions all the faults by which those examples were distinguished from their types, adding not a few of his own beside. Blind leaders of the blind then, can it be wondered that they should lead those who blindly submit to be guided by them—into the ditch? or that architecture can never flourish until we shall throw off their trammels?

Two examples are given of the New Order, perhaps the one with the single torus might suit a column on a gradated pedestal (as in the Doric) and without any other base: and the double torus might have one with the base of the voluted orders; but in either case the shaft must be fluted, nor is this necessity to be regretted, for unfluted columns are under any circumstances in ornamental architecture to be condemned as deficient in that alone which gives them beauty—the *variation* of light and shade.

With respect to architrave, frieze and cornice, nothing new seems to be required; any of the many Greek, or some of the early Roman examples may be taken, giving the preference to those used with the voluted capitals; but if triglyphs be exhibited on the frieze, I must be allowed to protest against the introduction of more than two metopes between centre and centre; a departure from which rule has rendered modern Doric a vile parody which ought to be scouted at and rejected by every person of good taste. With the Greeks (as I have often before remarked) triglyphs were the index of proportion with us, (too often) a mark of the want of it, and of the bad taste of the projector, who not being satisfied with making his intercolumniations too wide, must needlessly indicate that he has done so. There are two things necessary to be attended to in a Doric composition—great size and due proportion, without the latter it may be a mass of deformity, and without the former mean and insignificant, but in neither case can it gratify the eye, or excite the admiration which results from an inspection of the ancient examples. Modern architects feeling this, have recourse to the pseudo Doric of Palladio, in cases where the Doric is too heavy, and the voluted orders are too light for their purpose—for such cases it is hoped that the examples now given may be found to answer better.

This new order might be called Victorine, in compliment to Her Majesty. As I am not a practical architect, I shall leave the suggestion in the hands of the profession, in the hope that it may be improved and completed, and thus rendered more worthy of the name I wish it should bear.

HENRY FULTON.

Clonmore, February, 1845.

ROYAL EXCHANGE—WINDOWS OF THE MERCHANTS' AREA.

(With an Engraving, Plate V.)

It is with no small satisfaction that, fulfilling a conditional promise on our part, we now give the design of the windows (they being all alike), in the upper order within the open cortile, or Merchants' Area, of the Exchange, for they are not only of very unusual character, but afford very much room for study. The other windows[1] were not shown to so much advantage as they deserved to be, because in order to exhibit several of them on the same plate, no more of them was drawn out than sufficed to explain the respective designs. In the present engraving, on the contrary, not only is the whole of the window-dressing but the entire composition, including the order itself, is fully exhibited, the drawing comprising one intercolumn of the upper part of the elevation. What has here been done is so far from being arbitrary that it is strongly motived: the problem was to assimilate the general composition of the upper order with that of the lower one, consequently the open arcades in the latter dictated something analogous for the other, that is to fill up the intercolumns with arches, for had not that been done they would have looked blank and heavy also. Had larger and loftier openings for the windows been required, they would, almost as a matter of course, have been treated as a series of arched Venetian ones, set within the arcades, which—notwithstanding Mr. Gwilt's furious protest against a number of such windows in the same design—would have had a pleasing effect, as may be seen in the south-west cortile of the Bank of England, by Sir R. Taylor. Here, however, windows of only 4 feet 2 inches in breadth by 9 feet 4 inches

1 As the figures of reference in the former plate were not explained at the time, we take this opportunity of supplying that omission. Fig. 1 shows one of the three central windows of the south front; figs. 2 and 3 one of the three ditto of north front; and fig. 4 one of the ten side windows of the south front.

ROYAL EXCHANGE WINDOW IN THE MERCHANTS' AREA.

PLATE V.

in height were required with arcades of 10 feet by 18 feet. Undoubtedly, the present windows—and taken by themselves they are of pleasing and unhackneyed character—might have been set within the arcades without other filling up; whereas, greater degree of richness, accompanied by great play of plan and diversity of surfaces, has been obtained by converting the arcades into large niches or coved recesses, cut by a plane or vertical *plafond*, occupied by the window and its immediate dressings. We perceive the same idea, though very differently treated in detail, adopted by Wren in some of the windows of St. Paul's, which may satisfy the scruples of those who can admire nothing unsupported by some sort of authority or precedent, but does not at all detract from the merit of what has here been done. If there be any part which we wish had been treated somewhat differently, it is the window-dressing or *chambraule* itself, for although exceedingly well composed, taken by itself, it appears to us that it would here have been better without the pediment, because the pediment cuts into and obstructs the small arch or lunette of the *plafond* somewhat disagreeably, and occasions some confusion of lines. The window might perhaps have easily been raised a little, so as to bring its cornice on a level with the impost mouldings of the arcade, and the lunettes might have been filled in with a series of medallion portraits of English sovereigns,—yet they would perhaps have hardly been seen sufficiently distinct at that height. Those who remember the design of the upper part of the quadrangle of the old Exchange, or can turn to any prints of it, will not admire the present design the less for comparing it with that truly hideous piece of architecture—so excruciatingly detestable that it is impossible to believe Wren was at all concerned with it, and to attribute it to him is only to disgrace his reputation.

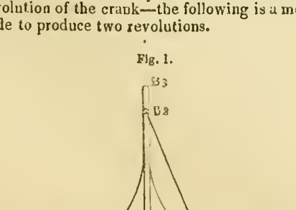
*** In the general description of the building, given in a former number of the Journal, we enumerated the tradesmen employed, but omitted the names of Messrs. Bunnett and Corpe, who furnished the patent revolving iron shutters to the whole of the shops.

MECHANISM FOR MULTIPLYING MOTION.

This subject has recently received much additional importance from the invention of the Archimedean screw for propelling steam vessels. It has been found by practical experiments, and has also been shewn independently by mathematical investigation, that the utility of the propeller depends in a great measure on the rapidity with which it revolves. Now the ordinary method of converting the alternate motion of the piston rod of a steam engine into a circular is by a crank; the number of revolutions of which equals the number of complete strokes of the piston-rod, as every time the piston-rod ascends from its lowest to its highest position and descends again, it produces one complete revolution of the crank. The revolutions thus produced are, however, found to be too slow for efficiently working the Archimedean screw without the intervention of cog-wheels or straps, which are therefore employed to multiply the number of revolutions of the crank. The employment of cog-wheels is, however, liable to many serious objections; the friction of the cogs against each other causes them to wear away, and therefore work untruly; they are also liable to constant breakage; and lastly, the noise which they cause in working is a serious impediment to their general adoption. The last objection has been in some measure met by the use of wheels with wooden cogs, to which however the two other objections apply with increased force. The following method of multiplying motion by a system of cranks only, is by no means offered as a complete solution of the important mechanical problem, but as nothing of the kind has been hitherto suggested, it may possibly contribute something towards the object in view.

Each complete stroke of the piston-rod, it was said above, produces one revolution of the crank—the following is a method by which it may be made to produce two revolutions.

Fig. 1.

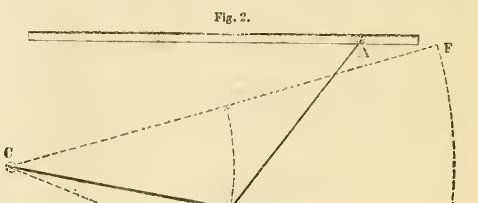


In fig. 1, A_2 represents the end of the piston-rod, (the rod itself is omitted for the sake of distinctness,) which end is capable of moving in a straight line from A to A_4. It is here supposed that the end is confined to this course by a groove or guide, as in direct action engines. A_3 is the middle point between A and A_4, opposite to this point is another groove B, B_3, at right angles to A, A_4, and about half its length. In this groove works one end, B_2, of a rod, the other end being connected with A_2; now it will be seen that when A_2 passes from A to A_4, B_2 passes from B to B_3 *and back again*, and that therefore one vibration of A_2 corresponds to *two* of B_2. For when A_2 is at A the rod is in the position of the dotted line, and as A_2 advances from A to A_3, B_2 ascends from its lowest to highest position, but it begins to descend again when A_2 has passed the middle point A_3, and finally is at its lowest position again when A_2 is at A_4. The same happens on the return of A_2; so every complete motion of A_2 produces two of B_2, and therefore a crank attached to B_2 would revolve twice as often as one attached to A_2.

It is obvious that the means, by which the alternate motion of A_2 produces a double movement of B_2, may be used to make B_2 produce a double movement in a third crank, and this again in a fourth, &c., so that we have here a method of multiplying the number of strokes of the rod (and therefore revolutions of the crank), by 2, 4, 8, 16, &c., that is, in mathematical language, by any power of 2. But in practice, after two or three multiplications the machinery would become too complicated to be efficient, and there is also another defect in the mechanism, owing to the extent of motion of B^2 not being more than half as much as A_2; indeed it will be exactly half as much (as may be seen by the slightest knowledge of geometry), when B, the end of the second groove, is brought close up to A_3, the middle part of the first groove. Now if many grooves were used, this diminution of their successive sizes would be so often repeated that the last rod would not have sufficient extent of motion to turn a crank of any useful size.

This evil may, however, be overcome, or at least palliated. It will be observed in fig. 1, that it is not absolutely necessary that the groove A, A_4, should be straight; the action would be precisely the same if the groove were an arc of a circle, or, which is the same thing, if the point A_2, instead of being the end of a piston rod, were the end of a beam, with one extremity turning on a pivot and the other moving backwards and forwards from A to A_4 in an arc, the motion of the second rod would be the same. This is exemplified in the next figure.

Fig. 2.



In fig. 2, a beam C D, moving about a pivot at C, one of its ends, is connected at B with a rod, of which the end A moves, as before in fig. 1, in a groove. The extent of motion of D, from E to F, is nearly as great as that of A, and another connecting rod might be attached to D to again multiply the motion. By such a contrivance as this the multiplication may be continued several times without an inconvenient diminution of the extent of motion.

This method of multiplying reciprocating motion may be applied directly to rotary motion, without the intervention of additional machinery. Figs. 3 and 4 exhibit a scheme for this purpose; A is, as in fig. 1, the end of the piston rod, moving in a groove between A_2 and A_7, (it is immaterial whether the groove be straight or A be moved in arc by the end of an engine beam); C, the centre about which the crank revolves, is opposite A_5, the middle point of the motion of A. Figs. 3 and 4 shew this crank in its different positions, the same letters referring to the same things in both figures. A, B, is the rod connecting the crank with A. We will trace the progress of the crank by referring alternately to the two figures, First, let the crank and connecting rod be in the position A_1 B_1 C, fig. 3; the crank revolving in the direction of the arrow, and A moving

Fig. 3.

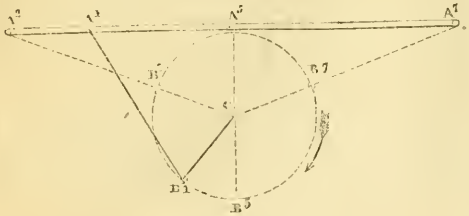
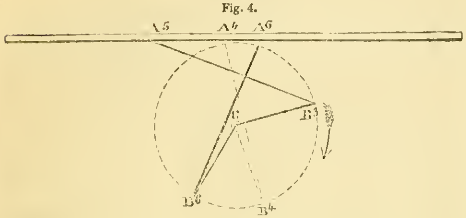


Fig. 4.

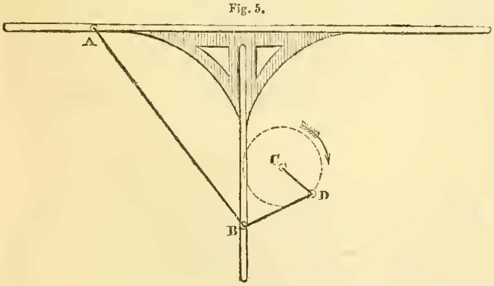


towards A_2; when it reaches A_2 the position will be that of the dotted line A_2 B_2 C, the crank and rod being in a straight line; the momentum will carry the crank on, and as A_2 now begins to retrograde, when it reaches some point A_3 the crank will have arrived at the position B_3 C. The next position is A_4 B_4 C, fig. 4; and the next A_5 B_5 C, the crank now being coincident with the rod. The next position is A_6 B_6 C; and before A reaches A_7 the crank will have completed one whole revolution. We need not trace the motion after the position A_7 B_7 C; it will be readily seen that when A returns, the motion continues as before, and when A has got back to A_2 the crank and rod will again be in the position A_2 B_2 C, and another revolution will have been accomplished.

Hence one complete vibration of A will correspond to two revolutions of the crank. The only difference between this crank and the ordinary crank now actually used is its position; here the pivot about which the crank revolves is opposite the middle point of A's course; at present it is put in a continuation of the line of A's course, and therefore there is only one revolution for every stroke.

Fig. 5 represents a combination of the idea of figs. 3 and 4 with

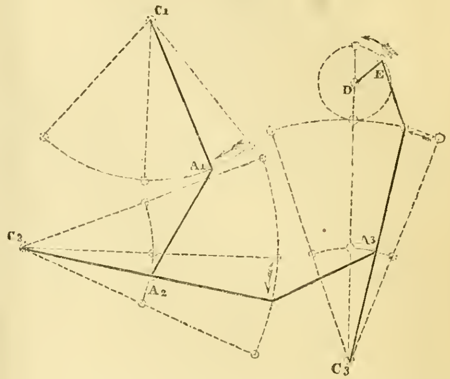
Fig. 5.



that of fig. 1. In this case the multiplication is four times; the figure requires but little explanation—for every course of A in its groove B will move twice in its groove, for every course of B the crank C D revolves twice, and therefore four times for every stroke of A.

We have said that it is quite immaterial whether the alternating points move in straight grooves or be attached to beams describing arcs; either plan may be used exclusively, or the two combined in any way found convenient. Fig. 6 represents a case in which there are no grooves; the multiplication is here eight times. It must not be supposed that the mechanism is complicated because a great many lines appear in the figure—the dark lines represent the whole machinery, the dotted lines lines merely show the different parts in their extreme positions. A_1 B_1 is the prime moving beam, oscillating about the pivot B; for every oscillation of A, the point A_2 of the second beam A_2 C_2 will oscillate in its dotted arc twice, owing to the connection by the

Fig. 6.



rod A_1 A_2; similarly, for every oscillation of the second beam, the beam A_3 C_3 will oscillate twice; and lastly, from what we have said before, it will be seen that for every oscillation of the third beam the crank D, E, will revolve twice; the motion will therefore, on the whole, have been multiplied eight times.

Having considered various methods by which reciprocating may produce multiplied circular motion, we may proceed to a method by which circular motion may produce multiplied circular. The method is extremely simple. A B fig. 7, is a crank revolving about A, and

Fig. 7.

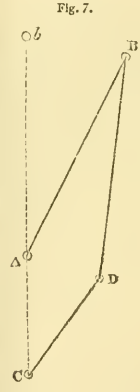
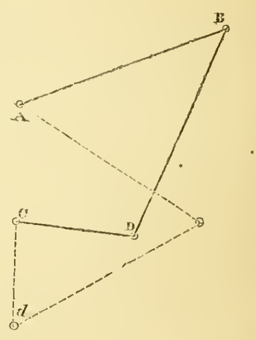


Fig. 8.



connected by a rod B D of the same length as A B itself, with a smaller crank C D about two-thirds or one-half the size of A B; C D revolves about C, and the distance A C = C D. For every revolution of A B, C D will revolve twice.

It is rather difficult to shew this by diagrams, but if the reader will exercise his ingenuity in tracing the motion by the successive positions of the two cranks represented in the above figures, he will see the truth of the statement. The same letters mean the same things in all five figures, and the cranks are supposed to move in the same direction as the hands of a clock do.

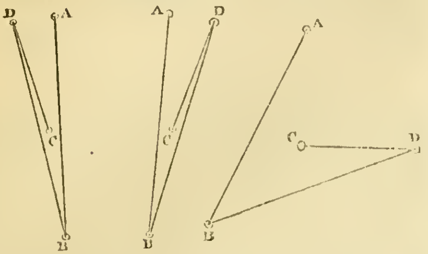
In fig. 7 A B is just past its highest position and begins to descend; C D begins to descend also. (When A B is in the dotted line A *b*, C D lies along C A.)

In fig. 8, A B is still descending; C D is also descending, till it reaches its lowest position C, *d*, after which it rises—A, B, however continues its descent.

In fig. 9, A B is now almost at its lowest position, and C D has risen almost to its highest again. When A B is actually at the lowest point, C D will have completed one revolution for the half revolution of A B.

In fig. 10, A B is just on the rise, and C D commencing its second revolution.

Fig. 9. Fig. 10. Fig. 11.



In fig. 11, A B has risen a little more, and C D has gone through a quarter of its course.

It is not necessary to trace the motion further; the course of A B in its ascent is exactly the same as in its descent, except that it pulls instead of pushing C D. When A B has arrived again at its highest point, C D will have passed through two revolutions.

This is perhaps the most convenient of these methods of multiplying motion; the axis of the second crank C D might be made to carry another of the same size as A B by which a fresh multiplication might be produced exactly similar to the first; a third multiplication might be produced from the second, and so on indefinitely. It may be observed that a combination of the method of these last four figures with that of fig. 5 would afford a very easy plan of multiplying the original motion eight times.

The above methods would, in many cases, multiply motion a sufficient number of times without being liable to the objections which apply to cog-wheels. In conclusion, it may be observed that the mechanism here described involves no waste of power. This might be demonstrated for each particular case, but it will perhaps be sufficient to remind the general reader of the common principle of mechanics—that increase of velocity compensates for diminution of power.

The number of revolutions of the steam engine crank is usually multiplied 4 or 5 times by cog-wheels, for the purpose of driving the Archimedean screw.

H. C.

THE CAMBRIDGE CAMDEN SOCIETY.

Those who maintain the vulgar notion that "honesty is the best policy," will feel no surprise at the announcement of the dissolution of the Cambridge Camden Society, a proceeding recommended by the Venerable the President, as "an act of dutifulness and an act of grace,"—fine words, if it were possible to attach to them any meaning. The proximate cause of this movement appears to be the retirement of several of the most influential patrons of the Society, disgusted by the persevering misconduct of the managing committee, or of the individuals who are permitted to exercise its functions, and more especially by a late obnoxious publication smuggled through the University press, in the name of the Society, under most aggravated circumstances of bad faith. It will occur to most unprejudiced people, that it would have been more to the purpose if those who have thus worked out their own disgrace and the dishonour of the Society, had dissolved themselves, instead of dissolving their constituency; and whether the members in general may or may not take this view of the case, yet remains to be seen. Feeling that Cambridge, of all places in the British empire, is one best calculated to establish and support an efficient Architectural Association, we should most sincerely regret the dissolution of the Camden Society, could we believe it possible so to cleanse it as to render it available for the avowed objects for which it was originally instituted—but we fear its odour has become too rank to admit of purification by any means. So the sooner it is dead and buried the better—the sooner will a more worthy successor occupy its place, profiting by past experience not to be made the tool of a party, or to suffer its management to pass into the hands of a *clique* of overgrown school-boys.

Our general sentiments on this subject are so well expressed by a correspondent at head quarters, in a late number of the Cambridge Chronicle, that we cannot do better than quote a portion of his letter.

"The President," (speaking of the dissolution of the society), "laboured under evident embarrassment. His address was feeble, perplexed, and, strange to say of him, uncandid. Much complaint was made of injustice, obloquy, misrepresentation, but with no graceful confession of the slightest fault or oversight on the part of the managers of the society. He enlarged on its services, but let fall not a word as to any impropriety in its authorized publications, or any imprudence in any of its accredited agents. No apology was made for the publication of a Romish Calendar by one of its secretaries, or of its being printed, through the confidence placed in him as such, at the Press of the University. Surely this gentle dealing savoured rather of the partiality of the lover than the discretion of the master. It was to be

> " To her faults *a little* blind,
> And to her virtues *very* kind.

"But what necessary connection had the conclusion of the address with the premises? The society, or rather some of its officers, have, in the estimation of certain dignitaries, committed grave errors. Therefore the society, constituted for useful and praiseworthy ends, must be dissolved. Is, then, no other course open? Cannot its management be amended? Is its original and proper object inseparably connected with the course of proceeding objected to? Is the 'Study of Ecclesiastical Architecture" to which these high personages are favourable, not capable of being pursued, unless in connexion with the encouragement of Popish absurdities or errors? Cannot useful hints be given to churchwardens for the preservation of the ancient and sacred edifices entrusted to their charge, without intruding into the office and duties of the Archdeacon? Cannot a design be furnished for a Church at Hong Kong, unless a Romish Almanack be simultaneously printed at the Pitt Press, by a secretary of the society, or the envelope of the plan be stamped with the effigies of Saints of the Romish Calendar?

" *The dissolution of the society, by its own act, because of complaints made on grounds here hinted at, amounts to a confession on its part, that it considers its avowed object not worth carrying out, unless it can be made the means of promoting other ends not avowed; and which, if they had been avowed, the society would never have been composed of its present members.* I cannot believe that the members at large will acquiesce in a resolution which can only be justified by such a confession on their part. Such indeed are, it seems, the views of the committee. But the existence of the society cannot depend altogether on them. However gifted and industrious, they surely are not the only members qualified to conduct the affairs of the society. If they are unwilling to submit to reasonable check and control, and to confine their labours within due bounds, let others more discreet be substituted in their place, who will carry out the legitimate aims of the society, without giving its apparent sanction to opinions tending to disturb the peace of the community, and to endanger the well-being of the Church."

The passage marked in italics, exposes most correctly the whole animus of the parties acting in the name of the Society. Why cannot they avow what they mean? Are they ashamed or afraid? That they are either the one or the other must be the inevitable conclusion of every one accustomed to call things by their right names. They have as much right to hold and to publish their opinions as other people, and in the name of common honesty let them do it without interfering with pursuits in which they have no real concern, and with which they have meddled only to bring them into disrepute and suspicion.

To those who prefer the crooked path to the straight, it will be a satisfaction to know, that the Ecclesiologist, although its cessation as the organ of the Society forecasts a shadow of the approaching catastrophe of the Society itself, is still destined to flourish under the guidance of the component *egos* of the *we* who piously drank the beer in the wheelbarrow (see the Ecclesiologist, No. 4). Farewell therefore to the Ecclesiologist of the Camden Society. The new series may at a future opportunity offer something for comment. For the present it may be sufficient to observe, on the authority of the preface, that its "tone and principles" are to be "the same," and "its objects identical" with those of the preceding publication, and as considerable importance is attached to a motto, (see page 29). We most respectfully beg leave to suggest a most appropriate one from a celebrated political ode—

> " How clear, convincing, eloquent and bold,
> The ready lie! with manly courage told!
> Which spoke in public comes with greater force,
> And heard by hundred is believeds of course."

KOLLMANN'S RAILWAY IMPROVEMENTS.

(With an Engraving, Plate VI.)

Sir,—The great importance which belongs to all subjects connected with improvements in the construction or working of railways, induces me to hope that the accompanying sketches and description of Mr. Kollmann's railway improvements may prove acceptable to your readers, at this time especially, as I do not remember to have seen any notice of the subject in the pages of your useful publication.

Whether or not the acknowledged defects in our present railway system will be so completely remedied by the adoption of Mr. Kollmann's inventions as he anticipates, is a question which perhaps actual experience will soon furnish the most satisfactory solution of—a highly respectable and influential company having been formed, and a sufficient capital raised for that purpose, and negociations entered into for carrying out the system on a new line of railway of considerable importance.

The defects in the present system which Mr. Kollmann proposes to remedy are—1st. The inconvenience of having the line of centres through the wheel axles rigidly maintained at right angles to the engine or carriage framing. 2nd. The necessity of coupling the wheels so as to preclude their running independently of each other round curves. 3rd. The necessity of using flanges to the wheels, precluding the use of cheaper materials for the rails if desirable. 4th. The defective action of the coned wheels at present universally used. 5th. The want of the means of ascending steep inclines without the use of assistant engines. 6th. The great danger of running off the rails (from the causes named), at high speeds, and the difficulty of bringing the centre of gravity low down. All these defects Mr. Kollmann conceives he has obviated in the plans, to describe which is the object of the present paper.

1st and 2nd Defects.—It will be sufficiently obvious that when the axles of the wheels are rigidly maintained at right angles to the carriage framing, that in passing round curves a sliding motion of the wheels must be engendered, owing to the greater distance which the outer wheels must travel as compared with the inner wheels, resulting in a loss of power (from the consequent friction), and causing injury to the rails, wheels and machinery, and making additional strength necessary; and as this inconvenience will be the greater the sharper the curve, great difficulty is often experienced in laying out a line of railway, from the difficulty of avoiding particular localities. In Mr. Kollmann's engine the wheels all run on separate axles, and each pair of wheels is retained in a frame, (*See Engraving*, figs. 1 and 2, *a a*,) working on the two pivots, *h*, or turnplates as a centre, these two pivots are connected to the corresponding ones on the other frame axle by the upper and lower perches *G g*. To the lower part of the frame axles are attached, the bearing frames of the horizontal guide wheels *b b b b*, which wheels, as the drawing shews, work against a middle guide rail, thus controlling the action of the bearing wheels and compelling their axles to work in a line radial to the centre of the curve; this arrangement also removes the 3rd Defect, admitting of the use of flat peripheries to the wheels, which may obviously be run on any material having a suitable surface, such as wood or stone.

4th Defect.—It can be easily shewn that the use of coned wheels occasions great loss of power, wear and tear of machinery, and danger at high speeds. If coned wheels be used, the rails must be inclined to give them an equal bearing, or the wheels will only have a bearing at one point, which very soon destroys both wheels and rails; nearly all engineers therefore now incline their rails, by which this inconvenience is produced, that as all the parts of the cone bearing on the rails revolve at different velocities, only one point can have a true rolling motion, all the rest must therefore have a constant rubbing action, and occasion loss of power and uneasy motion, as is shewn by Lecount, Treatise on Railways, Ency. Britt., who after demonstrating the extent of loss of power from this cause, states that the more perfectly the principle is carried out the more friction will be caused; another fertile cause of wear to the machinery and uneasy motion is the unavoidable variation in the levels of the opposite rails, occurring from various causes, which destroys the equilibrium of the cones, and causes a continued rolling motion from side to side, increasing with the speed, and causing considerable friction. This is entirely obviated by the use of horizontal guide wheels and flat bearing wheels, and allowing them but little play.

5th Defect.—By the use of the small driving wheel *e*, keyed to the shaft of the driving wheel *d*, and an additional side rail on inclines, shewn by the dotted lines, fig. 2, the engine is enabled to ascend steeper gradients, and yet to preserve its power of rapid motion along levels and lesser gradients.

6th Defect.—It will be evident that by the peculiar arrangement of the frame axles that the engines and carriages may be brought much lower down than on the present system, thereby diminishing the chances of being thrown off the rails.

Mr. Kollmann estimates that by the adoption of his system the expenses of forming and maintaining a railway will be reduced at least one half.

Observer.

ARCHITECTURAL GLOSSARIES.

Sir,—I have lately seen the Glossary in Gwilt's Encyclopædia, recommended *editorially* as the best of the kind, an opinion to which I strongly demur, since it appears to me to be very defective, and otherwise not a little unsatisfactory. In proof of its defectiveness I may be allowed to point out some of the terms which are omitted, although they require explanation far more than many which are introduced, and if some of them are not in very frequent use, they are far more likely to occur than a great many which are given by Mr. Gwilt, but which are never used by English writers at all. Among the terms omitted by him are:—Antefixæ; Astylar; Bed-mouldings; Bird's-beak moulding; Bird's-eye Maple (the names of other woods, Deal, Mahogany, Oak, &c., being given); Boudoir; Columniation; Compass-window; Diapering; Diocletian window; Fan-tracery; Flamboyant; Flange; Foliation, foliated; Half-timbered; Hood-mouldings; Intonaco; Loggia; Lombardic; Lucarne; Pargetting; Polychromy; Raffle; Renaissance; Riser; Rosewood; String-course; Supercolumniation; Terminus (of a Railway); Three-quarter (columns); Tholobate; Velum; Veranda; Water-leaves; Walnut-tree wood; Weather-mouldings.

Now the very first term in this list accuses Mr. Gwilt of strange negligence in passing it over, it being of very frequent occurrence, and just the kind of word for which a glossary is likely to be consulted by those who most need the assistance of one. The same remark applies to the second one, perhaps to the third also; at any rate if "bed-moulding" was thought sufficiently to explain itself, it might have been presumed that "bed-chamber" was not so cabalistic and mystic a term as to stand in need of interpretation. Still, the last was probably introduced for the purpose of tacking to it the highly sapient or sappy remark, that "its finishings of course depend on the rank of the party who is to occupy it"! Of course, good Mr. Glossarist; if people want a spare sleeping-room for "a poor relation" they are not likely to think of fitting it up like a state bed-chamber.

Though he is no doubt to the full as well qualified, Mr. Gwilt is less ambitious of displaying his erudition in etymology than Mr. Britton was, and so far shows greater discretion, because although he is never quite so funny as was the latter gentleman in some of his derivations, he is sometimes rather unlucky; for instance, when he derives "Cemetery" (*Cœmeterium*), from Κειμαι "to lie," instead of Κοιμοω "to sleep," which latter origin gives the term a most impressive signification, a cemetery being a place where mortals sleep the sleep of death!

I do not, however, wish to send Mr. Gwilt thither. To say the truth, we can't yet spare him; he must live to revise and mature his Glossary and Encyclopædia, and to fill up all gaps and yawning chasms in the latter will furnish him with labour for many years to come. In the opinion of some his book may be a prize, but I am sure it is one that has a great many blanks in it. Not a syllable of information is to be derived from it in regard to the architecture and architects of Scotland, Ireland, and the United States. No doubt information of the kind is not to be found accumulated in such heaps that it can be readily transferred from one book to another without any trouble; it must be looked for in holes and corners, a hundred volumes must be ransacked in order to get at the materials for a few pages. By such means alone is it that the common stock of knowledge on any subject can be enlarged from time to time by really fresh additions; and it is but natural to expect that any work calling itself an Encyclopædia should bring down information on the subject it treats of to the very time of publication. At any rate, as a lexicographer, Mr. Gwilt ought to have distinguished between the terms "Intercolumniation" and "Intercolumn," instead of which he discards the latter altogether.

I remain, &c.,

P. Hill.

Continental Scientific Meeting.—The thirteenth meeting of the French Scientific Congress is to be held at Rheims, some time between the first and tenth of September next, and to last, as usual, ten days. M. Gousset, archbishop of Rheims, and president of the academy in that city, is to be president of the managing committee.

Kollmann's Patent Locomotive Engine.

Fig. 1.

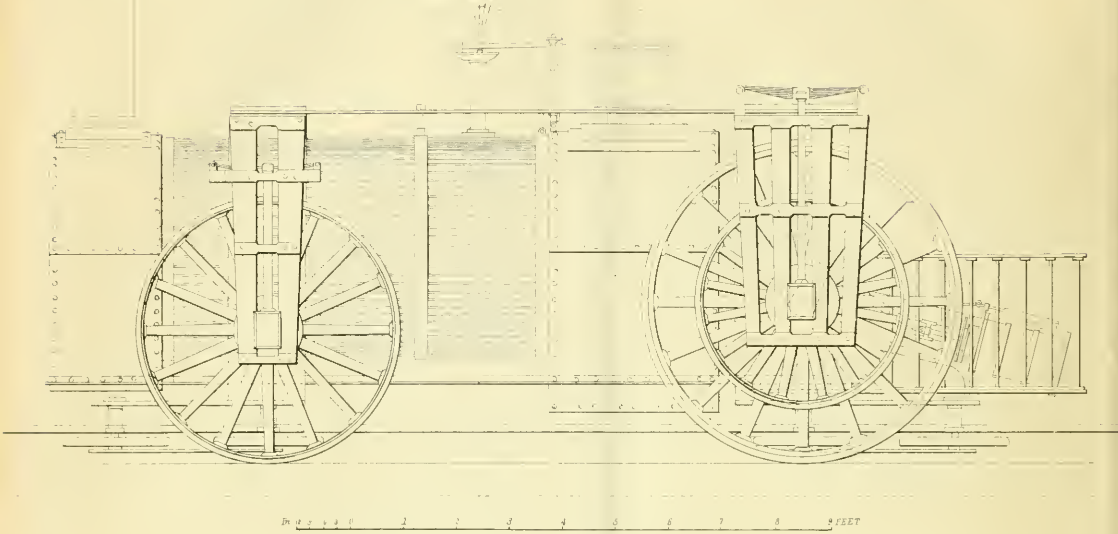
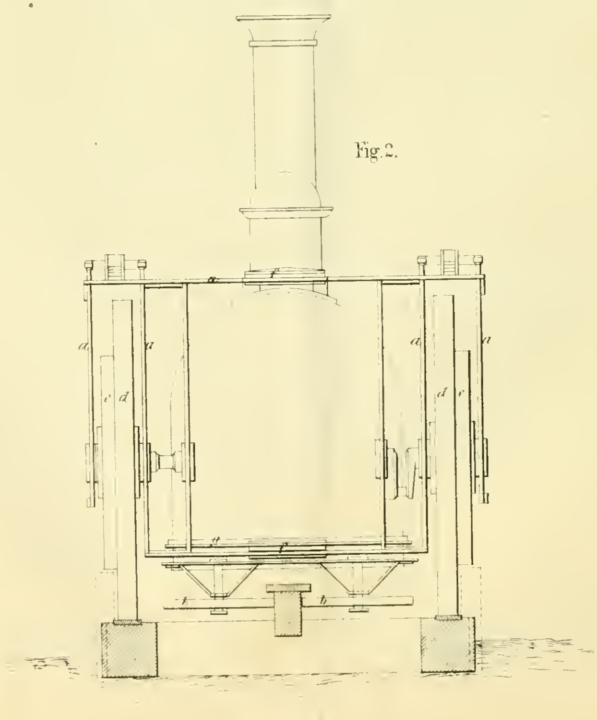


Fig. 2.



J. Spencer del. & Litho 5 Hungerford St. Strand

PILE DRIVING MACHINE.

"*Description of the Piling Machine used at the Montrose Harbour Works.*" By JAMES MILNE. Communicated by GEORGE THOMAS PAGE, Assoc. Inst. C.E. *Read at the Institution of Civil Engineers.*

The method of applying a portion of the power of a steam-engine, in driving piles, was successfully employed by Mr. James Milne, in the progress of the Montrose Harbour works.

The upright guides are of the ordinary construction. The ram, which weighed 12 cwt., was first worked by eight men, with a crab fastened to the base. The clipper, or clutch, with its slider, is similar to those ordinarily used, except that the upper extremities of the clipper, are made of sufficient length to allow the slider to rise 15 inches, after the ram has been disengaged by the slips; the ram chain, which is shackled to the clipper, passes over a pulley at the top of the guides, and is led off to the other part of the machine by another pulley in the base of the guides. The hoisting machinery, figs. 1 and 2, which is substituted for the usual crab winch, is fixed upon a framing, which is placed at a given distance behind the guide frames.

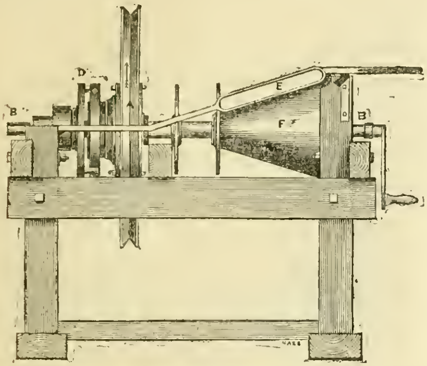


Fig. 1.—Elevation.

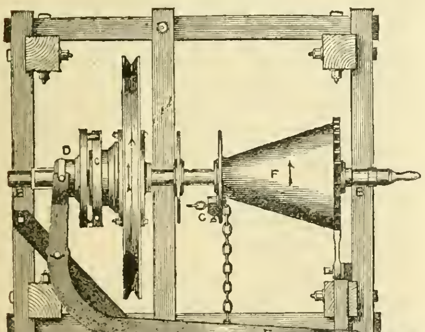


Fig. 2.—Plan.

A pulley A, figs. 1 and 2, runs slack upon the shaft B, and is driven by a rope connected to the steam-engine. In a seat turned in the centre block of the pulley A, is a friction strap C, the extremities of which embrace the prongs of the clutch D, when it is engaged as shown in the wood-cuts; this clutch slides laterally on keys sunk in the shaft, and is engaged and disengaged by the lever, E. The cone, F, is also keyed to the shaft; the ram chain passes through the double part of the lever, E, and through the aperture in the flange of the cone (as shown in fig. 2), where it is fixed by a pinching screw at G; the ball I, slips along the chain, and is fastened by a pinching screw at any part, giving the required length.

In working the machine, the pulley, A, figs. 1 and 2, revolves in the direction shown by the arrow; the clutch having been engaged by the lever, the shaft and the cone, on which the ram-chain is coiled, will revolve also, and raise the ram by the clipper, until it is disengaged by the slips on the guides. The ball, I, which is fixed to the chain, is at the same instant nearly close to the lever, and as the clipper with its slider is allowed to rise about 15 inches further, the ball then strikes the lever, pulls it back, and thus disengages the clutch; the shaft and cone being then at liberty, the weight of the clipper and slides (nearly ¾ cwt.) uncoils the chain from the cone, the clipper therefore immediately descends again, and catches the staple in the top of the ram, when the man in attendance pushes forward the lever, and engages the clutch for another stroke. By a slight addition to its present gearing, the machine itself might be made to perform this re-engaging operation also.

The crank on the end of the shaft, B, figs. 1 and 2, and the ratchet wheel and pall on the large end of the cone, are used for coiling the ram-chain on the cone, in order to fix the ball, I, to its proper place. The cone is preferred to a cylinder, as it increases the velocity of the ram as it ascends, and thereby, considerably frees the machine from any jerk in starting; and also when working a lighter ram, the chain can be coiled upon a larger diameter of the cone, and the speed is increased, in the same ratio as the weight is diminished.

When piling in a straight line, the plate for the bottom guide pulley, fig. 3, is fastened to the base of the upright guide frame and is moved round the bolt at A, as a centre to the different angles in which the ram-chain is led from the engine.

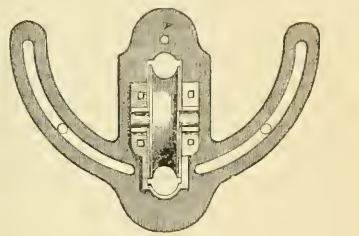


Fig. 3.—Swivel guide pulley.

The machine is driven from the steam-engine, by a pulley of 4 feet 10 inches diameter, making 35 revolutions per minute, which gives motion to the pulley, A, figs. 1 and 2, of 3 feet 6 inches diameter, causing the shaft and cone to revolve with a velocity of 48·33 revolutions per minute; this, with the 12 cwt. ram, which is worked from the smallest end of the cone, gives about seven strokes per minute from the height of between 10 feet and 12 feet; or six or seven times as much work as could be accomplished by manual labour.

COCKERELL AND COLONNA.

SIR—What could Professor Cockerell possibly mean by recommending with such outrageous admiration as he did in one of his Lectures, the strangely fantastical performance of the old Dominican—he lived to the age of ninety-four—Fra Francesco Colonna, surnamed Potifilo? Does the Professor meditate an English version of it with a commentary of his own? Curious it certainly is, highly curious; but in my poor opinion it is any thing but calculated to promote an intelligent study of architecture. In order to give some idea of the learned Dominican's acuteness and reasoning, it will be sufficient to instance the reason he assigns for the lower part of the flutings of columns being sometimes filled up with what is called "cabling;"—a reason so marvellously monstrous that I should feel some scruple as to noticing it, did I suppose that your Journal circulates among lady readers. By the cabling or rods inserted in the flutes, the learned ancients, he gravely tells us intended to express or *symbolize* the male sex, the flutes themselves plainly answering to the recipient parts of the other sex, and they are continued to so much greater extent "*perche quella lubrica natura excede la virile in lascivia*"!!! Was there ever such monstrous extravagance, and gross bestiality of imagination!

Pity that Wren was so ill-informed as to the real meaning and signification of cabled columns, for had he been properly enlightened as to it, he would not have introduced such profane and scandalous things into St. Paul's.

Yours, &c.,

Piccadilly, Feb. 17th. COMMON SENSE.

AMSTERDAM AND ROTTERDAM RAILWAY.

"*Account of the Railway from Amsterdam to Rotterdam, and of the principal works upon it.*" By the CHEVALIER FREDERICK WILLEM CONRAD, M. Inst. C.E.; translated from the French by CHARLES MANBY, Assoc. Inst. C.E., Secretary, and read at the Institution of Civil Engineers. [1]

This railway, the first that has been constructed in Holland, is due to the enterprize of a public company, called "The Railway Company of Holland;" whose affairs are managed by a council of administration, consisting of five commissaries and the engineer. The difficulties of construction, arising from the peculiar physical character of the locality, were amongst the least that the company had to contend against; the directors were however satisfied, that the utility of the undertaking would be finally understood in the country, and that by perseverance, all obstacles would be overcome.

The company was formed on the 8th August, 1837, at Amsterdam, and within a short period, the statutes received the royal sanction; but no sooner had the contract been made, for the execution of the first division, from Amsterdam to Haarlem, than numerous law-suits arose, owing to the hostility of the proprietors of the land, over which it was intended the railway should pass; the consequent difficulty of expropriation, and serious discussions with the engineer, to whom, at that period, the execution of the line was entrusted, and which terminated in his resignation, caused great delays, which were prejudicial to the undertaking.

At length, the Government, at the request of the council of administration, appointed the author of this paper 'Engineer Director,' and he entered on his duties in March 1839. After a minute inspection of the line, he found it necessary to complete the first division, between Amsterdam and Haarlem, according to the designs of the former engineer, but to adopt different and more eligible plans for all the other divisions. This first part was opened on the 20th September, 1839, and the dispatch that had been used, enabled the council to announce, at the general meeting held in April 1840, their intention to continue the execution of the remainder of the line, without delay.[2] The assent of the government being granted, the greater part of the year 1840 was occupied, in gaining the concurrence of the regencies of the different towns and the 'polders,'[3] through which the railway would pass, and in effecting the expropriations.

In the beginning of the year 1841, the first contract for works was made, including the bridge over the river Spaarne at Haarlem, fig. 5. This bridge, which is of iron, has six openings, the piers are of brickwork, faced with cut stone. The two middle openings have an iron swing bridge, see figs. 5 to 10, of a very simple and solid construction, which opens and shuts both openings, at the same time, to render the passage of the vessels as rapid as possible, as between fourteen and fifteen thousand pass through annually. The principal beams of this swing bridge, fig. 7, are each upwards of 75 feet 6 inches, and were cast in a single piece; the whole bridge weighs upwards of 110 tons, and the machinery for moving it is so perfect, that one man turns it easily in two minutes. There is also a method of holding the bridge firmly shut, during the passage of the train, at which times alone it is closed, and a self-acting signal is attached to it. During the construction of this bridge, the channel of the river was diverted, that the navigation might not be interrupted, and the whole was completed in one season. There are also five fixed bridges, of the same style of architecture, over the canals within the town of Haarlem, the station at which place is neat and simple.

After much difficulty in obtaining possession of the land for the railway, a contract for the cuttings and embankments, at a given price per cubic metre was made, to be executed as fast as each individual portion should be obtained, either by private purchase or otherwise; by this means, much time was saved, and the line was completed to Hellegom, during the season of 1841.

At Vogelenzang, near Bennebrock, the canal of Leyden, and the high road, are both crossed by a trellis bridge, figs. 11, 12, and 13, in length 177 feet at angle of 30° with the canal. This bridge is built entirely of red deal, excepting the roadway beams, which are of oak, and is formed by three series of planks, crossing each other in the form of trellis-work; there are three openings, of which, those on either side are each 32 feet 4 inches span, and the centre one is 111 feet 6 inches span; the trains pass without causing any vibration.

The next step, was to make a contract for the trussed timber bridge, figs. 14 to 17, to cross the canal and the towing-path, at an angle of 60°, near Leyden, for which the span was required to be 56 ft. 5 in.

Near this spot is the 'Warmonder Leede' one of the navigable canals, which at the same time acts as a drain, for conveying water from the interior of the country, into and out of the Lake of Haarlem, by the dykes of Katwyk, as well as serving for commercial and agricultural purposes. The regency of Rhynland, insisted that the bridge to cross this canal, should have five openings, each 20 feet 10 inches, of which, the centre one should have a swing bridge, figs. 14, 16, 17, for the facility of the navigation of the canal. This is of a novel construction, on the system of a sliding bridge; it is built of timber, and the platform is easily moved by one man.

The nature of the soil, from the 'Warmonder Leede' to the town of Leyden, was such as to render it necessary, to form the railway on fascines or faggots. This plan was also necessary, on all the first part of the line; and even at the Leyden station, the whole of the buildings were erected upon a similar foundation, which appears to answer very well.

Beyond Leyden, the railway crosses the Rhine at an angle of 82°, by a trussed timber bridge with five openings; the three centre ones have each a span of 32 feet 10 inches, and the two side ones are each 19 feet 8 inches span. One [of these latter, is for the navigation of the river, and is furnished with sliding platforms, opening both ways; they are easily managed by one man.

It was not until the end of the year 1841, that the Company obtained possession of part of the line of railway, at 'Sloterdyk,' in the first division, after a law-suit of four years' duration, relative to the expropriation, and after being obliged to pay a large sum to the proprietor, for the permission to pass temporarily during the law-suit; without which, the first division, between Amsterdam and Haarlem, could not have been opened. These difficulties were encountered throughout the whole line, to such an extent, that at a short distance from Leyden the obstinacy of a single landowner entirely stopped the progress of the works, and obliged the Company to build a temporary station for that town; without this step, the opening of that part of the line would bave have been retarded for three or four years, there being no legal means of accelerating the process of expropriation. The line was then opened from Haarlem to the immediate neighbourhood of Leyden.

In the course of the year 1842, the whole of the second division, and great part of the third, were completed. Several aqueducts, five large bridges, and a number of small ones were built; the latter being all over navigable canals, were made to swing on simple brackets; the permanent station at Haarlem was completed; the foundations were laid of those at Leyden and Amsterdam; and the workshops for the repairs of the engines, &c., were finished. These circumstances are only mentioned to show, that considering the delays occasioned by the defective jurisprudence in the matter of expropriation, more than common diligence had been used to enable the line to be thus far opened.

After the opening of the second division, several of Stephenson's new patent locomotive engines were added to the stock of the Company, and after ample trial of their qualities, they were considered to be the best engines in the service.

A part of the third division was opened as far as Voorschoten, in the month of May, 1843, and thus, with the aid of omnibusses and diligences, the line was completed as far as the Hague, although, owing to the legal difficulties already named, the swing bridge to cross the Hague and Delft canal, could not be constructed, nor the permanent station at the Hague be built. These latter works have only been completed in the last year (1844).

Such were the difficulties the Company had to contend with, from the delay caused by the defective state of the law of expropriation, and the rapacity and prejudice of the proprietors over whose land the line had to pass, that it was only on the 6th December 1843, that the railway was completely opened for public use, all the works, as well as the different stations being completed, and a simple and effective system of management established.

The stock of the company now consists of thirteen locomotive engines, with their tenders complete, and one hundred and three carriages of three different classes, which number will be considerably increased.

From the opening of the different divisions up to the 1st. December 1843, the locomotive engines have traversed a distance of 239,786 English miles, and 1,513,935 passengers have been conveyed.

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[1] We are indebted to the Editor of the "Railway Chronicle," for the principal part of the wood engravings illustrating this article, which originally appeared in that valuable Journal.

[2] The divisions of the lines are—

		Metres.		English Yards.
1°	From Amsterdam to Haarlem	16817·40	=	18381·4
2°	„ Haarlem to Leyden	28270·30	=	30891·1
3°	„ Leyden to the Hague	15303·80	=	16726·2
4°	„ the Hague to Rotterdam	24000	=	26232·0
	Total	84391·50	=	92230·7

or about 52½ English miles; with fifty-eight bridges in the three first divisions.

[3] The "polders" are the spots of land which have been drained and are now cultivated: their level is usually below that of the sea.

In consequence of the difficulties experienced through the defective law of expropriation, a petition for its revision was presented to the States General, and, from its favourable reception, it is presumed, that such a law will be passed, as will facilitate the formation of railways throughout the kingdom, and will cause the speedy extension of the present one as far as Rotterdam, thus uniting two cities so long celebrated in the annals of commercial enterprize.

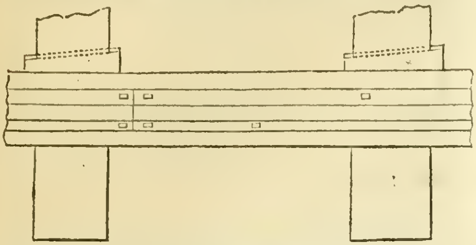


Fig. 1.—Plan of rail, longitudinal timbers, sleepers, and wedges.

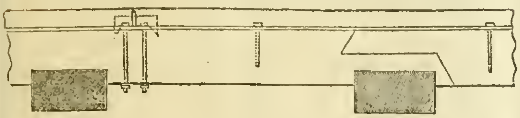


Fig. 2.—Section of sleepers, showing the joint-plates, and mode of fastening the rails.

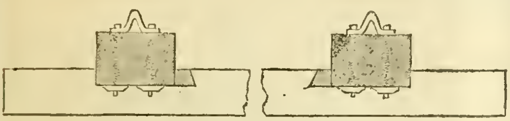


Fig. 3.—Section of longitudinal timbers, wedges, and rails.

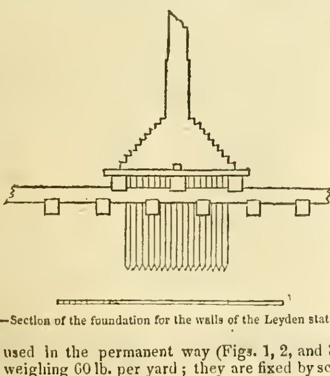


Fig. 4.—Section of the foundation for the walls of the Leyden station.

The rails used in the permanent way (Figs. 1, 2, and 3) are of a bridge form, weighing 60 lb. per yard; they are fixed by screws, upon longitudinal timber bearings of Riga timber, caulked down upon sleepers of the same timber, and secured by oak wedges. The ends of the rails are fastened by nuts and screws, through the longitudinal bearings, with joint plates and cramps. This method of fastening is stated to be very complete, and the motion of the carriages over the joints is without shock. The gauge is 6 feet 6 inches from centre to centre of the rails; and the cost of each single line of railway laid is £2394 10s. per mile. The dimensions of the various pieces, their number, weight, and price are given in the paper in minute detail.

The general width of the top of the earth-work for the rails is 29 feet 6 inches. The inclination of the slopes of the embankment, is twice its vertical height. The side benches vary in width between 3 feet 3 in. and 6 feet 6 in. The ditches are 13 feet in width, and the ballasting is composed of sea-shells (schulpen).

In marshy spots all the earth-works are laid upon beds of fascines, more or less extensive according to the nature of the ground. In those situations where the railway traverses pools of water, the fascines alternate with beds of rubble, and are held together by stakes and wattles, until the weight of the earth is laid upon them and the mass is consolidated. The earth-work is chiefly composed of sand from the sea-beach, and is covered with turf.

The station at the Amsterdam terminus is a semi-circular building of brick and cut stone, with projecting wings, and sheds on iron columns, founded on piles in the usual Dutch manner. The station at the Haarlem terminus is also of brick and stone, but is not founded on piles, as the ground was sufficiently solid to bear a building. The Leyden station, which is of the same construction as the others, stands on such bad ground, that it was necessary to construct a raft, placed upon oak piles, to receive the foundation of the building (Fig. 4.)

The station at the Hague resembles the others, but being constructed on good ground, piles were not necessary.

The bridge over the Spaarne at Haarlem (Figs. 5, 6, 7, 8, 9, and 10) consists of six arches of 26 feet 3 inches span each; four are fixed, and the other two are occupied by a cast iron swing bridge, which generally remains open for the convenience of the navigation, and is only closed at the times of the passage of the trains. The machinery for turning this bridge (Figs. 6, 7, 8, 9, and 10), and for simultaneously opening or shutting both arches, is situated on the centre pier, which is constructed, like the others, of brick and cut stone, upon piles of fir. A self-acting signal is attached to this, and all the other swing bridges, in order to show their position.

The bridge-keepers reside in two small wooden lodges, built in the river, opposite to each end of the centre pier. The bridge being equally balanced upon the pivot, the labour of working it is small, as compared with that required for working a half-arch swivel-bridge; and it possesses the far more important advantage of perfect stability and freedom from vibration, when once fixed between its bearings—an indispensable condition for a railway bridge.

Fig. 5 is a side elevation of the bridge, showing the two centre openings and the piers of brickwork with stone facings. The foundation piles of the piers are from 8 inches to 11 inches square, and 26 ft. 3 inches long. On these piles, are laid the longitudinal beams of a timber apron, which traverses the whole of the openings, and extends above and below the bridge, to the extremities of the cut-waters, and on these are placed the transverse bearers of the piers. The whole of the foundation is of white deal. All above the dotted line in the figure is iron-work.

Fig. 6 is a plan of the iron framing of the swivel-bridge, consisting of five long girders, connected by transverse and diagonal pieces, supported by six rollers, working on a circular rail or bearing-plate; concentric with the latter, is a fixed circular rack for a travelling pinion, shown on a larger scale in Figs. 8, 9, and 10.

Fig. 9 is an elevation of one of the piers, and a section through the roadway. The brickwork on the facing is 1½ and 2 bricks thick, of bricks of the best quality (clinkers) set in strong tarras cement: and the inside is of bricks of inferior quality set in bastard tarras cement.

Fig. 10 is a transverse section of the swivel-bridge, showing the transverse pieces bolted, through their flanches, to the girders. The operation of working the bridge will be at once understood by an examination of this figure, in connexion with figs. 7 to 10. The action of the hand-wheel is transmitted by bevelled gear to the shaft of the travelling pinion, and the bridge is thus made to revolve on its centre, supported by the six rollers. The bushes of all the roller axles are adjustable, by an apparatus shown in figs. 8 and 10, by means of which they may be screwed down to a point, at which each roller carries its due share of the weight.

Figs. 7 and 8 show the machinery for securing the bridge, when closed. The pinion on the axle of the hand-wheel, fig. 9, works the sector rack. A long connecting rod is jointed at one end on an arm of the rack, and at the other on the arm of an axle, which carries three eccentric or cranked rollers. The hollow in the section of each roller, corresponds to the convex section of a bearing-block, upon which it is brought down, by an alteration in the position of the crank which carries it. When the bridge is secured in this position, the effect of which is to give it a firm bearing at each end, by distributing the weight over the two ends and the centre, it is evident, that it can have no lateral motion, and still greater security is given to it by the bolts, which are shot into their mortices, by means of a projecting arm on the connecting rod.

The following are the principal dimensions:—

	Ft.	In.
Thickness of the centre pier	21	10
" piers nearest to the centre on each side	7	4
" piers nearest to the abutments	6	6
Length of the iron swivel-bridge	77	6
Width of ditto	20	10
Length of the middle girder	77	6
" intermediate pair	76	6
" outside pair	74	9

BRIDGE OVER THE SPAARNE AT HAARLEM.

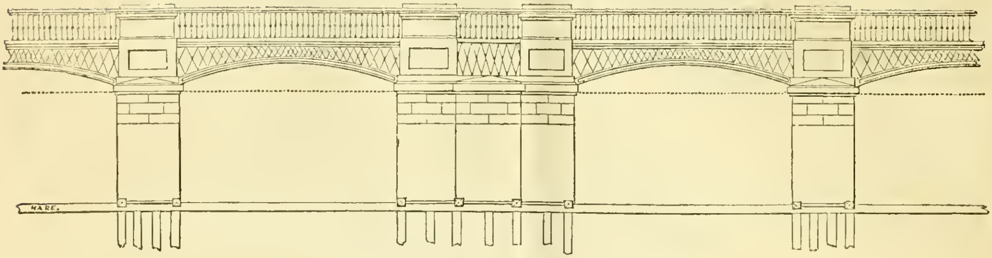


Fig. 5.—Elevation of the centre pier, and part of the arches.

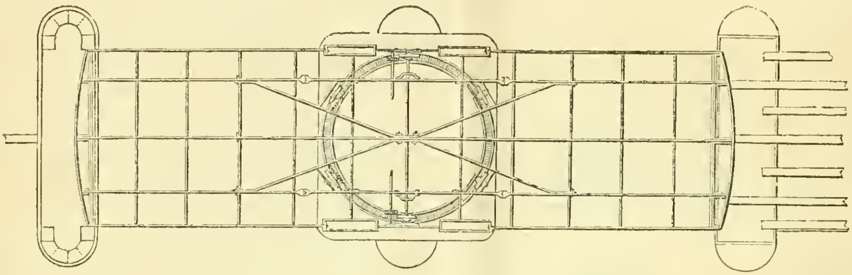


Fig. 6.—Plan of the Swivel Bridge.

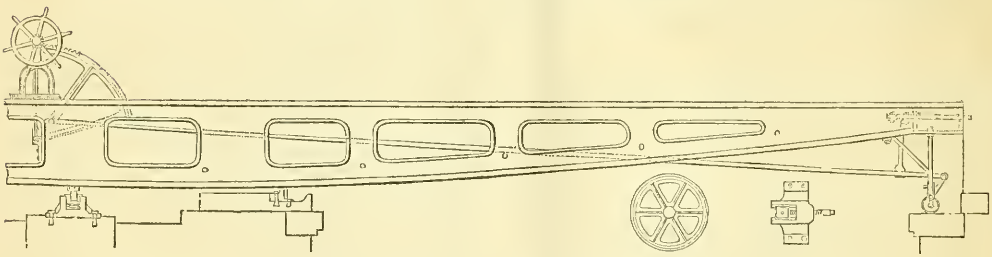


Fig. 7.—Elevation of half of the swing bridge, showing its machinery.

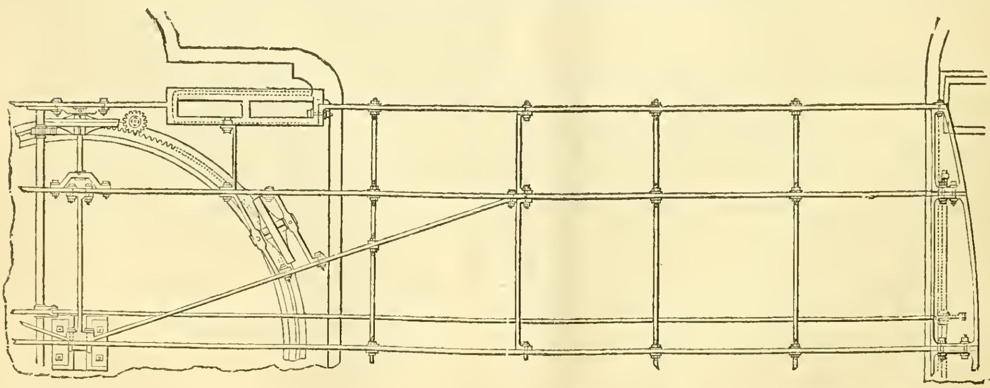


Fig. 8.—Plan of half of the swing bridge, showing its machinery.

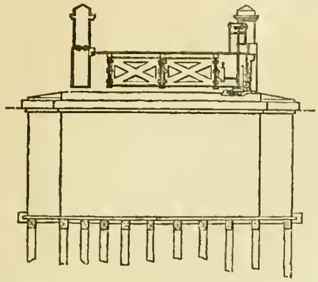


Fig. 9.—Section of the swing bridge at the centre pier.

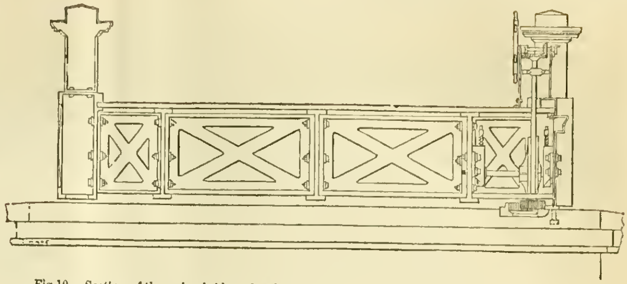


Fig 10.—Section of the swing bridge, showing the machinery for opening and closing it.

TIMBER LATTICE BRIDGE AT VOGELENZANG.

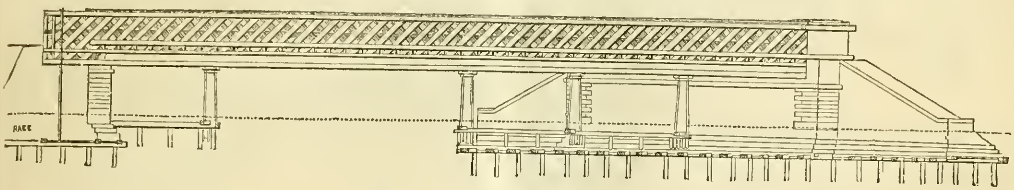


Fig. 11.—Elevation.

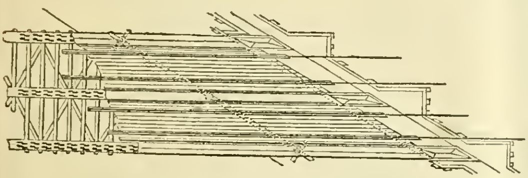


Fig. 12.—Plan of the platform, showing the trussing.

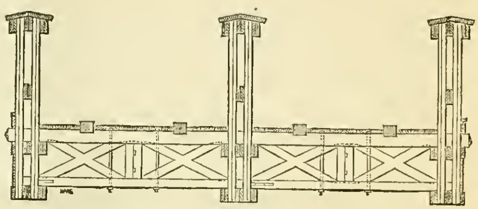


Fig. 13.—Transverse section.

TRUSSED BRIDGE OVER THE RHINE AT VINK.

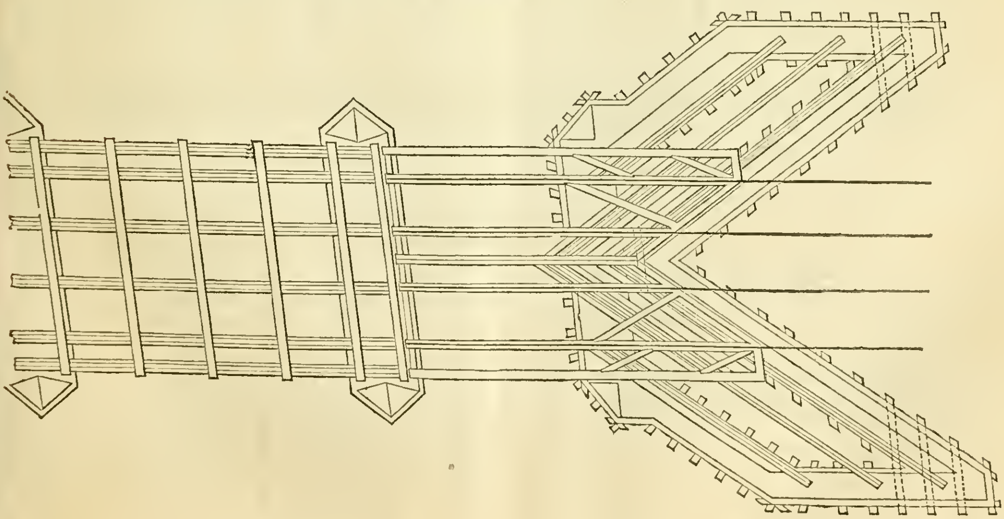


Fig. 14.—Plan showing the sliding platfotms.

TRUSSED TIMBER BRIDGE OVER THE RHINE AT VINK.

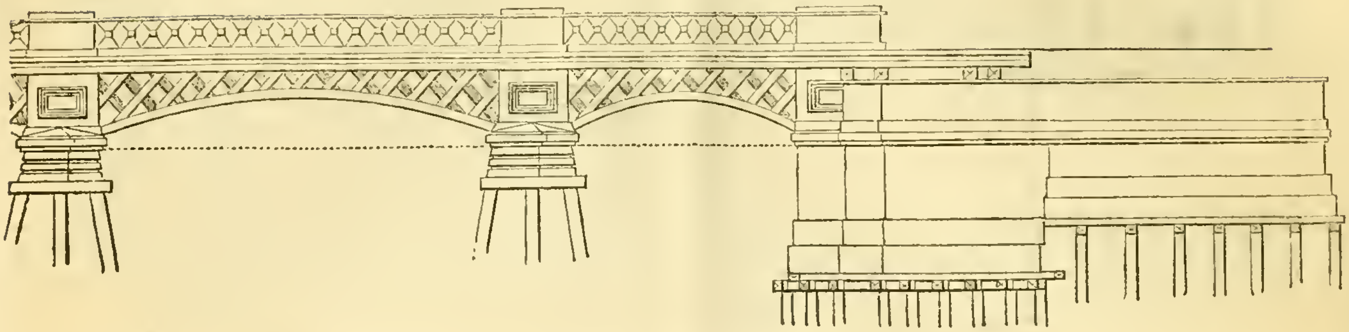


Fig. 15.—Elevation.

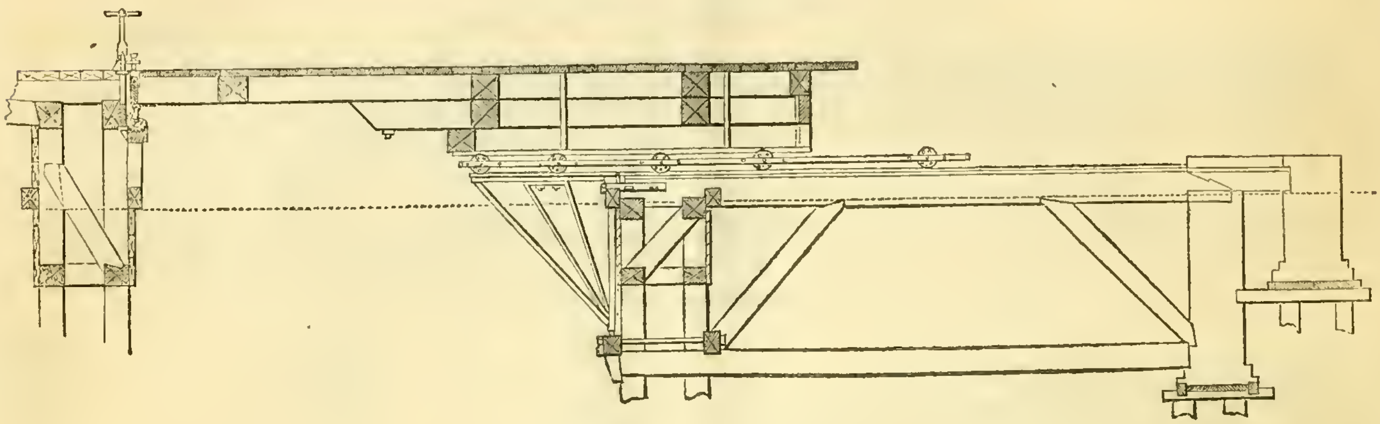


Fig. 16.—Section of the sliding platform.

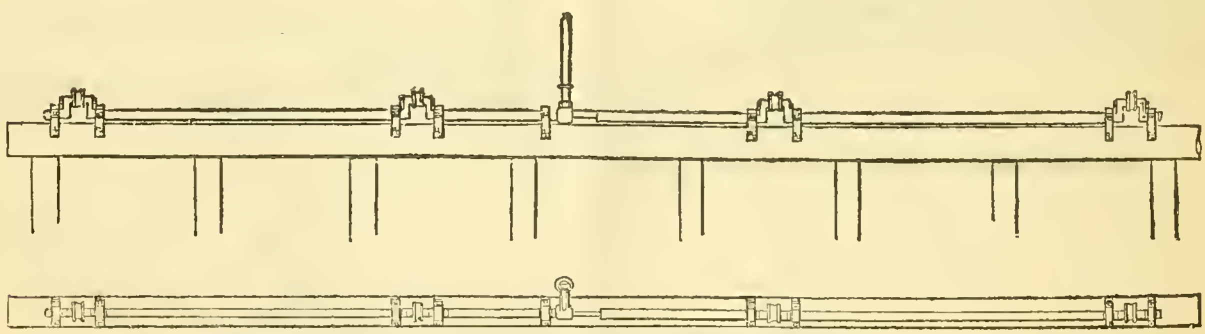


Fig. 17.—Eccentrics for fastening the platforms in their situations.

TURN RAIL BRIDGE.

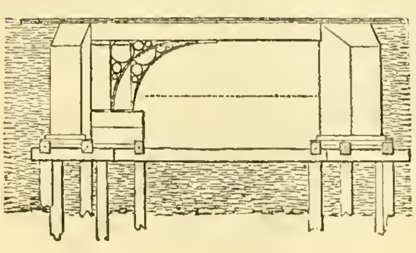


Fig. 18.—Elevation.

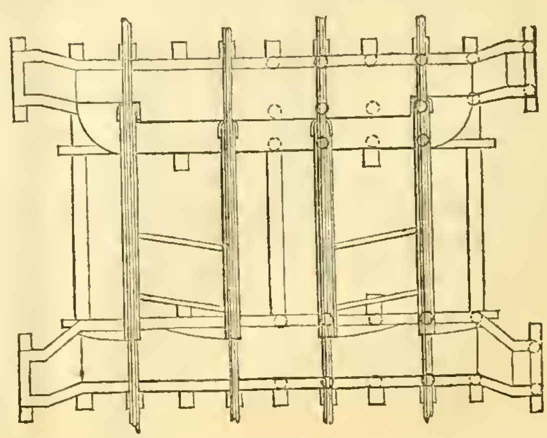


Fig. 19.—Plan.

	Ft.	In.
Depth of the girders at the centre	4	0
,, at the ends	1	0
Thickness of the three middle girders	0	2¾
,, outside pair	0	1¼
,, oak planking of the platform	0	3

The castings were made at the foundry of Messrs. Dixon and Co., at Amsterdam.

The cost of this bridge was 83,000 florins (=£6916 13*s*. 4*d*.) All the details of dimensions and cost are given in the paper.

The timber bridge at Vogelenzang, figs. 11, 12, and 13, is built on the American trellis-work system; it is 177 feet 2 inches long by 32 feet 6 inches wide, and spans the high road and the canal, with its towing-path, at an angle of 30° with the latter. The piers are of masonry upon piles.

The timber-work consists of three ribs of lattice-work, one on each outer side of the platform and one in the centre, between the two lines of rails. Each series consists of battens of red Riga deal, 3 inches thick and 12 inches wide, crossed at an angle of 45° with the horizon, and therefore at right angles with each other, as shown in the elevation, fig. 11, and well fastened, at each crossing, with oak trenails. More than one-third of the depth of the lattices is below the platform; and its general stability is very much increased, and lateral vibration is prevented, by the diagonal trussing shown in the transverse section and plan, figs. 12 and 13, of the platform. The transverse oak bearers, 10 inches square, on which the planking of the platform is laid, are placed at intervals of about 3 feet, every alternate one being trussed, as shown in the section, fig. 13, and the truss bound together by a pair of iron screw-bolts, 4 feet long, placed between the longitudinal bearers of the rails. The planking of the platform is of white deal, 3 inches thick and 20 inches wide; and, excepting this and the oak bearers of the platform, the whole of the timber-work is of red Riga deal.

The following are the principal dimensions of the parts:—

	Ft.	In.
Length of the bridge	177	0
Total width of ditto	32	6
Width of side openings	29	0
,, middle opening	111	6
Height of the platform	15	9
,, lattice above ditto	7	10
Depth of the lattice below ditto	5	2
Total height of the lattice ribs	13	0
Clear width of each roadway	13	0

This construction is stated to be very satisfactory, and to have cost only 46,000 florins (= £3833 6*s*. 8*d*.)

The trussed timber bridge over the Warmonder Leede crosses the river at an angle of 50°. It has five openings of 20 feet 8 inches each; through one of these the navigation is carried on, and it is closed when the trains pass by a sliding platform moving diagonally upon rollers, which is worked by one man, and by very simple mechanism, like that of the double platform bridge at Vink, figs. 14, 15, 16, and 17.

The heads of the piles for this bridge required to be cut of, and a tenon to be worked upon each, below the water line; this was done by a simple apparatus, consisting of a deal box, figs. 15, and 16, well put together and caulked, so as to be water-tight: it was 6 feet 6 inches long, 4 feet 3 inches wide, and 3 feet 3 inches deep. Through the centre of the bottom there was a hole, large enough to admit the head of a pile, A. Around this hole was nailed the open bottom of a sack, B, of stout canvas, strengthened with leather. Two cords, C C, were made fast, by one end of each, to the box, and the others were passed through pulleys in the sides.

When a pile was required to be cut off, the box was put over it, and by weights within it was caused to descend as low as was requisite; by means of the two cords, the lower end of the sack was then drawn round the pile, A, so as to form a water-tight joint; by a small pump, the water was then emptied from the box, into which a workman descended, turned back the canvas sack, B, and after sawing off the pile cut the head into any desired form. This system is stated to have been used wherever the piles were required to be cut off under water, and to have been very successful.

The cost of the bridge over the Warmonder Leede was 44,600 florins (=£3716 13*s*. 4*d*.)

The trussed timber bridge, which crosses the canal and the towing path near Leyden, at an angle of 60°, is fixed, and has a span of 56 feet 5 inches. Its cost, with some accessory works, was 34,800 florins (= £2900).

The trussed timber bridge over the Rhine, near Vink, beyond Leyden, is at an angle of 82° with the stream; it has five arches, three of which have openings 32 feet 10 inches each, and the two side arches are 19 feet 8 inches each; one of these later, which is intended for the navigation, is closed by two parallel platforms, which slide diagonally in opposite directions, figs. 17, 18, 19, 20, and 21; when opening they are moved simultaneously by one man, with very simple machinery. The cost of this bridge was £3133 6*s*. 8*d*.

The single swivel bridge over the Delft canal, at the Hague, is of cast iron, and spans the canal at an angle of 72°, with only one opening of 26 feet 3 inches. The piers are of masonry founded on piles. Its cost was 31,000 florins (= £2583).

The railway necessarily passes over numerous canals, whose traffic must be provided for; it was consequently requisite to provide a cheap and simple mode of crossing them; the author therefore devised the form of bridge shown in figs. 18 and 19, and has called it "the Turn-rail bridge."

Four timber bearers, 12 inches deep by 6 inches wide, carry the two lines of rails; they are jointed on to heel-posts of oak, shod with iron, which turn upon centres, on plates set in the masonry of the abutment. The bearers are further supported by brackets of cast iron, fig. 18, and each pair is connected by two bars, turning on joints, to preserve the parallelism of the rails. Each pair opens outwards, for the passage of the boats, and when they are closed, the ends of the bearers rest in recesses prepared in the masonry for their reception, fig. 19, in order that the ends of the moveable rails, shall coincide with those of the fixed ones. This form of bridge is very cheap, and is found to answer well, for a span not exceeding 16 feet.

The relative proportions of the fares, per traveller, reduced to English money and distance is—1st class, 1·66*d*. per mile; 2nd class, 1·33*d*. per mile; 3rd class, ·83*d*. per mile.

COMPETITION.

Sir—Not being myself a professional man, I have no personal interest whatever in Competition, therefore at any rate I shall not be supposed to speak from any private views of my own, or with the feelings of one who has been unsuccessful and disappointed. Consequently the light in which I look at Competition is only as to its operation for real good,—for the advancement of architecture itself, or not. Competition ought to work for good by breaking-up monopoly, by exciting emulation, and by affording talent as yet obscure, opportunities of manifesting itself, which might not present themselves in the ordinary course of professional employment. But if it holds out—or is made to appear to hold out advantages and inducements to architects, it also imposes the most honourable dealing towards them, and perfect good faith, on those who invite them to compete, and who have the benefit of anxious labour undertaken only with a mere chance of success.

Nevertheless, the inviters seem frequently to act as if they were altogether irresponsible, and emancipated not only from all restraints of honour, but from those of common honesty also, and whatever they may be as individuals, are in their capacity of "Committee," guilty of such arrant double-dealing and dirty shuffling, as in less *respectable* persons would be called downright knavery and swindling. I am sorry there should be room for such offensive remark,—neither am I sorry for that alone, since I am sorry, exceedingly so, to find that perfect impunity is granted to malpractices of the kind, and that architects suffer themselves to be imposed upon by bilking Committees without daring to demand justice. Now and then, indeed, there is a little complaining and grumbling—a little show of remonstrance, but 'tis invariably a mere flash in the pan. Never does any thing come of it; the affair is allowed to die away and be forgotten, so that the complainants merely exhibit their own chagrin to no purpose at all.

It seems to be exactly thus with regard to that outrageously gross case, the late Competition for the Choristers' Schools at Oxford, which scandalous as it is, is now apparently quite dropped, and hushed-up, notwithstanding that it is one which requires the very strictest investigation, and the most thorough sifting into. The epithets I have applied to it, are not at all too strong, for foul injustice has been committed somewhere,—either *by* the parties who now stand criminated, or *against* them; and if it be the latter, they ought to rebut the injurious aspersions cast upon them, and openly vindicate their honour.—How stands the case? It is positively asserted—nor has any attempt been made to contradict it—that although Mr. Derrick had previously declined to enter the Competition, he ultimately did so, and made his designs after all the others had been sent in according to the time specified. Now this was certainly most unprofessional and unjustifiable conduct on his part. Still it is less astonishing to find an individual so dishonourably unscrupulous where his own private interests are immediately concerned, than to find that the College authorities—men who it may be supposed have some character for integrity to support, should have connived at such unfairness, and have allowed him to do what they must have known and ought to have felt was on their part a treacherous violation of contract between themselves and the Competitors. And have those *gentlemen* now not a single syllable to offer in their defence?—cannot they even attempt to explain away the untoward circumstances against them?—cannot they even muster up logic enough among them all to convince the world that black is white, and fraud and deception become virtues when they can plead "benefit of clergy"? And the Competitors?—do they now intend to let the matter drop, like good easy people, instead of making such an example of those Oxford Dons as would prove a most wholesome warning to all future Committees?—Let us hope not. Every one of them ought to bring his action at law for Breach of Contract.

Unless the grievances arising out of Competition are chiefly imaginary,—unless there is a good deal of unfairness in imputing unfair dealing to Competition as generally managed, the profession ought to do what they have scarcely tried to do in any shape—take up the matter bodily as a body; and were they really hearty and unanimous in doing so, they would no doubt be able to devise means of putting a stop to the abuses complained of; whereas at present, while complaints proceed only from individuals, and from parties immediately interested in the respective particular cases, the silence of the profession, and of the "Institute," as its representative, looks very much like acquiescence in the actual system of Competition, without the slightest desire for any reform in it.

I remain, &c.

BYSTANDER.

THE CHURCH AND THE CAMDENISTS.

SIR,—Bigotry and ultra-intolerance are stated by your spirited correspondent "Z Z," in the May number of the *Civil Engineer and Architect's Journal*, to have taken hold of the "Cambridge Camden Society," and to have diffused their imperative and limited policy into all their works, their conceptions, and their reasonings —if *reasoning* it can be called. Does it not show a very narrow, weak, and clouded imagination to suppose that classical elegance or beauty is not elegance and beauty, because it is pagan, because it did not emanate from monkish ignorance engendered in the dark cells of superstition? This must be bigotry and intolerance with a vengeance; the greatest slavery to which the human mind can be bowed down to. In this enlightened railway period of intelligence and knowledge, it would hardly be thought that Englishmen could be found of such truly perverted intellect, but I perceive their influence is extending into the midland counties of England, through the instrumentality of the clergy—a pious race. At Bronley, a parish in Shropshire, containing nearly 5000 inhabitants, where the recent incumbent, a sprig of nobility who has taken upon himself the cure of souls—the old church, which contained 1000 to 1200 persons, and which from the period of its first existence, having been rebuilt in 1701, and would have stood for 150 years longer, and was always considered too large, was under the plea of its being *too small*, and being "*a hard church to preach in*," pulled down and a Gothic structure erected in its place at a cost of 7 or £8,000, contrary to the strong feelings and desires of the greater portion of the parishioners. To have built a Grecian structure I should conceive would have given it a tincture of Paganism; therefore, instead of constructing a building on strict mathematical principles, which would be found efficacious in conveying the words of the minister uninterrupted to the ears of the congregation, and making it of practical utility, it has been deemed right—if right it can be called—to build it upon one of the clumsiest and pillar-crowded forms they could select; and this for no other reason—not as I observe of utility, a vile or useless cause in these times, nor taste—but in consequence of the *rage* for following our forefathers, men clouded and swayed by excessive ignorance, men just emerging from the darkness and gloom of benighted reason, in the early dawn of bewildered knowledge, without established order or consistency. Thus these persons scoff, with their presuming knowledge, the extensive learning and science of the present illuminated and illuminating period, and rush with a reckless ardour to embrace the offspring of bigotry and superstition which a morbid appetite for *novelty* demands.

Referring to the different remarks you have made on the *Ecclesiologist* in the *Journal* for 1844, pp. 440, 441—it is there noted that "the restoration of the rood screen being determined upon;" "the restoration of stalls," and other paraphernalia of Catholicism. Were not these the remains of papacy? and are the members of a reformed church, which still wants reforming, to fall into the old, discarded, and contemptible rites and ceremonies? are they to be renovated, which have fallen and have been thrust away by the force of reason, wisdom and experience, to be again reared up and promulgated as the only mode of worship? 'Tis sophistry and a blind hallucination with the prostration of the best faculties of man. The quotations found in the pages above referred to—from this sacred work of the Camden Society—are truly laughable, such as "cast-iron stoves are inadmissible"—for why? because the poverty and ignorance of our early forefathers could not procure them; whilst the simple, sickly, childish twaddle of their effects "to stifle the sickly, scorch the strong, amuse the irreverent, &c. &c.," is just as reasonable as to say you shall not use carpets upon your drawing-room floors, but litter them down, as in the days of Elizabeth, with straw or with rushes. Then the idea of "a simple ring of iron, the size and kind of which encircles a coach wheel," to be filled with fire from a furnace is admirable. *O tempora! O mores!* From such mentors, or such noodles, the Lord defend me and all her Majesty's lieges.

I am, Sir,

Yours very respectfully,

December, 24*th*, 1844. A. B.

NEW BUILDINGS ACT.

SIR,—The Metropolitan Buildings Act has now come into operation, and of all the bungling Acts which ever were patched up by the concocters of laws this surely is the worst, nor can some of its very useful provisions, loaded as they are with everything to stultify them, redeem it from this deserved censure. My present purpose is to name only one of these which now affects me personally.

My house not being large enough for my family and business (while as the situation suits me, and I and my business are well known here I desire to stay), I have long been negociating for a renewal of my lease, and have just now succeeded, under a covenant to extend my house over a part of my yard; so far all is satisfactory, and my surveyor was desired to lay down plans for the work. But, alas, a short time since a butcher set up his trade in an adjoining street, and in spite of the remonstrances of the neighbourhood, and every means in their power to prevent it, he has established his slaughter house in the rear. The bellowing of his cattle and the stink of his offal has already driven away the best of my neighbours, who are not, like myself, bound to the spot.

An act of parliament framed expressly to abate nuisances ought surely to have provided a remedy for so great an evil, and this act has done so *with a vengeance* by inflicting a heavy penalty—on whom think you? On the party committing the nuisance of course, you will say. But no, the penalty falls entirely on his unfortunate neighbours, and on me among them, while he himself, the cause of the injury, laughs at us in his sleeve and goes scot free. As if the nuisance I complain of was not enough, I am not allowed to enjoy *even my own*. By clause 55 he is allowed to remain, while as his slaughter house is already within 50 feet of the back front of my house, I cannot enlarge it without violating the same clause, prohibiting any dwelling house to be erected within the prescribed distance under a penalty of £50 per day, and so I am compelled to remain in a house too small for my family in order to oblige a neighbour in continuing his nuisance. I know but one thing like this, and that occurred a few years since at a police office—where a party was convicted of an offence against a statute, and in which on such conviction one half the penalty was to be assigned to the king and one half to the informer, when, to the gratification of the convicted and the consternation of the informer, the only penalty was found to be a month's imprisonment and the pillory —so much for modern legislation. I might fill a quire with similar absurdities in this new act, which *must* be either repealed or greatly modified ere long.

I am, Sir,

Your very obedient servant,

February 10*th*, 1845. A SUFFERER.

FIRE DAMP ALARUM.—At the *Academie des Sciences*, at Paris, M. Chuart's invention was explained, it consists of a ball or globe, contained in a chemical solution highly sensible to any deterioration of the atmosphere, and acting upon a lever, which sets an index in motion, and thus shows the vitiated state of the atmosphere, whether in a mine or elsewhere, long before the common air can be so saturated with gas as to explode on the application of light. M. Chuart has added to his invention an alarum bell, which is struck by the lever when the ball is thrown off its equilibrium by the vitiated state of the atmosphere. Since M. Chuart first exhibited his apparatus he has made a great improvement. His ball was originally of glass, which was not only too heavy, but also liable to breakage. He now makes it of copper, so very thin that its weight is almost nominal, and yet it is perfect in every part. It is stated that he arrived at this perfection by means of the galvanic process, which gives a thinner substance than any mechanical means could effect consistently with the compactness that is required for the certain operation of the apparatus.

ACHROMATIC TELESCOPES.

Sir,—Some time since we had in your valuable Journal, a detailed account of the means used by Lord Rosse in the construction of his six feet reflector, and the way in which he surmounted every difficulty must have afforded no small interest to all who follow scientific pursuits. Difficulties of a different kind, and even greater than those met with by the noble lord, have to be contended against in the construction of achromatic refractors of large sizes; the workshops of our best opticians fail when required to produce lenses of a greater diameter than 7 or 8 inches; we have been out-done at Munich in this respect, I understand that one has lately been completed there by Merz and Ertel of the vast size of 16 inches.

Now, following up the description already given of the method of constructing reflectors, a paper by some of your competent correspondents on the manufacture of refractors could not fail to be of great interest to your readers, and assuredly a journal like yours forms the best channel for the communication of such information. The description might be continued still further, to the telescope itself, by way of making the paper more generally interesting, describing the principles both of refractors and reflectors, including the Gregorian, the Cassigranian and Herschel's telescopes, their comparative and actual magnifying powers, as well as the expected results from an increase of size. I understand from very good authority that could a refracting object glass be made equal in diameter to Herschel's large telescope, the habitations in the moon would be distinctly brought to view. I know of no work where such information may be sought or satisfactorily obtained, and therefore submit the subject for the consideration of yourself or any of your correspondents.

Mizar.

Liverpool, Jan. 22nd, 1815.

BROWN'S ORNAMENTAL TILING.

Sir,—At page 429 of your Journal, for November, is an article entitled "Brown's Ornamental Tiling," setting forth also his grooved ridge tile, the invention of that ingenious and persevering individual. It then goes on to state that Mr. Kendal was the first architect who introduced them; almost simultaneously must have been their introduction by Mr. Watson, whose name however does not appear at all in the article as connected with the ornamental tiling. Being in Mr. Watson's office in Manchester Street, as I was also in 1840, when he designed and executed the Ornamental Building in St. James's Park for the Ornithological Society of London, also a villa on the banks of the Thames, it occurs to me that it ought to have been named that he there used and designed the ornaments Nos. 4 and 5, not deeming those shown on No. 18 of a sufficiently defined character. He subsequently designed Nos. 6 and 7 for his own residence, Surbiton Gardens, Kingston, Surrey, built in 1842. Nos. 8 and 9 show the front, end, and side of an eaves tile altogether new, originating with, and designed by Mr. Watson, which has a peculiarly rich effect in the execution, and which is capable of endless variety. No. 10 is also Mr. Watson's original idea, and designed as a terminal ornament over a gable, which he found so much the want of, the first time he introduced Mr. Brown's grooved ridge tiles. The plain tiles Nos. 1, 2, 3, 11, 12, and 13, are also in part designed, and in part greatly improved in their proportions by Mr. Watson. Thus the thirteen first diagrams emanated from him, the full size drawings being in our office, and I am quite sure you will feel a satisfaction in having the subject correctly stated. It is rather a singular circumstance that from the number of architects practising, Mr. Brown has not introduced any other designs, although the whole of the thirteen have been in general use for a period averaging more than three years.

I am, Sir,
Your obedient servant,
Robert Hamilton.

Woodlands,
Norwood, Surrey,
Dec. 13, 1844.

Aix-la-Chapelle.—The restoration of the celebrated church of Notre Dame, originally erected by Charlemagne, is proceeding with great activity. The thirty-two magnificent columns, some of marble, others of granite, which had been carried off by the French to Paris, have been entirely repolished, and are ready for being put up as before within the central octagon. They came originally from Rome and Ravenna, and were ordered by the royal founder to be employed for this edifice, in the year 726.

ON THE PROPOSED NATIONAL EXPOSITION;
Or Yearly Exhibition of Works of Art, Manufacture, and Trade.
No. II.

Some fatality attends men of genius in England, above those of any nation on the earth, and simply, I believe, for want of such an establishment, both as a nursery of worth, a storehouse of merit, and a refuge for the destitute. This may appear a startling sound to persons not initiated in the secret memoirs of the brightest minds and best of men; but, to him who has seen, as I have, the struggling worth of Dodd wanting daily bread, Dundonald sleeping upon straw, and Accum without fire in a garret in Islington, it will excite no surprise; more especially when it is remembered that, in this kingdom, few Boards exist which do not merit the appellation of blocks; where the abuse of patronage reigns paramount; one where, during thirty years, I have known only one public secretary whose letters were either intelligible on the one hand, or bore on the other any reference to the subject in question, so that, in less than twenty years, no evidence whatever exists to which any rational being would refer; where, I say, the higher patronage is so grossly abused that qualification is the last possible consideration in the appointment made, albeit thousands of lives and millions of money rest on the hazard of the official die; and where, in addition to all this, the monstrous applications of etiquette so obviously defeat every effort of worth, that even a confessed blunder must not be enquired into by any future Board; although its notoriety becomes published in Gath and proclaimed through the streets of Ascalon by the common experience and consent of all society; and where too, as I have before asserted, no one institution exists embracing, in the most distant degree, its views, its powers, or its worth unto man.

It will be said, perhaps, we have the "Society for the Encouragement of Art, Manufactures, and Commerce." Let us see the fact,—it issues a yearly list of premiums and trinket prizes for subjects oddly chosen and strangely measured; for I remember, some thirty years ago, it offered a gold medal, or one hundred guineas, for refining whale oil, when Dundonald, Dinsdale or Nicholson, then engaged over it, could have commanded five or six thousand guineas easily—but gas was then rising above the horizon of oil—and a hundred more such absurdities; and to obtain these prizes all ideas of patent, profit, or further benefit must be repudiated, so that he, who must live, tells his knowledge to the world, in ninety cases out of the hundred, idly with valuable things, while silly ones *readily* receive the so-called reward, a case of which I remember quite in point—a premium was refused (at the instance of Hume the druggist), for the best permanent white ever yet made for water painting, and a premium given to Blackman for some trash called oil colours in cakes, so permanent that no man ever yet could use them at all, these cakes being real brickbats!

The late Dr. Charles Taylor, its then secretary, was my personal friend. I have carefully watched its career, and unhesitatingly and fearlessly I proclaim its total incompetence to produce its founders' wished-for end.

I have lost, in the current of time, all recollection of the actual premium received, many years ago, by Mr. H. Trengrouse when he communicated to this society the means of assisting vessels in distress by rockets—it might have been a silver Isis medal—but I do know that it lay a dead letter, and certainly no profit to Trengrouse, until Dennett, by way of trade, copied it a quarter of a century afterwards, when Carte, the Ordnance storekeeper, copied him in his turn, and society has reaped some long deferred benefits, and ninety-nine educated men in every hundred remain ignorant of the facts to this day.

Something very similar occured with the non-capsizable and non-swampable life boat—though a common boat sent to sea in the William Darley, Hamburgh steamer, from Kingston-on-Hull, ten years ago, as mentioned in my last paper, and that by an individual who would have smiled ineffably to have seen his boat placed, with poor Christopher Wilson's, in the Society's archives, until time permitted some Shipwreck Society bird to copy it: and, I ask, could such things be with a National Exposition of Works of Art, bearing the real inventor's name. Here, Sir, Mr. Trengrouse's name would have been written in letters of gold, here the laurel wreath given by ancient Rome to all who "served the state" would have been entwined for his brows, here he had found fortune as well as fame, and that had been rendered unto Cæsar which of right belonged unto Cæsar; here no Seppings could have lined his nest with the moss and feathers appertaining to Skeene; here the poor starving German of whom Sir William Congreve bought, for a few shillings, the subject of two patent rights, would have received that protection and reward which no silver medals or gilt gingerbread could give, in the nature of things, while, with the Society, the light was hidden beneath a bushel.

I have a volume of facts from the experience of five or six other persons of similar character. Now, Sir, if these unquestionable errors of our practice and defects of our established usages and institutions, which strike at the root of all the best impulses and dearest ties of the community, do not prove the want of an Exposition I shall cease to judge of facts by my senses, or call upon those of other men. Now to the ways and means I propose for forming their Exposition.

To raise five thousand shares—devisable by will, but not transferable in the way of traffic—at ten pounds per share, with calls of £1 only at periods to be fixed, and with powers to call for a future ten pounds on each share, or raise additional shares of the same value and in the same manner, would amply suffice.

The commencement of course requires some funds; but in a *bonâ fide* utilitarian cause, and which could scarcely fail in its objects and end, scores of capitalists would be ready to aid us. It might be provided that as soon as one thousand shares are subscribed—the business of the Institution was to commence. If all party feeling, all political and polemical prejudice be excluded, I have no doubt of success: a committee of friends to the cause should be at once solicited, a secretary, *pro tempore*, appointed, &c. &c.

A council of twenty-four should govern the affairs; six councillors going out every year and others chosen. The secretary, collector and servants alone to be paid.

On deciding upon a plan of building, such should be chosen as would admit of each portion being part and parcel of an uniform whole, and so constructed at first that it might be gradually enlarged. With reference to receipts beyond paid up capital—first, there would be certain ones arising from fees of one shilling, to be paid on admission, in every five pounds value of the admitted article; secondly, one shilling from each visitor admitted on any one of the four days of the week when it is not open for gratuitous admission, Monday and Tuesday being devoted for public admittance gratuitously. There would also be the gifts and bequests from the affluent.

WILHELM DE WINTERTON.

December 4, 1844.

ON MONUMENTS.

(Abridged from the Ecclesiologist.[1])

The theory and proprieties of Christian Monuments have naturally engaged considerable attention during the last few years, as forming a most important part in that revival of architectural taste, which seems at length to have partially dawned in this country. Much investigation of ancient examples, and much eloquent enforcement of their universally fine feeling and graceful beauty, have already effected more than we might have hoped for in improving modern practice, and in checking that restless and ill-judging caprice, which owned no standard of excellence, and had no consciousness of the absurdities of its own creation. The half-naked marble effigy, the heathen emblems of inverted torch and cinerary vase, the pediment and the pilaster, the cupid and the cherub, have given place, in many a church, to the Catholic symbol of the blessed Cross, the glowing Memorial window, or the consoling and inspiring portraitures of Saint and Angel. Once more will monuments represent the departed, sleeping, as of old, in hopeful peace: not dead, extinct, annihilated, nor again in any unreal attitude of life; but only as it were, in expectant slumber, withdrawn but for a time from their fellowship with earth. In a word, we are beginning to feel the force and meaning of these things, and heartily to abjure and detest the wretched and profane trash which, for the last two centuries, has disfigured our churches.

So searching has been the enquiry into this subject, that perhaps little now remains to be said about monuments, viewed simply as architectural features. It will not be our object to attempt to throw additional light on what is already well understood, but rather to discuss the ancient principles in connexion with present usage, in order to point out what kinds of monuments are best under particular circumstances, and how they may be treated in an age which refuses unconditionally to accept, even on questions of architectural propriety, the authority of mediæval antiquity.

The evils of sepulture within the walls of churches are now beginning to be felt and acknowledged. Many an old church has already been brought to the ground from this cause; and many more are, to this day, distorted, disjointed, and seriously endangered (as was our own St. Sepulchre's, till its recent restoration), from the lapsing of the foundations through the same means. And though this extensive mischief has generally been caused by the most culpable carelessness, and might perhaps be easily avoided in future, still there are other reasons which combine to render the practice decidedly objectionable, except under certain circumstances, which we shall hereafter explain.

All the ancient monuments which are to be met with in this country, may be classed under eight general heads.

These are:

1. Sculptured coffin-stones.
2. Recumbent effigies.
3. Plain and low sepulchral recesses, with or without either of the above.
4. Brasses and incised slabs.
5. Canopied mural tombs, differing from (3) in size, projection from the wall, and degree of richness.
6. High-tombs, often bearing a brass or an effigy of stone or alabaster.
7. Floor-crosses and Lombardic slabs.
8. Sunken effigies, *i.e.*, slabs showing a part only of a figure, in an open circle or quatrefoil, at the head or feet, or both.

Each of these will demand a few observations as to their appropriate use.

For a Founder, especially if of rank or consequence, nothing can be more correct than a low arched recess in the chancel or aisle wall, provided the style be not later than Decorated. A low shelf, or ledge of masonry, should be placed under it against the wall, upon which either a recumbent effigy with clasped hands may be laid, or a coffin-stone, sculptured in bold relief with a floriated Cross. If it be preferred, it is still less expensive to lay down a flat slab of dark native marble, bearing an incised Cross with floriated stem and calvary, and with the arms or badge of the deceased by the side, and a legend cut in deep characters round the edge. This is an elegant and simple design. At the same time we should have some hesitation in recommending its introduction in an ancient church, which would in some sort be committing an anachronism; but in a new edifice, and under the above circumstances, it is perhaps almost exclusively correct. For it is probable that founders' tombs were peculiar both in position and design. Even now they are common enough in the north wall of chancels, though a vast number may have been destroyed in demolishing credences and sepulchres, for which they were often used, or may now lie hidden behind wooden altar-panelling. If the founder of any new church should desire this ancient form of sepulture, the tomb might very well be constructed during his life-time, and a recess prepared under the wall in laying the foundations. Such anticipative works were extremely common in ancient times, as we may infer from dates and names partly cut and never finished.

Recumbent effigies are confessedly among the most touching and interesting ornaments of a church. We doubt if any object more strongly arrests the attention of all, whether young or old, learned in, or ignorant of Ecclesiology, than the simple figure, as it lies prostrate over the tomb, ungraceful though it be in its drapery-folds, and rudely severe in its outlines. The cross-legged knight in his hauberk of mail; the bishop with chasuble and staff; the abbess in wimple and habit.

The same, but in a much less degree, might be said of Brasses. Here however we have no hesitation in urging our artists to recover so fine and effective a department of Catholic art. We believe that brasses are the most fitting kind of monument that, under general circumstances, could be adopted. When we consider that their cost would not exceed, and seldom equal, that of mural tablets, we shall think it strange indeed that a positive and most unsightly disfigurement should so long have been universally preferred to one of the greatest ornaments which a church can possess. There may indeed be at present a difficulty in procuring them of correct execution, and reasonable cost, though we shall always be glad to give information how this may be done; but a general demand for them would immediately produce the requisite supply.[2]

Sculptured or incised slabs are precisely on the same principle as brasses, for which they were probably a less costly substitute. These are generally late, and of alabaster; but early examples are found, sometimes on high tombs. It may be remarked that various slabs of this kind are sometimes marked with five small Crosses, like altar-stones, as at St. Peter's, Tempsford, Bedfordshire; a circumstance likely to mislead. We have met with several other instances; one at St. John's, Stamford.

The canopied mural tomb is the most costly and beautiful of all monuments. It ought to have crockets, pinnacles, finials, shafts, buttresses, panels, and tracery, with under-groinings, colour, gilding, and diapers, according to the style and design. In some cathedrals these stand isolated like a shrine; but this is rarely the case in parish churches, where they are almost always strictly *mural*[3] Generally they are formed in the wall, which is recessed to the depth of about two feet, to include a table-tomb without projecting beyond the wall-line. Effigies seem the most usual and appropriate complements of

[1] The 'Ecclesiologist' is no longer connected with the Cambridge Camden Society.—Editor.

[2] We have seen some excellent brasses furnished by the Messrs. Walker, of London. One large double brass, with canopies and legend, cost £60; another, a floriated Cross, with calvary and legend, £15. We take this opportunity of informing our readers that these gentlemen have made arrangements for making monumental brasses to any size and degree of richness.

[3] The most beautiful example within seven miles of Cambridge, is at All Saints, Landbeach. The fine specimens at St. Michael, Trumpington, and All Saints, Little Shelford, may also be mentioned.

these recesses, which must be regarded as partaking of the character of niches. A vast number of ancient mural tombs of this kind remain; many exhibiting the finest possible workmanship, and the greatest profusion of ball-flowers, mouldings, feathered cusps, and other decorative detail. We need hardly cite the incomparable tombs of Westminster Abbey, nor observe that the Percy Shrine, at Beverley, may indeed have once been the wonder of England for its chasteness and extraordinary richness of ornament.

Some examples of Perpendicular date, by their enormous size and height, violate true principles, which require that such features should always be subordinate. Such an extravagant design is the tomb in the chancel of St. Andrew, Hingham, Norfolk, which extends from the ground to the roof.

This kind of monument, however, in no respect defends that favourite modern deformity, a *Gothic mural tablet*. We object to these altogether as most faulty on the grounds both of principle and effect. It is just like trying to make galleries look tolerable by panelled Gothic fronts. A white marble slab, enclosed between two buttressed pinnacles, and recesssed some few inches behind a crocketted canopy, the whole standing out perhaps on a moulded bracket between two windows, or over a door; this is often erected, at a very great cost, under the mistaken idea that because its details are Gothic, it is therefore consistent with Gothic principles.[4]

A priest's monument must be devoid of high pretension.[5] Either a brass, or a floor-cross, with a chalice sculptured on one side of the stem, is the most fitting. It should be laid down in the chancel floor, in our opinion, whether it immediately covers the body or not. For a grave-stone, in its highest use, is not so much intended to mark the exact spot of sepulture, as to record the fact, and commemorate the event in the prayers of the Church. Monuments form so conspicuous a part of decoration, as well as of the moral of church architecture, that to deny them a place in the interior of the sacred fabric would be to deprive it of no inconsiderable portion of its religious effects.

High tombs occur principally in chancels, or near Altars, and usually attached or at least close to the wall. They were often used for Easter sepulchres. The position on the north side of the High Altar is well known. At All Saints, Milton, and St. Mary's, Sawston, near Cambridge, there are high tombs in this place which date after the "Reformation." The latter was erected during the reign of Queen Mary. The best place, however for these tombs is a chantry chapel. Here they may be rendered gorgeous with heraldries and painted effigies. In other parts of a church they are apt to be too cumbrous, as well as too prominent and conspicuous. For example, the alabaster effigies so commonly in vogue from the time of Queen Elizabeth downwards, generally partake too much of pride and ostentatious display in their great size and the exuberance of their ornament. Thus they encumber rather than decorate a church. Nevertheless, they are infinitely better than the modern pagan marbles. Upon the whole, however, they appear to us the least desirable to revive of any kind of mounment; and, indeed, they were the invention of a late period, at least in their isolated and altar-like form; for when placed under rich canopies, their nature and effect are materially changed, principally from their recessed position within a wall.

There is an unusual but very becoming kind of monument, which may be called the coped high tomb, of which a specimen from the church-yard of St. Giles, Bredon, Worcestershire, is given in the *Instrumenta Ecclesiastica*, Part III. There is a fine example at St. Mary's, Salford, Bedfordshire. In this case, the design resembles a low coffin-shaped sarcophagus, standing about two feet above the floor.

The sunken effigy is a device which might perhaps be fit for modern adoption, though ancient examples are either so rare, or so little appreciated, that we doubt whether a single attempt has been yet made to revive their use. For this reason it may be well to describe them in detail. A thick slab of stone or marble has a deep circle, quatrefoil, or other geometric aperture, sunk in its upper face at one extremity, in which, a little below the level of the surface, is represented the head and neck of the deceased, and sometimes part of the clasped hands, as if the whole figure were encased, and but partially revealed from within the solid stone. At St. Andrew's, Utterby, St. Oswald's, Howel, St. Nicholas, Normanton, and St. Stephen's, Careby, all in Lincolnshire, very good examples occur. Sometimes the feet are shown at the bottom, as well as the head at the top of the slab; but this is not very often found.

Coffin-stones are often raised on low plinths of masonry, even when not placed under an arch. At St. Germans, Scothern, Lincolnshire, there is a beautiful one sculptured in relief, of Early English date. It is placed close to the western entrance; a remarkable position, which we remember to have observed elsewhere, and one that may perhaps have been dictated by a sense of unworthiness to approach nearer to the Altar.

ON THE MARBLES OF IRELAND.

By Mr. Wilkinson.

Read before the Geological Society of Dublin, January 8, 1845. The paper was illustrated by upwards of 80 fine specimens of polished marbles from various localities in Ireland. Some of these were exceedingly beautiful and much admired by the members present, most of whom were not aware that Ireland possessed so many varieties of native marble.

In bringing under the notice of the society the accompanying specimens of the marbles of Ireland, I have thought it would not be altogether uninteresting, nor alien to the objects of the society, that a few remarks should be made on the subject. The designation 'marble' implies, as every one is aware, a quality of stone which admits of comparatively easy conversion, and is worked to a smooth surface susceptible of polish. Those stones which are capable of receiving a high degree of polish and brilliancy of effect, like the variety of diamonds, gypsum and spar, &c., have been by most nations held in estimation, and have in various ways been used for ornamental purposes. The word marble does not however apply to the latter, but to those which are harder than gypsum, and being found in considerable masses are suitable for larger operations, and in its most restricted sense to the limestone formations only. The marbles of a country are amongst those geological products, which in an economic point of view are perhaps the most interesting in consequence of the various useful and ornamental purposes to which they may be applied.

The use of marble in Ireland during past periods has been very limited, and even at present the purposes for which it is used are very circumscribed. This arises possibly to some extent from the very little general information which exists relative to their varieties, and to the uses of which they are susceptible. The specimens now on the table, with a few brief observations relative to their external characteristics, and the localities where they were found, are therefore submitted, in the hope that some little advance, however small, may be thereby made in their more general application. While the marble rocks of Ireland have been quietly reposing in their native beds for many centuries past, the marble of other nations, where the arts and sciences have flourished, has been extensively used. There is an aphorism which prefers "use before ornament," and it is well illustrated in connexion with the various rocks—those alone which were necessary for the construction of habitations, for the formation of places of security, or for ordinary public works of utility, have been brought into use. The refinement of the age, and the consequent influence of higher feelings, have, however, brought into use those finer-textured and variegated-coloured rocks, which, while they furnish ornament and delight the eye, enable the skilful sculptor, by the clear and delicate outline they are capable of forming, to imitate and almost indefinitely to perpetuate those triumphs of art in which, by unity of expression and perfect harmony of outline, Nature seems almost to have been surpassed. Of such may be mentioned those celebrated sculptures of beautiful forms which have, by means of marble, perpetuated the elegant and expressive allegories of the ancient Greeks to the admiration, if not to the emulation, of the present generation. The use of marble by the ancient Greeks and Romans appears to have been carried to an almost unbounded extent. The number of marble statues in the city of Rome alone almost exceeds belief. In the writings of historians we are made acquainted with the extensive use made of the marble rock by the most refined nations. Thus we read of the very elaborate marble embellishments of the ancient Indian temples, of the elegant and luxurious baths in which the ancient Romans and the inhabitants of eastern nations indulged, and of the refreshing coolness which the polished surface of the marble produced. The use of the marble was, however, but little known in Europe during the dark ages which succeeded the fall of Rome; and even until the revival of the fine arts in the fifteenth century, when the Italian school of architecture produced a different taste, the use of marble was comparatively very limited. The resuscitation of art prevailed in different applications of marble; and it was then exclusively used for forming the internal faces of the walls, for the embellishment of buildings, by using variegated coloured marbles. In the age of Elizabeth marble was extensively used in England for large monumental tombs, the decorations of fire-places &c. At this period variety of colour was the chief object sought, and to a limited extent marble was then used in Ireland for the same purposes. The materials so used were almost without exception procured from Italy. During the last century marble was chiefly employed in the decoration of chimney pieces, for ornamental slabs or similar purposes, the material being worked according to the fashion or taste then prevailing, in imitation of the ornament common to the revival of the Italian architecture, and familiarly known as the

[4] We think ourselves justified in this opinion, even though a very few mural tablets occur (as at All Saints, Bakewell), of ante-reformation date. There is a great want of propriety in thus perching aloft that which should lie immediately over the ground, as the idea of contact with earth is surely an essential one in monuments.

[5] Sepulchral recesses, as described above under the third head, with effigy in full vestments, are not very uncommon. But even these are more usual in the nave or aisle wall than in the chancel. Many examples of these monuments may be found in 'Fisher's Collection of Bedfordshire Antiquities,' and in that noble work, 'The Sepulchral Monuments of Great Britain,' 5 vols. folio, published in 1796, which contains a great number of illustrations of every kind, style, and period. At St. Mary's, Fulbourn, near Cambridge, there is an emaciated effigy of a former Rector, close to the Altar.

cinque cento style, and which consisted in inlaying the forms of flowers or figures in different coloured marbles, for costly chimney pieces or other works of the kind, which possessed a beauty in design much in advance of the common or general use at its first introduction. Many such examples of the working of marble are met with in Ireland. At the present day the use to which marble is generally applied is varied; but, with the exception of statuary, it is extensively used but for very few purposes, amongst which may be stated the construction of chimney pieces, mural tablets, flooring ornamental slabs, hearth-stones, vases, and in some few instances staircases and columns. Its most extensive use is, however, for chimney pieces and mural tablets.

For most of the purposes stated the marbles of Italy are still imported for use in Ireland, and it thus more immediately concerns the Geological Society, in the practical consideration of their pursuits, to investigate the quality of the marble productions of the country, in order that the professional architect may be enabled to avail himself of such information and apply them in the designs entrusted to his execution.

Although the use of marble or ornamental stone in internal decoration is as yet very limited, there can be but little doubt that with the advancing improvement of the country marble will hereafter be more extensively brought into use, and made to contribute both to the ornament and solidity of our edifices much beyond the present practice; and there is no doubt that with greater use much improvement would be made in the mode of working the material. To those who may be of opinion that the labour of converting the material to use may be an impediment to its more general adoption, it may be proper to make a comparison between the labour encountered in completing the almost innumerable sculptures which remain to us of ancient Egypt, worked out of the hardest basalts, granites, or porphyritic rocks, and the difficulties encountered by artists in the use of marble rocks, the difficulties bearing about the same relative proportion as the use of marble would to that of plaster. The use of marble at the present day, and for the purposes to which it is most commonly applied, is very different from the practice of a former age. Every one must be familiar with the ordinary mode in which marble is applied in the construction of common chimney pieces, consisting of nothing more than the division of the block into a number of slabs, which, by the aid of plaster of Paris and iron holdfasts, are secured together in imitation of a solid mass. However sufficient this may be for ordinary purposes, it is certainly very inferior to the construction from the solid enduring stone. In all the ancient domestic buildings of the country we find the solid chimney pieces constructed of limestone or dark marbles of the locality, and where undisturbed these are generally still in a sound and perfect state. Old street buildings in the west of Ireland, and at Kilmallock in particular, present examples of this construction, and possess a very pleasing outline. Instances will very often occur in country mansions or public buildings in the vicinity of which local marbles are attainable, in which such constructions might be imitated with great economy and effect, and where for many architectural purposes it might with much advantage be very extensively applied

The physical or external character of the marbles constitutes the chief consideration with reference to their use for decoration or ornamental architecture, their colour and internal structure being the most important. Their chemical character has reference more to the facility with which they may be converted into use, and their capability of receiving and retaining a certain polish. In their simplest and purest state, marbles chiefly consist of carbonate of lime, which is of a white colour; the whitest kind, however, is frequently associated with quartz or silex, which more or less deteriorates it. This is more or less united both chemically and mechanically in various ways with nearly all the marbles. The variations in colour arise chiefly from accidental causes, in the greater or less admixture of carbon, or the stains of various metallic oxides, or the sectional outlines of embedded fossils. Magnesia enters largely into the serpentine variety of marble. The more chrystalline and least earthy marbles are the least durable. The compact or finely granular crystalline marbles being superior to those which are largely crystalline or of a slaty texture. Almost all the varieties burn into quick lime; several of them, however, exfoliate in the conversion before they become caustic, and fall into sand when exposed to the ordinary mode of separating the carbonic acid; such qualities are, therefore, very inferior for ordinary cement, as they make a costly and meagre mortar; it is, however, to their use as materials for decoration that the present observations are chiefly intended to relate.

The colours of the marbles of Ireland are almost as numerous as those obtained from Italy. The dark colours vary from jet black to dark dove colour, purple, blue, and grey. The light colours vary from the pure snow-white, to the celined, cream coloured, pink, and light grey. The variegated consist of the serpentine, black and white veined, mottled, and those marked with fossil organic remains. The serpentine is here included, from its common use for the purposes to which marble is applied, and from its being so commonly called the "green marble," although it is not, strictly speaking, a marble The black marbles, which are those of most value in Ireland, are extensively met with, and belong to the formation familiarly known as the lower limestone. The merchantable beds of the best quality are met with in the counties Galway, Limerick, Carlow and Kilkenny; in the counties of Mayo and Waterford black marble is also met with. At the former places they have been extensively worked.

The best quarries are considered to be those close to the town of Galway, near the bank of Lough Corrib. It occurs there in three beds, varying from about 9 to 12 inches in thickness. One of these is called the London bed, most of the *black marble* raised from it being exported to London; blocks are raised from it of an average size of about 5 to 10 feet in length, and 4 to 5 feet in width; blocks of the size of 20 feet long may be raised. Some in lengths of 16 feet have been exported, and converted at the Esher-street marble works in London into a magnificent staircase for the Duke of Hamilton, in Scotland; the wide steps, large landings, and solid carved balustrades being formed of this marble worked to a beautiful jet black polish; and, doubtless, when brilliantly lighted, and surrounded by various other brilliant accessories appertaining to a palatial residence, will produce an effect of princely grandeur which to a contemplative mind would originate reflections on its present use, and the countless centuries it has laid dormant in its native beds, where it has been protected by the overlaying limestone from the violent disturbance which its broken and rugged surface exhibits; nor in a less degree would it originate reflection on the rude labours of those who, ignorant of its destiny, have raised it from its native bed, and the numerous hands and skilful artists it has given employment to in its passage to its present destination. The marble beds are covered in the new quarries by about twenty feet of limestone, the raising of which adds much to the expense of obtaining it, although a considerable sale occurs of the limestone for common building purposes. Except near the marble beds the quarrying of it is effected by gunpowder. A considerable quantity of this marble is sawn by water power into slabs, and exported from Galway in that state to England and America. These marble beds most likely embrace a considerable area, and also continue under the water of Lough Corrib, with which they are now nearly on a level. At Oughterard, the western extremity of the limestone formation, and in several other parts of it, similar marble beds are met with and worked; those at Oughterard, in the opinion of the marble workers in London, contain more or less silica, which renders them less valuable. At Limerick considerable quantities of black marble are raised, and both used in the locality and exported. At Carlow and Kilkenny very fine black marble is raised; at Kilkenny the best beds, which were very thin, have, I am informed, been nearly exhausted. Most of the marble obtained from Kilkenny abounds with shells, and which become more marked and conspicuous as the marble becomes dry and exposed. Chimney-pieces made from the Kilkenny marble are to be met with in most parts of Ireland and are familiarly known, an extensive use of this marble having at one time prevailed; that which is a jet black and free from shells is now more generally esteemed. The polish of black marble is considerably affected by dampness, and is much preserved and improved by being kept dry.

Wherever the black marble beds are met with they are assorted with the limestone beds, and the difference in quality appears almost accidental; some of the over or underlying beds often present a strong contrast in the quality of the stone. In other places there is a gradation in character from the adjoining ordinary limestone to the fine marble. In the impure limestone formation of the calp series beds of black marble are frequent. They are generally more or less marked with fossils, and inferior to those beds belonging to the lower or light-coloured limestone formations, and seldom receive a good polish. Wherever the limestone formation prevails in which the marble beds occur, the economy of raising it is dependant on the depth of overlaying rock or soil which requires to be removed, and of the demand which exists in the neighbourhood for the common rock, either for masonry or burning into lime. In some localities the limestone rock itself more than repays the cost of removing it; and in those localities where this formation prevails these considerations and the quality of the marble beds determine the economy of raising it. Except at Galway and Limerick, where much of it is exported, it is almost solely used in the surrounding localities for ordinary purposes, and most extensively for large grave stones, for which purpose it is sawn into slabs of three or four inches thick, and for this the demand is very considerable. The best qualities, however, are seldom so used.

Dark grey and dark mottled grey marbles are met with chiefly in the King's County and several parts of the county of Cork. Near Tullamore marble is obtained in large blocks capable of receiving a fine polish, and considerable use is made of it for chimney-pieces and work of that kind. The limestone around Cork produces easy working marble of a light grey or dove colour, and more or less mottled, and receives a good polish. In the primary districts of the county Donegal a light grey and bluish-grey coloured marble, of close grain, is met with to a great extent; it is, however, most of it, hard to work from the quantity of silex it contains. The same kind, and of a bluish tint, is also met with very frequently in Connemara. Marble of this description is common to most primary districts—it is compact in texture, but does not often produce a satisfactory polish. Most of the primary limestones are met with in exposed ridges of surface rock, alternating with or embedded between rocks of the slate formation, and the strata generally possess a vertical or strongly inclined direction. In the northern portion of the county of Donegal it is, however, very frequently met with in successive horizontal beds and easily quarried. In the counties of Donegal and Galway primary limestone of a coarsely crystalline texture is abundant, polishes very well, and varies in colour considerably. Most of the limestones of the country which are of a fine grain are highly crystalline, are susceptible of a polish and produce a light grey and bluish-grey colour. Of the light coloured limestones the pure white is most esteemed; it is met with in Connemara, and in several localities is exceedingly compact and hard; it is found in narrow, vertical or highly inclined seams between the slate rocks, and contains veins parallel with the vertical face of the seams, which prevent any cubical masses beyond a small size from being obtained—its great hardnees in conversion, and the difficulty of quarrying it renders its use very limited.

White marble occurs in the western portion of the county Donegal, and differs much from that of Connemara; it is coarsely granular, of comparatively easy conversion, can be obtained in cubical blocks and in great quantities; its very coarsely granular texture, however, is prejudicial to it for many purposes. Some of this marble has been employed in sculpture, and has appeared in the exhibition of the Hibernian Academy. In comparison with the white marbles of Italy, and that from Carrara, which is the kind chiefly imported into Ireland, the white marbles of Ireland are certainly inferior for sculpture and the ordinary uses to which white marble is applied; where, however, it can be boldly used in these localities where the expense of carriage would be much avoided, there is no doubt that it may be frequently employed with much advantage for many purposes.

At Cheevy, near Dungannon, very delicate *cream-coloured marble* is obtained; very compact in texture, receives a high degree of polish, and blocks of great length can be procured. The coarsely crystalline and fossiliferous limestone at Ardbraccan produces light-coloured marble of easy conversion. Of the variegated marbles of Ireland, the *sienna* of the best quality is, perhaps, the most beautiful. It is met with in the King's County in several places. The best I am familiar with is a veined or mottled sienna, obtained near the Seven Churches. Some of it has been wrought into chimney-pieces and other ornamental purposes at the marble words at Killaloe; it is susceptible of a high polish, and exhibits many bright and distinct colours. Marble of the same character also prevails, differing in colour, having a dove-coloured ground veined or mottled with the sienna colour. In the county Armagh a sienna, or rather *brownish-red marble*, is met with, containing great numbers of fossil shells, with which it is strongly marked; several varieties of colour from a very light reddish brown to a rather dark red are also met with, and more or less marked with shells. At Pallaskenry, in the county Limerick, a dark red and mottled marble is abundant, and has been much used. A red-coloured marble, of a compact but slaty texture, occurs in the county Cork, extending from the city in a narrow seam, as far as Ballincollig barracks, a distance of several miles; it is hard to work, and dull in colour, but was at one time extensively used. The *serpentine or green marble* of Connemara is, some of it, very beautiful; generally, however, it is of a dull green colour—the injudicious mode of raising it by blasting with gunpowder, has much injured most of what has been raised, and considerably prejudiced the sale of it. Blocks of considerable size, from which large slabs can be obtained, can be raised, and many are found lying on the surface of the ground near where the rock is met. The difficulty of conveying it over bad roads, and the too high price asked for it by the proprietors, in comparison with what green continental marble can be obtained for, are impediments against its more extended use. Black and white marble, and that of a mottled character, occurs in several localities; it is quarried near Cork, in the counties of Waterford, Longford and Kerry, and some of the varieties are beautiful. That obtained near Mitchelstown is well marked, and receives a high polish. The limestone obtained near the Seven Churches in the King's County, when polished, produces a good marble of an even grey colour. It is strongly mottled with very numerous fossil organic remains, which, in the opinion of many persons, gives it a very pleasing appearance. It is easily worked and raised from the quarries in their beds. It may be remarked that this marble in a polished state has been used in the construction of the doorway of one of the principal ruins at the Seven Churches. Some of the stones retain their polish to this time; others exhibit decay, and thereby the variable quality of the different beds. I have only to add, that the foregoing observations are to be considered as a slight description of the varieties of the Irish marbles, and are made more particularly to introduce the various specimens to the notice of the Geological Society.

Cornish Engines.—An order has been received at the Hayle Copper-house Foundry (Sandys, Carne, and Vivian), for two 40-inch cylinder engines for the Kew Water Works, to be completed in six weeks, besides sundry machines for those works.

PATENT REVOLVING GRANARY.

The revolving granary was invented by a French engineer, M. Vallery. It consists of a large wooden cylinder, pierced with holes, and lined with metallic cloth, and which turns horizontally on its axle; it is divided into different parts round a hollow tube, which is the centre of the system; the apparatus must only be filled four-fifths, so that there may be room for the corn to turn over, during the revolving of the machine; a fan ventilator, placed at one of the ends, draws the air from the cylinder, and forces the exterior air to pass through the corn, and to go out by the central tube. This granary possesses all that is necessary for the economical preservation of corn for an unlimited time, without the loss of any of the nutritious parts; and it can also be used for any description of grain; it protects the grain against the devastation caused by insects without employing any deleterious gas or injurious matter; and it prevents fermentation even when the corn is housed in a wet state. These advantages are attainable without incurring a great expense for buildings, and require very little manual labour.

M. Vallery's system has received in France the approbation of all competent judges. The *Academie des Sciences*, in a report made by Messrs. Biot, Baron Sylvestre, Baron Dupin, Baron Seguier, after numerous experiments, formally declared, "That M. Vallery's revolving granaries rid the corn from the insects contained in at the time of housing, and effectually protects it from all future ravages, opposing an effectual bar to the ingress of fresh insects which would introduce themselves into it—that this system prevents fermentation by the airing to which the corn is subjected—that it will moisten corn which has become too dry, by the facility the ventilation affords, of passing through the corn a current of air impregnated with steam;—and, lastly, that the corn can be warehoused in a much smaller space;—that, consequently, this granary, formed on the two principles of airing the corn, and of shifting it, possesses all the necessary qualities, as well for the preservation of the corn, as for the expulsion of the insects,"

The patentees intend to construct granaries of various sizes; from 10 to 100 quarters, observing, that each granary, being divided into eight compartments, may contain, if required, eight different kinds of grain. The price of each granary is £1 per quarter, according to its capacity, thus, it will be £50 for a granary of 50 quarters.

RUINS AT NINEVEH.

There is so much interest attached to the recent discoveries of the French Consul, amongst the ruins of Nineveh, that we think the following particulars, supplied to the *Malta Times*, by one who appears to have a personal acquaintance with the antiquities recovered, worth adding to the few which we gave last week. With the early history of the discovery our readers were long since made acquainted, in letters from M. Botta himself, and they have from time to time been informed of the progress of his researches. We shall therefore come at once to results. Fifteen chambers, some above 100 feet in length, and evidently forming part of a magnificent palace, have been opened. Their walls are entirely covered with inscriptions and sculptures. The latter are, almost without exception, historical, and illustrate events of the highest interest, sieges, naval manœuvres, triumphs, single combats, &c. The inscriptions, are in a cuneiform character, and are of such great length that all the arrow-headed inscriptions before known, if united together, would not equal them. The character used closely resembles that found in the middle column of the inscriptions of Persepolis, Hamadan, (Echatana), and Bisutun, and in the earlier inscriptions of Van. Each wall bears two rows of sculptures, one placed above the other, and the inscriptions, containing generally about twenty lines, are graven between. Frequently, however, they also occur on the garments of figures, or on towns and other objects found in the bas-reliefs. There cannot be a doubt, therefore, that they contain a description of the events recorded, and the names of the principal actors in them—in fact, that they are a portion of the historical records of a kingdom. We have alluded to the variety of the subjects described by the sculptures, but the spirit and beauty of their execution form the widest field for astonishment and conjecture. To those who have been accustomed to look upon the Greeks as the true perfectors and the only masters of the imitative arts, they will furnish new matter for inquiry and reflection. I shall, I think, be hereafter able to show, that, even if they cannot be referred to a period much antecedent to the earlier stages of Greek art, they have, nevertheless, no connexion with it, and are perfectly original both in design and execution. Whilst probably contemporaneous with many of the most ancient sculptures of Egypt, they are immeasurably superior to the stiff and ill-proportioned figures of the monuments of the Pharoahs. They discover a knowledge of the anatomy of the human frame, a remarkable perception of character, and wonderful spirit in the outlines and general execution. In fact, the great gulf which separates barbarian from civilized art has been passed. Although the ornaments, robes, and various implements of war are finished with an extraordinary precision and minuteness, they in no way detract from the effect of the whole, nor do they add heaviness to the figures.

The extreme beauty and elegance of the various objects introduced among the groups are next to be admired. The shapes of the vases, of the drinking-cups, the sword-scabbards adorned with lions, and the shields decorated with animals and flowers,—the chairs, tables, and other articles of domestic use, —the ornaments of the head, the bracelets and earrings, are all designed with the most consummate taste, and rival the productions of the most cultivated period of Greek art. There are undoubtedly faults in the general execution, such as a frequent contempt for the relative proportions of the figures; and it is evident that a variety of hands may be traced in the workmanship.—*Athenæum.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE ROYAL SCOTTISH SOCIETY OF ARTS.

January 13, 1845.—The PRESIDENT in the Chair.

The following communications were made:—

1. Description of a Plan for the construction of a spacious *Harbour of Refuge in the Frith of Forth*, or in such locality as may be recommended on the east coast of Scotland, as the means of diminishing the loss of British ships in future, and preserving the lives and property of shipwrecked persons. By Captain John Donaldson BOSWALL, R.A. A Model, constructed to show the peculiar Plan of the Breakwaters, and the action of the Flowing and Ebbing Tides, was exhibited.—Captain Boswall's method is a restoration of the ancient Roman and Carthaginian mole. The breakwaters are to be built of solid masonry, but are to be pierced, at regular intervals, with small openings, on a level with the bottom of the harbour, so as to allow the flowing and ebbing tides to sweep through these openings, and thus to cleanse away any sediment or deposit which, where solid breakwaters are used, is found to accumulate, and in the end to render the harbour shallow and inefficient. This model was beautifully constructed by our ingenious townsman Mr. Howell, and unseen mechanism underneath raised and depressed the water, so as to give it all the effect of the flowing and ebbing tide.

2. *On a New Method of rendering Baily's Compensation Pendulum free from Hygrometric influence.* By ROBERT BRYSON, F.R.S.E. The process was exhibited.—It is well known that simple pendulum rods of every material are lengthened by heat and shortened by cold. Wood is found to be less affected by temperature than metal, and has therefore latterly come much into use. But wood is liable, on the other hand, to be affected by the hygrometric state of the air, that is, the pendulum rod is swelled and elongated by damp, and contracted or shortened by dryness. Mr. Bryson's object in this improvement is so to treat the wooden rod that it shall be little, if at all, affected by the damp or dry state of the air; the late Mr. Baily having compensated, by the leaden bob of a particular length, against the effect of heat and cold. Mr. Bryson, then, places his wooden rod, fitted with its springs, &c., within a metallic tube, which is pierced with small holes, and he makes this to turn constantly like a roasting spit over a number of small jets of gas,—which process has the effect of completely dissipating the moisture which exists in the wood, and while in this state the rod is suddenly withdrawn from the tube and plunged over head into another upright tube filled with copal varnish, and there allowed to lie for 24 hours. The varnish thus penetrates every pore of the wood, and coats it also on the surface and on both ends, so that it is rendered perfectly proof against hygrometric influence.

3. *On admitting the Back Light in a Portable Diorama*, upon different parts of a picture at different times; and on using light from oil, &c. By GEORGE TAIT, Esq.—This was a beautiful and ingenious addition to the effects capable of being produced by Mr. Tait's very elegant invention of the Portable Diorama, whereby the light can be shut off, or introduced to different parts of a picture, and is very effective, especially in night views.

January 27.—ALEXANDER BRYSON, Esq., M.G.S., in the Chair.

The following communications were made:—

1. *Account of the Public Works at Hartlepool*;—particularly the Cofferdam, by which the water of the sea was shut out from above 200 acres of slake, during the excavation of the tide-harbour, the docks, and the building of the quay walls. By Mr. JAMES MILNE, engineer, Newcastle-on-Tyne.—A model and drawings to scale were exhibited.—This was a valuable detailed account of the public works carried on at Hartlepool; and particularly of the manner in which the great cofferdam was constructed, and the driving of the piles was facilitated, and contained practical remarks on the best angle at which the piles, both seaward and landward, ought to be driven.—The model and drawings were beautifully executed to scale, and were much admired.

2. *Description of a proposed Valve for the Atmospheric Railway*, with a Drawing. By Mr. JAMES BEATTIE, Montrose.—This was a very ingenious suggestion for a continuous Valve for the Atmospheric Railway. A semicircular hollow being cast on the top of the exhaustion pipe above the slit—a hollow pipe or tube of leather, filled with oil or other substance, is laid in it, the oil keeping the tube always lubricated—and on the approach of the railway train the leathern tube is lifted by a pulley or roller attached to the first carriage, and, as the carriage moves onwards, the leather tube falls again into its semicircular hollow, and covers the slit. The tube is lifted only to the extent of perhaps two or three feet at a time.

3. *Description of An Atmospheric Railway.* By Mr. JAMES MILLER. His idea for the Atmospheric Railway, is, in place of a valve, to have the exhaustion-pipe cut longitudinally, so that it may be opened by pressure, and close tight of itself when the pressure is removed. Two wings are cast upon the tube, in such a way as to be acted on by the weight of the first carriage; the tube is thus opened, so as to allow the communication with the piston to pass through; and as the carriage moves on, and the pressure is removed, the tube closes of itself again, so as to be air-tight.—He also proposes a Conical Pivot for locomotive carriage axles, knowing from experience that such a form is much stronger than where formed with an abrupt shoulder.

Feb. 10.—DAVID STEVENSON, Esq., F.R.S.E., V.P., in the Chair.

The following communications were made:—

1. (Part I.) "*Remarks on the Trade Winds, and other currents in the Atmosphere, at Barbadoes; with an attempt to develope the Causes of Hurricanes in the West Indies.*" By ROBERT LAWSON, Esq., Assistant-Surgeon, 47th Regiment.

The author endeavours to establish, by a long series of observations, the causes which produced so great variations in the direction and force of the trade winds, confining his attention more particularly to Barbadoes. These changes have hitherto been referred to the heating influence of the sun on the atmosphere within the tropics, little attention being bestowed on the effects of aqueous diffusion, and the influence of the sun and moon's attraction.—By the anomalous directions of the wind during the month of June 1841, being quite at variance with the received opinions as to the cause of the trade winds, and from subsequent observations, Mr. Lawson refers the causes of these currents to other influences than the mere increase of temperature in the atmosphere within the tropics.—The results of these observations will form the second part of this interesting communication, alike valuable to the philosopher and the navigator.

2. "*An account of Mr. Fairbairn's Observations on the use of Cast-Iron in the Construction of Warehouses, &c.; with the Results of Mr. Eaton Hodgkinson's Experiments on the best form of Cast-Iron Beams and Pillars, with Illustrations, was given by* JAMES TOD., Esq., Sec.

In the course of his observations, Mr. Tod called the attention of the Society to the great importance, to the security both of life and property, of this subject being better understood by practical men, such as architects, builders, founders, &c.

First, in regard to cast-iron pillars, he showed that Mr. Hodgkinson has, by elaborate experiments (for which he had received the Gold Medal of the Royal Society of London), established many interesting facts in regard to the relative strengths of different shapes of pillars. In particular, taking three pillars, in every respect alike, excepting that the first had both its ends rounded; the second, one end rounded and the other end flat; and the third, both ends flat—he found that their relative strengths were in the ratio of one, two and three, the pillar having both ends perfectly flat being the strongest. A flat disc on the end of the pillar gives a small additional strength. Second, in regard to cast-iron beams, Mr. Hodgkinson found (Memoirs of the Literary and Philosophical Society of Manchester, Vols. IV. and V., new series)—that the strongest form is secured by having two flanges an upper and under one, connected by an upright feather. The beam to rest on its lower flanges, in which the greatest breadth and thickness of metal is to be placed; the upright feather is to be made much thinner, and also the top flange; and the top and bottom flanges are both to be broadest in the middle, tapering away by a parabolic curve towards the extremities to less than half the breadth which it has at the centre.

Mr. Tod exhibited a model beam, which he had got constructed on this principle, so as to show more clearly the strongest form; and he remarked that not only was it common to find beams cast upon a wrong principle, having the thickness of metal in the wrong place, but when these beams are put into buildings, that they were placed with their broad flange uppermost, in which position Mr. Hodgkinson's experiments prove that they have hardly one-third of the strength (in reality being only as 323 to 1000) to what the same beam would have had if the broad flange had been placed undermost. He also exhibited enlarged drawings of the pillars upon which Mr. Hodgkinson experimented, showing the places where these broke respectively when loaded to the breaking point.

ROYAL INSTITUTION.

January 24.—W. R. HAMILTON, Esq., V.P., in the Chair.

ON THE BUSINESS OF THE MINT. By Professor BRANDE.

Prof. Brande took a review of the chemical and mechanical history of a mass of gold, from its importation into this country to its issue to the public in the form of coin. Gold is imported from South America, Africa (in the form of gold-dust), and from the Ural Mountains in Russia. The supply from this last-named source Mr. Murchison has shown to be continually increasing. This gold is sent to the Mint by the Bank. The Bank, however, first melts and also assays (or analyzes) it by its own assayer. The gold is sent in ingots—massive oblong pieces—each weighing 15lb. These, from the process just referred to, are of known purity and quality. When received at the Mint from the Bank, the ingots are weighed in the presence of responsible officers of both establishments. They are then delivered to the Master's assay-master for analysis. Prof. Brande here explained that, for the purposes of circulation, it was necessary that gold and silver coin should be mixed with an inferior metal in certain accurate proportions. This *alloy*, as it is called, is, in the case of gold, usually a mixture of copper and silver in equal proportions—but it is essential that the copper thus used should be perfectly pure. In the gold coin of this country, eleven parts of pure metal are combined with one part of alloy, while in the silver coin $\frac{18}{20}$ of alloy are considered sufficient for $11\frac{2}{20}$ parts of silver. The French standard is the same for both metals—viz. 9 metal and 1 alloy. Having thus been rendered less flexible, and more available for the purposes of coining, the ingot of gold is melted in a black-lead crucible; during this process it is carefully stirred by a black-lead rod to insure the equal diffusion of the alloy throughout the mass. Were this precaution neglected, the quality of the bar into which it is cast would not be uniform. And it is obvious that a scarcely appreciable variation in this respect might seriously deteriorate the value of coin. The same process is adopted in regard to silver, excepting that Mr. Morison has advantageously adopted cast iron, instead of black-lead, as the material of the melting-pot for this metal. Prof. Brande here noticed one of the discoveries of Dr. Wollaston as having a most important bearing on the chemical operations of the Mint. By rendering platinum malleable, and thus convertible into crucibles and retorts, Dr. Wollaston not only provided means for manufacturing sulphuric acid at a cheaper rate, but enabled that substance to be readily used in extracting silver from ingots of gold. The Refiner extracts, at a small cost, the silver which generally accompanies masses of gold. And, as no seignorage is charged on coining, and as he is entitled to coined in exchange for uncoined gold, without expense, whatever silver he can remove from his ingot is so much clear gain to him. The bar of gold is now consigned to the ancient company of *Moneyers*, and here the mechanical operations, which convert it into coin, commence. These, however, are necessarily controlled by chemical principles. When broken down, as it is called, (*i.e.* squeezed to the thickness of the coin), the bar is *annealed*, (heated, that the metal may become tractable,) but heated out of contact with air, lest the alloy should burn. Prof. Brande described, and illustrated by models, the operations of the rolling-room: the extremely accurate uniformity in the thickness of the ribband of gold, from whence the blanks are struck, obtained by Sir J. Barton's machine. He then showed how, by means of most delicate adjustments, any minute variation in the quality of different parts of the ribband was compensated in the blank-cutting machine, He explained Mr. Bolton's contrivance for making the atmospheric pressure the moving-power in this powerful, yet most accurate engine; and proceeded to describe how, after being again annealed, the blanks are stamped and milled. Prof. Brande briefly noticed what are called the trials of the pix; *i.e.* the examinations into the quality and purity of the bullion before it is received by the Moneyers, and when, having been coined by them, it is about to be issued to the public. These examinations are always strictly private. The result, however, is sufficiently and most creditably notorious—the acknowledged purity of British coin. Prof. Brande concluded by calling attention to the manner in which the operations of the Mint ensured the quick production of coin of unimpeachable weight and fineness; how loss of interest on bullion was obviated; a national panic prevented by the rapidity of a coinage, which, though so quickly accomplished, will bear comparison, as to execution, with that of any country in the world.

PROFESSOR FARADAY ON THE LIQUEFACTION AND SOLIDIFICATION OF GASEOUS BODIES.

On Friday evening, Jan 31, Professor Faraday delivered a most interesting lecture, at the Royal Institution, in Albemarle-street, on the liquefaction and solidification of gaseous bodies. Before commencing his lecture he read an extract from a letter written by Professor Liebig, of Giessen, shortly after his visit to this country, in which the learned writer said, the thing which struck him most in England was the persuasion that only those works that had a practical tendency attracted attention and commanded respect, whilst those which were purely scientific were almost unknown; and yet the latter were the true sources from which the others flowed. In Germany, added Liebig, it was the contrary; but he did not say that that was better—in his opinion the golden medium was the proper course.

Mr. Faraday then proceeded with his lecture. The condensation of gases (said he) had been brought before the public some years ago. A gas was one of those substances in an aerial form which remained permanent under the ordinary circumstances of temperature and pressure, whilst vapour was like gas, but which under ordinary circumstances was condensable again into liquid. It was at one time thought that all gases were perfectly elastic fluids, but by his researches he had succeeded in turning into vapour the following nine gases, namely,—chlorine—muriatic acid—sulphurous acid—sulphuretted hydrogen—carbonic acid—euchlorine—nitrous oxide—cyanogen—and ammonia. One of these, namely, carbonic acid, the late celebrated Thilorier, of Paris, had, after many experiments, obtained in a solid state, and Bunsen had subsequently obtained also cyanogen in a similar condition. But although continued attempts have been made to solidify the other seven, and by immersion in deep water a pressure of 200 atmospheres, *i. e.* of 3,000 lb. to a square inch, had been produced, still they had been unattended with success. He would explain what he believed to be the reason of the failure. If he took a bottle half filled with ether (and this was Latour's experiment) and applied to it heat, the ether would rise in vapour, and so would continue until the vapour was much condensed. At last, the liquor below and the vapour above would be of as nearly the same weight as possible, and the least degree of additional heat would turn the liquor into vapour, or, if taken away, convert the vapour into liquor. Observe what happened. At that temperature of ether no pressure could bring the vapour into a liquid state; at a lower temperature it would. He believed, then, the reason why so many had failed in liquefying and solidifying gases was, that although they could procure the immense pressure mentioned, they could not obtain a degree of temperature sufficiently low. He would explain in what manner he had succeeded. He had taken as his basis carbonic acid gas in its solid state as produced by Thilorier. A quantity of carbonic acid, in partly a liquid and partly a vapour state, being confined in a tube, the expansion of the vapour forced the liquid through an orifice in the side into a cylindrical brass box, and by the cold produced by the expansion of the gas, a part of it was immediately converted into a solid substance like snow. Its temperature in that state was 70 degrees below 0 of Fahrenheit; but though he took that as his basis, it was not low enough for the purpose of his experiments. The temperature must, therefore, be further decreased. It had been demonstrated by Thilorier, that if ether were applied to solid carbonic acid, the temperature could be reduced to even 105 degrees below Fahrenheit; but a lower degree was still required, and that was obtained by exhausting the air. His object, then, was to combine this extreme degree of cold with great pressure in his experiments on gases. The means by which he effected it he thus described;—A quantity of gas in a glass vessel was forced by a condensing pump into a tube inserted in the receiver of an air pump; that part of the tube inserted in the receiver was made of common bottle glass (the strongest kind for experiments, and capable of bearing an enormous pressure) in the shape of a retort, and the bent or lower part of the tube lying immersed in the cold bath (produced by solid carbonic acid combined with ether, after the air had been exhausted), gas in a liquid, and by an increased degree of pressure, in a solid state could be obtained.

The learned professor illustrated the truth of the principle by producing olefiant gas in a liquid state, and observed that he had succeeded in obtaining in the same condition phosphuretted hydrogen, hydriodic acid, hydrobromic acid, fluoboron and fluosilicon; and in a solid form sulphurous acid, sulphuretted hydrogen, euchlorine, nitrous oxide, hydriodic acid, and hydrobromic acid. He had made carbonic acid the type of the others, but he thought nitrous oxide would give a power of temperature as far below carbonic acid as that was below common ice. He saw no reason why the same result might not be obtained from oxygen, hydrogen, and nitrogen; and, in fact, he had hoped that evening to have shown oxygen in a liquefied state, but he had failed in his experiments, not because his principle was wrong, but from the porous and hence imperfect nature of the vessels used. With respect to hydrogen, he had had indications in the course of his experiments that it would be found to be a metal of a most subtle nature.

As this subject is one of considerable importance, we give the letter of Professor Faraday to M. Dumas, describing the mode of performing the experiments.

"I sought in the first place to obtain a very low temperature, and employed for this purpose Thilorier's bath of solid carbonic acid and æther, placing it however under the recipient of an air-pump. By maintaining a constant vacuum, I lowered the temperature to such a degree, that the carbonic acid of the bath was not more volatile than water at the temperature of 86°, for the barometer of the air-pump stood at 28·2 inches, the external barometer being at 29·4.

This arrangement made, I joined together, by means of corks and stopcocks, some small glass and copper tubes, so that with the aid of two pumps I was able to subject various gases to a pressure of 40 atmospheres, and at the same time to submit them to the intense cold obtained under the air-pump, and to examine the resulting effects. As I expected, the cold produced several results which pressure alone would never have done, and principally in the solidification of bodies ordinarily gaseous. The following is a sketch of the various results:—

Olefiant gas was condensed to a beautiful colourless transparent liquid, but it did not solidify; it dissolves the resinous, bituminous and oily bodies.

Pure *hydriodic acid* may be obtained either in the solid or liquid state. Solid hydriodic acid is very clear, colourless and transparent; generally several fissures traverse the mass; it greatly resembles ice.

Hydrobromic acid may also be obtained either as a limpid and colourless liquid, or as a clear transparent solid.

Both these acids require a very careful distillation in closed vessels and under great pressure, to be obtained pure and colourless.

Fluosilicic acid was condensed to the liquid state, but it is repuisite to operate at the lowest temperature. It is extremely liquid and mobile, like hot æther; it then produces a pressure of about 9 atmospheres, and gives no sign of solidification. It is transparent and colourless.

Fluoboric acid and *phosphuretted hydrogen* presented some results of condensation.

Hydrochloric acid liquefies readily at less than 1 atmosphere of pressure, but it does not solidify.

Sulphurous acid freezes immediately, as was to be expected.

Sulphuretted hydrogen becomes solid, and then forms a white, transparent, crystalline mass, bearing greater resemblance to solid nitrate of ammonia or to camphor, than to ice.

Carbonic acid, when it passes from the liquid to the solid state, without being dispersed in the form of snow, constitutes a very beautiful substance, transparent like crystal, so that for some time I doubted whether the tube that contained it was empty or full; and I was even obliged, in order to ascertain the presence of a solid body, to melt a portion of it. Solid carbonic acid exerts a pressure of 6 atmospheres, which proves how readily liquid carbonic acid ought to become solid when allowed to escape into the free air.

Oxide of chlorine is a beautiful, orange-red, very friable, crystalline substance. It exhibits no trace of explosive power.

Protoxide of nitrogen is one of the gases which I had formerly condensed. I have seen in the journals that M. Natterer has repeated my experiments with a compression-pump, and that he has obtained the liquid in the open air. I have likewise condensed it to a liquid by means of my pump, but I have moreover solidified it by means of the cold bath. It then forms a beautiful transparent or colourless crystalline body, but in this state the pressure of its vapour does not amount to that of 1 atmosphere; and this result is confirmed by another experiment, in which, having opened a vessel containing this liquid, a portion evaporated, cooled the remainder, but did not solidify it. The cold produced by this evaporation is very intense, which was proved by placing the tube and its contents in a bath of solid carbonic acid and æther in the air. This bath, which instantly freezes mercury, behaved like a vessel filled with hot liquor, and immediately caused the protoxide of nitrogen to boil violently. It is therefore my intention to employ the liquid protoxide of nitrogen for some new experiments on hydrogen, oxygen, and nitrogen; for on placing a bath of this liquid protoxide in the receiver of an air-pump, and expelling the air and the gas, we are able to place the bath of the protoxide relatively to that of the carbonic acid *in vacuo*, in the same relation that the two baths observe in the air.

Cyanogen freezes, as was already proved by Bussy.

Perfectly pure and dry *ammonia* may be obtained as a transparent, crystalline white substance, heavier than liquid ammonia, and diffusing very little odour, from the weak tension of its vapour at this temperature.

Arseniuretted hydrogen and *chlorine* do not pass from the liquid to the solid state.

Alcohol becomes thick like cold oil, but does not crystallize any more than *caoutchene*, *camphene* and *oil of turpentine*, but these bodies become viscid.

Binoxide of nitrogen and *oxide of carbon* did not exhibit the least sign of liquefaction at the lowest temperature, and at a pressure of 30 to 35 atmospheres.

While making these general observations, I have determined several numbers relative to the point of fusion of these various gases and their tension at different temperatures. The numbers will be given in the memoir which I am preparing on this subject, and in which I hope to have something new to say respecting the state which oxygen, nitrogen or hydrogen may affect in passing to the liquid state. Will this latter body present itself in the metallic form, as you think? Will nitrogen prove to be a metal, or retain its place among the non-metallic bodies? This, experience will show.—*Ann. de Chim. et de Phys.*, Jan. 1845.—*Translated for the Chemical Gazette.*"

THE CAMBRIDGE CAMDEN SOCIETY.

Nov. 7.—The President in the Chair.

A paper on "*Architectural Drawing considered as the handmaid to the study of Ecclesiology*," was read by the Rev. Philip Freeman, M.A., Chairman of the Committee. He commenced by insisting on the value of a knowledge of mouldings; and explained the method of drawing their outlines in section or elevation. He then proceeded to propose a nomenclature for the science of mouldings, referring to the ingenious work of Professor Willis (who was present), on the subject. The latter part of the paper was devoted to an examination of Hogarth's propositions with respect to beauty. Mr. Freeman then applied these principles to the phenomena of the various *styles* of mouldings, and showed that the Decorated forms answered all Hogarth's for the highest beauty and grace. Whence he concluded that this might be regarded as another argument in justification of the Society's principle that *Decorated* was the most perfect style of church architecture.

Nov. 28.—The President in the Chair.

A paper was read by Rev. F. W. Collison, M. A., Fellow of St. John's college, *on the History of Altars.* He adduced passages from ancient writers in chronological order which mentioned the material of the altar; showing that stone and wood had been simultaneously used in most ages of the Church; and proving that Bingham is, on more than one occasion, wrong in inferring from particular passages that wood was the more common material. Examples were enumerated of altars in wood, stone, gold, silver, and even in earth; and much interesting information about ancient churches was contained in the extracts which were quoted. Mr. Collison next showed that Ridley's injunction for breaking down altars could not be binding upon other dioceses. He sketched the history of the disputes respecting altars from that time to the accession of William of Orange, assigning each order or counter-order bearing on the subject to its right place. He established that stone altars(if ornaments of the church), were distinctly enjoined by the last enactment of the Church, at the revision in 1662; by which the Rubric enforcing the use of such ornaments of the Ministers as were in use in the second year of King Edward VI., was strengthened by the remarkable addition of the words "ornaments of the church." No one could deny that a stone altar was such an ornament in the year referred to; and this Rubric of 1662 is the only authoritative standard of the Church, repealing absolutely any intervening canons, precedents or injunctions.

DECORATIVE ART SOCIETY.

On Wednesday, the 12th ult., an introductory paper was read by Mr. Vicary, "*On the Physiology of Timber Trees considered with reference to Manufacturing Purposes.*" He commenced with a notice of the few government and private collections of specimens of timber in this country, and expressed his regret that in almost every case no scientific arrangement had been attempted, whereby a study of the varieties of timber could be promoted. He contrasted in a forcible manner the attention devoted in our national museums to stuffed birds, &c., with the almost total neglect of a useful classification of timber, although entering as it does so largely into our every day comforts and conveniences.

The growth of trees and the capillary action of the sap, &c., the formation of knots and the consequent weakness wherever they occur, were next noticed, as also the effect of pruning or lopping at a wrong season, thereby generating what is usually termed dry rot.

The patent processes of Mr. Payne were introduced, exhibiting a series of experiments, his modes of preserving timber from decay and rendering it incombustible, also of hardening any English woods and dyeing them of various colours, so as to make them available for the purposes of the cabinet maker.

The paper was illustrated by upwards of 200 specimens of different woods, English and Foreign, sound and in various stages of decay.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

January 13, 1845.—George Smith, Esq., V.P., in the Chair.

The Institute opened their proceedings for the first time, this evening, in their new rooms, which are far more convenient than the old apartments. They are upon the same premises.

It was announced that the King of Prussia had purchased the whole of the drawings and papers of Schinkel, the eminent German architect.

Mr. Donaldson read a paper "*On the History of Architecture*," the first part of which was given in last month's Journal, aud a continuaion in the present number.

January 27.—H. E. Kendall, Esq., V.P., in the Chair.

Mr. Poynter read a paper "*On the Domestic Architecture of France during the middle ages, relating principally to the* 15*th and* 16*th centuries.*" The high roofs which were affected in that country in civil as in ecclesiastical architecture, have rendered the dormer window one of the most striking features of the domestic style, from the 13th century down to the present day, and in the stone buildings of the period of the *Gothic flamboyant*, it became the object of the richest and most elaborate decoration, of which one of the most conspicuous examples is at the Palais de Justice, at Rouen. The *tourelle* overhanging the angles of the domestic edifices of the middle ages, especially in town buildings occupying the corners of streets, is another peculiar feature of the French style. Many are still remaining in different quarters of Paris, some still preserving the high conical roof, and metal finials with which they invariably terminated. The façade of the Hotel de Sens, in that city, one of the very few relics of the larger town houses of the middle ages, is flanked with two of these *tourelles.* In England they are never seen, but may be traced in Scotland with some other indications of the French alliance with that country.

During the 15th and 16th centuries, a very large proportion of the street architecture of France was of timber, richly carved and decorated in a variety of ways. In the 15th century brick began to mingle in the façades, filling up the intervals between the timbers, and the use of bricks of different colours, disposed in patterns, contributed greatly to decorative effect. This style of building was especially prevalent in the Bourbonnais. Glazed tiles were introduced for the same purpose, and when plaster was used, which was very commonly, it was sometimes ornamented by patterns sunk in and filled with coloured mastic. To harmonize with the coloured surfaces, the carved timbers were painted and even gilt.

The *renaissance* introduced a new style of decoration long before it materially altered the principles of the distribution and construction of buildings of the domestic class. The transition from the Gothic to the Italian, in France, operated in a manner differing materially from the Elizabethan or Anglo-Italian, on our side the channel—its peculiar feature is the composition of Gothic forms with Italian details, a principle carried out with great ingenuity, and with extraordinary skill in execution. The works of the *renaissance* are for the most part valuable as works of art. Under Jean Goujon, the French school of sculpture, (which had maintained a high standard of comparison throughout the middle ages, even from the 10th century,) became one of the most graceful and refined in the whole circle of modern art.

Down to the period of Louis XIV., the most magnificent domestic edifices were built with little attention to convenience. Customs now confined to the lowest class subsisted among those distinguished by wealth and rank, down to the close of the 17th century, in some of the provinces of France. When the Great Condé attended the meeting of the States of Burgundy, he was received at the houses of the magistrates of Dijon in rooms which served for parlour, hall, dining-room, kitchen, and even bed-room. In such a room, called the *chambre menagère*, it was then the custom for the whole family, servants included, to live in common. In other respects there was no want of luxury. When Condé returned to court, he said to the king, "your province of Burgundy is rich—the kitchens are tapestried."

Feb. 10.—J. B. Papworth, Esq., V. P., in the Chair.

Mr. G. Hawkins read a paper, illustrated by diagrams, descriptive of the '*King's Scholars' Pond Sewer*." The main drain of one of the principal divisions of the Westminster Commission of Sewers, occupying the whole channel of a rivulet, formerly known as Dye Brook, having its source at Hampstead, and draining an area of two thousand acres, fifteen hundred of which are covered with houses. The whole of the lower part of the district drained by this sewer is below the ordinary high-tide level of the Thames. It is, therefore, essential that means should be adopted to secure a free emission of the sewage into the river without admitting the ingress of the tide. This object has been attained by the construction of double flood-gates at the mouth of the sewer, and by gradually enlarging its capacity at the lower end, so as to enable it to receive and retain, during several hours in every tide, during which the gates are shut, the whole accumulated sewage of the district—calculated, under ordinary circumstance, at 120,000 cubic feet, and considerably more during storms. This sewer in its course passes immediately under Buckingham Palace. Within a few years, a large portion of it has been reconstructed, under circumstances of extraordinary difficulty, arches of considerable span having been worked to a great extent under densely-populated neighbourhoods, without any suspicion on the part of the inhabitants of what was going on a few feet below the foundation of their houses. In its present complete state, it is perhaps the most remarkable and extensive piece of sewerage ever executed in this or any other country.

Mr. R. Hawkins, architect, read a paper "*On the Sculpture and Architectural Fragments brought from Xanthus*," and placed in the British Museum during the last two years: and exhibited a restoration of one of the principal among the numerous tombs discovered by Mr. Fellows during his expeditions into Lycia, the last of which Mr. Hawkins accompanied. We shall defer our notice of this paper until next month.

Feb. 24.—G. Smith, Esq., V. P., in the Chair.

A report from the Council was read "*On the Essays submitted in the Competition for the Medal of the Institute*," recommending that it should be awarded to one of the three papers sent in "*On the Qualities and Uses of Slate as a Building Material*." The essay having been read, and the recommendation of the Council approved by the meeting, the successful candidate was announced to be Mr. T. Nicholls, a student of the Institute.

Mr. Habershon, architect, sent for the inspection of the meeting two capitals and a base, found in digging the foundations of the new church at Jerusalem, and requested the opinion of the members as to their age. These objects excited much interest, being probably the first fragments sent to England from the antiquities of that city. Mr. Scoles observed that one of the capitals, of the Doric order, closely resembled those of a tomb in the Valley of Jehosaphat, to which, on a former occasion, he had assigned a date somewhere about the Christian era. The other capital exhibited foliage of a very low period, verging on the Byzantine.

METROPOLITAN IMPROVEMENT SOCIETY.

At the last meeting of this society, communications were read from Sir Robert Peel and the Earl of Lincoln, in answer to applications from the secretary relative to the long promised Ordnance Survey and Map of London, and the projected encroachment upon the carriage-way of Lincoln's Inn-fields. On the first subject, it appeared that, the estimated expense of a Metropolitan Survey having exceeded his anticipation, Sir Robert Peel had been deterred from introducing a Bill for the object. The amount of the Ordnance estimate was not stated; and, from the discussion which ensued, several members of the society seemed of opinion that the expense of a comprehensive survey for public use could not well exceed that which had actually been incurred within the last six months, in the numerous local surveys in the neighbourhood of the metropolis by railroad companies. The whole of these surveys would have been unnecessary if an Ordnance Map of London, with contour lines, had existed on a scale of 5 feet to the mile, and the Board of Trade would have had a simple means of testing both the correctness and expediency of the various plans submitted to them for railroad lines with new termini in the metropolis.

On the subject of the projected encroachment on the carriage-way in Lincoln's Inn-fields, for the purpose of insulating the new law courts, the Earl of Lincoln had satisfactory reasons for believing that the project had been definitely abandoned.

Various drawings were laid on the table, embodying the suggestions of Mr. Laxton, Mr. Austin, and other gentlemen, for removing the defects of the Government plan for an embankment of the Thames between Westminster and Blackfriars bridges. The Government plan had been postponed, and might ultimately be given up; but it appeared possible to obviate the objections made to it, and it was determined to seek an interview with the Earl of Lincoln, to submit for his consideration the improvements required.

ON THE LAW OF TIDES.

At a recent meeting of the Royal Society a paper '*On the Laws of the Tides on the Coast of Ireland*, as inferred from an extensive series of observations made in common with the Ordnance Survey of Ireland,' was read by G. B. Airy, Esq., Astronomer Royal. The elaborate investigations, of which the results are communicated in the present paper, were suggested by the necessity of adopting some standard mean height of the sea, as a line of reference for the elevations ascertained in the operations of the Ordnance Survey of Ireland. Colonel Colby, R.E., who conducted that survey, had with this view determined to institute a series of observations on the height of the water in different states of the tide; and, conceiving that these observations might be made subservient to improvement in the theory of the tides, requested the assistance of the author in laying down the plan of observation best calculated to effect that object. The suggestions which were in consequence made by the author, were adopted in their utmost extent by Colonel Colby; and the collection of observations was placed in the author's hands in the winter of 1842. The whole number of observations exceeds two hundred thousand; and they derive extraordinary value from the circumstance of the localities of their simultaneity, their extensive range, and the uniformity of plan on which they were conducted. Their reduction was made by the computers at the Royal Observatory, Greenwich, under the superintendence of the author.

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

DRAINING TILES.

John Bailey Denton, of Gray's Inn Square, Middlesex, land agent, for "*Improvements in machinery for moulding or shaping clay and other plastic substances for draining and other purposes*."—Granted April 18; Enrolled October 18, 1844.

The object of the invention is for combining two screws, whereby they simultaneously act to press clay or other plastic matter through moulding surfaces: which is effected in the following manner—a cast iron cylinder or box is divided into two compartments longitudinally, each has a piston accurately fitted and attached to two rods, working alternately by the action of two cranks and connecting rods on a shaft turned by a winch with a fly wheel; at the end of each compartment of the cylinder are fixed die plates with apertures of the shape of the proposed moulded substance; on the top of the cylinder there is a square box in which are two vertical screws moving in opposite directions; on one side of this box there is an opening hopper-shaped for putting in the clay, and in the bottom there is an opening communicating with the cylinders, through which is forced, by the action of the screws, any clay that is placed in the box. The screws are turned by means of a bevil wheel on the end of the two crank shafts, working into another bevil wheel on the end of a vertical rod; on the top of this rod is a cog wheel that turns two wheels keyed on to the top of the screws, so that when the crank shaft is turned the motion is transmitted through the bevil gear to the screws. The whole of the apparatus is secured on the top of a frame with four wheels, so as to be easily moved from place to place.

The operation of making the moulded surface is thus performed—the clay is put through the hopper into the top box between the screws, and by the continued action of the two screws the clay is constantly being mixed and forced down into the cylinder, and then by the action of the pistons alternately pressing on the clay in each compartment of the cylinder it is forced through the orifice of the die plates, and then cut off to the proper lengths.

STEAM ENGINE IMPROVEMENTS.

James Petrie, of Rochdale, Lancashire, engineer, for "*certain Improvements in steam engines*."—Granted May 22; Enrolled Nov. 22, 1844.

The first improvement is for the application of an apparatus to steam engines for cutting off the steam, when working expansively, by means of a moveable cam, in addition to the ordinary eccentric used for working the D valves, which moves a rod sliding in guides on the eccentric rod, and is connected to a bell crank lever mounted loosely on the cross shaft which moves the D valves; this bell crank lever is connected by a vertical rod to a horizontal shaft at the back of the cylinder intermediate the top and lower steam boxes; on the middle of this shaft are keyed two short levers, which are connected by links to rods moving vertically through stuffing boxes in the bottom part of the upper and the top part of the lower steam box, and connected to sliding or cutting off plates on the back of the slides of the D valves; by the movement of these cut-off plates the steam is cut off close to the nozzles, and may be regulated to any degree by altering the throw of the eccentric, which causes the slide to close the steam aperture at any part of the stroke. This apparatus appears to be very similar, if not identical, to the one adapted by Messrs. Easton and Amos to the engine of the Reform Club, and described in the *Journal*, vol. VII., 1844, p. 102, where it is stated that it was twice patented long after its adoption by Messrs. Easton and Amos.

The second improvement is a method of connecting the aforesaid cutting-off plates or slides with the governor, so that the steam may be cut off earlier or later by the action of the governor. This is effected by an apparatus consisting of a headstock sliding on a bed and attached by a link to the end of the eccentric rod, and by another link fastened on to a cam mounted on the headstock at one end and at the other end the bell crank lever before described. The headstock is connected by bevil wheel gearing to the shaft of the fly wheel and the governor, the action of the latter moves the headstock backwards and forwards according as it expands or collapses, and the cam round its axis; this movement regulates the cutting off slides, and causes the speed of the engine to go quicker or slower as may be required.

IMPROVEMENTS IN MAKING IRON AND STEEL.

CHARLES LOW, of Robinson's Row, Kingsland, Middlesex, for "*Improvements in the making or manufacturing iron and steel.*"—Granted May 25; Enrolled Nov. 25, 1844.

These improvements relate to the manufacture of malleable iron and steel by using a mixture of the following materials ground,—42 lb. oxide of manganese, 8 lb. plumbago, 14 lb. wood charcoal, and 2 lb. saltpetre.

This mixture is thrown into the blast furnace either with the iron stone or fuel, with each charge of ore as will produce 480 lb. of metal. It can also in a fine state be introduced into the puddling furnace, when the pig iron is in fusion, by throwing a few pounds upon the surface every few minutes, thoroughly incorporating it by stirring it in the metal, until the 66 lb. are used, or until the metal begins to thicken; it is then balled and sent to the tilt hammer and rollers, and passed through the usual process for making malleable iron. The same mixture may be used in the manufacture of cast steel from malleable iron made by the above process, by adding 2 or 3 lb. of the ingredients to every 30 lb. of steel, when in the melting pots, during its conversion into cast steel. The same object may be more immediately effected by adding the ingredients in the same proportion as for steel to the malleable iron made as above, and then the application of a moderate heat will fuse the iron in contact with the mixture and immediately convert it into cast steel.

GAS RETORTS.

JOSEPH COWEN, of Blaydon Burn, near Newcastle-upon-Tyne, merchant, for "*certain Improvements in making retorts for generating gas for illumination.*"—Granted June 4; Enrolled Dec. 4, 1844.

The improvements are, first for making illuminating gas retorts of Newcastle or Stourbridge fine clay, or any other suitable clay, mixed with sawdust, pulverised wood, charcoal, coke, carbon obtained from the interior of gas retorts, and other carbonaceous materials, in such proportions as the quality of the clay may require, the larger the quantity of alumina the greater will be the quantity of carbonaceous matter required, varying from $\frac{1}{20}$ to $\frac{1}{4}$ of the earthy materials; by this mixture the clay is made porous and less liable to crack.

The second improvement relates to the making of illuminating gas retorts in moulds consisting of a cylindrical box, flat on the top or end, with an aperture therein and a conical mouth piece at the bottom, closed by a moveable plate; through the centre of the cylinder and the mouth piece passes a core of the shape of the intended retort, leaving a space round the core at the aperture of the mouth piece and at the bottom equal to the thickness of the material to form the retort; a piston is made to fit the interior of the cylinder and round the core, with guide rods passing through the flat top or end, moveable by mechanical power. For cylindrical retorts the clay is put into the cylinder with the moveable plate covering the mouth piece, it is then compressed by means of the piston, which forces the clay to fill the interstice surrounding and at the bottom of the core at the orifice of the conical mouth piece; the plate is then removed and the piston forced forward, when the clay comes out the shape of the retort, and is then cut off to the required length by a wire and taken to the drying place. Any other shaped retorts may be made by introducing a core of the shape proposed and having a die with an outlet of the same form made to fit the mouth piece, the die is applied after the clay is first compressed in the cylinder as before stated, the piston in this case is fixed to the core which advances with it through the mouth piece and die plate.

SCREW PROPELLERS.

CHRISTOPHER DUNKIN HAYS, of Bermondsey, Surrey, wharfinger, for "*certain Improvements in propelling vessels.*"—Granted July 3, 1844; Enrolled January 3, 1845.

The improvements in propelling vessels consist in the first place in a novel mode of transferring the motive power of the engine to the propeller, whereby the latter may be driven at different speeds according to circumstances, and without the necessity for altering the speed of the engine, and also an improved mode of constructing certain of the working parts, whereby the friction thereof is considerably reduced. Secondly, in a nove construction of propeller. The principal object of the invention is the application or employment of an auxiliary steam power for propelling sailing vessels in a more economical and advantageous manner than has hitherto been done. According to the present mode of employing steam engines as an auxiliary power for assisting in propelling sailing vessels, the engines and propeller are only brought into use occasionally, and under certain circumstances, such as during calms and light winds, but when favourable or strong winds prevail, the propeller and engine are thrown entirely out of use, and become so much dead and useless weight in the ship. Instead of following this plan the inventor makes use of the auxiliary steam power continually during the whole of the voyage, and under all circumstances that it can be of the slightest use. For this purpose he employs an engine and propeller of such a power as will be capable of propelling a vessel unaided by any other power, at a moderate rate of, say four or five knots per hour during calms and very light winds, and by the adaptation and employment of a certain apparatus hereafter described, and which is connected to the engine and propeller shaft, he is enabled at all times to propel the vessel four or five knots per hour, or nearly so, beyond the speed that she would go if unaided by this apparatus. For example, suppose that the engine will, as above stated, propel the vessel at the rate of four or five knots per hour in a dead calm; if a light wind capable of propelling her two knots per hour without other assistance should arise, then by the additional power of an engine and propeller with his apparatus adapted thereto, he imagines by the two powers combined they will propel the vessel, say about six or seven knots per hour, and if the wind should increase so as (unaided) to propel the vessel four or five knots, then by the additional power of the engine she will proceed at the rate of eight or nine knots per hour, or nearly so, and so on according to the wind. The means employed to effect this object consist in the employment of differential gearing for communicating the power of the engine to the propeller shaft, and whereby the propeller can always be driven at an increased speed according to the speed that the vessel would be propelled by the wind alone.

The following are the words of the specification:—"In order to fully understand this point, it will be necessary to examine what would be the effect of the ordinary auxiliary steam power upon the progress of a ship. Suppose this auxiliary power is calculated to propel the vessel four knots per hour unaided by any other power, and to effect this object the propeller is obliged to make sixty revolutions per minute—now if a wind springs up which unaided is also capable of propelling the vessel at the same or a greater speed than the engine is calculated for, it follows that although the propeller may still revolve sixty times per minute, still there is no (or at any rate very little) increased speed imparted to the ship, and the propeller is revolving uselessly, as the passage of the ship through the water would of itself drive the propeller at nearly the same speed if the latter were detached from the engine. The method I adopt in making the propeller available under these circumstances, is to drive it at a speed greater than that which the progress of the ship itself would give the propeller in its progress through the water—that is to say, if the speed of the ship sailing four knots per hour, is such as would cause the propeller to revolve sixty times per minute if detached from the engine, it is clear that it will be necessary for the engine to drive the propeller an additional sixty, making one hundred and twenty revolutions in all, in order to propel the vessel about eight knots per hour. It would be understood that the engine is not required to exert any increased power to obtain this increased speed, as the ship's motion drives the propeller one sixty and the engine the other sixty revolutions, the wind therefore by means of the motion of the ship through the water assists in driving the propeller and the engine gives it an additional impetus. If the vessel is propelled by the wind at the rate of six knots, a further increase equivalent to an additional four knots, must be made in the speed of the propeller before the full benefit is obtained from the power of the engine, and so on according to the increased power of the wind."

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

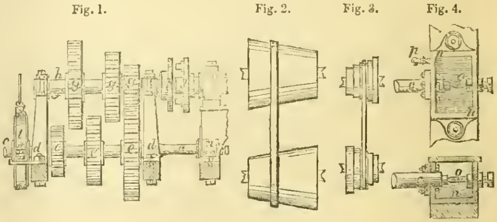


Fig. 5.

The accompanying engravings show the method adopted by the patentee for carrying the invention into effect. Fig. 1 represents a longitudinal vertical section of the differential gearing; *c c* is the propeller shaft which is supported by and turns in bearings *d d*; *e e e* is the differential gearing. Another shaft *f f*, furnished with a feather *h*, is mounted in bearings immediately above the inner end of the propeller shaft, and also carries toothed wheels *g g g* of different diameters, and which wheels are mounted on and made to slide easily along the shaft *f* when it is required to change the speed of the propeller, the feather *h* of the shaft *f* passes through and loosens all the wheels *g g g*, and of course carries them round with it. The shaft of the engine is seen at *i*. and carries at its end a clutch *j*, which when brought into contact with the clutch box *k*, on the inner end of the shaft *f*, causes the latter with its wheels *g g g* to be carried round and drive the propeller shaft. It will be seen upon referring to the engraving that the slowest motion is in gear, as would be the case in calms or very light winds, when it is the whole power of the engine only rather than the speed of the propeller that is required; but if a breeze should spring up, then it will be necessary to increase the speed of the propeller. To effect this the engine must be temporarily detached by loosening the clutch: the second pair of wheels must then be put in gear, and the first put out of gear; then upon connecting the engine again, the speed of the propeller will be very much increased.—If the breeze should freshen still more, the engine must be again detached, and the third pair of wheels put in gear, the others being previously put out of gear; as the wheels *g g g* all slide freely along the shaft this object is easily effected by the attendant engineer. A friction brake *l* of the ordinary kind is mounted on the propeller shaft for the purpose of preventing it from revolving, while the toothed wheels are being put in and out of gear.

The inventor also proposes sometimes to adapt the invention to the shafts of paddle wheels, as exactly the same effect may be produced therewith.

A variety of other different plans might be devised of effecting the object of the invention—viz. driving the propeller at different speeds according to the speed that the vessel advances by other means; but the method he has shewn above he believes to be the best, although he does not intend to confine himself thereto. In figs. 2 and 3 is shewn a means of effecting the same object, by means of cones, pullies, or drums, and which may under certain circumstances be found useful. The speed of the propeller is regulated by moving the band along the cones, pullies, or drums, one set of which must be mounted on or connected to the engine shaft, and the other on the propeller shaft, which passes through the stern post of the vessel, as usual when this description of propeller is employed.

To reduce the frictions at the bearings the inventor introduces a number of anti-friction rollers placed around the shaft, and allowed to revolve both on their own axis, and also round the shaft itself. The bearings are provided with proper packing to prevent the water from entering the vessel. At *n n*, fig. 1, is a bearing for resisting the horizontal thrust of the propeller shaft when in rapid rotation. This bearing is shewn upon an enlarged scale at figs. 4 and 5, fig. 4 is a view looking from above, and fig. 5 a transverse vertical section. The bearing consists of a metal box screwed to a stationary framing, the pin o bears against one end of the shaft *c c*, and can be tightened as may be required. The metal box *n* is filled with water until about half of the end of the shaft c is immersed, and then a quantity of oil is poured in, which always floats at the top; the cock *p* is for ascertaining the level of the two liquids. By constructing the bearing in this manner it is kept cool, as the water in the box will abstract the heat from the working parts and prevent them from getting overheated.

The second part of the invention is for improvements in the construction of propellers; it consists in mounting any convenient number of straight blades at an angle round the shaft, in such a manner that the angle may be varied according to the speed at which the vessel is required to progress. The angle is regulated by a ring, firmly connected either to the propeller shaft or to radial arms which carry the propellers, and made to turn round on a point, so as the ring is moved round on its axis; it either screws in or forces out the outer ends of the arms, and by that means alters the angles of the blades.

The claim is, first for the employment of differential gearing of any description whereby the speed of the propeller, or propeller shaft, may be increased or diminished according to circumstances without altering the speed of the engine. Secondly, the adaption or application of a number of rollers round the propeller shaft in the bearing in the stern post, and also the mode of constructing the end bearing, and keeping it cool by means of water and oil as above shewn and described: and thirdly, the improved construction of propeller described, whereby the angle of the propeller may be varied according to the speed of the vessel.

AZIMUTH AND STEERING COMPASS.

Edward John Dent, of the Strand, London, chronometer maker, for "*Improvements in ship's compasses.*"—Granted July 30, 1844; Enrolled January 30, 1845.

Amongst the evils arising from the present construction of compasses are the following:—1st. The friction arising from the imperfect mode of suspension; which is that of a hollow cup in centre of the needle, resting upon a steel point; in which case it is obvious that a want of horizontality in the card will cause considerable friction between the convex sides of the pivot and the sides of the cup. 2ndly. A considerable error is caused by the assumption, that the *magnetic axis* of the needle coincides with what is called the *maker's axis*, which is the line determined by the marks or zero points on the extremities of the needle; which error in flat needles, such as are usually applied to compass-cards, is frequently of such magnitude as to be quite inadmissible, even in compasses for common purposes, much less for those intended for accurate experiment. 3rdly. Another source of inconvenience and inaccuracy arises from the unequal amount of inertia as regards the axis, or horizontal line drawn through the centre of the card, about which line it is compelled to vibrate or deviate from its horizontal position by means of the alternate pitching and rolling of the vessel. However well the gymbal apparatus, in which the card is placed, is balanced, yet as the card has a motion or time of vibration to itself, depending upon the position of the axis of its vertical vibrations with respect to the axis of the needle—which vibrations are not altogether under the control of the gymbals although its vibrations are continually checked, and its quiescence disturbed by it in consequence of the supporting pin coming in contact with the sides of the cup, as before mentioned—yet in the construction of the binnacle compass, the card ever will be subject to irregular deviations from the horizontal plane, arising from this cause.

The mode by which the inventor has removed these evils has been by altering the nature of the suspension; that is, by suspending the card in a similar way to the balance of a chronometer, and with equal delicacy, both ends of the pivot acting on diamonds, and the holes jewelled, by which means the card is constrained to move very nearly in the horizontal plane, since in this respect it is entirely under the control of the gymbals. The friction is also considerably reduced by this mode of suspension. The great accuracy with which the card returns to the same position has been clearly shown by a great number of experiments. To remove the error arising from the non-agreement of the *marked* or *maker's* with the *magnetic axis*, a simple contrivance is effected for the *inversion of the card*, so that either side of it may be placed *above* or *below*. Since the marked axis of the needle is in each of these positions at equal distances from, but on opposite sides of the magnetic meridian, a mean of an equal number of observations in both positions of the card will evidently eliminate any error of this nature, and give the true magnetic azimuth of the observed object, *at the time of observation*, by an equal compensation of error. It is also plain that the constant adjustment required to make a delicate needle horizontal in different magnetic latitudes is rendered thus unnecessary.

DOCKINS'S PATENT HEMITROPE,

Or Double Wedged Blocks, applicable to Paving and other purposes in Wood and Stone.

In casting our eyes over those leading streets of the metropolis now paved with wood, we find a something wanting in all of them, and this want is so palpably manifest to even common observers as to endanger the existence of all the patents now in operation. There is an evident want of unity in design and execution, a neglect or want of knowledge of the minor details and finish; thus one patent is too complicated and consequently too expensive, another fails in the absence of or in the use of concrete, another destroys itself by its own expansive powers; in short, objections start up on every side, which are but too readily laid hold of by those antedeluvians who sigh for the good old times when the stones were disposed to wage perpetual war with tender feet, relieved only by occasional deluges of mud. The principle of M'Adam was unphilosophical, it was a mechanical method of rapidly converting granite into mud, the stones being broken small, sand added thereto and water *ad libitum;* a principle equally inconsistent applies to the wood pavements now laid down, concrete or no concrete, the bed is laid down without reference to carrying off the excess of moisture in this excessively wet climate of ours, the wood is chosen for cheapness and not for durability, and laid down and grooved; it is then made the receptacle of every kind of filth, as though the end and aim of the patentee was to rot it as soon as possible; even the surface grooving is clumsy and unscientific, for the unprotected perpendicular fibres being soon beaten down by heavy vehicles, the grooves in wet weather are immediately filled up, and aided by the mud become equally dangerous to man and beast. Cleanliness would do much towards preserving the wood, but street cleanliness is of late little attended to.

We have been led to these reflections by a perusal of the patent now before us.

An idea of the shape of the block may be formed by supposing one of the triangles of an equilateral triangular prism to be turned 60° on the axis of the prism. If new lines of junction be now drawn between the angles of the opposite triangles, the three rectangular sides are converted into six triangles, the alternate bases of which are the sides of the primitive triangles. The plain of the six triangular sides inclines outwards from the base towards the apex by an irregular quantity, which diminishes as the length of the axis increases. A section of this solid taken through the centre of the axis, and at right angles to it, would present a regular hexagon; but, if equal quantities are cut off at each end by sections at right angles to the axis, the remaining central portion of the solid is precisely in the form of Mr. Dockins's block; the two ends, that is the base and upper surface, being irregular hexagons with equal alternate sides, and the other six sides of the block being equal and similar trapeziums.

A vertical section of the block bisecting two opposite sides of the irregular hexagon will present a rhomboid; and if the block be turned on its axis, and similar sections be taken at intervals of 60°, the rhomboids will incline alternately in opposite directions. It is on that peculiarity in the form of the blocks that the patentee principally relies for their efficacy in supporting each other and maintaining an even surface, three sides of each block being so inclined as to rest on the surrounding blocks, and the other three sides inclined the reverse way preventing the blocks from rising, as the short sides of the hexagons at the surface coincide with the central parts of the long sides of the adjoining hexagons; small triangular interstices are left which may be filled up with grouting, affording by this means a footing for horses. The accompanying diagrams will elucidate this form more fully.

Fig. 1 is an isometrical, and fig. 2 a linear bird's eye view. In fig. 2 the

Fig. 1.

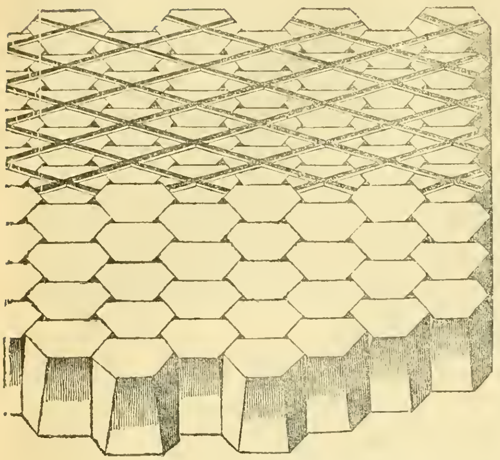
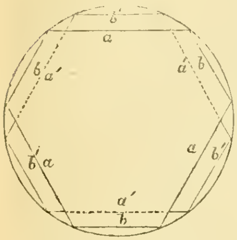


Fig. 2.



block exhibits its economical cutting from round timber, shown by the circular boundary line. The upper surface consists of six sides, three of which, *a a a*, being larger, and three, *b b b*, smaller than the sides of a hexagon inscribed in the same circle. The under surface has the same boundary lines for its sides, viz. three, *a' a' a'*, being equal to *a a a*, and three, *b' b' b'*, being equal to *b b b*; but these are turned round in such a position that each of the larger shall be parallel to the smaller, and *vi e versâ*, thus forming two triple wedges, the one to resist upward and the other to resist downward pressure.

Was this ingenious discovery confined in its application to wood paving alone, it would certainly be a step gained in the knowledge of this art, but its capabilities are still more admirably displayed in forming, in slate, stone, or marble, ornamental floors, pavements and walls, and the most beautiful devices for marble slabs may be carried out an expense scarcely exceeding the present bungling methods of disposing the pieces in a concrete bed; well secured on its sides, very little of any cement is required to unite the pieces and none for its bed. The specimens in slate exhibit a series of squares to which the principle is successfully applied, forming a pavement highly ornamental and well adapted for ground floors of mansions where damp is prevalent.

The wooden blocks are produced by a machine at four operations, which first cross-cuts them into lengths of six inches, these are placed on a travelling bed, fixed at the required angle to receive the first two cuts from parallel circular saws, these are returned and placed in a proper position for cutting the second pair of sides, and again the process is repeated, which finishes the block ready for grooving. In laying them down the patentees are determined to profit by the dearly bought experience of those who have gone before them; their first object, in combining economy with durability, will be to secure a bed which shall receive and pass off the waters, and the hemitrope or double wedged block enables them to do this most effectually; this will be the first and most decided improvement upon the present methods which by confining the water to the base of the wood causes it to rot long before its upper surface is removed by fair wear and tear. The expanding powers of the wood will also be allowed for, which can be done without diminution of its cohering powers, the blocks reposing upon each other receiving and distributing the superincumbent weight, until it is lost in the surrounding distance. Its other advantages are simplicity of construction in laying, raising, and relaying, and in manufacture; its strength and solidity when laid down; its cheapness, being 10*d.* per yard cheaper than Stead's, (the cheapest now known,) and 2*s.* 11½*d.* cheaper than Count de Lisle's, its capabilities of resistance and of preserving its grooved surface by steadily maintaining its position.

REVIEWS.

On the History and Art of Warming and Ventilating Rooms and Buildings. By WALTER BERNAN, C.E. London: G. Bell, 1845.

The advancement of the art of warming and ventilation is now such, and so much attention is directed to it, that it is of importance to the architect and engineer to obtain a good acquaintance with it. Employers become more exacting as to their own comforts, and the subject is so little understood, so unsuccessfully dealt with, and so much controversy exists as to modes of proceeding that sound information is most useful. Mr. Bernan goes into the subject from the beginning, explains the several modes of construction adopted, and inventions reported, and produces a small work, copiously illustrated with engravings, and with a good index. We shall feel it our duty to return to this work.

Practical Geology and Ancient Architecture of Ireland. By GEORGE WILKINSON, Architect. London: Murray.

The proper understanding of the resources of a country as to building materials is much aided by a reference to its ancient and public monuments. We have then practical facts to deal with, we have often the advantage of long experience, sometimes of numerous data, and we are enabled to arrive at a safe judgment as to the relative values of the several materials. It will be recollected how much this test was made use of by the Commission for enquiring into the Building Materials for the New Houses of Parliament, and which led to the production of a body of evidence, useful not merely for the particular purpose in question, but to all parties employed in the constructive arts throughout the country. Mr. Wilkinson has performed the same task for Ireland, and taken up the subject comprehensively. This leads of course to many interesting discussions, the progress of Norman architecture in Ireland, the origin of the round towers, &c., matters in which we feel that our readers will justify us in reverting to on an early occasion, when we hope to give engravings of some of the many examples adduced by Mr. Wilkinson. We may observe that the work is not merely practical, but ornamental, being illustrated with many plates and upwards of seventy highly finished wood engravings.

The Quarterly Journal of the Geological Society, No. I. Edited by the Vice-Secretary of the Geological Society. London: Longmans.

The Geological Society it is well known is one of the most active and vigorous of the learned bodies, its proceedings abound with practical results, and its members are bound to it by a strong regard for their general and individual reputation. Geology from a speculative science has now become one of a most practical character, important to the agriculturist, the miner, the engineer and the architect; there is a great demand for sound information. The papers read before the Fellows are nearly all of immediate or permanent interest, and the Society feeling the great injury which was inflicted by delaying many most valuable communications for insertion in the quarto transactions, has resolved upon the publication of the present Journal in an octavo size, at a cheap rate, and we earnestly wish the undertaking success, and recommend it to our friends. It contains all the proceedings of the Geological Society with numerous plates and engravings, and much other valuable matter. The name of the Editor, Professor Ansted, the author of the recent valuable work on Geology, goes far in giving a guarantee to the work.

An Essay on Aerial Navigation; pointing out the Modes of Directing Balloons. By JOSEPH MAC SWEENY, M. D.—Cork: G. Purcell and Co. 1844.

Too few practical experiments have been made on this subject to allow of our discussing it at any length in our pages, and we refer those who feel an interest in it to the pages of Dr. Sweeny, who has evidently devoted much attention to it.

Project for Transporting Large Merchant Vessels by Railroad across the Isthmus of Suez. By Sir WM. CORNWALLIS HARRIS, Major of Engineers, Bombay. London: Blackwood, 1845.

The title of this pamphlet declares its object, and throws the matter open for discussion by our readers, to whom we leave the decision as to the relative superiority of the several plans proposed for effecting a great national object. The plan is decidedly practicable and particularly with the stiff hulls of iron vessels.

The Year Book of Facts in Science and Art.—London, Bogue, 1845.

Time passes so fast, and science makes such rapid strides, that we can hardly keep the two in pace together. The appearance therefore of the successive Year Books, under their able editor, comes as a useful refresher to the memory. The present volume is not less valuable than its predecessors, nor less carefully got up.

The Metropolitan Buildings Act, with a Cyclopædia. By ALFRED BARTHOLOMEW, F.S.A., Architect. London.

This is by the late Mr. Bartholomew, whose lamented decease so recently took place. The Cyclopædia is of a most elaborate character, giving copious references to the Act, and forms a most useful pocket compendium for all architects and surveyors.

Papers on Subjects connected with the Corps of Royal Engineers. Vol. 7. London: Weale, 1845.

We return to the Papers of the Corps of Royal Engineers, as we shall be obliged to do again, from want of space adequately to discuss them now, though we feel most anxious to enter upon the consideration of a work which contains so much that is useful and valuable.

The first paper is one of a very practical character, on the military defence of the coasts, by Col. Lewis, R.E. We may observe by-the-bye, that this and all the papers are copiously illustrated with plates and engravings. Major Jebb, R.E., has a paper on the construction and ventilation of prisons, with the details of Pentonville Central Model Prison. The experiments in Blasting on the South Eastern Railway, at Dover, form the basis of Lieut. Hutchinson's contribution on the conducting power of water as applied to submarine explosions. The paper of Capt. Walpole is the description of a work executed by the Royal Engineers, a bridge over the Kat River, at the Cape of Good Hope, a very good example of how such undertakings may be carried out under considerable obstacles. The Notes on Swing Bridges, by Capt. Nelson, are interesting, and may be of use for the colonial service, where such a cheap mode of passing a river is often desirable. The Memoranda on Transition Lime and Limestone, at Plymouth, by Capt. Nelson, R.E., is a practical paper, which will prove very acceptable. Captain Denison, the editor, has a description of Dredge's Suspension Bridge erected over the Regent's Canal in the Park. This paper acquires additional interest, from the circumstance of describing the failure of an abutment. The editor also contributes a description of the Balance Gates at the Compensation Reservoir, of the East London Water Works, at Old Ford, erected by Thomas Wicksteed, C.E. Captain Harness has a description of a Small Observatory, erected at Chatham, for the Corps of Royal Engineers. The next paper is on the subject of the experiments carried on at Chatham, by the late Lieut. Hope, R.E., on the Pressure of the Earth against Revetments. It is derived from imperfect memoranda, but it will be found valuable for reference and for subsequent investigations. The account of the Failure of a Floor at Edinburgh, in 1833, is by Lieut.-Col. Manson, R.E. This class of papers as we have occasionally intimated is of great importance, for practical men want to know not merely what to follow, but what to avoid. The Report on the Construction of an Iron Beacon in Connecticut, is derived from American documents. The article on Railways, by S. DRYSDALE DEMPSEY, is a kind of digest or compilation of the existing practice in reference to this important class of public works. A sequel to it is the description of the mode pursued in repairing the retaining wall in the Camden Town Cutting. The last paper is on Engineering in Holland, by Capt. Hughes, of the United States Army, an American state document, which gives an authentic description from recent data of the great engineering works of Holland, and particularly of the plan for draining the Haarlem Meer. The Katwyk Canal and other large hydraulic works are also carefully described.

The Appendix has some useful papers, particularly two wrought iron roofs, one of which, that at the Bricklayer's Arms Station, we published some time ago.

The volume which is large, contains no less than forty-six plates; a profusion of illustrations, which adds to the value of the work, and is quite in character with the enterprise of the publisher. As the volume appears to thrive under Capt. Denison's care, we hope that many such will be brought forth under such efficient superintendance. The civil engineer will find here a great many practical examples, to which he may refer with pleasure and advantage, and which he can find no where else.

RAILWAY MASONRY.—Messrs. Groombridge and Sons intend shortly to issue a new edition of the late Peter Nicholson's valuable work on Railway Masonry.

HARBOURS OF REFUGE.

Report. To the Right Hon. the Lords Commissioners of Her Majesty's Treasury.

We, the undersigned harbour commissioners, appointed by your Lordships' minute of the 2nd of April last, whose names are hereunto subscribed, have the honour to report to your Lordships the result of our proceedings in pursuance of the objects pointed out to us in that minute.

We entered upon our important and difficult duties with a deep sense of the responsibility under which we should have to offer our opinions.

This feeling lost nothing of its force during our visit to the south-east coast, nor is it diminished on a review of the circumstances under which we have now to present for your Lordships' consideration proposals, which, if approved, must necessarily trespass largely on the public revenue.

The Treasury minute under which we act gives for our guidance three principal objects, viz.:—

1. The formation of ports of refuge for the safety and convenience of vessels navigating the British Channel.

2. That these should be calculated to become, in the event of hostilities the stations for ships of war.

3. The consideration of expense as compared with the public advantages likely to result from the construction of such works.

Our instructions do not bind us by any strictly specific limits. We are told, "If we think one harbour in the channel is not sufficient, we are at liberty to extend our inquiries accordingly."

We avail ourselves of the scope thus given to us, and being unanimously of opinion that one harbour would not be sufficient, we proceeded to the extreme west of the narrow part of the channel at Portland, and eastward to Harwich, which, though not strictly within the limits of the channel, is on the south-east coast, and forms an important termination to our line in that direction. Any less comprehensive view of the coast would have fallen short of the spirit of your Lordships' instructions.

The surveyors placed at our disposal by the Admiralty were directed to make detailed surveys of the anchoring ground at each place, and also to ascertain if any change had occurred since the publication of the last charts.

This service has been admirably performed by Captain Washington and the officers of Her Majesty's surveying vessel the Blazer, at the eastern ports, and at Portland with equal skill by Commander Sheringham and the officers of the Fearless surveying vessel.

Throughout our proceedings we have received unlimited assistance from the Lords Commissioners of the Admiralty. and, amongst other advantages, their Lordships have permitted us to refer, as occasion required, to their hydrographer, Captain Beaufort, whose ready help has been most useful.

We obtained every information we could desire from the officers of the Cinque Ports, from the officers of the Royal Engineers, the collectors of Customs, and from the officers of the Coast Guard.

The report of the select committee of the House of Commons on shipwrecks, to which we are referred by your Lordships, has been read by each member of the commission, and the copious information contained in that volume is well worthy the attention of all who may at any time be engaged in considering matters relating to the ports and maritime interests of the kingdom.

It was not to be supposed that an inquiry of such a nature as the construction of harbours could be entered on without bringing forward many intelligent persons with propositions of various kinds; and the appendix shows their names and the nature of their proposals.

To each individual we have given a patient hearing, as our minutes of examination fully testify; and every fair consideration has been bestowed on their plans.

We invited the Chairman of Lloyd's and the Chairman of the Shipowners' Society to meet us, or to delegate others to state the opinions of those great mercantile bodies with reference to the positions they consider best as ports for the shelter of their trade.

We have also had before us every class of persons who were though capable of affording information, including several eminent engineers; and, in order to guard against the often misleading opinions of residents at the different ports, we have examined many others practically acquainted with the various places, whom we believed to be unbiassed by local partialities.

The examination of persons so varied in their pursuits could not but afford much useful information. It has, however, been no light task to deal with the conflicting opinions they offer.

With these preliminary remarks we proceed to lay before your Lordships the result of our deliberate consideration of the whole of the circumstances which have earnestly occupied our attention.

FORENESS.

We proceeded, in the first instance, to Foreness, near the North Foreland, the site which the Harbour Commission of 1840 recommended as the place third in importance for an artificial harbour, giving a preference first to Dover, and secondly to Beachy Head. (See 'Journal,' vol. iii., 1840, p. 246.)

It is right to name the persons who composed that commission,[1] in order that their

[1] Rear-Admiral Sir James Gordon, K.C.B.; Captain Vidal, Admiralty Surveyor; now commanding Her Majesty's surveying vessel the Styx; Lieutenant-Colonel Thompson, Royal Engineers; Captain Drew, an elder brother of the corporation of Trinity-house; Mr. J. Walker, and Mr. W. Cubitt, civil engineers.

opinions may have the influence justly due to the high distinction they hold in their different professions.

The commission of 1840 had specific limits assigned to its operations—namely, "To visit the coast between the mouth of the Thames and Selsea Bill; to examine the ports with reference to their being available as places of shelter for vessels passing through the Channel, in cases of distress from weather, and also as places of refuge for merchant vessels from enemies' cruisers in time of war; and more especially as to their being made stations for armed steamers employed for the protection of our trade in the narrow parts of the Channel."

We quote this instruction both with reference to what we have to state respecting Foreness, and to other matters we shall have to mention in the course of our report.

Foreness stands well in the fairway of the traffic between the Thames and the Downs, and would, no doubt, if converted into a harbour, frequently prove to be a very convenient anchorage for outward-bound vessels caught off the Foreland by strong south-west gales, and for homeward-bound ships meeting with adverse winds.

The commission of 1840 give weight to their proposal in favour of Foreness by observing that a harbour there "must be regarded as one of refuge for vessels navigating or stationed in the North Sea;" but if their instructions had not precluded them from the consideration of Harwich, we think they would have suggested the improvement of that splendid natural harbour, at a small expense, rather than have proposed a large outlay of money in constructing one at Foreness.

Nothing can be more manifest than the fact that Harwich, as far as position goes (being actually on the shores of the North Sea), is the proper place for a squadron of steamers on that station, as well as for a harbour of refuge for merchant ships; while the neighbouring anchorage in Hollesby Bay is favourably suited for ships of the line.

On this account it seems to us unnecessary to construct a harbour at Foreness; and we think the commission of 1840 would have taken the same view of the subject if Harwich had come within their examination.

RAMSGATE.

Our next visit was to the port of Ramsgate, a mere creek in 1748, but now of such capacity that, in the last three years, the number of vessels which arrived in that harbour amounted on an average to 1,600 sail a-year, exclusive of fishing craft, town hoys, and the daily voyages of steamers.

Ramsgate harbour is kept clear partly by its backwater; and if ever the basin at the west end, designed by the late Mr. Rennie, be carried into execution, it will give increased power of backwater, and enable the port to receive many more ships.

The improvement of Ramsgate harbour is the result of vigorous efforts by the managing trustees, and their success, which cannot be too highly appreciated, is forcibly exhibited by contrasting its present increased utility with the facts stated by the celebrated Smeaton, who says that the number of vessels that entered the harbour in the year 1780 amounted to 29, in 1785 to 215, and in 1790 to 387 sail. Whereas in the last three years it appears on the evidence of the harbour-master there arrived in the port in 1841, 1,543; in 1842, 1,652; in 1843, 1,606; average 1,600 sail.

Of the number of vessels that arrived in 1843, 31 gave an average of 457 tons each; and when it is recollected that more than two-thirds of the trade of Great Britain is carried on in vessels under 400 tons, it shows the advantages the mercantile marine derives from this port in connexion with the Downs. The harbour-master states that in the winter of 1832 there were at one time 434 sail in the port, and if the additional basin before alluded to at the west end be made, there will be room for upwards of 600 sail.

It will be an improvement if the approaches and entrance to the harbour can be deepened by the use of dredging vessels, or other means applicable to the purpose.

THE BRAKE, OR SMALL DOWNS.

The next place we have to notice is "The Brake," within which is the anchorage called the "Small Downs." It is here that a harbour has been proposed by Sir J. H. Pelly, deputy master of the corporation of the Trinity House, one of the committee of management of Ramsgate Harbour, and a member of this commission. Any suggestion of this nature, coming from such a quarter, could not fail to engage our best attention.

The "Small Downs" is an anchorage of considerable extent, lying between the Brake Sand and the shore northward of Deal. The holding ground is good, and it is the general anchorage of the smaller class of merchant vessels having occasion to bring up in the Downs, thus leaving the Great Downs more clear for ships of a larger draught of water. The Brake Sand is about five miles in length, with a depth upon it at low water, spring tides, of from 3 to 12 feet. It shelters the Small Downs from the east in the same way that the Goodwin Sands shelter the whole of the Downs for a distance of nine miles.

We have before us an elaborate plan and a very full report, addressed to the trustees of Ramsgate harbour, respecting a design prepared by Sir John Rennie, by which it appears that the breakwater he proposes to construct is to be five miles in length, at an estimated cost of 3,280,000*l*. This plan is to convert the Small Downs into a close harbour by constructing a solid work along the spine of the Brake, to be brought up two feet above high water mark. There is, however, a modified suggestion of Sir John Rennie, which, if adopted, would reduce the cost to about 1,300,000*l*.

Another proposition was submitted to us for a work on the Brake Sand by Captain Vetch, late of the Royal Engineers, by which he proposes to make a sheltered anchorage within the Brake at a cost of 85,000*l*.

A third by Captain Sir S. Brown, R.N., also for the Brake, the details of which will be found in the evidence.

It has lately been shown by an Admiralty surveyor, Captain Bullock, that the Brake Sand has gone about 700 yards bodily in shore.

The Trinity House, on obtaining the survey from the Admiralty, shifted the south and middle Brake buoys, and issued a painted notice to all mariners of this remarkable change.

The commission of 1840, which included the late Captain Drew, one of the most able men of the Trinity House, say, in reference to the "expediency of enclosing the Small Downs," that "the magnitude and extent of such a work which would require a breakwater and pier of upwards of five miles in length, the small depth of water at the northern entrance and the uncertain nature of the foundation, induce us to abandon the idea of a harbour of refuge at that place."

According to the spirit of your Lordships' instructions, and strictly in conformity with those issued by the Admiralty to the former commission, we have in preference directed our attention to the narrow part of the Channel, where the navigation is dangerous to ships contending with adverse winds, and where in war the risk of capture would be greatest; it is there that we are to provide harbours of refuge for merchant ships, and suitable ports to enable our vessels of war to maintain their stations in order to give protection to the passing trade.

A harbour in the Downs can only be for ships that have actually passed all the risks of the narrow part of the Channel, or for ships waiting to commence their voyage.

For these reasons, and considering the Downs in its present state an excellent roadstead, with Ramsgate harbour immediately adjoining, capable of containing at one time upwards of 400 sail, and which may be made to receive 200 sail more, we do not feel ourselves warranted in proposing any outlay of the public money in the Downs.

DOVER.

History affords proof of the importance attached to this place as a military and naval station.

As the advanced post of England on the south-east coast, the want of a harbour here of sufficient capacity for the reception of vessels of war, and for the convenience and protection of trade, has attracted the notice of Sovereigns and Ministers from the earliest times, and has led to a large expenditure of money for the improvement of the present tidal harbour.

In considering positions eligible for the construction of breakwaters, it should be borne in mind that an inner harbour is an indispensable requisite; and, if there is no natural advantage of that sort in the position selected, there must be the double operation of building an inner as well as an outer harbour.

There are few places that in this respect possess greater advantages than Dover. It has a dry dock for repairs, and extensive quays with storehouses. Besides the outer receiving harbour, there is a basin covering more than six acres (now being enlarged to double that size), and a third, called the Pent, which the late Mr. Rennie, in his report to Mr. Pitt, in 1802, says may of itself be made capable of receiving many sloops of war and gun brigs, and which the Dover Commissioners are now considerably improving.

Mr. Pitt, when Lord Warden of the Cinque Ports, was earnestly intent on having Dover Bay enclosed, and it was this circumstance which led to our obtaining from the Master-General of the Ordnance the plan of a harbour in Dover Bay by the late Major-General Ford, of the Royal Engineers.

There are two points, each of great importance, which have been suggested as objections to any proposal for converting Dover Bay into a harbour; one, that the holding-ground is not good; the other, that it will have a tendency to silt up.

With respect to the quality of the anchoring ground Her Majesty's steam vessel the Blazer, of 500 tons, and 120 horse-power, was ordered there to test its tenacity to the utmost. The nature of the experiments, and the satisfactory result, will be seen in Captain Washington's report in the appendix.

In reference to the question of silting up, the commissioners directed samples of the water in Dover Bay to be taken up at different times of the tide, in different depths, and under varying circumstances of weather, which have been transmitted to the director of the Museum of Economic Geology for examination. The result, as reported by Mr. Phillips, will be found in the appendix.

The committee is of opinion that more extensive experiments are necessary, in order to determine the quantities of matter borne in suspension by the tidal currents on this part of the coast, and liable to deposit; and beg, therefore, to suggest to your Lordships the propriety of their being continued under the direction of the Admiralty for the space of a year in all circumstances of weather.

Dover, situated at a distance of only 4½ miles from the Goodwin Sands, and standing out favourably to protect the navigation of the narrow seas, is naturally the situation for a squadron of ships of war. Its value, in a military point of view, is undoubted; but the construction of a harbour of refuge there is, in our opinion, indispensable, to give to Dover that efficiency as a naval station which is necessary in order to provide for the security of this part of the coast and the protection of trade.

DUNGENESS.

This place is a singular formation of shingle, spreading over a space of several miles, stretching out seaward into the fairway of the channel, and having at its termination deep water close to the beach. It is without buildings, except the lighthouse and several batteries, the barracks of which are occupied by the coast guard.

The point of Dungeness has lengthened out considerably since the present lighthouse was built, in 1792. There is an inscription within the tower by which it appears that at the time it was built the sea was at a distance of 100 yards at low water. We, on our visit to that place, measured it, and found it to be about 190 yards, showing that it has lengthened out 90 yards in 52 years.

It is to be regretted that no periodical account has been kept of the lengthening out of the point, which, if it had been taken every year and registered in the lighthouse, would have afforded information of great importance, and would have shewn whether the rate of elongation has been uniform or otherwise. The commission consider it very desirable that an accurate record be preserved hereafter of all alterations of Dungeness point and its immediate vicinity; of its annual extension seaward; of the effects of great storms upon it; and generally of the movement of the shingle. For this purpose the commission beg to suggest that the Admiralty, in conjunction with the Trinity House, be requested to give directions on the subject.

Dungeness has ever been remarkable for its good holding ground. Both bays afford excellent and extensive anchorage, according to the state of the wind. It is in evidence that upwards of 300 sail have been sheltered in the east bay at one time, and that more than 100 vessels were at anchor in the west bay a few days before the commission arrived there. Where nature presents so much accommodation and shelter, it will always be a matter for serious consideration whether it may not be well to be satisfied with what is already so good, and to give to other places of acknowledged importance, in point of position, the artificial assistance they need, in order to render them available as places of secure anchorage. Dungeness does not possess the advantage of an inner harbour, as Dover, Seaford, and Portland. This, however, takes nothing from its value as a roadstead for merchantmen and for ships of war.

Having come to the conclusion that it was not expedient to construct a breakwater at Dungeness, we do not advert in detail to what has appeared in evidence as to the effects which such a work would be likely to produce on the lengthening or otherwise of the point, and on the anchorage in the east and west bays; but we refer to the opinions of several eminent engineers touching the advantages of this important place.

BEACHY HEAD, EASTBOURNE, AND SEAFORD.

We have now to draw your Lordships' attention to the bay on the east side of Beachy Head, and westward of Langley Point, which the commission of 1840 proposed as a site for a breakwater.

The shoals called the Royal Sovereign and others as laid down in the Admiralty chart, first attracted our notice with reference to this work; it was, therefore, thought desirable to have a more detailed and extended examination of the bay by the surveying vessel placed at our disposal by the Admiralty.

The result has been the discovery of several other patches of shoal water, as shown in the accompanying chart, and our previous impression as to the hazard of placing a harbour of refuge in such a situation has been so strengthened that we decided to look for a more eligible one on the west side of the head. There is no inner harbour or opening along the coast on the east side of Beachy Head.

On the west side of Beachy Head the anchorage is free from the dangers which render the east side less eligible as a place for constructing a harbour of refuge. The holding ground off Seaford is of the best quality, and is much resorted to in easterly gales.

The commission is of opinion that there is no good position in the neighbourhood of Beachy Head, where a harbour is as necessary as in any part of the Channel, (being about half way between Dover and Portsmouth,) except in Seaford-road, and the accompanying chart shows the place where a breakwater may be constructed with great advantage to the trade, and as a station for armed vessels.

The commission is fully aware of the objections which may be made to the formation of a breakwater harbour on the west side of Beachy Head, considering the prevalence of the westerly wind; but the local disadvantages on the east side of the head induce it to give a decided preference to the west side, and the proximity of Newhaven has materially influenced their decision.

NEWHAVEN.

Newhaven is a convenient tidal harbour, and may be considerably improved inwardly, as well as by carrying out a breakwater from "Barrow Head," into a depth of three fathoms at low water spring tides; by advancing the piers seaward, giving a wider entrance, and dredging the channel enclosed between them; but, as it cannot be made accessible at all times of tide, it does not come within the scope of our instructions to recommend any present outlay of the public money for this purpose.

It will be the interest of the commissioners of the Upper and Lower Ouse to apply their revenues to the utmost advantage, so as to give increased facilities of access to the harbour, should a breakwater be constructed in its vicinity.

PORTLAND AND WEYMOUTH.

Our next and last visit westward was to Portland, which, from its situation with reference to the Channel Islands, and as the boundary of the narrow part of the Channel in this direction, came naturally within the range of our investigation.

A squadron stationed at Portland will have under its protection, jointly with Dartmouth, all the intervening coast, and these places, with Plymouth, will complete the chain of communication and co-operation between Dover and Falmouth, a distance of 300 miles.

There is everything at Portland to render the construction of a breakwater easy, cheap, and expeditious, and the holding ground in the road is particularly good. A large part of the island facing the bay is Crown property, and contains abundance of stone. It has numerous springs, and plenty of the best water may be had in any direction for the supply of ships.

The roadstead also possesses the advantage of an inner harbour at Weymouth.

HARWICH HARBOUR.

We have now to submit to your Lordships a few observations respecting Harwich harbour, which we consider one of very great importance to the trade of the country.

This harbour, formed by the junction of the rivers Stour and Orwell, is one of the finest, and may be rendered one of the most useful havens in the kingdom. It has a sufficient depth of water and good holding ground over an extent capable of containing many hundred ships.

But, with the exception of a channel of 18 feet in depth, too narrow for general purposes, the entrance to this port is not deep enough to admit ships of more than 12 feet draught of water at low spring tides; it is therefore at present a tidal harbour as regards ships of a larger class.

It is remarkably well situated for the convenience of a north sea squadron, and for the protection of the mouth of the Thames.

It is the only safe harbour along this coast, and is in the direct line of traffic between the Thames and the northern ports of the kingdom, as well as of the trade from the north of Europe.

There is a dockyard, with building slips belonging to the Crown, and the property under the Ordnance Department is extensive.

It appears in evidence that by the falling away of Beacon Cliff, on the west side of the entrance, and the lengthening out of Languard Point, on the east side, the harbour has sustained great damage within the last 25 years.

The bottom at the entrance to the harbour, and the coast on each side, are composed of blue or London clay, in which are layers of "cement stone," in great demand both in England and on the continent. Hundreds of hands are constantly engaged in collecting it, and the evidence shows that by excavating the cement stone in front of the Ordnance premises, near the foot of Beacon Cliff, the water has spread so as to be diverted from its natural course, and the tide rendered so comparatively feeble, that it no longer acts with its accustomed force on Languard Point, which has consequently grown out 500 yards within the past 40 years, as shown by the plan. It has already nearly filled up the deep water channel, and by its further increase threatens to destroy the entrance.

In the appendix there are reports to the Admiralty, from the officer carrying on the surveying service in the neighbourhood of Harwich, to which we beg to refer for a full confirmation of our opinion of the necessity of taking immediate measures for the preservation and improvement of this harbour. If this be not done soon, it is impossible to calculate on the extent of mischief which may take place; for, on every south-west gale the Beacon Cliff is in peril of being washed into the sea.

We, therefore, feel it to be our duty to submit to your Lordships the pressing necessity for carrying out a breakwater or stone groyne, from the outside of the Beacon Cliff, so as to surround the foot of it, and to extend the same over the shoal water to the north part of the Cliff-foot rocks, as described in the plan No. 6.

We also recommend deepening the channel to the harbour to 18 feet at low water spring tides, by removing the shoals called the "Altars," and the eastern part of another shoal called the "Glutton."

PROPOSED BREAKWATERS.

Having made such observations respecting the different ports as may be necessary to enable your Lordships to form a judgment on the proposals we have to submit, and having given to the subject referred to us all the attention which its importance demands, we recommend:—

1. That a harbour be constructed in Dover Bay, according to plan No. 1, with an area of 520 acres up to low water mark, or 350 acres without the two-fathom edge; with an entrance 700 feet wide on the south front, and another of 150 at the east end,

Entertaining the strong opinion we have expressed of the necessity of providing, without delay, a sheltered anchorage in Dover Bay, we venture to urge upon your Lordships' attention the advantage of immediately beginning the work by carrying out that portion which is to commence at Cheesman's-head.

Whatever may be finally decided upon as to the form and extent of the works in Dover Bay, the pier from Cheesman's-head, run out into seven fathoms water, appears to be indispensable as a commencement, and it will afford both facility and shelter to the works to be subsequently carried on for their completion.

This will give sheltered access to the present harbour during south-west gales, and protect it from the entrance of shingle from the westward; it will afford time also for observation on the movement of the shingle within the bay, and for further enquiry as to the tendency which harbours of large area, on this part of the coast, may have to silt up.

These enquiries the commission consider to be of essential importance, and the results will afford the means of determining on the greater or less width that should be given to the entrances of the proposed harbour.

2. We propose that a breakwater be constructed in Seaford Road, in a depth of about seven fathoms of water, one mile in extent, and sheltering an area of 300 acres, as shown in plan No. 2.

3. That a breakwater be constructed in Portland Bay, to extend a mile and a quarter in a north-eastern direction, from near the northern point of the island, in about seven fathoms of water, having an opening of 150 feet at a quarter of a mile from the shore, and sheltering an area of nearly 1,200 acres, as shown in plan No. 3.

If only one work is to be undertaken at a time, we give the preference to Dover, next to Portland, and thirdly to Seaford.

MODE OF CONSTRUCTION.

Various plans for constructing breakwaters have been laid before us by highly intelligent individuals, whose projects are noted in the appendix, and fully explained in the evidence.

We are directed by your Lordships to report on the expense to be incurred by the completion of the works which we recommend; but, as no approximate estimate of this can be made without determining the general principles and modes of construction, we have examined the engineers who have come before us and other authorities upon these important points.

The various opinions have been considered by the commission, who prefer for the construction of breakwaters, and for the security of the works of defence upon them, the erection of walls of masonry.

The commission do not offer any opinion as to the profile or degree of slope necessary to insure to the structure the requisite stability. They consider that this will be best decided by the Government, under professional advice, when the works shall be finally determined on.

The cost of either mode of construction having been stated to be nearly the same, whether it be masonry or a long slope of rough stone similar to that of Plymouth breakwater, the commission beg to lay before your Lordships an approximate estimate of the works at the several places, viz.:—

Dover	£2,500,000
Seaford	1,250,000
Portland	500,000
Harwich	50,000

MILITARY DEFENCES.

The military members of the commission are of opinion that there will be no difficulty in providing for the defence of the proposed harbours.

They recommend that casemated batteries be constructed on the breakwaters themselves, and that these should be supported by works and defences on the shore, flanking the approach to them and to the entrance to the harbours.

At Dover and Seaford there already exist works of defence contiguous to the site of the proposed breakwaters, capable of being adapted to this object.

The island of Portland possesses great natural advantages for defence, and for the formation of a naval and military depôt, during war, to any extent that may be required.

The military officers are further of opinion, that the position and construction of the works necessary for the defence of the proposed harbours cannot be decided on until the exact site and relation of the latter to the shore shall have been finally determined.

CONCLUSION.

The commission cannot close their report without expressing in the strongest terms their unanimous opinion and entire conviction that measures are indispensably necessary to give to the south-eastern frontier of the kingdom means and facilities, which it does not now possess, for powerful naval protection. Without any, except tidal harbours along the whole coast between Portsmouth and the Thames, and none accessible to large steamers, there is now, when steam points to such great changes in maritime affairs, an imperative necessary for supplying, by artificial means, the want of harbours throughout the narrow part of the channel.

The distance chart which accompanies this report shows the positions where, if our recommendations are carried out, harbours of refuge or well-protected roadsteads will afford shelter to our commerce. By these means, and with the advantages of steam by sea, and of railroads and telegraphic communication by land, the naval and military force of the country may be thrown in great strength upon any point of the coast in a few hours.

The several recommendations we have thought it our duty to lay before your Lordships must, if adopted, occasion a large outlay of the public money, but when life, property, and national security are the interests at stake, we do not believe that pecuniary considerations will be allowed to impede the accomplishment of objects of such vast importance.

T. BYAM MARTIN, Admiral, Chairman.
HOWARD DOUGLAS, Lieutenant-General.
J. D. DUNDAS, Rear-Admiral.
J. H. PELLY.
PETER FISHER, Captain, R.N.
J. N. COLQUHOUN, Lieutenant-Colonel, R.A.
R. C. ALDERSON, Lieutenant-Colonel, R.E.
JOHN WASHINGTON, Captain, R.N.
J. WALKER.

I dissent from this report, because I consider the mass of evidence to be in favour of Dungeness, and because I cannot recommend a large close harbour at Dover, where the pilots consider the holding-ground generally indifferent, and the engineers say it will silt up.

W. SYMONDS, Surveyor of the Navy.

August 7, 1844.

Kaunstadt, in Wirtemburg.—A very extensive and splendid structure has been erected at this place, containing baths, picture and other galleries, various rooms for balls and assemblies, and above all very spacious conservatories, furnished with the choicest plants and disposed in the most tasteful manner. What name it is to bear does not seem to be yet determined upon, so at present it goes only by the one which it has obtained from the public, of 'Das Maurische Bad,' or the Moorish Bath, in consequence of its being in the Moorish style. It is constructed of stone of two different tints, laid in alternate courses, and all the architectural members and ornamental details are said to be faithfully rendered from the finest specimens of Arabian architecture in Spain. In fact, Zanth's (the architect) name is of itself almost sufficient pledge for refined taste and most careful study of decoration. No doubt, too, he has availed himself of our own countryman, Owen Jones's magnificent work on the Alhambra. One conspicuous feature in the design is a copper dome, richly gilt, and the octagon conservatories, whose sides are composed of rich open and lattice work filled in with glass, have also gilded domes. Further than these few and scanty particulars our information does not go at present, but we trust that we shall be able to give ere long some more full and exact account of so singular and interesting a building.

Gartner's Designs.—Professor Gärtner of Munich, Klenze's successor there as the king's special architect, and who has erected most of the recent monumental structures in the Bavarian capital, has just commenced a series of all the principal buildings he has executed, herein foollowing the laudable example of both Schinkel and Klenze. We have not yet actually seen the publication, but have little doubt it will prove a worthy companion to those above-named, and an interesting and valuable acquisition to the architect's library, which, to say the truth, has not of late received many additions of any kind to its stores. None of our English architects of the present day ever publish correct and detailed designs of their buildings, although some of them, it may be presumed, have executed such as are well deserving of being so represented—very far more so, in fact, than the majority of those which are engraved in previous collections.

Expeditious Bridge Building.—Mr. Dredge has just erected a bridge over the Blackwater river, county Tyrone, Ireland. This bridge has been in contemplation nearly forty years, the only obstacle being the immense expense of any structure on the old system, and probably for forty or a hundred years more the county would have been deprived of the advantage now conferred, but for Mr. Dredge's estimates, and his highly approved plan. Mr. Dredge has not added much to the long delay, by any dilatory process of construction; when the iron was on the ground he astonished the public with the rapidity of the work, the bridge being extended and completed 'in one week.' The bridge is 74 feet span, and for the heaviest traffic. It was erected at the cost of the Earl of Caledon.—'Wiltshire Independent.'

Strasburg Cathedral.—The *Presse* states that the belfry of the Cathedral of Strasburg has deviated considerably from its perpendicular within a short time, and has inclined more than six feet, calculating between the elevation of the summit and the base. A catastrophe is feared, which the most skilful architect is incompetent to prevent.

An Elevated Sea-Beach.—The operations of opening the ground for the Granton Railway has exposed an interesting section of alluvial soil at Wardie. After a surface of sandy loam, mixed with some peaty substances, from the decay of vegetable remains, there is exposed, at the depth of two or three feet, a bed of sea sand, on the surface of which lie pebbles and sea shells, indicating in the most distinct manner the remains of a sea-beach. The shells are smooth and waterworn, and are principally specimens of the univalves, which exist at present on the neighbouring shores. This deposit is elevated about ten or twelve feet, as far as may be hurriedly guessed, above the level of high water tides—no great elevation when considered geologically, but still not the less interesting.—'Caledonian Mercury.'

Plating upon Steel.—At the Paris Academy of Sciences, Dec. 30. a communication was received from M. Desbordeaux, of Caen, proposing a mode of plating upon steel by the galvanic process. In the mode of operating practised by Messrs. Ruolz and Elkington, it is found necessary to cover the article which is to be silvered with a slight coating of copper, without which the steel will not receive the silver. M. Desbordeaux states that the necessity for this coating of copper may be avoided by plunging the article for a few seconds in a mixture composed of one gramme of nitrate of silver, one gramme of nitrate of mercury, four grammes of nitric acid, at forty of Beaumé's aerometer, and 120 grammes of distilled water.

NEW PROJECTED RAILWAYS.

THE DECISIONS OF THE BOARD OF TRADE.

(Continued from Page 62, February Journal.)

RAILWAYS IN ENGLAND.

The Manchester and Leeds District.

In favour of the—	*Against the—*
Barnsley Junction,	Leeds, Dewsbury, and Manchester,
Leeds and Bradford Extension to Skipton and Colne,	Manchester. Bury, and Rossendale—Heywood Branch,
Leeds and West Riding Junction,	West Yorkshire.
Manchester and Leeds—Heywood and Oldham Extensions,	
Manchester and Leeds — Burnley Branch;	

The Liverpool and Manchester Railway Branches.

Patricroft and Clifton,	St. Helen and Rufford.
Parkside,	
Extensions into Liverpool,	
Blackburn, Burnley and Accrington Extension,	
Blackburn, Darwent and Bolton,	
Bolton, Wigan and Liverpool,	
Churnet Valley Railway (from Macclesfield to Tamworth and Derby, with a branch to the Potteries),	
Trent Valley Railway;	

The Worcester and Wolverhampton District, and intermediate the London and Birmingham and Great Western Railway.

Birmingham and Gloucester—Deviation line,	Birmingham and Gloucester—Wolverhampton line,
The London, Worcester, Rugby, and Oxford Railway, with an extension from Worcester to Dudley (narrow gauge);	Oxford and Rugby (wide gauge),
	Oxford, Worcester, and Wolverhampton (wide gauge).

Extension of Railway to Shrewsbury.

Shrewsbury, Wolverhampton, Dudley, and Birmingham;	Shrewsbury and Wolverhampton (Grand Junction),
	Shrewsbury and Stafford.

RAILWAYS IN WALES.

Extension of Railways in South Wales and Herefordshire.

In favour of the—	*Against the—*
South Wales Railway,	Gloucester and Dean Forest.
Monmouth and Hereford (Great Western)	
Newport and Pontypool;	

RAILWAYS IN SCOTLAND.

In favour of the—	*Against the—*
Clydesdale Junction,	Edinburgh and Glasgow — Stirling Branch,
Caledonian,	Glasgow, Dumfries and Carlisle,
Edinburgh and Hawick,	
The Scottish Central;	

RAILWAYS IN IRELAND.

In favour of the—	*Against the—*
Cork and Bandon,	Great South West (Ireland) Direct,
Great Southern and Western—Cork Extension only,	Great Western—Dublin to Mullingar,
Waterford and Limerick; subject, as regards the portion of the line between Limerick and the Junction with the Great Southern and Western Extension line, to equitable arrangements for securing to the Great Southern and Western Company full accommodation for the purposes of the Limerick traffic going in the direction of Dublin and Cork:	Ditto—Alternative Line,
Waterford and Kilkenny,	Ditto—Extension Line,
Great Western—Dublin to Galway,	Londonderry and Coleraine;
Londonderry and Enniskillen;	

And recommending the postponement until a future period of the—

Dublin, Carlow, and Wexford,
Dublin, Wexford, Waterford, and Carlow,
Dublin and Wicklow,
Kilkenny Junction.

DALHOUSIE,
C. W. PASLEY, G. R. PORTER,
D. O'BRIEN, S. LAING.

OPENING OF THE MARYPORT AND CARLISLE RAILWAY.—On Monday, Feb. 10, this line was opened between the respective towns of Carlisle, Aspatria, Maryport, and Wigton. From Maryport to Carlisle is a distance of twenty-eight miles. The line was commenced in May, 1837; there are no tunnels, and no very deep cuttings or high embankments on the line; the heaviest cutting is at Aspatria, where between 300,000 and 400,000 cubic yards of heavy clay and wet sand had to be removed, and was found to be a work of great labour and difficulty. The bridges on the line are numerous, but not difficult, only two rivers, the Calden and the Waver, being to cross once each, the total number over and under the railway being 77. The steepest gradient on the line is 1 in 203, and varying from this to 1 in 1900. The deepest cutting is thirty-six feet, and the highest embankment is thirty-seven feet. The cost per mile will be about 10,000*l*., exclusive of engines and carriages.

BERLIN.—The lately inaugurated frescoes, which now adorn the background of the portico or colonnade of the Museum, according to Schinkel's intention for it from the first, are said to excite some scandal among the Berlinese by the nudity of the colossal female figure. On the other hand, notwithstanding that these poetical composition are ultra-pagan in idea, not a few people it is said, "mistake the figures for those of saints."

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JANUARY 21, TO FEBRUARY 24, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

John Melville, of Upper Harley-street, Middlesex, Esq., for "Improvements in propelling vessels."—Sealed January 21.

Johann Gottlob Seyrig, of Lenton, Nottingham, mechanician, for "Improvements in scouring, bleaching, and dyeing machines, also in machines used in filtering and in drying, or extracting liquid or moisture from different substances."—January 25.

George Henry Taunton, of Liverpool, civil engineer, for "Improvements in machinery for revolving windlasses, barrels, spindles, shafts, and for pumping."—January 25.

William Trueman Yule, of Wilson street, Finsbury-square, preserved provision manufacturer, for "Improvements in preserving animal and vegetable matters."—January 28.

Thomas, Earl of Dundonald, for "an Improved rotary engine to be impelled by steam, and which may be also rendered applicable to other purposes." (Being an extension for the term of fourteen years of letters patent granted to him by His late Majesty King William the Fourth.)—January 28.

Martyn John Roberts, of Bryn-y-caeran, Carmarthenshire, gentleman, for "Improvements in machinery for preparing and winding, and spinning and winding wool, flax, and other fibrous bodies.—January 28.

George James Norton, of Weymouth, Dorset, cook and confectioner, for an "Improved cooking apparatus, parts of which are also applicable to the purposes of lighting and heating."—January 28.

Nathan Whiteley, junr., of Stoney-bank, Huddersfield, manufacturer, and Joseph Hopkinson, junr., of Huddersfield, engineer, for "certain Improvements in machinery or apparatus for raising the nap or pile on woollen, cotton or other cloths, also for brushing and cleansing the same."—January 28.

John Leslie, of Conduit-street, Hanover-square, tailor, for "Improvements in stoves and apparatus used in consuming fuel and in ventilating."—January 28.

Edwin Rose, of Ogley, Stafford, engineer, for "certain Improvements in the manufacture of grain into flour or meal."—January 28.

Matthew Allen, of Worship-street, Shoreditch, builder, for "certain Improvements in stoves and apparatus for heating."—January 30.

Thomas Page, of Cambridge, painter, for "certain Improvements in the mode of painting or decorating with oils and other colours."—January 30.

James Johnston, of Willow-park, Greenock, Esq., for "new and improved processes and machinery for making and refining sugar."—January 31.

Thomas Middleton, of Loman-street, Southwark, engineer, for "Improvements in machinery for the manufacture of artificial fuel, bricks, tiles, and other similar articles."—January 31.

Arthur Varnham, of the Strand, stationer, for "Improvements in the manufacture of paper in order to prevent fraud, which he intends to call safety and protective paper."—February 4.

William Snoxell, of the Quadrant, blind manufacturer, for "Improvements in roller blinds and shutters."—February 4.

William Henry Smith, of Wellingborough, boot manufacturer, for "certain Improvements in the construction of boots, shoes, and other coverings for the legs and feet, and also in the means of or apparatus for fastening the same upon the leg or foot."—Feb. 4.

Henry Nibbs Browne, of Shadwell, sugar refiner, for "Improvements in the manufacture of sugar."—February 4.

John Seaward, of the Canal Works, Poplar, engineer, for "certain Improvements in steam propelling machinery."—February 5.

Darius Isaac Green, of Villiers-street, Strand, gentleman, for "Improvements in the means of raising and moving heavy bodies, parts of which are applicable amongst other uses to mines, vessels, and public works." (Being a communication.)—February 8.

Robert Bewick Longridge, of Bedlington Iron Works, Morpeth, Northumberland, for "an Improved locomotive engine."—February 10.

Frederick Herbert Maberly, of Stowmarket, in the county of Suffolk, clerk, master of arts, for "certain Improvements in machinery or the apparatus for stopping or retarding railway or other carriages; applicable also for these purposes in regard to other engines or wheels."—February 10.

Thomas Truman, of Cromwell Lodge, Brompton, gentleman, for "an apparatus, being an improvement for filtering and purifying water."—February 10.

Richard Haworth, of Bury, Lancaster, engineer, for "certain Improvements in steam-engines."—February 10.

William Irving, of Regent-street, Lambeth, engineer, for "Improvements in the construction of apparatus for cutting ornamental forms, beads, recesses, and mouldings, in wood, stone, and other materials."—February 10.

Peter Fairbairn, of Leeds, in the county of York, engineer, for "certain Improvements in machinery for drawing, roving, and spinning hemp, flax, tow, silk, wool, and other fibrous substances."—February 10.

Oglethorpe Wakelin Barratt, of Birmingham, experimental chemist, for "certain Improvements in the manufacture of acids, and in treating the noxious vapours or gases given off from chimneys and from chemical and other works."—February 10.

John Bramwell Gregson, of Dunston, Durham, manufacturing chemist, for "Improvements in the manufacture of Epsom salts and carbonate of lime, commonly called precipitated chalk, parts of which improvements are applicable to other purposes."—Feb. 10.

Joseph Quick, of Sumner-street, Southwark, in the county of Surrey, engineer, for "an improvement in steam engines."—February 10.

James Clark, of Glasgow, power-loom manufacturer, for "certain Improvements in weaving."—February 14.

Thomas Brown Jordan, of Cottage road, Pimlico, mathematical divider, for "Improvements in machinery and apparatus for cutting, carving, and engraving."—February 17.

James Graham, of Calvert-street, Middlesex, metal refiner, for "Improvements in the manufacture of zink, antimony, and brass, in casting brass, and in apparatus for making pots used in such processes."—February 17.

Samuel Hall, of King's Arm's yard, Coleman-street, for "Improvements in steam-engines, boilers, furnaces, and flues, in consuming fuel, preventing smoke, and in propelling vessels."—February 20.

James Murdoch, of Staple-Inn, patent agent, for "certain Improvements in the manufacture of gas, and in the apparatus employed therein."—February 20.

John Bottom, of St. Philip's-road, Sheffield, machinist, for "certain Improvements in carpenters' stocks and braces."—February 20.

William Stevens Villers Sankey, of Hampstead, master of arts, for "certain Improvements in fastening and securing letters, packets, and despatches."—February 20.

John Place, of Hoddlesden, Lancaster, manufacturer, for "certain Improvements in looms for weaving."—February 20.

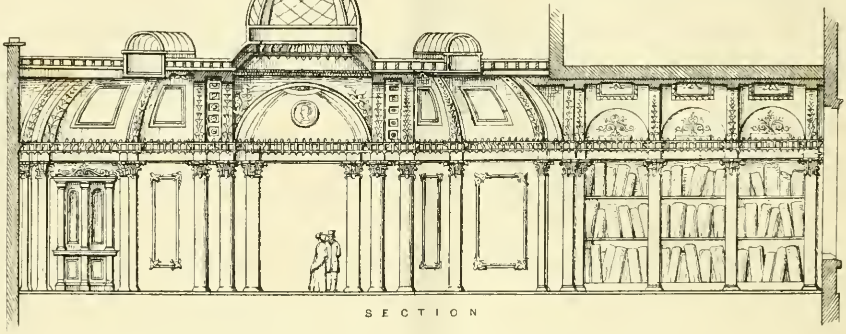
George Brown, of Glasgow, for "certain Improvements in the manufacture of soda."—February 20.

John Weatherstone, of Cassington, Oxford, yeoman, for "an Improved dibbling machine for planting seed or grain."—February 20.

Robert Oxland, of Plymouth, chemist, for "Improvements in the manufacture of chlorine."—February 20.

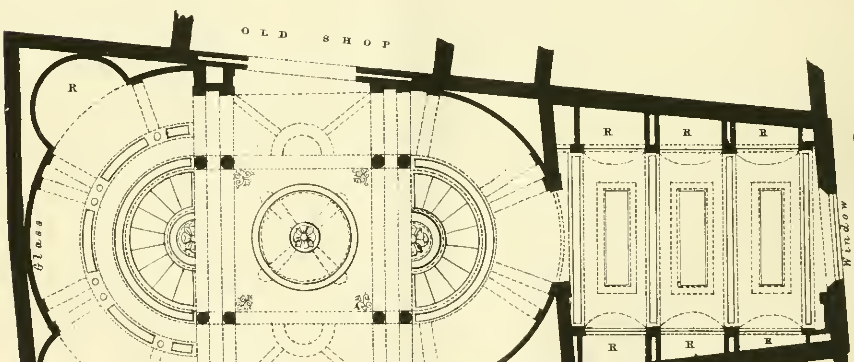
John Baptiste Vallauri, of Oxenden-street, civil engineer, for "Improvements in lamps and wicks."—February 24.

Joseph Howard of Blackfriars-street, Manchester, hatter, for "certain Improvements in the manufacture of silk plushes, silk velvets, worsted, and other plushes."—Feb. 24.



SECTION

MESS^RS WILLIAMS AND SOWERBY'S NEW SHOW ROOM, OXFORD STREET.

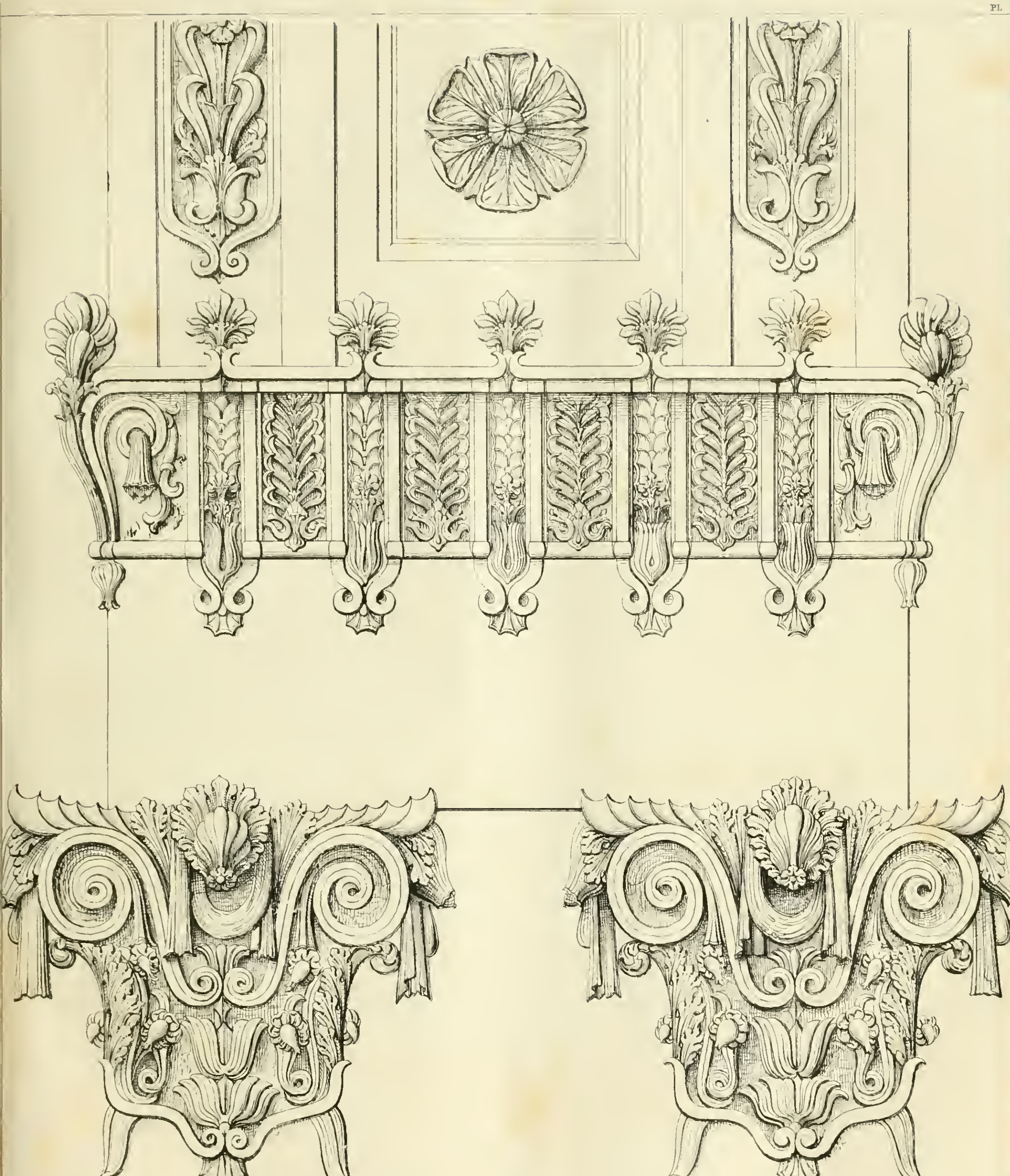


PLAN

O. MOCATTA, ARCH^T

10 5 0 10 20 30 40 50

J. R. Jobbins, del^t



J. R. Jobbins,

NEW SHOW ROOMS AT MESSRS. WILLIAMS AND SOWERBY'S, OXFORD STREET.

(With Two Engravings, Plates VII and VIII.)

Besides being quite a *lion* in its way,—its actual purpose considered, this very handsome apartment is of more than ordinary interest as an architectural study, since in addition to embellishment it displays unusually felicitous contrivance of plan, and affords a striking instance of the peculiar charm attending artistical arrangement of ensemble preparatory to decoration. No matter how sumptuously they may be fitted up, rooms are almost invariably of monotonously uniform character in one respect, being rectangles inclosed by four flat walls, and lighted from one side. There are thousands of splendid drawing-rooms which present only the minimum of architectural design, they being far more indebted for what character or attraction they possess, to the decorator and upholsterer than to the architect himself, who does little more than decide their size and proportions, and provide for others to operate upon, the raw material of bare walls. Even the Clubhouses supply scarcely an exception to the rule. All the more welcome, then, is the one which forms the subject of the engraving, and which is so creditable to the taste and ability of Mr. Moratta.

We do not recollect having ever before met with an instance of an apparently very ungain and obstinate form of site being completely overcome without any loss of space, and with such ingenuity of contrivance, that perfect regularity of plan is kept up to the eye, and even when the deviation from it is discovered—which is not so easily done by every one in the room itself as in a plan of it,—satisfaction is rather enhanced than the contrary. The architect had here to contend with an awkwarkness of shape somewhat similar to that of one of the rooms of Lloyd's in the Royal Exchange, where owing to the obliquity of its North side, the East end is wider than the other. In such case, many would have cut the Gordian knot very summarily by deciding that it was not worth while attempting to correct or disguise the irregularity, the place being after all "only a shop!"—or it would have been proposed to rectify the defect by merely carrying the two longer sides at right angles to the ends, thereby reducing the East end to the same width as the narrower one, getting out closets behind the partition. Had that been done there would have been the unexceptionable *secundum artem* parallelogram,—nothing either better or worse than if there had been no difficulty at all at the outset, whereas now, instead of being merely got over, the difficulty has been so admirably turned to account, that we may fairly ascribe to its existence what is most felicitous in the treatment of the plan.

There is besides considerable novelty in other respects, including the mode of lighting the semicircular ends; and also the ornamental details of the order, the capitals of whose columns are freely treated as original compositions. We do not, however, undertake to decide how far their design is to be approved of, because that would require more deliberate examination than we have had the opportunity of making. For a similar reason it is somewhat doubtful to us whether the striking distinction made between the shafts of the pilasters and those of the columns, be altogether satisfactory: while the latter are of scagliola in imitation of Siena marble, the faces of the others are decorated with paintings upon *raised* slate panels.—Would it not have been better both for the sake of greater novelty as well as uniformity, to have decorated the shafts of the columns also with painted arabesque ornaments on them?

The general *coup d'œil*, we should observe, is greatly enhanced by two spacious compartments, viz., at the East end and on the North side, being entirely filled in with looking-glass. Indeed, effect seems to have been studied throughout, and no pains spared to render the apartment an unusually scenic piece of architecture. The principal dimensions are as follows:

General size of room	57 by 35 feet.
Diameter of larger semicircle	36 ft. 6 in.
smaller ditto	35
Dome	10 6
Height of Dome	35
Columns	14
Ceiling	23

The engraving Plate VII. shows a plan and a vertical section of the room drawn to a scale of 16 feet to the inch, letters r are recesses for carpets, &c., and Plate VIII. shows the capitals of the columns, the enrichments of the cornice and soffit of the arch upon an enlarged scale of 1½ inch to the foot, the upper enrichment of the cornice is continued all round the show rooms.

CANDIDUS'S NOTE-BOOK. FASCICULUS LXIII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. The doctrine of Architectural Professors and Teachers is little better than the doctrine of despair. What it strives most earnestly of all to impress upon us is the fatal idea that architecture has already and long ago reached the utmost possible limits of its career, and that nothing remains for it but to commence anew another stoic year in which all the past is acted over again. Nay, so preposterously in love are they with such doctrine—as if it were the most encouraging and comfortable one that could be adopted,—that even to hint at the possibility of our being able to achieve fresh and yet untried excellence in architecture, is treated with contumacious scorn as arrant heresy. Not content with our admiring and doing full justice to former excellence, they insist upon our not seeking to obtain any other that shall be worthy of being admired in its turn. They prohibit, under the penalty of their severest anathemas, every attempt of the kind—an excellent method, by the bye, of verifying their own dismal prophecies, it requiring no great prophetic skill to foresee that we certainly shall never get a single step forwarder in art so long as we agree to stand stock-still. Architecture, says Victor Hugo, is the only art for which there exists no future: and such, thanks to the combined bigotry and dulness of its hierophants, seems to be the case. We are not even so much as permitted to imitate those whom we are bound to admire, by pursuing the same course and producing fresh ideas *pro re natâ*. We are expected to be impressed with a lively sense of our own incapacity, and to be thoroughly grateful accordingly. We are relieved from the necessity of *studying* former productions of the art by having only to copy them, no matter though the copies should be somewhat Æsopian, and remind us of those pithy fables of the Ass in the Lion's skin, and the Jackdaw in borrowed plumes.—Most cheering and consoling doctrine truly!—No wonder then that academical Professors exhort us in their lectures *ex cathedrâ* to follow the clever policy of stealing from books ready-made designs for porticoes.

II. Were you to propose any adjunct to a church in the shape of a fore-court with a cloister on its sides, for monuments—or of an inner vestibule for similar purposes, the idea would be instantly scouted as something "monstrous extravagant," and causing wasteful expense. Yet it is the *manner* rather than the *matter* of the expense that startles people. You may add to the body of a church what amounts both in size and cost to another structure although only an *extra* to the church itself, and no objection whatever shall be made to it. For instance, to a church some seventy feet in length within, you may add what shall be upwards of a hundred feet, provided you do but put it in a certain position and orthodox attitude, namely placed upright instead of horizontally. To build a noble portico that added forty or fifty per cent. to the cost of a church would be deemed a sort of madness, but to erect a tower and spire that add cent. per cent. to it, is considered merely matter of course, notwithstanding that it seems very oddly at variance with that strict economy and exact computation according to which the utmost number of sittings are to be provided within a given space, for to leave any space unoccupied within, or to provide more than was actually required to be occupied would be considered absolute wastefulness. How far a tower and spire are at all serviceable or worth their cost by increasing "church-accommodation" accordingly, I leave the reader to decide. To say the truth, there is just now a sort of mania for church architecture, in the Gothic style, and with tower and spire as indispensables; and in that species of design we have just reached a degree of decent respectability where we seem destined to stick fast. One thing of the kind is pretty much like another: a spire is becoming quite as common-place a matter as a portico; and, it may be suspected, is like the latter frequently received as an equivalent substitute for all other merit, and as what must at all events be provided, even though it be by cutting down the rest of the design, and by paring away not only mere ornaments but essential and characteristic detail. The *manufacture* of Gothic is, no doubt, greatly improved, but a good deal of Gothic is little better than mere manufacture. Neither is that style very well fitted for new churches in towns and streets where every thing else is of quite modern physiognomy, and where it consequently shows itself like a puerile affectation of antiquity. If we must build churches of the kind in towns, they ought at least to be insulated and further, detached as much as possible from other buildings so as to be viewed as independent objects, whereas now they are generally built into a line of spruce modern houses. Besides, if we must employ Gothic for such purpose, it ought at any rate to be the Gothic of a more advanced period and more ornate species than that which is now almost exclusively employed. The character that is both pleasing and appropriate for a village church is unsuitable for one in a town,—that is for one now built, and placed where every thing else is quite *townish*, and withal, evidently of to-day's growth. Therefore before it is determined upon that a new church shall be Gothic, it would be as well to take into consideration the character of the locality.

III. Luck certainly has a good deal to do with deciding the reputation and vogue of buildings. While some are universally cried up, chiefly, it would seem, because the high opinion first expressed of them, has ever since been implicitly adopted, and has been repeated by every successive writer, and upon every occasion, others of equal merit are scarcely spoken of at all. It is the fashion—I can call it nothing else, to extol St. Martin's by wholesale, speaking of it in the lump, as if not only the *portico*, but the *church* itself was entitled to admiration, although nothing can be more anti-classical, more un-Corinthian, or more at variance with the style of the portico, than is all the rest of the structure, the background of the portico itself not excepted. There is about as much similarity of character between the body of the edifice and the portico, as existed between Old St. Paul's and the Corinthian colonnade tacked to it by Inigo Jones. On the other hand, St. George's Bloomsbury, which, it may be observed, now forms so fine an architectural object as seen from the line of new street leading from Oxford Street into Holborn,—is never mentioned except for silly cavilling at its steeple. In regard to those two churches, criticism blows hot and cold with a vengeance: in the one case it willingly shuts its eyes to all demerits, for the sake of the portico; in the other it fixes them so intently upon the statue on the summit of the steeple that it can discern nothing but that "absurdity." The noble pose of the portico on a stylobate of just sufficient height to give it additional importance,—artistical combination of masses, originality of character in the ensemble, play of light and shade, and perspective—these excellences are passed over in silence—either most sulky or most stupid, although of a kind that those who are capable of feeling them would, for their sake, almost have forgiven the architect had he stuck up George II. with his head downwards. But the steeple—well! that campanile is the most classically conceived thing of the kind we possess. In comparison with it, Wren's vaunted steeples are little better than gimcrack: scientifically constructed they may be, but in themselves are not worth the skill bestowed upon them. They who admire that of Bow Church, Cheapside, may equally well be delighted with the freaks of Borromini, so too, those who are charmed with that of St. Bride's, ought to be in raptures with a Chinese pagoda.—Awfully heretical as all this is, yet there are probably more who will agree with it in *petto*, than will care to confess as much. Those who think differently from myself are of course safe, for they have *numerus defendit* on their side, and can prove the excellence of their taste by an overwhelming majority of votes—a majority of all the wiseacres who can give no better reason for the opinion they hold, or would be thought to hold, than that "Every body has always admired Wren's steeples,"—and—myself excepted—who can resist such powerful argument?

IV. Not only have critics—that is, such critics as Ralph and Walpole, and their Grub-street copyists—depreciated St. George's Bloomsbury, but architectural writers, and those who have formed collections of architectural designs for publications, have been no less unjust. There are no representations of it in the Vitruvius Britannicus, none in the Public Buildings of London,—no mention of it or of Hawksmoor in either of the treatises on architecture in Brewster's Encyclopædia and the Metropolitana, although various structures of far less interest and value are noticed. A somewhat similar fate is that of what, though attended with considerable drawbacks, it being upon too small a scale to make any figure where it is placed, is one of the most classical or tasteful pieces of design in the whole metropolis, for rarely do we hear the *ci-devant* Melbourne now Dover House, Whitehall, quoted as a superior specimen of architecture, nor has an elevation of it ever been published—at least, I have never met with one. This shows with what sort of judgment and taste those who cater for architectural publications select subjects for them; and that such a design should have have been overlooked by George Richardson, when he was glad to enlist so many poor, feeble, and crippled things in his New Vitruvius Britannicus, is perfectly astonishing—or rather would be so, to any one unacquainted with the triple stolidity of bookmakers. That there should be no published elevation of the beautiful little screen façade of Dover House is the more to be regretted because so represented, and therefore seen apart from anything else, it would show itself to greater advantage than it does in reality—merely on account of its being too diminutive for a piece of street architecture, unless it could have been placed so as to be in some measure detached from other objects, and made to form a principal one terminating the vista in a short street; whereas, facing, as it does, Inigo Jones's Banqueting House, it looks Lilliputian, (*i. e.* literally, little-boyish—Swift having formed the word from the two Danish ones *Lille* "little," and *Putte* "a child"); it looks Lilliputian, I say, by contrast. It is a pity that Holland did not at all events give greater altitude to the portico, by carrying it up higher than the rest of the screen, making the columns there as high as the entire order of the other part; had which been done, besides more variety being given to the general composition, and greater dignity to the portico, the intercolumniation would have been very greatly improved in consequence of the diameter of the columns being increased in proportion to increase of height; whereas now, being only tetrastyle, the portico looks too wide in front for its height. One particular merit that ought not to be overlooked in it, is the manner in which it is attached to the building—not merely stuck up or pushed against it, as is the case with so many other things of the kind, which look as if they were after-thoughts, and added to what was not prepared for them, but firmly knitted together with the part of the front immediately behind it. It is alleged as a fault in the design, by those who have condescended to notice it at all, the two insulated columns with the entablature breaking over them, in the compartments next to the portico, support nothing. There certainly appears to have been no very particular reason for breaking the entablature, because there was nothing to hinder its being carried across the intercolumns, thereby giving to those parts of the front the appearance of blank colonnades—that is, without any passage between the columns and the wall behind them, as is the case with those in the front of the Bank. One reason that was not done may have been that it was thought that those parts would, in such case, have appeared too much like a repetition of the portico, the number of intercolumns being the same, viz. three, in all those three divisions of the front. Nor will I be sure that as now placed, with the entablature breaking over them, and surmounted by a vase, those columns do not tell more decidedly in the composition, and produce a more piquant effect than they else would have done. At all events they are picturesque, and if they show themselves to be no more than architectural embellishments of no positive use, they have the merit of being strikingly ornamental, which is very much more than can be said of a great many things which though intended only for decoration, and very costly into the bargain, produce scarcely any effect at all. To object to what is here done chiefly because the order employed is Greek instead of Roman in its character and details, is hypercriticism in its dotage, for the absurdity—if absurdity it is—would have been just the same in the other case. Had Holland intended—as he most assuredly did not—to pass off this façade as an exact example of Greek composition, and veritable Greek application of columns, he would of course have been guilty of a very strange error. The adoption of the Greek style in regard to matters of detail, does not impose upon us the obligation of confining ourselves to the Greek practice in all other respects; or if it does, there is no alternative for us but to discard that style at once, as one wholly insufficient for our practice, and one which it is impossible to keep up with any sort of consistency if we are to abide by the mere letter of it, instead of endeavouring to catch the spirit of it, and infuse kindred eloquence of taste into features and combinations unknown to Grecian architecture. In fact, unless we admit of some latitude in the application of columns, and the introduction of them for ornament and effect in composition, we ought in consistency to tolerate no columnar architecture at all that does not strictly conform to the severity of Greek principles as exhibited in Greek temples. If we are to stick to principles, the style or particular fashion of the building affords no excuse for transgressing them, and for employing columns and orders of Roman or Italian character after what we hold to be an unpardonably solecistical manner, when in lieu of them we make use of Greek ones. Therefore, if what Holland has done with so much artistic feeling, with insulated Greek Ionic columns in the façade of Dover House, is to be censured as a license quite inexcusable, notwithstanding the beautiful effect attending it, neither ought Inigo's façade on the opposite side of the street to escape reprobation as being radically solesistical, and composed on principles quite contrary to those of legitimate columnar architecture, and also for exhibiting microstyle orders and supercolumniation. However, it is some comfort to find that even such scrupulous souls as are scandalized at Holland's felicitous heresy can endure, without wry faces, the far more monstrous and tasteless heresy of sticking up a single huge *polar* column, or pole in the shape of a column, for no other purpose than to hoist a statue on the top of it;—how conveniently elastic are some folks' architectural principles!

V. A third building which has obtained far less notice than it deserves—in fact, has hardly ever been noticed at all, is that called the

Commercial Buildings or Rooms, in Mincing Lane. Although in such a horribly, vulgar and "vastly ungenteel" situation, it is one that would grace aristocratic Piccadilly. Luckily it is not in that quarter, or it would make the Duke of Wellington's house look meaner and dowdier by comparison with it than it now does,—and, as has been observed, that neat and spruce and trim thing seems to have been built for the residence of Mrs. Fry, rather than for that of the Conqueror of Waterloo. The former Apsley House was just as dignified in appearance, and had at least the merit of being unsophisticated, and free from any minikin offectation of style at all. Nay even Philpot Lane can show a nobler specimen of architectural taste—but I must stop: Philpot Lane is not to be mentioned with impunity to ears polite. I have blundered sadly in naming it, for it will now be discovered that I reside there myself,—which being the case, my opinions will henceforth be considered those of some low vulgar-minded huckster, some dealer in oranges, and of course not worth one farthing—no, not even one of the new half-farthings.

THE XANTHIAN MARBLES.

By M. Rohde Hawkins, Esq.

Abridgment of a Paper read at the Royal Institute of British Architects.

The object of the present paper is to give some acccount of the sculptures and architectural fragments which have been brought from Xanthus, and placed in the British Museum during the last two years. It will not therefore be out of place to give some account of the circumstances which have led to their discovery, and of the measures which have been taken in order to procure and convey them to this country.

In February 1838, Mr. Charles Fellows, while travelling in Asia Minor, determined to explore more particularly its south-western corner, opposite to the island of Rhodes, this district having formerly been the site of ancient Lycia. His chief inducement was that this country had not before been visited by any Europeans with the object of investigating its remains; and little was known of it beyond the existence of some few towns lying along the sea coast. Of these, Telmessus, now called Macry, Antiphellus, Myrus, and Patara (these three latter still retaining their ancient names), had alone, up to this year, been examined scientifically. In that year, however, Mr. Fellows determined to proceed into the interior, and to examine more fully whether there were any remains of the cities of ancient Lycia. He started, therefore, from Patara, and after travelling up the country for about 10 miles, he came to the ruins of the city of Xanthus, which he describes in the following words:—

The ruins are wholly of tombs, triumphal arches, walls, and a theatre. The site is extremely romantic, upon beautiful hills, some crowned with rocks, others rising perpendicularly from the river which is seen winding its way down from the woody uplands, while beyond, in the extreme distance, are the snowy mountains in which it rises. On the west the view is bounded by the picturesquely formed but bare range of Mount Cragus, and on the east by the mountain chain extending to Patara. A rich plain, with its meandering river, carries the eye to the horizon of the sea towards the south-west.

The monuments and tombs are the most striking objects in this city, of which the most interesting were standing at the period of Mr. Fellows' visit. The first was a stele, about 21 feet high and 7 feet square, covered on the top by a broad overhanging lid, immediately under which were eight bas relievos, representing the well-known classical story of the Stealing of the Daughters of King Pandarus by the Harpies. They are now placed, by the exertions of Mr. Fellows, in the British Museum, and are well deserving of attention, both from the very early period at which they were probably executed, and from the character of their workmanship, which is unlike any sculptures hitherto preserved in the Museum. The second monument was of a different form, being of that peculiar style of architecture which abounds in Lycia, but is never seen in any other country. This monument is also now deposited, together with the sculpture, in the British Museum, having been procured for it during the last expedition to Xanthus; there can be no doubt but that it will be reconstructed. It will be here interesting to give the description of this tomb, as given by Mr. Fellows in his Tour in Asia Minor.

It is a sarcophagus, entirely of marble, standing on the side of a hill rich with wild shrub. The roof is somewhat grey, and the fractures of the lower parts are tinged with the shade of red which the marble assumes after long exposure to the weather, and in places with yellow blended with brown. On the top, or hog's-mane, is a hunting scene; some figures are running, others are on horseback galloping, with spears in their hands and mantles blown by the wind, chasing the stag and wild boar, which has turned to attack the pursuer; the whole of the figures, although in a small frieze, are well formed and finished. On each of the sloping sides of the roof are two stones projecting about a foot, as found on all these tombs, but which upon this are carved into lions' head crouching on their paws; upon one side of the roof is a group in which a warrior, carrying a shield, is in the act of stepping into his chariot, which is of the early simple form, with wheels of four spokes only, and is driven by a man leaning forward, with his arms stretched out holding the reins and a whip or goad: four beautifully formed horses, prancing in various attitudes, are drawing the car. The chariot and horses appear sculptured on the other side of the roof, differing only in the attitudes of the figures. In the upper panels at the ends or gables are traces of small carved figures. On the side of the tomb is a group of figures, which I will describe, beginning from the left hand. A finely formed figure in a simple robe, his hands folded before him, and with a head of bushy hair, stands, as if in attendance behind the chair or clawed seat of the principal figure, who, clothed in rich folded drapery, with short hair, sits in the attitude of a judge, with one arm somewhat raised; before him stand four figures; the first is mutilated, but appears similar to the second, who has long bushy hair, confined round the head, and looking like a wig; his attitude is that of a counsellor pleading for the others; the loose robe falls gracefully from one shoulder, and is thrown over, so as almost to conceal one arm; two other figures, differing only in having the hair shorter and the arms hanging down, stand apparently waiting the decision of the judge, and complete the well-formed group. At the end on a larger scale, are two figures of warriors, clothed only with girdles of armour round their loins, and petticoats reaching nearly down to their knees. The background on the same stone contains a long, but, from mutilation, partially illegible inscription, which I did not attempt to copy. On the opposite end of the tomb are two other figures of the same size; one, clothed in a loose robe, stands in a commanding attitude fronting the spectator, with an arm raised over the head of a naked figure also standing.

On the other side, under a single line of inscription, is an animated battle-scene; men on horses are fighting with others on foot; all have helmets, and those on foot have shields; some fight naked, others with a loose shirt or blouse descending below the thighs, and confined by a belt to the waist. The horse of the principal figure is ornamented with a plume, and the rider has a kind of armour to protect his legs. The groups upon the two sides are three feet six inches high, by nine feet in length.

The *hog's-mane* does not at either end extend to the full length of the roof; and at each extremity of it is a niche for attaching another stone. It is probable that there may have been at each end, when the tomb was perfect, some ornament, perhaps a helmet, or figure of an animal corresponding in character with the other subjects. It is not surprising that so beautiful a tomb should have been broken open in all parts; but as each chamber is now exposed, I trust that it may not receive further injury.

Mr. Hawkins next proceeds to give some account of the last monument brought over to this country from Xanthus, and of the reasons which induced him to restore it in the manner shown in the drawing exhibited; the only part of the building which was visible above ground was a basement, 33 feet long by 22 feet wide, formed of rough blocks of the limestone of the country. In making the excavations Ionic bases, shafts, and capitals of columns were found; these were all of small dimensions, the columns not being more than 14¼ in. diameter at the bottom. A considerable quantity of egg moulding was also found; it was pierced on the top with a mortice hole to receive the base of the column, and the circle of the base is also marked upon it, but near to these marks, in almost every instance, there occurred an irregularly shaped sinking, this was accounted for by finding draped statues of dancing females, the plinth of which had been let into the egg moulding; thus far there was ascertained that the statues and columns came alternately, and that they were placed upon the egg moulding. Sculptured friezes of four different sizes were formed —3 ft. 4 in., 2 ft., 1 ft. 7½ in., and 1 ft. 5½ in. respectively in width—the two larger were in stones not exceeding 5 feet in length, and therefore too short and also too large to have been placed *over* the columns, they are therefore placed round the base. It becomes, however, necessary to give some authority for assigning to a building so lofty a base. Now the tomb of Mausolus, at Halicarnassus, has always been considered to have had a similar arrangement. In the work of Canina there is a beautiful restoration, which, with the exception of the pyramidal top, is precisely similar to this building.[1] There is also in Caria a monument still existing which, although of later date, has still the same characteristics of a lofty base surmounted with columns, Mr. Hawkins alluded to that at Mylassa, given in the Ionian Antiquities, this although unornamented with sculpture, has still the same arrangement of building; and there exist many tombs, at Alinda in Caria, and at Hierapolis in Phrygia, of the form of the base, but not having at the

[1] The restoration of Canina's, however, is taken from a medal which has a head of Artemsia on one side and the Mausoleum on the other, but it is now always considered to be a forgery of the 15th century, it is therefore of no real value, except to show what was the generally received idea of the Mausoleum at that time, when the Italian architects were certainly giving a great attention to the works of antiquity.

present time any columns on the top, all these have however an entrance into the basement, Mr. Hawkins therefore placed one in the base of this building, making use for that purpose of an architrave and part of a cornice which were found close at the foot of the east end of the building. The egg moulding on which the columns and statues stood became the cornice of the base. It next became necessary to find the various members to form the cornice of the building, but during the whole of the excavations no details at all corresponding to an architrave could be found; but taking into consideration the great quantity of sculpture with which the building was ornamented, it was probable that the frieze was also sculptured, and on examining the frieze, 1 ft. 7½ in. in depth, it became evident that that had stood upon the columns, their greater length, being about 7 feet long, admitting of such an arrangement, and the under surface showed where it had rested on the columns, as those parts were quite protected from the weather.

The frieze then occupies the space usually given to both frieze and architrave; the cornice over it is of great size, and disproportioned to the building; but as the different details were found round the base of the building, there can be no doubt but that they belonged to it, there being also evidence on the stones themselves that they do so. Mr. Hawkins places in the cornice a row of dentils, but he does not carry them up beneath the corona of the pediment, the only argument against them is the exceedingly small number which was found: but the arguments in their favour are, he considers, conclusive. In the first place, there is, he believes, no instance in the whole of Asia Minor of an Ionic cornice omitting the blocks; again, two different sizes of corona were found, one projecting 10½ inches from the bed mould, the other 4¾ inches, but on the underside of the latter marks were found which proved the existence of blocks, the exposed parts being weather-beaten, and by omitting the blocks in the pediment it lightens the cornice, and gives an opportunity for using the more projecting corona. It is from the size of the tympana (portion of that belonging to each end of the building being found), that we are enabled to ascertain with considerable accuracy the *width* of the building; of course it would not be easy to lay down so acute an angle quite truly, but certainly within a very little, and the width thus arrived at is confirmed by the length of the stones which form the frieze. The exact length of the building is less easy to ascertain. There is one piece of evidence which Mr. Hawkins thinks will prove satisfactorily the length of the building to be very nearly what he has drawn it, namely, that upon the base, which still exists, there are the marks of the bed worked for the next course; this bed extends 1 ft. 9 in. inwards from the face of the work, it is therefore evident that the next course of stones must have extended to that size; now there is no evidence of any other stones to be placed upon this, except those of the Parian marble, these stones are all 1 ft. 4 in. thick, and therefore could only have been set in 5 inches from the face of the base—this will apply both to the length and width; the only objection that has been made to this is that by this arrangement it requires 6 columns to form the flank, but he thinks there are many instances of an equal number of columns to the flank of buildings. Temple of Jupiter Penellenius at Egina has 12 columns in the flank, and 6 in front; again, the Temple of Jupiter Olympus at Athens had 20 columns in front, and 20 at the side; also one of the temples at Agrigentum. A question which will, however, be eventually set at rest when the friezes of the base have been properly arranged in the Museum; at present, it is sufficient to know that it is possible to place the stones so as to suit the arrangement he has proposed.

The last object was to assign a place for the smaller frieze, Mr. Cockerell suggested that the building was peristyle, enclosing a cella, and that the smaller frieze ought to be placed round it, and this arrangement is somewhat confirmed by the actual quantity of the frieze which was obtained during the excavations.

Specimens of all the details which Mr. Hawkins mentioned have been brought to England, and are now placed in the British Museum. The Lacunaria are well worth attention, as they retain somewhat of the colour with which they were originally decorated; the ovolo mouldings have been coloured to imitate the egg and tongue ornament; and a bead and reel ornament has been *painted* round the soffit, instead of being carved projecting from the face of the stone, as was the case with the Lacunariæ of the Erechtheium, one of which is now deposited in the Elgin Room. It now only remains to give some description of the sculptures with which this building has been ornamented.

It was apparently built for the purpose of commemorating the capture of the city of Xanthus, or perhaps for the tomb of some person or persons intimately connected with that work. The largest frieze represents, on all the four sides, an indiscriminate combat, some of the combatants being on foot, some on horseback, some are draped in long flowing robes, while some appear to be destitute of all clothing, some of the horses are remarkable as having the short cut mane which is to be seen on the sculptures of the Panathenaic processions from the Parthenon. The next frieze in size, and placed over the last described, represents the capture of the city of Xanthus, by Harpagus, the General of Cyrus, which event took place 546 B.C. This event is described by Herodotus; and it will be as well to give the description here, as it will be seen that the sculptures follow very closely his account; he writes as follows:—

After these successes Harpagus drew his army into the plain, in order to attack the Lycians of Xanthus, who, though they are few in number yet having assembled what forces they could, took the field and fought the Persians with great courage. But being overpowered with numbers, and forced to retire into the city, they put their wives, children, and servants, with all their riches into the castle and set fire to the place, which when they had done, and all was burnt, they engaged themselves by the strongest oaths to die together, and to that end, returning to the field of battle, they renewed the fight and were cut to pieces to the last man.

This frieze may be divided into four subjects, one represents the fight which took place outside the walls; the next a sally from the city, which is being repulsed by the attacking party; the third the storming of the city, where the ladders are seen placed against one of the towers, and the storming party are climbing up the ladders, evidently intending to take the town by surprise, as they have divested themselves of all covering to their feet; the fourth side appears to represent the trial of some prisoners before some Eastern chief seated on a chair, this figure is not improbably meant to represent Harpagus. The frieze placed round the tops of the columns may also be divided into four subjects, one for each side of the building; the first represents a fight, some of the combatants being on foot, some on horseback; the next represents a procession, the people being in Greek costume, bearing offerings in fruit and cattle; the third is a Persian offering, those bearing the offerings being clothed in Persian costume, and bringing those offerings most prized in the East—fine clothing and horses; on the fourth side is a very spirited wild boar hunt, the huntsmen being mostly on horseback, but some are on foot, and their horses appear to be running wildly about as if they had thrown their riders. The small frieze, which is placed round the cella, appears to represent the feasts and sacrifices which are so frequently painted upon the tombs of Greece and Etruria.

The dancing figures between the columns are all standing on some emblem, either a fish or a bird. Statues of a smaller size are also placed on the acroteriæ. The tympana are also sculptured, the one with a very spirited battle scene, the other represents a male and female seated opposite each other, with figures standing behind them diminishing in size as they approach the angle of the pediment.

There must be of course many conjectures with regard to the date of the building; history, as yet, gives us no clue whatever;—two ways remain, one is to judge from the architectural detail, the other from the sculptures. With regard to the architecture, it will bear comparison both with the Temple at Samos, which is admitted to be one of the earliest existing specimens, while at the same time many of the details are very similar to those of the Temple of Minerva at Picene, which we know, from an inscription on the temple, was built by Alexander. One argument in favour of its antiquity is, that it was apparently built to commemorate the taking of Xanthus, which took place as we have seen 546 B.C., and it is not likely that the conquerors would have waited more than one century to erect a trophy of their success; yet it is also possible that some wealthy descendant of Harpagus, whose son we know was made governor of that district of Asia Minor, might, at some much later period, have wished to commemorate the actions of his ancestor. With regard to the date of the sculptures, Mr. Hawkins thought it would be better to wait for the opinion of those gentlemen who have made such matter their study, and who therefore will probably be able to produce conclusive evidence to support whatever opinions they may advance.

The Desert of Africa.—At the *Academie des Sciences*, at Paris, M. Fournel, an engineer of mines, gave an account of his travels in the Desert of Africa. Amongst other things, M. Fournel furnishes the heights above the level of the sea at sixty places. Constantina, he states, is 2083 feet above the level of the sea; but the oasis of Biskara, which is only 60 leagues from Constantina, is but 246 feet above that level. M. Fournel considers, that by sinking Artesian wells, it would be practicable to have a constant and abundant supply of water throughout the whole extent of the Desert. Some of the variations of temperature recorded by M. Fournel are curious. He informs us, that in the night of the 16th of March last, whilst bivouacking on the plateau of Batnah, the thermometer stood at 6° below zero, whereas during the day it had risen to 33°.

COMPARATIVE LOSS BY FRICTION IN BEAM AND DIRECT ACTION STEAM ENGINES.

A paper purporting to be a mathematical investigation of this subject was read in February 1843, before the Institution of Civil Engineers, by Mr. William Pole. It is here proposed to examine the correctness of Mr. Pole's investigations; for though the period of publication be by no means recent, the subject is not one of merely passing interest which renders a postponed review useless, and as the paper has been rewarded by a "Silver Telford Medal," it comes before the public with the authority of the Institution of Civil Engineers, and therefore if inaccurate, may deceive many who take for granted the conclusions of a mathematical paper which they are unwilling or will not take the responsibility of investigating.

It may as well be stated, without circumlocution, that the object of the present review will be to show that errors are committed in Mr. Pole's paper, not merely of a casual nature or numerical, but arising from assumptions so essentially false that they can scarcely be supposed to have been promulgated by a person adequately acquainted with theoretical mechanics. It will also be here attempted to be proved that these erroneous conceptions totally vitiate the practical tabulated results deduced from them.

We will first, before entering on the discussion, premise that Mr. Pole's paper is founded on the following preliminary considerations, to which we do not at present offer any objection:—the friction alone investigated is that, which arises at joints and axles by the strain caused by the action of the engine itself; the friction arising from tightening "stuffing" or "packing" the parts is excluded; the laws of friction assumed are those usually laid down in mathematical books, though Mr. Pole is doubtless aware that experimentalists are by no means agreed upon their absolute accuracy; the total friction at a joint is made to depend on the degree of pressure at that joint, and the space passed through by the rubbing surface, conjointly; the whole pressure of steam is reckoned uniform, and $= P$; the inertia and weight of the machinery is disregarded. We now proceed to quote the first case examined by Mr. Pole, and his explanation of the figures.

Fig. 1. Fig. 3. Fig. 2.

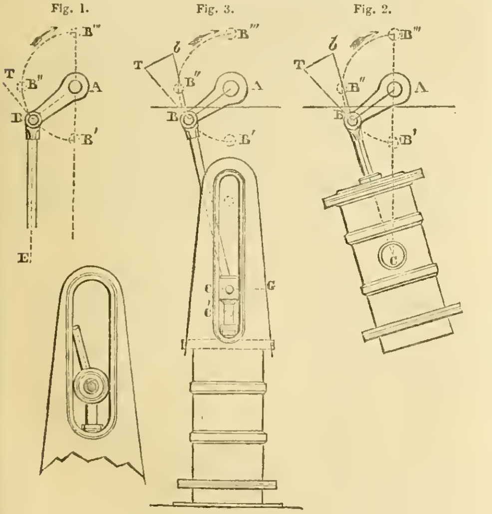


Fig. 4.

"10. Figs. 3 and 4, show the *direct action* engine; fig. 2 the *vibrating* engine; and fig. 1 the supposititious arrangement referred to in the next Article. It is almost needless to add, that only as much of each is shown as is necessary for explanation, other parts being omitted to avoid complexity.

"In the following calculations, a, b, c, d, &c., represent the radii of the bearings marked A, B, C, D, &c., respectively in the figures: $r =$ A B, the radius or length of the crank; $l =$ B C, the length of the connecting rod; and P is put for the supposed uniform pressure acting on the piston, or transmitted through the engine.

"The friction will be calculated in each case for a single stroke of the piston, *i.e.* for a semi-revolution of the crank, from B′ to B‴. That for the back stroke, completing the circle, will be equal to this in amount.

"It will be advantageous in some few instances to simplify the expressions by taking approximations; but in all these, the deviation from the truth is so slight as to be unimportant, and not affecting the general correctness of the result.

"11. We may first examine the simple arrangement shown in fig. 1, where the uniform force of the piston is supposed to act upon the crank pin B in a direction always parallel to itself and to the line B′, B‴. This would assume the connecting rod indefinitely long, which cannot exist, except in hypothesis: the arrangement may therefore be called for distinction, the

Hypothetical Engine.—The friction to be determined will be that upon the two bearings A and B, the crank shaft and the crank pin.

"12. *For the bearing* B. The pressure upon this bearing will be constant, by the supposition, and $= P$: therefore the *resistance* from friction will also be constant, and $= m\,P$.

"Now if $b =$ radius of gudgeon, the *space* passed through by the rubbing surface will $= b$ multiplied into the angular distance the gudgeon moves in its bearings. This angle, in a semi-revolution of the crank, will $= 180° = \pi$; and the surface will pass through a space $= \pi\, b$; whence the *loss by the friction* of this bearing in a semi-revolution, will, (Art. 7), $= m\,P\,\pi\,b$.

"13. *For the bearing of the crank shaft* A. The pressure upon this is not constant, as it is on B, but varies with the position of the crank. When this latter has moved from B′ through any angular distance B′ A B, which call θ, the force P acting upon B will be resolved into two; one in the direction of the tangent B T, tending to turn the crank round, and the other in the direction B A (or A B if $\theta > 90°$): the latter will be the pressure upon the bearing A, and will be found by the rules of statics to be $= \pm P \cos\theta$, the upper sign being taken when $\theta < 90°$, and the lower from 90° to 180°: hence the *resistance* from friction $= \pm m\,P \cos\theta$," &c.

We do not transcribe the whole of the investigation, as the above furnishes all that is requisite for our purpose. It will be seen that in (12) the pressure at B is assumed as uniform, and $= P$. Nothing can be more remote from the truth, and we really cannot help observing that, to use the mildest terms, it seems almost incredible that a person who understood the fundamental laws of motion could make the assumption. The pressure at B depends not only on the steam pressure, but also on the amount of work to be done—the resistance offered by the crank, and its consequent velocity. If we suppose this resistance zero, the pressure at B will be zero also;—so far from its being *always* $= P$, it will be *never* equal to it while the engine is in motion; for if the two ends of the piston rod were acted upon by two equal and opposite forces P, we should have a system statically disposed, and the piston would be at rest, or move forward with uniform velocity which it does not, since it changes its direction many times in a single minute.

This one simple consideration ought to be quite sufficient to set the matter at rest; but as the whole of Mr. Pole's conclusions depend on this fatally erroneous principle, we may be forgiven for adducing a few illustrations to show that the pressure in such a case as the present depends on the resistance which the prime-mover meets with.

If a body lying on a smooth table be drawn along it by a string passing over the edge of the table, and fastened to a second descending body, does Mr. Pole suppose the tension of the string $=$ the impressed moving force, namely, the weight of the descending body? If the problem be worked correctly, it will, we think, be found that the tension depends on the mass of both bodies.

If two particles descend vertically by their weight alone and one of them lie upon the other, is the mutual pressure equal to the impressed moving force of the highest—its weight? If Galileo be any authority there will be no mutual pressure at all.

By D'Alembert's principle, the effective moving forces of a material system are equated with the impressed; by Mr. Pole's, the impressed moving forces may be equated alone.

The following consideration also might, we should have thought, have prevented the above assumption being made—the piston rod moves with variable velocity; when the crank is at its highest or lowest, very slowly; when the crank is horizontal, rapidly. How then can a body acted on by constant forces alone (as the piston rod is, if the steam pressure at B, reaction at B be constant) move rapidly and slowly by turns?

The following is offered as an attempt to calculate correctly the reaction in one of the simpler cases of the problem.

A constant vertical force P acts at the end of the piston rod E, and the force retarding rotation has a constant moment N about A. To determine the motion, neglecting weight and friction.

m, the mass of B E, M k^2 the moment of inertia about A of A B and parts attached. Then, using the other letters as before, the moment of impressed forces about A will be

$$P\, r \sin \theta - N;$$

$P\, r \sin \theta$ estimates the moment of P correctly, because $\sin \theta$ is negative when the rod descends; x, the vertical height the rod has risen from its lowest position at time t—excluding the consideration of its lateral motion by the idea of its length being indefinitely great. Hence by D'Alembert's principle, the equation of moment is

$$P\, r \sin \theta - N = m \frac{d^2 x}{d t^2} r \sin \theta + M k^2 \frac{d^2 \theta}{d t^2} \qquad (1.)$$

But by the geometry

$$x = r \text{ versin } \theta$$

$$\frac{d x}{d t} = r \sin \theta \frac{d \theta}{d t}.$$

Hence multiplying (1) by $\frac{d \theta}{d t}$ we get

$$P\, r \sin \theta \frac{d \theta}{d t} - N \frac{d \theta}{d t} = m \frac{d^2 x}{d t^2} \frac{d x}{d t} + M k^2 \frac{d^2 \theta}{d t^2} \frac{d \theta}{d t}.$$

Integrating

$$C - P\, r \cos \theta - N \theta = \tfrac{1}{2} m \frac{d x^2}{d t^2} + \tfrac{1}{2} M k^2 \frac{d \theta^2}{d t^2}.$$

And if when $\theta = 0$ $\frac{d \theta}{d t} = \omega$,

$$P \text{ versin } \theta - N \theta = \tfrac{1}{2} (m r^2 \sin^2 \theta + M k^2) \left(\frac{d \theta^2}{d t^2} - \omega^2 \right) \qquad (2.)$$

Which determines the velocity of the crank for every position.

If R denote the reaction at B,

$$R = P - m \frac{d^2 x}{d t^2} \qquad (3.)$$

But $\frac{d x}{d t} = r \sin \theta \frac{d \theta}{d t}$

$$= r \sin \theta \left\{ 2 \frac{P\, r \text{ versin } \theta - N \theta}{m r^2 \sin^2 \theta + M k^2} + \omega^2 \right\}^{\frac{1}{2}} \qquad \text{from (2.)}$$

Differentiating with respect to t.

$$\frac{d^2 x}{d t^2} = r \cos \theta \left\{ 2 \frac{P\, r \text{ versin } \theta - N \theta}{m r^2 \sin^2 \theta + M k^2} + w^2 \right\}$$

$$+ \tfrac{1}{2} r \sin \theta \frac{P r \sin \theta (m r^2 \text{versin}^2 \theta + M k^2) - N \{ M k^2 + m r^2 (\sin^2 \theta - \theta \sin 2 \theta) \}}{(m r^2 \sin^2 \theta + M k^2)^2}$$

Substituing this value of $\frac{d^2 x}{d t^2}$ in (3), we have the value of R in terms of θ, &c.; and it will be seen from the exceedingly complicated nature of this expression, even in the simplified form of the problem which we have taken, how remote from the truth is Mr. Pole's assumption.

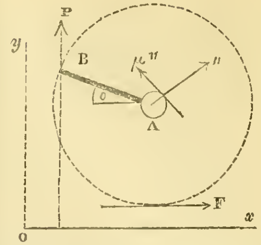
We have dealt with this first error thus particularly because, being the basis of every one of the calculations which follow, it totally vitiates them all, and, even if no other error occurred, must condemn the whole paper.

But even if this first objection were not fatal, there would be found many others entirely invalidating the results. In Art. 13, quoted above, it is assumed that the pressure on the bearing A lies along A B. Nothing can be more erroneous. The direction of the pressure is a function of many variables, as we will presently shew. We may, however, previously observe that the double sign in the expression

$$\pm P \cos \theta$$

is sufficient confutation of the assumption from which it is deduced. When the expression passes from one sign to the other it must pass through zero. Hence when the crank is horizontal there must be *no* pressure on its extremity A! That is, the crank will support itself and its concomitant machinery by some virtue of its own! On this supposition, if the end of a beam rest on a table the beam will support itself horizontally; which case by no means agrees with our usual experience.

The following problem will, we submit, shew that the direction of the pressure depends on many quantities. We have omitted all the machinery but the crank itself, and exclude also the consideration of gravity.



An uniform crank A B, revolves about A, acted on at B by a constant vertical force P. A constant retarding force acts at the lowest point of B's path tangentially. The end A turns on an axle with friction. To determine the direction of the pressure on the axle.

The axle will touch the hole in which it works at one point. Let π be the pressure normal to the two circles, and $\mu\, \pi$ the friction tangential to the two circles. X, Y the resolved parts of the pressure along the axes of co-ordinates $O x$, $O y$. Then the resolved parts of the friction are

$$-\mu X, \qquad \mu Y.$$

Let r be the distance of any particle of A B from A; its co-ordinates are

$$r \cos \theta, \qquad r \sin \theta;$$

θ being the angle through which A B has revolved from the horizontal at the time t. If m be an unit of the mass of the crank, the resolved effective forces of the particle are

$$m\, d r \frac{d^2 (r \cos \theta)}{d t^2}, \qquad m\, d r \frac{d^2 (r \sin \theta)}{d t^2}$$

A B $= a$, radius of axle $= c$.

The equation of horizontal forces is by D'Alembert's principle

$$F + X - \mu X = \int_0^a \left\{ m\, d r \frac{d^2 (r \cos \theta)}{d t^2} \right.$$

$$= \frac{d^2 \cos \theta}{d t^2} \int_0^a m\, r, d r$$

$$= \tfrac{1}{2} a^2 m \left(- \cos \theta \frac{d \theta^2}{d t^2} - r \sin \theta \frac{d^2 \theta}{d t^2} \right) \quad (1.)$$

The equation of vertical forces,

$$P + Y + \mu Y = \int_0^a \left\{ m\, d r \frac{d^2 (r \sin \theta)}{d t^2} \right\}$$

$$= \tfrac{1}{2} a^2 m \left(- \sin \theta \frac{d \theta^2}{d t^2} + \cos \theta \frac{d^2 \theta}{d t^2} \right) \qquad (2.)$$

If the moment of inertia about A be $M k^2 = \frac{1}{3} M a^2$, the equation of moments is

$$R\, a \cos \theta - F\, a - \mu \pi c = \tfrac{1}{3} M a^2 \frac{d^2 \theta}{d t^2} \qquad (3.)$$

Integrating (3) we get the value of $\frac{d \theta^2}{d t^2}$, and substituting in (1) and (2) these values of $\frac{d^2 \theta}{d t^2}$ and $\frac{d \theta^2}{d t^2}$ we get two equations independent of t.

And since the inclination of π to the horizontal is

$$\tan^{-1} \frac{Y}{X};$$

we get that angle exhibited as a function of θ, R, F and m.

The reader may judge hence how near the truth is the assumption above quoted.

We now proceed to other investigations of the paper. After what has been said they may be disposed of more briefly.

"14. We may take, as the next simple arrangement, a form of engine which was early used in steam boats, having been patented and so applied by Mr. Aaron Manby, in 1821, namely,

"THE VIBRATING ENGINE,

"Fig. 2, in which the cylinder being made to oscillate upon the gudgeons C, the connecting rod is altogether dispensed with.

"The friction we have to consider is that upon the three bearings A, B, C.

"*For the crank pin* B. The piston rod acting directly upon this gudgeon, the pressure will necessarily be constant $= P$, and therefore the *loss by friction* in a semi-revolution will be, as in Art. 12,

$$= m P \pi b.$$

"16. *For the gudgeons* C. The pressure upon these will also be uniform = P, and the *resistance* to motion = m P."

(15) is wholly vitiated by the same assumption as (12). An additional source of error is the assuming the pressure at B to lie along B C. If this be so, what force thrusts the cylinder out of the vertical? (16) also assumes the pressures at the two ends of B C equal and opposite, which could only be the case when the rod was at rest. Again,

"17. *For the crank shaft* A. Making the angle B′ A B = θ, as in Art. 13, the constant force P upon the crank pin will resolve itself into two, one to turn the crank round, and the other in the direction of the length of the crank, which latter causes the friction upon the crank shaft bearing.

"While the crank pin is travelling from B′ to B″, this pressure will be in the direction B A, and at B″ it will vanish, and from B″ to B‴ it will be in the direction of A B.

This is all totally wrong. The reaction at A is assumed to be along A B, whereas the direction of the pressure is a function of many variables, as we have shewn for a similar case.

We have not quoted the rest of the investigation. Assumptions, which do not even approximate to the truth, can hardly lead to results worth transcribing.

"18. We may now proceed to consider the

DIRECT ACTION ENGINE,

as the form shown in fig. 3, (or with the modification as in fig 4,) is generally termed.

"The friction in this will arise from the strain upon the bearings A, B, and C, and from that upon the guide at G. In each of these cases the strain varies as the engine moves, and each will therefore require the application of the calculus for its solution.

"Let A B, = the length of the crank, = r; and B C, the length of the connecting rod, = l. Let θ = any angle B′ A B described by the crank, beginning from B′, and ϕ = the corresponding angle B′ C B. Also let P be the uniform force exerted by the piston rod, and a, b, c, the radii of the gudgeons A, B, C, respectively.

"19. *For the bearing* C. At this joint the pressure P resolves itself into two, one in the direction C G, perpendicular to the resisting surface of the guide (= P tan ϕ), and the other along the connecting rod C B $= \frac{P}{\cos\phi}$. The latter is the pressure upon the gudgeon, and the *resistance* from friction will therefore be $= \frac{m P}{\cos\phi}$."

The web of error seems here beyond disentanglement. We may however, be safe in saying that the pressure at C does *not* = P. Mr. Pole has resolved a force at right angles to its own direction!

"20. *For the crank pin* B. The pressure upon this gudgeon, and consequently the *resistance*, will be the same as for the last-named,

$$= \frac{m P}{\cos\phi}.$$

"While the crank is moving from B′ to B″, and the angle φ is increasing, the differential of the *space* the rubbing surface moves through

$$= b\left(1 + \frac{\cos\phi}{\sqrt{\frac{r^2}{l^2} - \sin^2\phi}}\right) d\phi; \qquad \text{(Note C.)}$$

and therefore the *loss* in this space

$$= m P b \int_0^{\sin^{-1}\frac{r}{l}} \left(\frac{d\phi}{\cos\phi} + \frac{d\phi}{\sqrt{\frac{r^1}{l^2} - \sin^2\phi}}\right).$$

"But when the angle φ comes to decrease, or while the crank moves from B″ to B‴, the differential is

$$= b\left(1 - \frac{\cos\varphi}{\sqrt{\frac{r^2}{l^2} - \sin^2\varphi}}\right) d\varphi, \qquad \text{(Note D.)}$$

and the *loss*

$$= m P b \int_{\sin^{-1}\frac{r}{l}}^{0} \left(\frac{d\varphi}{\cos\varphi} - \frac{d\varphi}{\sqrt{\frac{r^2}{l^2} - \sin^2\varphi}}\right).$$

"NOTES."

"(C.) Art. 20. Let θ, ϕ, r, l, b, be as in the text, and produce the line C B to b. Then the space the rubbing surface will have passed through during the motion of the crank from B′ to B, will be = $b \times$ angle b B A. But b B A = $(\varphi + \theta)$ and $\sin\theta = \frac{l}{r}\sin\phi$.

$$\therefore \text{ space} = b\left(\phi + \sin^{-1}\frac{l}{r}\sin\varphi\right)$$

$$\text{and } d.\text{space} = b\left[d\varphi + \frac{\cos\varphi}{\sqrt{\frac{r^2}{l^2} - \sin^2\varphi}} d\varphi\right].$$

"(D.) Idem. Beyond B″, $\theta = \pi - \sin^{-1}\frac{l}{r}\sin\phi$, therefore the second term of the differential changes its sign."

Here the impressed forces are equated without the effective, in violation of D'Alembert's principle; secondly, the pressure is assumed to lie along B C, in which case there would be no force to thrust it out of the vertical. But we have quoted the above principally on account of the notes. From note C it would seem that the geometrical considerations of this paper are not conceived in a happier spirit than the mechanical principles. We would humbly submit that *if* the pressure lie along B C, the rubbing surface will move through a semicircle for a semi-revolution of the crank. When the crank is in its lowest position A B′, the highest point of the circular pivot presses on the highest of the hole in which it works; when the crank is in its highest position, the highest point of the pivot presses on what was at first the *lowest* of the hole. Therefore, as the pressure is continuous, the rubbing surface has described an angle = π. It is remarkable that in the exactly analagous case at (15) this error has not been made.

We omit several of the following articles; not because they afford no materials for comment—on the contrary they are every one erroneous—but because they repeat errors which we have already exposed. The last quotation we shall make is from (24), where the direct action engine continues to be spoken of. After a totally fallacious investigation of the friction against the guide, it is added:—

"23. In fig. 4, a friction roller is added to the preceding arrangement, which causes the motion against the guides to be a rolling instead of a sliding one. The friction from the *rolling* will be very small if the surfaces be hard and well faced, and may be neglected altogether. That from the *rubbing* of the axle in its bearings will be to the amount in the last Article as the radius of the axle is to that of the roller. Let the former = v, and the latter = u, then the friction will be, &c."

Here, again, all is wrong, the diminution of friction will not be in proportion to the radii of the axle and roller only. The rubbing space will be diminished in proportion to the radii, and the leverage will be increased in such proportion to the radii. So, according to Mr. Pole's own plan of making the total resistance equal to the friction multiplied by the rubbing space, the two frictions here will be as the squares of their radii. If the radius of the axle be $\frac{1}{4}$ that of the roller, its friction will be $\frac{1}{16}$ that of the roller—Mr. Pole would make it $\frac{1}{4}$: a slight discrepancy truly.

We shall not make any further extracts, because most of the subsequent errors seem to be of the same nature as those which we have already examined; and we wish to be as brief as possible. We can, however, state circumspectly and with perfect confidence that in *every* paragraph one or more of these errors occur. Had one single article been free from them we would have gladly quoted it here, in contrast to those reviewed above. But, however ungracious may be the task of dwelling on errors, we are compelled, after a careful examination of every paragraph, to declare that *not one* approximates even in the remotest degree to the truth.

It will be observed that the errors which we here exhibit, arise, even if we admit that the considerations entertained by Mr. Pole are all that affect the case. But there are two circumstance which powerfully influence the question which we wish to mention, as no notice of them has been taken in this paper.

First, it was premised by Mr. Pole that he should omit all consideration of friction arising from the tight working of joints. Now if the cylindrical hole of a joint presses the axle on all

[1] On reperusal of our remarks, the error here alluded to appears to be κατ' ἐξοχὴν "the gem of the collection." We once thought that many of Mr. Pole's errors arose from his believing by some strange hallucination that he was discussing a statical instead of a dynamical problem. But the resolution of a force at right angles to its length is referable to no system of either statics or dynamics with which we are acquainted.

sides, any strain on the rods would, by pressing one side of the axle closer against the hole, relieve the pressure on one half the axle and increase it on the other half.

The next point is, that the pressure of the piston cannot be fairly considered constant, as the steam is cut off before the stroke is finished, that the piston may gradually come to rest at either end of its path.

It is important that it should be understood that the errors above commented on are not rectified even on the assumption that the problem is statical and not dynamical. The class of errors first considered would, indeed, be removed by this assumption, but the rest would remain. Take one instance beside that of resolving a force at right angles to its direction—the direction of the pressure at A would, on either of the suppositions, be affected by the direction of the resistance offered to the engine.

We cannot help thinking that the problem which Mr. Pole has attempted to discuss is infinitely too complicated for solution, without several hypotheses be first made to simplify the analysis; and these hypotheses must be the result of careful experiments. If there had been even *some* resemblance to truth in Mr. Pole's investigations, those who came after him might have supplied his deficiencies. As it is, however, we have to regret that he has thrown away his labour, and perhaps misled others. In the present discussion we think we have laid down no mechanical principle which is not generally recognized by mathematicians; to them, we fear, Mr. Pole's philosophical attainments will appear but small, though perhaps to some general readers the "Silver Telford Medal" will be conclusive against us.

H. C.

SCAFFOLDING FOR LARGE ERECTIONS.

"*Account of the Scaffolding used in erecting the 'Nelson Column,' Trafalgar Square.*" By Thomas Grissell, Assoc. Inst. C.E.—*Read at the Institution of Civil Engineers.*

In adopting the principle of timber scaffolding for buildings, in preference to poles and ropes, Messrs. Grissell and Peto, the contractors, were influenced by considerations of saving both time and expense. They had long been impressed with the want of scientific principle, exhibited in the ordinary scaffolding, and were more readily induced to turn their attention to that now referred to, which they believe to be an essential improvement, and calculated to be of considerable advantage to contractors on large works. The author is well aware of the progress which has recently been made by the civil engineers and architects of this country, but he ventures to claim some share of merit for the practical builders, to whom is committed the execution of the works designed by the engineer and the architect; and when a review is taken of the stupendous public works which have been executed within the last few years, it is evident, that without the exercise of great skill and the introduction of new modes of reducing labour, the amount of work could not have been executed within the time.

The necessity for this reduction of labour on large works had been long felt in the north, and methods had been adopted in consequence, to emulate which, this timber scaffolding was introduced to London. The system had been employed, in rather a rude form, by Mr. Tomkinson of Liverpool, in his quarries and stone yards, for moving stones of large dimensions. Scaffolding of a somewhat similar kind was used in the erection of the Arc de Triomphe, Barrière de l'Etoile, and at the Eglise de la Madeleine, at Paris.

The first time it was used by Messrs. Grissell and Peto, was for the erection of the Reform Club House (Pall Mall), under Mr. Barry, in 1838; then at the large graving-dock at Her Majesty's Dock-yard, Woolwich, under Mr. Walker in 1839, and it is now employed very extensively at the New Houses of Parliament. In these constructions its general applicability was proved, and in the erection of the Nelson Column (commenced in 1840), where it was carried up to the height of 180 feet, its stability at a considerable elevation was fully tested. Its usefulness is manifested, by the facilities which it affords to the workmen, particularly in buildings of stone. By its aid, and with the travelling machine at its summit, one mason or 'setter,' can set as much work in one day, as was formerly done in three days; whilst at least six labourers are dispensed with, who, with the old mode of scaffolding, were always required to be in attendance. It is also well known, that scaffolding poles and cords are not only expensive, but are subject to rapid decay, and after a few years' wear become useless; in fact, the scaffolding of a moderately extensive building costs a large sum when first purchased, but it is almost valueless after a comparative short period of time. Such is not the case with the timber scaffolding, which may be said to be of no greater cost to the contractor than the expense of its erection, which will not exceed in any ordinary case three-pence per foot cube. It is not secured together by either bolts or spikes, so that the waste is trifling, and after having performed its duty as a scaffold, it may be removed piecemeal into the building, at the level of each floor and be used directly for constructing the roof and the internal carpentry of the structure. The timber having become seasoned by its exposure to the weather, is consequently better fitted for immediate use. These advantages have been proved in the buildings which have been mentioned, and after an experience of more than five years, the author strongly recommends the adoption of the system. He also advises its use in moving and working large stones, either for permanent erections, or in masons' yards. If used on a wharf the rent would soon be saved in labour, and by allowing the stage to project 8 feet or 10 feet over the river, the scaffolding would be found to answer the purpose of a crane.

The scaffolding at the Nelson column, designed by Mr. Allen under whose direction the work was executed, is described in the *Journal*, Vol. VI. 1843, p. 409, the annexed engraving is a perspective view.

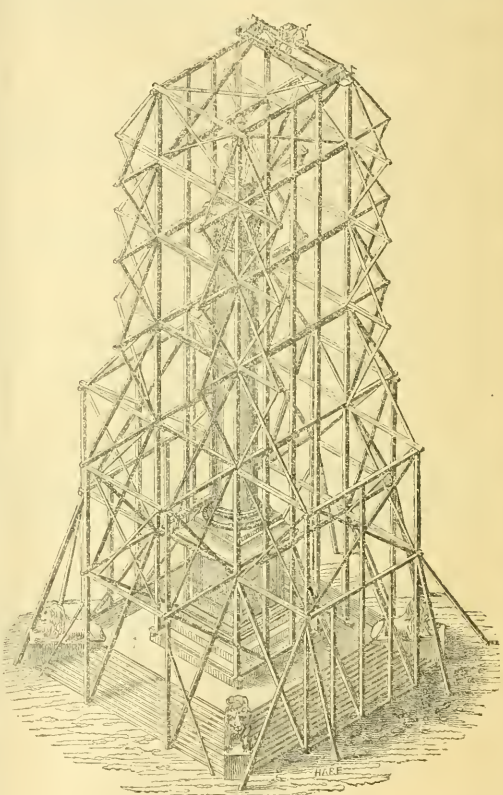


Fig. 1.—Scaffolding of the Nelson Column.

Mr. Nicholson remarked, that a scaffolding of a similar description was used in 1837 by Messrs. Cubitt, (Gray's-inn Road), for erecting the entrance gateway of the London and Birmingham Railway (Euston Square.) It was composed of two parallel rows of whole timber uprights, 50 feet high and 17 feet apart, surrounding the building fig. 2; these were well stayed by diagonal braces, and a tram-way was formed on the top of each row, by horizontal sill pieces, bolted down and secured by plates. The building work was executed by the aid of travelling carriages upon the tram-ways, and when the masonry had reached the height of the first scaffold, a second series of uprights and sills was added, making the total height 90 feet, which enabled the work to be completed without an accident.

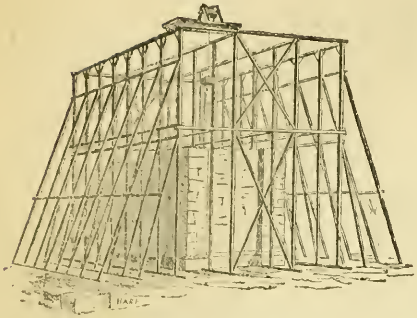


Fig. 2.—Scaffolding used for building the entrance of the Euston Square Station of the London and Birmingham Railway.

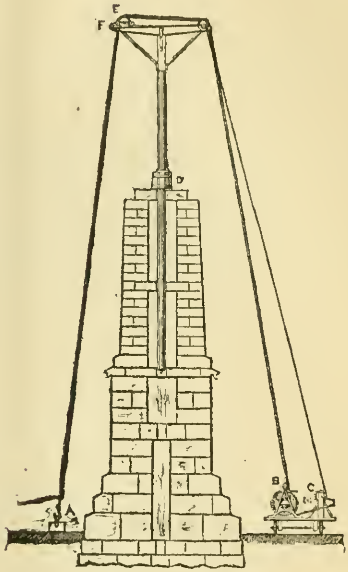


Fig. 4.—The Malcolm Column.

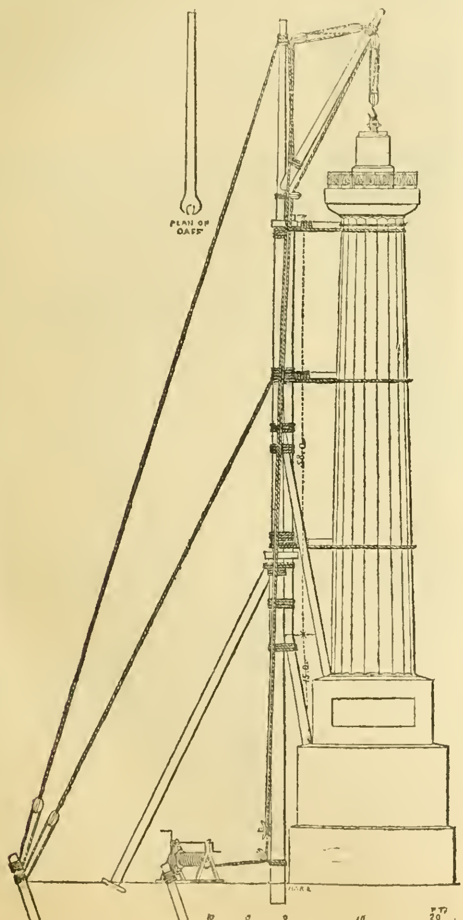


Fig. 3.—Derrick used for building the Commemoration Column at Devonport.

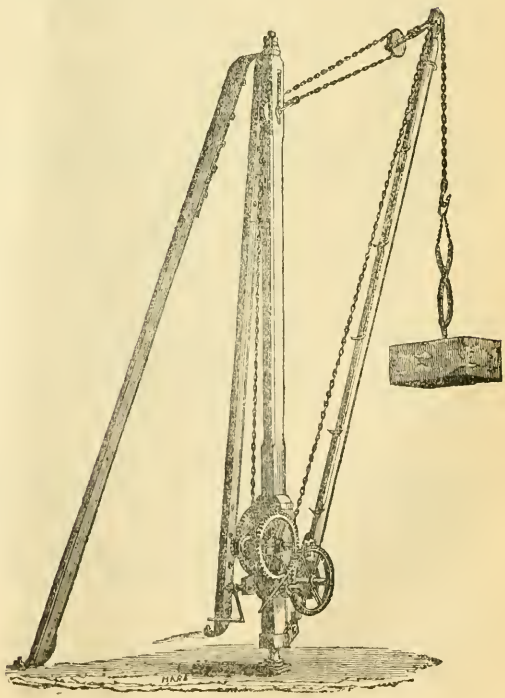


Fig. 5.—Derrick crane used at Granton Pier (Edinburgh.)

Mr. Harrison believed, that a scaffolding of a somewhat similar construction was used by Messrs. Rennie, at the Victualling-yard at Plymouth, in 1826.

Mr. Rennie said, that the scaffolding employed for raising the statue and other heavy parts of the work, at the Victualling-yard, was on the derrick principle, and was somewhat similar to that used for erecting the Commemoration Column at Devonport, fig. 3.

Mr. Grissell stated, that when writing the account of the scaffolding at the Nelson Column, that which had been used by Messrs. Cubitt, at the entrance of the London and Birmingham Railway, had entirely escaped his recollection; he now remembered it perfectly, and was happy to have the opportunity of acknowledging that fact. He could not speak too highly in praise of the system, and he thought its advantages had, as yet, been underrated. The waste of timber was comparatively nothing; while serving as scaffolding it was becoming seasoned, and like that at the Nelson Column, could be immediately worked up, in situations demanding dry timber. The cost was one-half, and sometimes one-third, of the ordinary kind of scaffold, if the loss by the rotting and destruction of poles and cords was taken into account. The saving of labour in raising the materials was very great, particularly where weights of from 8 tons to 14 tons required to be lifted. If steam power had been used at the Nelson Column, a still greater saving would have been effected. Another considerable advantage was the freedom from danger to the workmen; during five years, in all the works where he had used this kind of scaffolding, only one man had been killed. That accident occurred at the Woolwich Graving Dock, when a man was thrown from the travelling carriage, by the handle of the winch striking him, from his having omitted to put on the break. He believed that this description of scaffolding might be safely carried still higher than at the Nelson Column, for although before the statue was hoisted, he had felt sometimes anxious, and had thought of attaching guide chains, and using other precautions, the fabric had stood so well, that he should not now hesitate to go to a greater height, relying upon the scaffolding alone.

Mr. Smith had adopted the system of the travelling winch on a framing, with great advantage in his carving room, for moving the heavy blocks of stone, from which the capitals of the columns for the Royal Exchange were cut. Without such mechanical assistance, he could never have executed his task within the required time, nor could the capitals have been raised and placed on the carriages, to be conveyed away, without much danger of injury.

Mr. Giles said, that Corby Bridge, over the Eden, on the line of the Newcastle and Carlisle Railway, was built by Mr. Denton, the contractor, by means of whole timber scaffolding put together in three stages. The bridge consisted of five arches, of 80 feet span each, 100 feet in height, and contained 400,000 feet of stone-work, which was executed with the greatest facility, chiefly owing to the convenience afforded by the scaffolding, and without any accident, excepting to the foreman, who fell twice from a considerable height, but fortunately was not killed.

Mr. Fowler said, that the scaffolding at the Cathedral at Cologne, was of whole timber; there was little doubt, that the system was very similar to that which was employed, when the building was commenced in 1248. The crane which was used in raising the materials, still remained on the summit of one of the towers; it was once removed, but was speedily restored to its situation, as the superstitious fears of the inhabitants of Cologne were excited by the occurrence of a storm, immediately consequent upon the removal of the crane. It had subsequently been constantly repaired as it decayed, so that at present little of the original remained, but the form was still the same. He believed that the materials for the York Column (Carlton Terrace) were raised by a kind of travelling carriage, on the top of the scaffolding.

Mr. Hawkins observed, that the scaffolds used at Vienna, for the erection of any building of importance, were always constructed of whole timbers, secured together by "dogs." In 1827 he superintended the erection of an extensive sugar-house at Vienna, where such scaffolding was used.

Mr. Colthurst stated, that at Devonport there was a column built of granite from Holman's Hill Quarry, near the Tamar. The shaft was 11 feet in diameter; its height, from the bottom of the shaft to the top of the capital was 65 feet 4 inches. The total height of the column, with its inferior and crowning pedestals, was 101 ft. 4 inches. Its height above the street, including the rock on which it stood, was 124 feet. The abacus of the capital was composed of four stones, each weighing between 3 and 4 tons. The stones of the column were raised and set, entirely without the use of scaffolding, by means of a series of tall spars joined together, fig. 3; the lowest being fixed into the ground and braced by diagonal pieces, was lashed and strutted to the lower part of the shaft. A gaff, with a jaw at the lower end, was then slung in the throat by a strong rope or chain, so as to work round the upright spar, in the jaw prepared for this movement; from the end of the gaff, blocks and a fall were suspended, in such a manner as to command every part of the work, by raising or depressing the point of the gaff, to increase or diminish its range. Crab winches sufficed to raise the stones; and it was stated that the work was executed in a very short time.

Mr. Rendel had seen this column while in course of construction; the derrick appeared to act well; and it was certainly a cheap mode of raising the materials.

Mr. Smith said, that in a recent visit to Liverpool, he had observed an ingenious mode, adopted by Mr. Tomkinson, for raising building materials, which almost superseded the use of external scaffolding. It consisted of a very high double "derrick," placed upon wheels running on a tram-way, laid parallel with the walls of the building; the head of the derrick curved over towards the wall, and steam power was employed for raising the materials, which appeared to be accomplished with rapidity.

The President remarked, that the Institution always viewed with pleasure, papers descriptive of the methods adopted by contractors, in the execution of works designed by Civil Engineers or Architects. The profession was much indebted to the practical skill and intelligence of the contractors, and it would be extremely interesting, to find recorded in the Minutes of Proceedings of the Institution, the names of the inventors, and the dates of the introduction of such ingenious modes of accomplishing works of magnitude, as had been described by Messrs. Grissell and Peto. This could only be arrived at by either the engineers or the contractors sending the necessary information, or by their giving it during the discussions at the meetings.

General Pasley described the method adopted by Mr. T. Slacks (Langholm), for building the obelisk which was erected on the Whitaw, Eskdale, to the memory of the late Major-General Sir John Malcolm, a native of that district. The obelisk, which was of white sand-stone, was carried up to the height of 100 feet above the foundation; it was built hollow, with thorough courses at intervals; through the centre of each of these courses was left a circular hole, fig 4. In the lower of these holes, was placed the foot of a pole 40 feet long, and 10 inches diameter; the next hole above served as a stay, whilst the upper one supported the whole weight, as around the pole was firmly fixed a collar D, of hard wood. Beneath this collar 17 metal balls, 3½ inches in diameter, were introduced, which, running in corresponding circular grooves in the collar and the thorough course, enabled the pole to revolve easily. Across the top of the pole was mortised a beam 12 feet long and 12 inches square, in the form of the letter T, and it was strengthened by diagonal iron braces and straps. By means of a crab winch B, with a rope passing over pulleys in each end of the transverse beam, the stones, as at A, were raised to the requisite height, and by a traversing carriage E, on the beam, a small crab C, and the pulleys F, the stone was enabled to run inwards to the spot for laying it. The crane was raised as each bond or thorough course was fixed, and the time consumed in the operation of moving it did not exceed two hours. This crane had been found very efficient, and had greatly reduced the cost of building the obelisk, which was completed in less than twelve months. For the ingenuity displayed in this simple modification of the balance crane used by Mr. Stevenson, at the Bell Rock Lighthouse, and for a clever hanging scaffolding used for completing the pyramidal top of the obelisk, the Gold Isis Medal was voted to Mr. Slack, by the Society of Arts, in 1836-7.

A model was exhibited, of a moveable derrick crane, fig. 5, which had been presented by Mr. Howkins. It was used by Mr. Wightman at the works of the Granton Pier, Edinburgh, and was stated by him to be very superior to any other kind of crane. It consisted of a vertical post, supported by two timber back-stays, and a long moveable jib, or derrick, which was hinged against the post below the gearing; this jib was held by a chain, passing from a barrel over a pulley at the top of the post, in such a manner that the extreme end of the jib could be raised almost vertically, or be lowered nearly to a horizontal position. The chief advantage it possessed over the old gibbet crane was, that it commanded concentric circles of from 10 feet to 60 feet radius, which was of great use in large works, as it could extend its sweep over a circle of 120 feet diameter, without being moved from its position; whereas, the old gibbet crane commanded only one circle of comparatively limited extent, and in moving it, as the works proceeded, there was a considerable loss of time.

Mr. Bremner stated, that he had seen the crane at Granton Pier; it was a very useful machine, and the only fault he could find with it was, that in an exposed situation, there was a risk of the wheel-work being destroyed. He believed that the contractors had found much advantage from its use. He had used, at the works of Lossiemouth Harbour, a crane of a somewhat similar description. The jib was composed of two spars, with the hoisting-chain working between them; the radius of its sweep was 60 feet, so that any spot within a circle of 120 feet in diameter was fully commanded by it, and that extent of work could be completed without moving the crane.

Mr. Gale presented two drawings of improved moveable jib cranes, the alterations in which had been suggested by the serious accidents which had occurred from the failure of the ordinary cranes. On investigating the circumstances connected with these accidents, he found that in general they had arisen from the snapping of the jib-chain. After numerous experiments, it occurred to him that this defect might be obviated by attaching the jib chain to the top of the post, instead of fixing it to the end of the jib; this alteration was productive of great advantage, the strain was found to be less than one-half that of the single jib crane, and it consequently required fewer men to work it. He had also applied a rope instead of a chain for working the jib, as it was preferred by some builders, and he had also made some minor improvements in the other parts of the cranes. These kind of cranes, were, he believed, introduced by Mr. W. York, at Glasgow, in the year 1833, and Mr. Gale had used the improved sort in 1842, at the erection of the New Court Houses, Glasgow. Since that time many builders had adopted them, and their advantages were becoming daily so evident that he would send, early in the ensuing session, a paper descriptive of them.

Mr. Thomson believed that cranes of this description were first used at Glasgow by builders. The contractor for the Grangemouth Docks, under Sir John Macneil, employed them in 1841 and 1842 with much advantage; he thought them the most useful kind of cranes for general work.

The President agreed in the opinion of the general utility of the cranes; he had been so pleased with them, that he requested Mr. Howkins to present to the Institution the model of that used at Granton Pier. With respect to the date of the introduction of the swinging-jib, or moveable derrick crane, it was used at Granton Pier by Messrs. Orrell of Liverpool, in 1838, and he believed that it had been commonly used by them for some time previously.

Mr. Wicksteed presented a drawing of the tackle used in elevating the pipes of the "stand-pipe" of the East London Water-works, fig. 6. A piece of timber A, 9 inches square, was attached vertically to the upper flanch of the pipe, and held below by an iron girdle B, which encircled the body of the pipe; guy ropes were attached to the top of the upright, which served as the points of suspension for the snatch blocks, through which were passed the fall ropes from the large and the small crab winches. The iron girdle had at its opposite sides two pivots, which traversed the lower end of two timber jibs C, connected at their upper ends by a cross piece D, from the centre of which were suspended the blocks and tackle connected with the large crab, by which the pipes were raised. When each pipe had arrived at its height, the jib frame was drawn up vertically by the tackle from the small crab, and the pipe was lowered to its position; the pins were put into the flanches, and the whole apparatus was raised and attached to it, in order to use it for raising the next pipe. This process was repeated, until the stand-pipe finished at a height of upwards of 130 feet. It was stated to be a very simple and economical mode of proceeding.

Sir M. I. Brunel exhibited a model of the scaffolding used by Sir Christopher Wren in the erection of the Monument, on Fish Street Hill. It was formerly the property of Sir William Chambers, and had been given by Mr. Heathcote Russell, C.E., to Sir M. I. Brunel, who presented it to the Institution. (*See* Engraving in *Journal*, Vol. I., 1838, p. 267.)

Mr. Allen presented a sketch, fig. 7, of the circular travelling crane now in use for erecting the central or ventilating tower at the new Houses of Parliament. It consisted of a circular base curb, at the top of which was fixed a toothed rack. In the centre was fixed a vertical post, with diagonal braces, carrying a centre point, around which the travelling crane worked, with its hoisting crab on the top. At the foot of each leg was inserted a toothed wheel, working into the rack, so that by means of winch handles the whole could be made to revolve. It was stated that the saving in labour was very considerable, but that the saving as compared with the cost of constructing scaffolding would be very much greater.

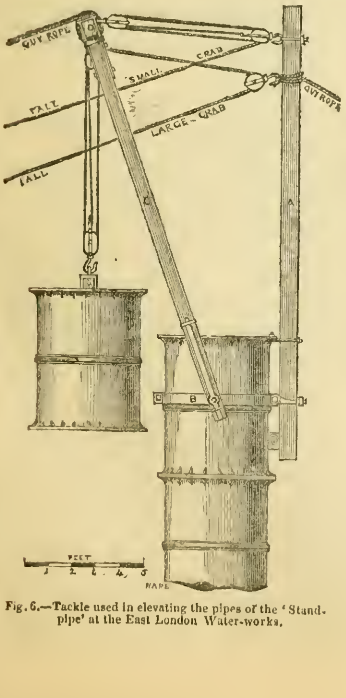


Fig. 6.—Tackle used in elevating the pipes of the 'Stand-pipe' at the East London Water-works.

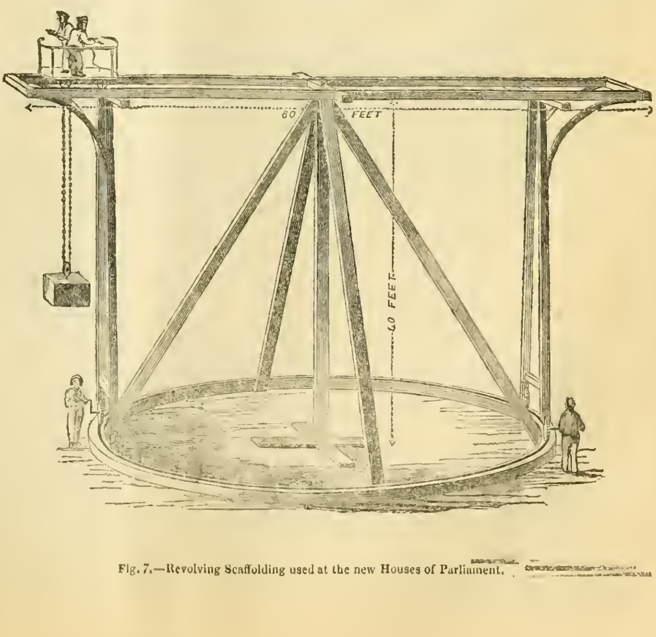


Fig. 7.—Revolving Scaffolding used at the new Houses of Parliament.

M. Pierre Journet described "*A System of Scaffolding, employed at Paris, for the Repairs of Public Buildings, Obelisks, &c.*"

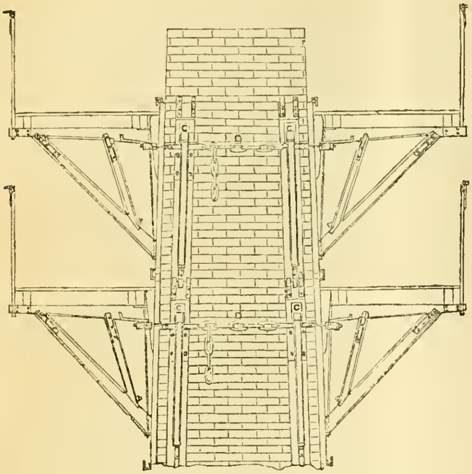


Fig. 8.—Elevation.

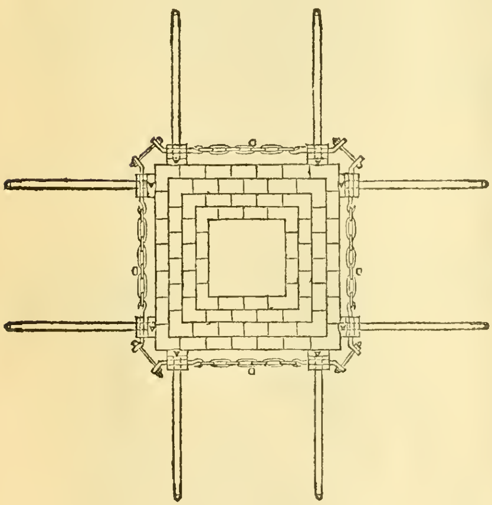


Fig. 9.—Plan.

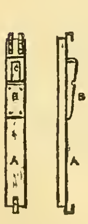


Fig. 10.—Upright Piece.

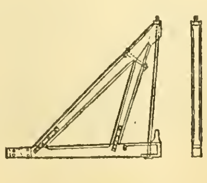


Fig. 11.—Bracket.

M. Journet considers that scaffolding may be divided into two classes; the first to comprise the more substantial kinds, which are employed in the erection of buildings and monuments; the second including the temporary constructions, used for repairing, or decorating the exterior, or interior of public buildings, dwellings, or monuments. He contends that the usual method of constructing scaffolding with poles, lashed together with ropes, is vicious and expensive, and is attended with danger to the workmen. That such a system is not necessary, but that scaffolding should be so constructed that the same materials should always serve, without cutting and without the use of ropes; and that it should be composed of a number of similar pieces, which should adapt themselves to every kind of building. Upon these principles the author designed the scaffolding treated of in the paper, in which he describes its more immediate application to building or repairing high chimneys for steam boilers, or other similar constructions. The distinguishing feature of the system is, that it acts by pressure upon the building, and is supported by it as it rises, no uprights being fixed in the ground.

In the case of the construction of a chimney (figs. 8, 9, 10, and 11), at each side, if it be square, or at given distances around it, if it be circular, are placed upright pieces of deal A, cut to equal lengths of 5 feet; upon each of these is fixed a cleat B, with an entail C, at the top; four binding chains D, with screws at each corner, are braced tight around the chimney at the bottom of the entails in the cleats; into these entails, and hooked upon the irons at the end of the chains, are placed the brackets, fig. 11, which support the scaffolding planks, and at the same time the light railing for the safety of the workmen; all these pieces are made precisely similar. The workmen fix a fresh set at every height of 5 feet, taking the set from below and fixing it above, so that there are never more than two sets in use at the same time, except those which are allowed to remain for forming stages for the ladders. They are placed with great rapidity, and in descending the men detach the uprights and binding chains, which have been allowed to remain in order to consolidate the work, while the mortar dried. The joints can be pointed as the scaffold is removed, and the work can be carefully inspected by the engineer or architect, which in the ordinary modes of construction is not possible.

The author contends that this method is superior to the now usual mode of constructing chimneys, by the workmen standing withinside, upon a scaffold formed upon bars let into holes in the work, and which obliges the men to lean over to do their work. In repairing chimneys, obelisks, columns, &c., he has used it very extensively, and the saving of expense is very considerable.

This system has been adapted in Paris to the construction and repairs, both external and internal, of dwelling-houses with much success, and the author promises, on a future occasion, a description of this application of the principle.

"*Repairing a chimney* 120 *feet high, at the Cotton Mill of Messrs. Couper, Glasgow.*" By Joseph Colthurst, Grad. Inst. C. E.

The way in which the tops of high chimneys have hitherto been repaired has been, either by erecting an outside scaffolding to the full height, or by incurring the, generally speaking, greater expense of stopping the works and allowing the chimney to cool, and then sending a man up the inside, who, by fixing spars across, is able to ascend to the top. To avoid the expense and inconvenience attendant on both these methods of proceeding, the author determined to adopt the following means:—The man engaged to ascend was furnished with a broad leather belt, to which was attached a strong spring hook; ladder irons were next provided, of the form shown in the sketch A, fig. 12, and the man then proceeded to drive them into the joints of the brickwork, at intervals of about 15 inches; then standing on one, and being hooked to that which was immediately opposite to his waist, he ascended, driving the ladder-irons in, one above the other, until he reached the top, from whence he removed some ornamental plates of iron which had been loosened by a storm, and which it was expected would be blown down on the buildings beneath by the next gale of wind. The ladder-irons were taken out as the man descended. The whole operation was performed in two days and a half, and would have occupied less time, if the smiths could have furnished the ladder-irons as quickly as they were required.

To ensure the safety of the man employed, a rope was passed up withinside all the ladder-irons, and was fastened to the belt round his waist and to a pin driven into the base of the chimney; this rope was, of course, payed out to him at each step as he ascended. It was also intended, in order to prevent the possibility of accident, that a cord should be fastened to the belt and then passed round the chimney, but the ladder-irons, when driven about six inches into the brickwork, were found to be so firm as to render both these precautions unnecessary.

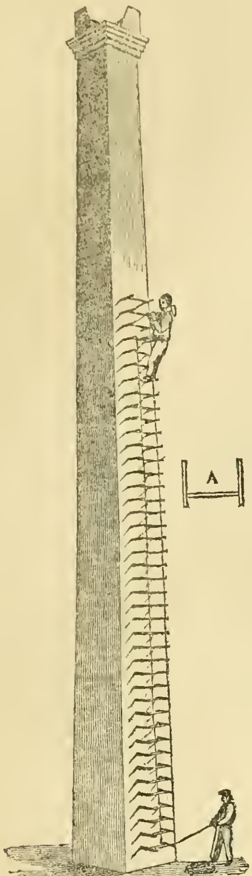


Fig. 12.

Including a bonus of £5 to George Wilson, the man employed to execute the work, the whole cost of these repairs was under £13.

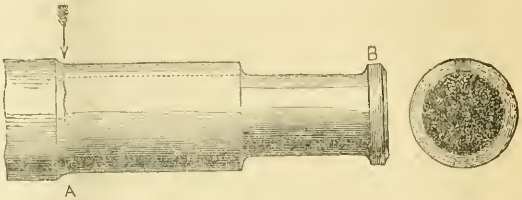
George Wilson is a native of Belfast, and since the repair of Messrs. Coupers' chimney, has practised the method described, as a sort of trade, and he has already ascended some of the highest buildings in the south of Scotland, amongst others the chimney of the Delmuir Chemical Works, and Carrickfergus steeple.

RAILWAY AXLES.

"*On the causes of fracture of the Axles of Railway Carriages.*" By Joseph Glynn, M. Inst. C.E.

Mr. Glynn states, that twice during the year 1843 he was placed in situations of danger from the breaking of the fore axle of a tender. On one occasion, the accident happened whilst the train was proceeding at upwards of 30 miles per hour, and every carriage was more or less injured. The journal was 2¾ inches diameter, the part adjoining it, where the wheel was keyed upon, was 3¾ inches diameter, the body of the axle at the shoulder was 4¼ inches diameter, and 3⅜ inches diameter in the centre of its length. The gauge of the railway was 4 feet 8½ inches. A short time before the accident, the tenders which, when empty, weighed about 2¾ tons, had been supplied with coke and water. The tank held 1000 gallons; and about 20 cwt. of coke had been received; very little of either had been expended at the time of the fracture of the axle. The total weight of the tender and its load was about 8¼ tons, on four wheels of 3 feet 6 inches diameter.

Both the fractures presented the same appearance (as shown in the annexed engravings), for about ½ inch in depth all round, there was a perfectly smooth cleft of a blue and purple colour; this annular cleav-



ing appeared to have been produced by a constant process; the central crystallized part being gradually reduced in diameter, until it was barely able to sustain the weight, and it broke on being exposed to a sudden strain. Mr. Glynn suggests that the smooth blue and purple cleft is produced by the alternate rupture and compression of the particles or fibres of the iron. It is observed that the fracture commences at the end of the key groove, which is about ¼ inch from the shoulder, against which the wheel is fixed. He is of opinion, that the breaking action commences with the first journey of the tender, and that the axles continually receive such injury as they would if they were laid over the edge of an anvil, at A, and received a constant succession of smart blows from a hammer upon the point B, the axle being constantly turned round. In addition to this percussive action, a powerful break is usually applied upon one end of the axle, while the wheel at the other extremity slides along the rails, tending to produce a tortional effect; it is generally noticed that the fractures occur at the ends of the axles, where the breaks are applied. It would appear that the axles of the tenders are more frequently broken than those of the other carriages; they carry heavy loads; very frequently make more journeys than either the carriages or the locomotives; and the break is applied upon their wheels at every station, although it may not be necessary to use it upon the passenger carriages. The nave of the wheel, the groove cut for the key, and the position of the shoulder, seem to point out the place where the fracture should commence.

Mr. Glynn is of opinion that the diameter of the axles should be increased where the wheels are hung, so that being greater in diameter than the body of the axle, by the depth of the key-groove, the mass would not be rendered weaker, by the cutting out of the groove. He recommends also, that the breaks should be applied simultaneously upon the wheels at both ends of the axles;[1] and he observes that there is probably a certain limit, in point of time, to the durability of all axles which are subject to such action; and that in many instances of the breaking of axles, the point of fracture is concealed, unless the wheels are taken off for the purpose of examination, which, he suggests, should in all cases be done.

[1] This plan is now adopted on many railways.

St. John's Gate, Clerkenwell.—The *Globe* states that this ancient ecclesiastical remnant is threatened with destruction, under the provisions of the new Building Act—complaints having been made to the overseers of the parish that it is in a state of insecurity, threatening to passengers. For some time past, the lodge entrance to the old monastery has been tenanted as a public-house; and it is apparently in a very dilapidated state, from want of proper repairs and attention. A strong desire exists, on the part of many antiquaries and of the inhabitants of the neighbourhood, to restore this interesting part of the ancient building, and to convert it into a literary and scientific institution, for the benefit of the inhabitants of the crowded district of Clerkenwell—after the familiar example of Crosby Hall. It is said that it could readily be made available for that purpose; and a public meeting is to be held, shortly, on the subject. The building has an interest for the literary and general antiquary, as well as for the antiquary "pure,"—as the scene of Johnson's interview with the printer Cave (whose house it was), and the birthplace of the *Gentleman's Magazine*, whose well-known vignette has recorded the fact to remote places and succeeding generations.

NOTES ON BRICKWORK WITH EXAMPLES OF TALL CHIMNEYS.

Bricks are generally of two descriptions, named after the manner of their manufacture either "slop" or "sand" made stocks, the latter being the generic name; other names are given to distinguish the varieties caused by excessive or deficient action of the fire in burning them, or if being of inferior materials or manufacture, as pickings, seconds, cutters, malms, clinkers, place, paviours, &c. The size of bricks made from different clays vary considerably after burning, and affects the price as much as 10 per cent., the bricks being usually sold by the thousand. The common method of comparison is to measure 4 bricks of the standard of 12 inches high, being 3 inches to each course, and if they only measure 11½ inches the proportion required to execute a rod of reduced brickwork will be as 4352 for the former to 4533 for the latter, and so on. I am firmly of opinion, notwithstanding the numerous machines described in your valuable Journal, that hand labour will supersede them all as regards expedition and consequent economy, as in one case it is admitted that when the clay is very irregular a pug mill is required to feed the machine, and the utmost gain alleged by the use of machinery is 2*s*. 6*d*. per thousand. I think, however, that the machine compressed bricks, even at the extra cost of 7*s*. per 1000, may, in some cases of extra quality being required, come into use. In estimating the duty, bricks are measured dry, and in 1835 the exaction amounted to £395,000. The oppressive nature of this impost is forcibly put by the case of a road surveyor who, at the Sessions of the East Riding of York, stated that government had granted leave to make bricks duty free for repairs in parishes where stone could not be obtained.

I cannot forego the pleasure of extracting the following remarks from the Preface to the Supplement of Dr. Ure's Dictionary of Arts, Manufactures and Mines. Oct. 1844.

"The incessant and vexatious espionage of the excise is a bar to all invention in every art under its control. From my long experience in the conducting of arts and manufactures, I feel warranted to declare that the excise system is totally incompatible with their healthy growth, and is in itself the fruitful parent of fraud, perjury, theft, and occasionally murder. The sooner this portion of the revenue, so oppressively, so expensively, and so offensively collected, is replaced by an equitable tax on property, the better for the welfare of this great country. In concluding a very extensive survey of the great branches of our national industry, this vile obstacle to their progressive growth became so manifest, that it would have been pusillanimous to shrink from the task of pointing out the magnitude of the evil." To talk of smoke nuisances and state of the dwellings of the poor, and this impost remain, is hollow cant.

But to return to the execution of brickwork, considerable difference of opinion exists as to the application of grouting and the use of water. One party says in his specification—"1st Every fourth course to be well grouted with lime and sand, and the rest of the work to be well bedded, and all the joints closely flushed up with mortar. 2ndly. The joints not to exceed ⅜ of an inch in thickness; the mortar to be mixed in such proportions, according to the strength of the lime, as will make good strong mortar, using as little water as practicable. 3rdly. Bricks to be sound, hard, well burnt and well shaped stocks, and equal to the sample exhibited, and the best in point of colour and shape to be selected for the exterior work, and attention to be paid that these be of one uniform colour and general appearance. The bricks to be bedded round without striking after they are once bedded. The mortar to be sufficiently thin to enable to flush the joints up full and round without grouting. No bats to be used, and no grouting shall be used in any part of the work. Mortar to be composed of 1 of lime measured dry to 3 of sand, mixed in a pug mill with as small a quantity of water as may be sufficient to reduce it to the consistency required, but no water shall be added to the mortar on any account after it has once passed through the mill in water. To grind the lime in water with edge stones to a thin smooth paste before mixing with the sand in the pug mill." The various requirements and modes as above set forth must influence the price. The wages of bricklayers are 5*s*. per day and labourers 3*s*. in London. The price of labour varies from 22*s*. to 35*s*. per rod of brickwork, arising from the thickness of the walls or height of the building, as in a building 70 feet high one labourer will be required to a bricklayer, in the middle 1½ to 1, at the top 2 or 2½ to 1, which I think would be the prudent limit of manual labour, beyond 70 feet I would recommend to be employed horse power.

I have attempted to keep an account of the number of bricks and yards of lime and sand on a large contract, and this was my result, 2,323,000 bricks, 1202 cubic yards of sand, and 1530 cubic yards of various sorts of lime, grey, white and blue; but from cement being used in some parts of the work, and pit sand instead of all being from the river, the account is not quite correct. In another case for labour in laying 244,600 bricks in a bridge there was paid £97 2*s*. 8*d*. Both cases being to a certain extent failures shew the necessity of having a standard computed to calculate from. In estimating for works, flues and fireplaces are not deducted, nor timber built into walls, and 2 in. are allowed for bedding timbers on walls. The foregoing allowances of bricks are sufficient to include waste.

On railways brickwork is computed by the yard—the following is the weight of a cubic yard in cement and in mortar.

	Ton	cwt.	qr.	lb.		Ton	cwt.	qr.	lb.
384 Dry bricks ..	1	2	1	20	.. ..	1	2	1	20
Sand, water and cement		6	2	4	Mortar		4	1	8
	1	8	3	24		1	6	3	0

These calculations show that brickwork in cement is $\frac{1}{10}$ heavier than when in mortar.

Approximate estimate per rod, mortar, including waste—

	£	s.	d.
4150 Stocks, at 36s.	7	9	4
1¼ cubic yard of lime, at 10s. 6d. ..		13	1
3½ ditto sand, at 1s. 9d.		6	1
Labour	1	16	0
Scaffolding		2	0
	10	6	6

If in cement 49*s*. extra.

Scaffolding poles are placed 10 feet apart, and are from 36 feet to 45 feet long, and cost about 2¼*d*. per foot. Putlogs are 6½ ft. long and 3 in. square, cost 1*s*. each. Ledgers are the same as poles, but laid horizontal at each scaffold height of about 5½ ft. Scaffold boards are 9× 1½ and in 14 and 15 feet lengths. A coil of rope of 2 cwt. 1 qr. 10 lb. will make 44 cords. For large buildings round poles are giving place to squared timber for scaffolding.

Bond of iron hoop has been used lately, and costs about 1½*d*. per yard, and four strips are used in the thickness of each wall at the foundation and under each floor, it is tarred and sanded before used. Exterior pointing tuck, or edge cut, 7*s*. per square of 100 feet, and is charged extra. In some parts of the country brickwork is charged by the superficial yard of 9 in. thick; in London it is charged by the rod of 272 superficial feet 1½ brick thick. The price varies of course as the distance from the kiln, which may be taken at sixpence per mile per additional mile. The maximum and minimum vary fully fifty per cent., say from 12*s*. 6*d*. to 24*s*. per cubic yard of brickwork. On railways brickwork is always measured by the yard, and charged, including digging of foundation, scaffold and centering, pumping water, &c., and so rigid have I known this applied that, in the case of a road under the line, the earth under the arch in the line of boundary has been disallowed and included in the measurement of the bridge for brickwork.

I was written to respecting chimneys by a party who is about to build a case for a stand-pipe or syphon to obtain a head of water in the projected water-works at Hamburgh, and in the course of enquiry obtained the particulars of those named below; and I here call attention to the skill displayed in the tower at Elswick, which stands very exposed on the brow of a hill, the taper looks quite parabolic—or if the term "entasis" is better liked, I will use it, as being more general than the former term. The whole of the examples are circular, and were built from the interor without scaffolding. I am fully convinced the circular plan is better than the square or octagon as regards strength, and even perhaps beauty of appearance. I give below the dimensions of three stalks of great height.

Dimensions of the chimney at Lee and Burnett's Alkali Works, at Felling, near Newcastle-on-Tyne. Extreme height from foundation to underside of top 212 feet. Extreme diameter at bottom of foundation 27 ft. 6 in. The thickness at bottom of footings is 6 ft. 6 in., and gradually diminishes to 3½ bricks the thickness of the first 36 feet in height, next 80 feet 3 bricks, 50 feet 2½ bricks, 30 feet 2 bricks, and 10 feet 1½ brick. The foundation is hard clay.

Dimensions of circular chimney at Friars' Grove Chemical Works, near Newcastle-on-Tyne. Begun Oct. 23, 1832; finished July 27, 1833. Total number of bricks used 313,000. Foundation, clay; and the chimney stands on a pillar dyke, the coal being wrought in the vicinity. Outside diameter at bottom of foundation 27 ft. 6 in.; inside 14 ft. 3 in. Extreme height 254 ft. 9 in. Thickness of walls, first 24 ft. 8 in. 3½ bricks, 107 feet 3 bricks, 53 feet 2½ bricks, 46 ft. 6 in. 2 bricks, 12 feet 1½ brick, stone top 6 feet, an uniform taper of 1¼ in. to the yard.

Shot tower at Elswick, built 1797. Extreme height 195 ft. 4 in. Parallel without taper for two-thirds of its height; it has a circular stone stair in the interior, projecting 2 ft. 6 in. from the wall, of 305 steps, 6 inches rise; thickness of wall at bottom 2 ft. 5 in. for about two-thirds of its height, at top 1 ft. 10 in.; exterior diameter, bottom 22 ft. 8 in., top 14 ft. 3 in.; the top is finished with a stone dome.

O. T.

St. Ann's, Newcastle-on-Tyne.

WESTMINSTER IMPROVEMENTS.

THORNEY ISLAND ET TOUT LE CHAMPS.

Thorney Island, et tout le champs, is the ancient designation of that district of the metropolis called Westminster, bounded on one side by Pall Mall and the Green Park, and on the other sides by the Thames and the Aye-bourne or Ty-bourne.

Thorney Island is about 470 yards long and 370 yards broad, washed on the east side by the Thames, on the south by a rivulet running down College-street, on the north by another stream wending its way to the Thames down Gardener's-lane: this and the College-street rivulet were joined by a moat called Long-ditch, forming the western boundary of Thorney Island, along the present line of Prince's and De la Hay streets. This island was the Abbey and Palace precinct, which, in addition to the water surrounding it, was further defended by lofty stone walls (part of which still remain in the Abbey-gardens): in these walls were four noble gates, one in King-street, one near New Palace-yard (the foundations of which I observed in December 1838, when excavating for a new sewer), one opening into Tothill, and one at the mill by College-street. The precinct was entered by a bridge, erected by the Empress Maud, at the end of Gardener's-lane in King-street, and by another bridge, still existing, though deep below the present pavement, at the east end of College-street.

On the spot thus powerfully defended St. Edward founded his celebrated abbey; and as at Athens from the *στοα βασιλικη*, where the Archon *βασιλευς* presided, the whole building derived its name, so the church of the Confessor's abbey gave name to the great city which in process of time grew up around it and extended itself so considerably to the northward and eastward, that in an ancient charter preserved in the British Museum, the boundaries of the City and Liberties of Westminster are thus defined.

"First up from the Thames, along Merfleet to Pollen-stock, so to Bulinga fen: afterwards from the fen, along the old ditch to Cowford: from Cowford up along Tyburne to the broad military road: following the military road to the old stock of St. Andrew's Church: then within London fen, proceeding south on Thames to mid stream; and along the stream, by land and strand, to Merfleet."

Thorney Island et tout le champs! who would imagine that from hence is derived the puzzling appellation Tot-hill Street. Tot-*hill* Street, says one, is evidently a misnomer, for it is quite low and flat, without any hill at all, but when we find "*Aiguille et Fil*" corrupted into "Eagle and Child," or the "Satyr and Bacchanals" converted into the "Devil and Bag of Nails!" we may without any very great stretch of imagination suppose tout le champs as the Norman-French spoken at Court became mixed with the language of the people, easily altered to tout le fields, and contracted to toutle, "touthull" or "tothill."

Although Thorney Island, for a period of seven or eight centuries, has continued to be the seat of the legislature, government, and law, as well as the place where the solemn compact between sovereign and people must be ratified, circumstances necessarily demanding the attendance of a vast number of persons, it excites our astonishment to find that the open space around the ancient Palace and the Abbey, and the site of Great George-street presented until lately the ill-assorted compound of architectural grandeur, human misery, and filth, which had grown up from the magnificence and the ill-judged benevolence of St. Edward. The only access for carriages to the precinct, during all these centuries, was through King-street, then in so miserable a state that faggots were thrown into the cart-ruts to facilitate the passage of the state coach on the days on which the King went to parliament; and, little as King-street may be thought of now, it was then a superb street in comparison with the others on Thorney Island, which consisted chiefly of narrow dirty streets lined with wretched dwellings, and of numerous miserable courts and alleys, situate in the environs of the palace and abbey; where in the olden time the numerous lawless characters claiming sanctuary found shelter; and so great had been the force of long custom, that the houses continued to be rebuilt, century after century, in a miserable manner, for the reception of similar degraded outcasts.

In accordance with various Acts of Parliament for the Improvement of Westminster, Thorney Island has been cleansed of these "miserable courts and alleys," and it is now that a similar clearing away of such places as Gardener's-lane, Snow's-rents, St. Ermin's-hill, &c. in toutle-champs is requisite.

It is in these narrow streets, and in these close and insalubrious lanes, courts, and alleys, that squalid misery and poverty struggle with filth and wretchedness, where vice reigns unchecked, and in the atmosphere of which the worst diseases are generated and diffused. That uncleanness and impurity are an unerring index, pointing out the situation where the malignancy of epidemics more or less exists, is a truth known and admitted from the earliest ages. It is in these situations, where matter of all kinds in a state of decomposition is allowed to remain, that the atmosphere is ever tainted with putrid exhalations, malaria that creates miasmata; here it is that we so often find the inhabitants afflicted with some contagious malady or other, and that a strong predisposition to receive infection exists, and a germ arises whence may emerge those overwhelming pestilences which often involve a whole community in their fatal consequences.

Nor let the higher classes imagine they are safe from the effects of the abominations in their vicinity; the germ of disease is wafted in at their windows, and they find their health injured in various ways by indigestion, low spirits, debility, &c., from this cause, although unaware of it. The history of the middle ages shows that it was in such low lying districts as the one under consideration that the plague and sweating sickness made the greatest ravages, and that the frightful mortality of these "visitations," as they were termed, depended in a great measure on malaria generated from uncleanliness and from deficient sewerage and drainage, while modern experience testifies that these are the real causes of the destructive effects of the cholera. The epidemics of the middle ages, arose almost solely in consequence of the deficient architectural arrangements of the towns, and the want of cleanliness. Had the cholera of 1832 been one-half so fatal as the black death of 1349, or even of later epidemics, the frame-works of society would have been loosened, and the empire in danger of being broken up. Those acquainted with the social effects of these scourges upon the thinly scattered population of the middle ages, would anticipate no less than this, from the destruction of five or six millions of persons in England within a few months. The utter depreciation of property, terror, despair, and a total abandonment of all social ties would have been the consequence.

Sir Robert Peel, with the wisdom so characteristic of that eminent statesman, has appointed a Commission for Metropolitan Improvements, and great is the responsibility which devolves on that Commission. We are now two millions, in about 50 years we shall be four millions; the present great metropolis will only be the centre of the then greater one, and as the political danger of destructive epidemics increases with the population, it becomes an imperative duty to ascertain whether we are *quite safe* from the recurrence of epidemic scourges, and if not whether we have the means of placing ourselves beyond their reach. The state of Westminster declares we are *not* safe; but by the combined effects of an improved system of public hygiene and medical science, the awful "visitations" may be rendered innoxious. Delay, however, is dangerous: for we may infer, from the experience of preceding epidemics, that the cholera will break out again, and its second advent may be with such a coincidence of atmospherical phenomena as to equal in destructiveness the most virulent of the pestilences recorded in history. We may *hope* this will not be the case, but hope alone will not do, we must try and prevent it, and proceed to examine how far the improvement of Westminster will assist in producing this desirable result.

The two bridges I have mentioned, the foundations of the walls of the passage along which St. Edward passed from the Palace to the Church, which still remain, and the Cock public house in Tothill Street, all evidence that the surface of Thorney Island has been considerably raised in the course of ages, and that both St. Margaret's Church and the Minster were ascended by lofty flights of steps, such as we observe attached to many of the continental churches. The great extent of land over which the tidal waters of the Thames formerly freely flowed having been much diminished by various embankments from time to time, the river in consequence reaches to a much greater vertical height than it did in ancient times; land which was heretofore high and dry would now be submerged but for the banks, which must have been repeatedly raised, as well as the ground on which habitations have been erected in the immediate vicinity of the river, hence, in Westminster, the further we recede from its banks the lower the ground becomes; the street in front of Canning's statue is 5 ft. 2½ in. above high water mark, the east end of Tothill Street 2 ft. 8¼ in., and the west end 9 inches only, while New Tothill Street is 3½ inches and Palmer's Village 12½ inches below high water mark.

It thus appears, that with the existing levels, it is impossible to remedy the evils complained of. The sewers which have lately been so injudiciously formed, just at a time when the neighbourhood was ripe for destruction, have only a fall of ¼ inch in 20 feet, instead of a fall of ⅛ inch to every foot which the commissioners profess to require, these sewers are, therefore, only so many gigantic cesspools, from whence noxious gases continually emanate.

The natural boundaries of the district for improvement resolve themselves into a square, of which St. James's Park is the base, King's-scholars'-pond-sewer and Long-ditch-sewer the sides. It follows, therefore, that the sewers in streets parallel to this base must have a much better fall, from a given summit level, than the sewer of a street approaching the hypothenuse, such as that now proposed by certain projectors, which sewer, if raised so as to give a proper fall, will be something like the embankment of a railway across the district, and if not so raised, why then the evils of deficient drainage, of which we have so long complained, and which we hoped soon to see remedied, are rendered permanent.

The true principles on which the improvement of Westminster should be conducted are—1st. A thorough, systematic, and provident application of the best medical and physical science to the architecture, drainage, and sewerage; to this end, the whole district must be gradually treated in the same manner that Mr. Cubitt is treating a similar district in the vicinity; the streets must all be raised so as to admit of an habitable basement floor to the houses, which modern usage, habits, and the necessity arising from the increasing value of ground demands. 2nd. To provide the most direct and convenient road (without intruding upon the Park), for carriages, carts, and vehicles of every description between Westminster Bridge and Grosvenor Place. 3rd. To open the most advantageous views of the Palace, the Abbey, and the great Victoria Tower; this involves commodious approaches to these national structures. 4th. To provide sites for the erection of improved, healthful, and appropriate dwellings for the poor.

There are many minor principles which in carrying out the plan it will be necessary to enforce, but which it is not at present requisite to enumerate, and by a well digested plan, now before a committee appointed at a public meeting of the inhabitants of Westminster, it is estimated that all these advantages may be attained without any ultimate loss of the public money; an advance of money would be required, which would be returned into the Treasury, most probably with a large profit, as the improvement of street after street was being accomplished.

These are nearly the principles which guided his late majesty King George the Fourth in his design for the improvement of Westminster, and had not old age so suddenly overtaken this magnificently-minded monarch, there is little doubt but that the execution of his plan would long since have been accomplished.

The fully carrying out a similar plan in Westminster would render any ministry popular, both with the crown and people, as an improvement worthy the present enlightened times, in which we are, day by day, more and more developing the power of mind over matter, and realizing that remarkable prophecy of Lord Bacon—"I have held up a light in the obscurity of philosophy which will be seen centuries after I am dead; it will be seen amongst the best legacies of princes to their people, in the erection of temples, tombs, palaces, theatres, bridges, making noble roads, cutting canals, granting a multitude of charters and liberties for comfort of decayed companies and corporations; in the foundation of colleges and lectures for learning and the education of youth, foundations and institutions of orders and fraternities for nobility, enterprize, and obedience; but above all the establishing good laws for the regulation of the kingdom, and as an example to the world."

William Bardwell.

Park Street.

FIRE-PROOF BUILDINGS.

Sir,—Will any of your kind correspondents favour me with an explanation of what constitutes a fire-proof building?

My own humble opinion is, that a fire-proof building, or a building made proof against fire, should be that within which, if a fire take place, the goods or furniture therein may be entirely consumed without in any way injuring the main structure.

Can any building in London be pointed out as such,—and why called fire-proof? State the materials and mode of construction. It is generally understood that there is no building in London built upon any defined principle, so as as to be considered thoroughly fire-proof.

X. Y.

Northumberland.

NOTE ON THE CAUSES OF EXPLOSION IN TUBULAR BOILERS.

The following brief explanation of a matter of great interest and importance will, I think, be acceptable to many of your readers at the present time.

The cause of explosion in tubular steam-boilers is usually the exceedingly rapid generation of steam arising from overheating the tubes. The due explanation of the effect will be found in considerations frequently overlooked. In discussing the effects of the motive power of steam engines, attention is usually confined to the statical pressure of the elastic vapour, irrespectively of dynamical operations. The latter, however, powerfully affect the case, which may be conveniently explained by reference to a familiar illustration—the explosion of a gun caused by a slight obstruction at the muzzle. It is well known that if the muzzle of a gun be stopped by a piece of card fitting it loosely, or by a small piece of dirt, the gun will frequently burst on discharge; and it seems at first anomalous that the elastic vapour of the gunpowder does not rather overcome the slight resistance of the card or dirt than the strong cohesion of the metal of the barrel. But the explanation seems to be this. In a compressed vapour, in ordinary cases, the elastic pressure is equal in every part. The constituent particles of the vapour speedily arrange themselves in such a manner that an uniform density and an uniform expansive force is established. But this mutual action of the particles, by which they dispose themselves in a position of equilibrium, although exceedingly rapid, is not absolutely instantaneous. It may be easily conceived, that if the gas generated by the ignition of gunpowder be not allowed free passage it will begin to accumulate in the neighbourhood of its origin—namely, the breach of the gun; and the process may continue till the cohesion of the metal is overcome by the increasing force of the accumulated vapour. Even where no obstruction is offered to the exit of the gas, it may be generated so rapidly that its own elastic force will not disperse it quickly enough; so that in this case also, accumulation of gas and the consequent effects may be produced precisely as in the first case. This instance exactly illustrates the effect of steam generated in very hot tubes. Even when the safety valve is free (and even when it is absolutely open), if the rapidity of generation of the vapour exceed the rapidity of dispersion, an accumulation will ensue. If it be granted that the cause of explosion is the evolution of hydrogen, the mechanical action is still the same. The phenomena are not affected by the nature of the vapour—whether those of steam or ignited hydrogen—but simply by the rapidity with which those vapours are evolved. In either case, the only remedy against explosion is to maintain all the parts of the boiler as nearly as possible at the same temperature.

H. C.

ON THE INTERIOR DECORATIONS OF THE ROYAL EXCHANGE.

A paper read by Mr. Dwyer, *before the Decorative Art Society.*

In my previous remarks upon the Decorations of the Royal Exchange, I treated principally of the effects produced when viewed as *specimens* of interior decoration—I briefly stated its various beauties and defects; and the discussion which followed, perfectly coincided in tendency with the critical notice I ventured to offer. From the extreme difficulty I experienced in obtaining admission to view the interior, the opinions which I then formed were not of that satisfactory nature I could have wished, not having had the opportunity of examining the work minutely; although I applied to the principal persons I was unsuccessful, and it was only by a manœuvre that I succeeded. The Royal Exchange having been since opened to the public, I have availed myself of the facilities thus offered, to inspect the decorations more attentively, the result of which compels me to state that they do not improve like a good picture upon acquaintance; the opinions I had previously formed were more confirmed at each visit. The decorations are of that order which lessen in value to the spectator according to the extent of his investigation. There is indeed such an abundance of ornament, so much prettiness, so much *surface*, without *depth*, that there remains nothing to dwell upon, all freshness of purpose is wanting, and in lieu of it appears a general frivolity, teeming with the tamest effects; although not wanting in variety, it only amounts to a variety of an inferior class; it betrays a similar mind and hand throughout the whole work.

Before entering into the principal or more important part of the present notice, I wish to continue, by a few remarks, a portion of the first one. In the description I gave of the frescoes, I stated that which was executed over the southern entrance to have been injured by damp; the stains have not only been considerably increased during the winter, but the colours are obliterated in several places, as is apparent to the most superficial observer. This has not arisen from the *dampness of our atmosphere*, but from *damp generated in the walls themselves*. In the second report of the Commissioners of the Fine Arts, which treats at great length on the manner and means to be adopted in painting in fresco, it states that in all "buildings erected without due precaution, in humid situations, it is found that the damp rises through the masonry by capillary attraction." The external coatings of the walls are thus affected to a considerable height; not only paintings are destroyed, but the plastering itself becomes detached. In Venice, where the foundations of so many houses are partly immersed in water, it has been remarked that the plastering is frequently loose, even to the height of 20 feet; the presence of damp to a still greater height, in a less pronounced form may therefore be inferred. It is probably owing to the action of moisture thus communicated, that paintings in the open air have decayed so generally in Venice, for it has been already remarked that the sea air, which is sometimes assigned as the cause of this decay, has had no such effect on external painted decorations in Genoa, the foundations of the houses being there dry. Several parts of the Royal Exchange exhibit signs of dampness, the colour either fading or peeling off. This is undoubtedly a very serious evil, endangering as it does the preservation of the whole structure. As there is not the slightest difficulty in preventing the ascension or descension of moisture in the walls of our buildings, it ought to be prevented in all edifices of importance whether intended for decorative purposes or not; the very simple contrivances required in the erection would amply repay the extra trouble, and would afterwards prevent that rapid decay so common to the buildings of this country. The wonderful preservation of the buildings of antiquity has been in a great measure from the peculiarities of the cement which resisted (whether manufactured intentionally or not) the action of moisture.

This is a very important subject, and worthy of the attention of all who desire to promote the lasting durability of all works which are great and beautiful, and designed to mark the state of this important epoch in the world's history.

It is to be regretted that the experiment of Fresco, the first of its kind publicly executed in this country, should have become so much injured, although the work in itself is not of much importance, still it is calculated to injure this peculiar and beautiful system of decoration in the opinion of many influential persons who may become prejudiced against the style, by judging of its value from its present aspect, yet a little consideration will convince us that when proper precautions are used, a mere distempered decoration will last for a considerable time.

The colours introduced upon the ceiling of the eastern entrance, which I have been given to understand is also a fresco, are of a most extraordinary appearance, this fresco certainly affords persons an opportunity to recognise the meaning of crudeness and want of harmony in colours; if intended as a contrast to many clearer specimens of harmonious colouring to be found in the colonnade, it has been undoubtedly successful, if however such a burlesque upon good taste was not contemplated, the sooner it is *painted out*, the better it will be for the fame of the artist.

In my former remarks, the western entrance, and of course the principal one, escaped my observation, and it is painted indeed in such a manner that it deserves little notice, being merely an oblong panel enriched by an oval centre, containing a wretchedly designed and ill executed ceiling flower of a dirty salmon colour.

The introduction of neutral tints in this the principal entrance, I should imagine was intended to familiarize the eye in some degree with colour, before entering the interior, and also to blend with the tone of the stonework, forming a sort of medium, or connecting link between the magnificent portico, and the decorations of the ambulatories. If such were the idea it has been most feebly carried out; the comparison to the beautiful enrichments on the ceiling of the portico is most contemptible, instead of supporting the very novel effects which have been introduced in this part of the building with so much success; the eye encounters an extremely common-place production, in a situation where above all others something is required which should *tell*, something which should please the eye by cleverness of design and skilfulness of execution; the colours might have been subdued as they are at present, and yet have blended harmoniously with the stonework as well as with the enrichments of the interior.

In the entrances of the Royal Exchange we have two effects of an opposite character, in the one I have just described, you enter the building and become familiar with colour by degrees; in the others you come suddenly upon striking and vivid colouring.

The idea in each is in principle good and illustrates the necessity of well weighing in the mind the relative value of effects, and the peculiar mode of treatment required according to the situation. Thus by entering the Exchange from the North and South side, the appearance is quite refreshing; the eye is captivated by a brilliant assemblage of glowing colours, the absence of which in the surrounding objects, contrasts in a most favourable manner, and assists wonderfully in giving fullness of tone and vigour to the whole arrangement. The general aspect of the interior appears very unfinished and abrupt; the walls and ceiling are so completely enriched, every little space therein being covered with ornament repeated at intervals throughout the colonnades, that the transition from such an abundance of colour to the stone pilasters upon the walls and other parts, presents an incongruity that must be obvious to every person. It would have been infinitely better to have left the stone of the walls plain, rather than have destroyed its effect by such contrasts; if the *apparent solidity* of the structure would receive injury by the introduction of colour on the pilasters, there would have been some extenuation for the defect, but when we are so fully aware that colour can not only be made a vehicle for grandeur of effect, but also assist in giving stability to the whole when arranged in a proper manner, we may indeed wonder at the want of mechanical tact (which is all it amounts to) displayed in the present decorations. The manner in which the ceiling is overloaded with ornament renders it also necessary to enrich the pilasters of the colonnade to support in some degree the stability of colour, that the whole be knit well together and not appear detached as at present; which not only renders the general contour very unfinished, but produces such peculiar distinctness in the effect which one part bears to another, that it impresses one with the notion of the work having been brought to an abrupt termination, somewhat similarly to an unfinished picture of an artist, the background of which is fairly rubbed in, leaving certain portions of the canvas untouched, to be filled in as the picture advances. This is just the appearance of the walls, in consequence of their being divided by the stone pilasters.

The ceiling and walls are too strongly coloured to blend in a satisfactory manner with the other portions of the building which are totally devoid of it, the contrast is thus crude and disagreeable, for no decoration can be imposing as a whole, with such abrupt parts in its composition. The use of colours contrasting and harmonizing one with the other, is not that it should individually appear more conspicuous than the rest, but merely to heighten or subdue, as may be required, certain portions of the work. The beauty of all decorations depends upon the harmonious combinations of the whole, *every part* must to a certain extent assist in promoting one grand effect, the most striking parts ought to form the principal beauties, because the eye will naturally attach itself to such portions of the enrichment, while the more subdued parts generally escape common observation.

Thus it is absolutely necessary in order to render the decorations of the Royal Exchange complete, to enrich in some degree the pilasters around the walls. The style adopted by Raffaelle in the decorations of the Vatican, the colonnades of which are somewhat similar, illustrates the manner of giving stability to the decorations without deteriorating the apparent solidity of the building: in the pilasters were introduced some of the most exquisite arabesques, and although the decorations do not display the highest order of harmonious colouring for which indeed Raffaelle was never very celebrated, he has exhibited the most consummate knowledge in the arrangement, the eye is not struck by any particular colour, all combine to produce *one* effect. The necessity of keeping this infallible rule constantly in view, must be evident, for upon it depends the success of decorative art.

The division of colour must have appeared much more singular when the Merchants' Area was paved in Tessera; if any part of the Quadrangle is to be paved in this manner, it ought to be in a situation where it would produce the most pleasing effect.

However great may be our desire for the display of novel effect, it is extremely important to maturely consider the manner of introducing it with success. Paving the Merchants' Area in tesserra requires no mean skill to render the general effect prepossessing in itself, and much more to improve the aspect of the building. The design which was executed in the area was certainly not calculated to materially increase the beauty of the whole. It was evidently the object of the patentees to make the pavement as striking and as effective as possible, not the building; and however cleverly arranged in itself, it did not possess those features necessary to heighten the whole appearance of the work; the want of perspective lines to assist in giving extent to the building was very apparent, this above all should be attended to, for it constitutes a principal beauty. Its decided failure here however may be the means of introducing it in a more satisfactory manner, therefore out of evil may come good.—In my previous notice I considered the details of the pavement, also the cause of its failure, and the introduction of asphalte in lieu thereof until the durability of the tesselated pavement was satisfactorily substantiated. The specimens which were afterwards laid to be tested by the winter, were upon different systems, every opportunity being offered by the Gresham Committee, to render the experiments of Messrs. Singer conclusive. The result at the present time in both is however very unsatisfactory; the tesseræ in several places have disappeared, and other parts have been so loosened, that they will soon share a similar fate. In buildings like the Royal Exchange where the public have ready access, experiments of this kind are calculated to injure or do good as the case may be, the value of tesselated pavement will be considerably lessened in the minds of those persons who merely judge of specimens which have been laid down in the area of the Exchange, but if an ampler field had been given that would have admitted competitors, the different methods adopted by several firms would have become known, and the value of each estimated accordingly, and the public would then have received the benefit of the trial. That a cement is used by a certain establishment, which renders the tessera a solid and compact body impervious to the weather, I am satisfied from my own observation, having daily seen a specimen, which has been laid down nearly two years, and remains as perfect at the present time as when first executed.

Its effect in the Royal Exchange would undoubtedly appear very beautiful, if introduced as I have before stated in a proper manner; to pave the area would not prove nearly so effective as paving the ambulatories, it would then be contrasted with the colours upon the walls and ceiling, in such case the design ought to be so arranged that lines should be drawn from one end of the colonnade to the other: if such a method were adopted, and skilfully carried out, it would produce, I am assured, not only an effective border round the great square, but its perspective lines would form a very imposing and beautiful appearance besides adding materially to the apparent extent of the interior.

The pavement however had better be dispensed with altogether, than an attempt be made at beauty of combination while such an exhibition of harlequin coloured placards adorns the walls; it reminds me of the fantastic appearance of an eccentric beadle, whose upper garments are gaily bedizened with finery, and his gold laced hat surmounted with peacocks feathers, whilst the lower man is clothed in rags.

That a great blunder has been committed there can be little doubt; either the decorations or the placards are out of place; they certainly do not agree together; it would have been in much better taste to have only introduced that which was of the greatest importance; if the decorations are so considered, why injure the effects by placarding the walls in such a conspicuous manner, for there appears to be no control exercised over the merchant whose principal aim is to render his board or bill as attractive as possible, and who therefore creates a motley assemblage of dignified boards and sprightly bills, delighting in the varied taste of the printer and painter. Should however these *expressive announcements* be deemed necessary to further the interests of business, (and past experience would of course soon decide such a question,) it almost borders on the ludicrous to observe the present arrangement. It could be even now considerably improved by modifying their appearance, they might be arranged in certain classes, of a definite colour and form, to be in fact a neutral tint, that should be employed on all occasions—thus it would not injure the artistical effect of the building, and yet preserve its usefulness.

Having treated of the principal effects, and the general expression of the decorations, I shall now briefly extend the subject, by considering whether the style is applicable to the building, and how far such a style of decoration will promote the Fine Arts of this country.

The principal thing to be considered by the artist in decorative works is, that his *style* should be pleasing, to be rendered *prepossessing* in their effects; for nothing can be more injurious than a cold, harsh, disagreeable style, even when viewed by the most able judges; its appearance must court observation. The second, and most difficult, is that the decorations should address themselves to the mind; it is in this the artist's skill is really required; it is in this that his powers will be put to the proof; mere ornamental design does not require great mental powers, although it is in the power of talented men to create much out of little, to raise that which was insignificant by appropriate and tasteful embellishments,—the different estimation, however, in which all acts are held, must be according to the manner in which they address themselves to the imagination; the more impressively the artist delineates his ideas, the higher will be his position in the profession.

In all decorative designs there is one presiding principle, which cannot be held too highly in our estimation, and which should govern all our arrangements, viz. "Fitness of Purpose," This, above all things, is the most important, and the most powerful characteristic of a refined taste, and the more we approach to a just appreciation of its value the greater will be our advancement towards a proper understanding of the noblest attributes of art. To uphold the dignity of art we must *feel* its effects, and understand the grand principles which govern it, that by educating the mind as well as the eye we may form a correct feeling for the arts, enabling us to judge of their real value.

It is easy to be pleased, and also easy to find fault, but extremely difficult to understand the reason of our being so—because we are ignorant of the causes which lead to such conclusions. Until the public taste becomes more enlightened, so as to estimate the true dignity of art in a proper manner, no grea tgood can arise. Ornamental design may be calculated to please the eye by its variety of form and fanciful colouring, but in such a building as the Royal Exchange something of more importance is necessary to uphold the character of the building, than that which now decorate its walls. Expressive and appropriate designs ought to have been introduced, that would have added an interest and created a charm to the whole work. The decorations are quite unworthy of the prominent position they now hold, and are extremely inappropriate; no attempt is exercised to express by intelligent design the character of the building, beyond a few insignificant devices which I have previously enumerated; so that the purposes of the edifice would be enveloped in mystery, and puzzle future antiquarians to decipher the use of such a building, if left to its own signification.

How different the system adopted by the ancients, how much are we indebted to their intellectual mode of enrichment, how exquisitely arranged! every building being readily distinguished by its peculiar decoration, exhibiting the highest order of design, and in the most eminent degree *fitness of purpose*. As an example, I may mention the celebrated frieze of the Parthenon, illustrating in a most forcible manner the procession to the sacrifice of the presiding goddess, Minerva, to whom the temple was dedicated, an enrichment intimately connected with the principal and most solemn ceremony of the people. Thus the purposes of the building were delineated in a striking and picturesque manner; this is what constitutes harmony and beauty of design, and the true feeling of high art exemplified and easily understood and appreciated by all classes, it tells its own story most effectively, without the aid of the historian. There is no building that I can recollect which offered so many advantages for the display of artistic talent as the colonnades of the Royal Exchange; it would have afforded great opportunities for the development of the genius and the soul of Art. The want of subject in the present decorations is self-evident,—what is there for the mind to speculate upon? what is there to remember beyond the emblazoned shields and meretricious ornament? what does it all amount to?—nothing.

The walls might have been illustrated with the history of commerce; tracing its gradual progress to its present eminence, and the establishment of the first commercial treaties with different countries might have been delineated. These would have created considerable interest in the building, and there would have been a sort of individuality about such decorations that would have more intimately connected foreign merchants with the building, it would have spoken to their sensibilities, and charmed the imagination by its ideal beauty. The name of the Merchants' Walk might still hold a place in arrangements of this kind, a tablet beneath each subject might be introduced that would answer for two purposes, first for the use of the merchants, secondly for the public, who would recognize the subject by the name on the tablet, which should of course correspond. Additional interest might be increased by the introduction of portraits of celebrated men who deserve a nation's thanks, and who ought to hold a position in the building which their exertions tended to raise to its present magnificence. There would exist in such a mode of decoration something which would excite our best feelings, and promote in an eminent degree the higher and more noble style of art, it would illustrate the rise and progress of civilization, the manners and customs of foreign nations, and give such ample scope for the artist's fancy that is seldom if ever afforded. If a similar opportunity as that offered by the Commissioners of the Fine Arts had occurred, to enable English artists to enter the lists, a very different result would have transpired. The present decorations are not worthy of the taste of the times; and it does not redound much to the credit of the citizens for employing a foreigner to decorate their principal and most public building, when many pupils from Somerset House School of Design could have executed the work not only in a better manner, but would have infused a spirit of intelligence into the decorations which does not at present exist.

The manner adopted by the committee has not been sufficiently liberal or extensive; it has been cramped, and limited to a certain few; extreme privacy is the cause of its failure; if there had been more openness in their proceedings it would have terminated in a much more satisfactory manner; such an opportunity to exemplify the talent of the nation rarely occurs, when it does it ought to be the ambition of every Englishman to offer every facility to his countryman, to enable him to compete for the honours which would naturally accrue upon the success of his efforts. It has been forcibly illustrated in our history, that the English artist, however great his talent, never received that share of patronage which was due to him as a man of genius—it was not, indeed, fashionable to employ him; and the only resource formerly left for the germs of native talent to exercise itself upon was to adorn "heroic signposts." Our position in Art has been of low cast, our best efforts were rendered feeble from repeated checks, there was nothing to call forth our abilities, nothing to excite us to develope great and beautiful ideas, our efforts were not appreciated until of late years. There has been, indeed, so much said upon foreign superiority in the Fine Arts over us, and we are continually receiving fresh announcements of their extraordinary talent, it can scarcely be wondered that some reliance is placed on these reports, naturally exciting a prejudice against everything English connected with the Arts. But when we contemplate the genius of such a man as *Barry*, striving, amidst penury and distress, to exterminate this odium which enshrouded the Arts, and the vaunted incapacity of the English artist; when we behold the works, that emanated from his desire to uphold the character of native artists, and remember under what peculiar circumstances they were executed—for (says Barry) I began the work without patron, fortune, or encouragement, without wages to subsist on, and with no other assistance to carry it on than what I was to derive from any other occasional works that might fall in my way.—when we behold his works, executed under such disadvantages, we may well pause and become lost in admiration at the nobleness of his views. And we are also indebted to the Society of Arts for their glorious specimens of British *talent* and *perseverance*, at once testifying what may be done by the English artist.

Although great praise may be due to the citizens of London for the introduction of the different *experiments*, assisting as they do the revived feeling of ancient magnificence, still there has been a golden opportunity lost, and one which the wealth of the citizen could so easily have taken advantage of; by liberally remunerating our best English artists, the walls of this commercial palace would have been embellished by appropriate design, and instead being the work of one, by the efforts of many, that the walls might be adorned by British talent, and thus form a public gallery for their productions.

The decoration of the Royal Exchange being the production of a German artist, will most undoubtedly have a beneficial effect in due time; it is calculated rather to improve than injure the English artist, for this reason, that it will create a spirit of competition, for while it raises our jealousies it stimulates our energies, and the success already attendant upon our renewed efforts in ornamental design clearly exhibits a marked superiority over any thing which has been executed in the Royal Exchange. The stability of all arts in a measure depends upon competition; the great schools which have arisen from the valued production of peculiar and original masters, and the success attendant upon them, have been attributed, and with great truth, to the competition of the students. Vying with each other in every fresh attempt, they renewed their efforts with a vigorous determination to excel that created in many instances those bright examples of talent which will be the admiration of ages to come. Nothing can better promote the interests of the English artist, than the public recognizing in the decorations of the Royal Exchange an inferior production; it will cause a reaction in their taste, they will be taught to enquire more fully into things, and thereby acquire knowledge which was before hidden; and from the great opportunities that are now offered to inspect works of art we may anticipate the best results, the public will be enabled to discriminate for themselves, and to judge of things in a manner they deserve; we shall then have no cause to fear foreign preference, we are daily growing stronger in power to compete with them successfully; and let talent be patronized wherever it is to be found, whether it be *native* or *foreign*, except in works which are *truly national*, it ought then to become *a national work*; every means should be used to exalt its position that it may be rendered worthy of the enlightened state of the times, for, to use the admirable words of Opie, "The progress of the Arts in every country is the exact and exclusive measure of the progress of refinement; they are reciprocally the cause and effect of each other; and hence we accordingly find that the most enlightened, the most envied, and the most interesting periods in the history of mankind are precisely those in which the Arts have been most esteemed, most cultivated, and have reached their highest points of elevation. To this the bright eras of Alexander the Great, and Leo the Tenth, owe their strongest, their most amiable, and their most legitimate claims to our respect, admiration, and gratitude; this is their highest and their only undivided honour; and if not the column itself, it is certainly (to borrow a metaphor from a celebrated orator), the Corinthian capital of their fame."

THE VENTILATION OF MINES, AND THE MEANS OF PREVENTING EXPLOSIONS FROM FIRE-DAMP.

A Lecture delivered at the Royal Institution, London, January 17, 1845.*

By Professor Faraday.

In again presenting myself—as I have often done on previous occasions, at the request of the appointed officers for the regulation of these Friday evening meetings—to commence the season, I think I shall best perform my duty by taking you at once to the particular matter which I intend to bring before you.

The circumstances under which I have been led to bring this subject before you are entirely new, resulting from a mark of confidence placed in Mr. Lyell and myself by the government, upon the occasion of the unfortunate accident which happened at the Haswell coal mine, in Durham. Upon that occasion we were sent down to observe the inquest, and not merely to watch the proceedings there, but to investigate the mode of working the mine, and to use our best judgment in bringing home an opinion on the present accident, and the causes of such catastrophes. I may state summarily, that the conclusion we came to was, that the inquest was conducted most fairly, openly, and in a very enlarged manner; that, under the circumstances, the catastrophe was purely accidental. Ninety-five men and boys, it is true, were unhappily killed, but no fault could be found with the proceedings of the persons concerned in the management and working of the mine, as far as the knowledge of practical persons up to this time had been made available by coal owners and officers. There were, however, certain observations which occurred to us, especially with regard to a part of the mine called "the goaf," which I intend to make the basis of this evening's lecture.

But before I proceed further, I had better warn you of an error which may occur in my language. In speaking hastily, I may sometimes use the pronoun "I," in the singular, and, at other times, "we," in the plural. I ought, perhaps, invariably to say "we," because Mr. Lyell was always with me. I cannot at the moment wait for his assent to every statement, and I hope that both he and you will excuse my using an incorrect word in my hurried language, and believe that in all good things we are together, in all extra things I alone ought to bear the responsibility.

I do not pretend to be a professional man as regards coal mines; I am, however, a man who has looked at the laws of nature, and as far as observation and practice have enabled me, I have applied them in working out their results. It was with some such feelings I first went down to Haswell. I do not venture to bring forward any plan of ours, nor do I wish you to regard with the same kind consideration as the Home Office the report I made to the Government, as one that is unexceptionable, but to look upon me at present as, perhaps, involuntarily advocating some particular view which came into our minds upon that occasion, because it is one which best commends itself to us.

I must first of all endeavour to make you thoroughly well acquainted with what a coal mine really is, and what is its mode of working; for if I leave you behind me in the first few steps of our progress, I shall never be able to take you with me afterwards. I have, therefore, for the purpose of illustrating this point, procured a few black boards, which will serve to convey to your minds an impression of what a mine really is. If you will look at these black boards, as representing a portion of the mass of coal in the mine, you will get a good notion of the meaning of the terms which I shall hereafter use. Supposing all this wood were laid down in one continuous mass upon a table, covered over by superincumbent matter: it would serve to represent to you what is called "a seam" of coal. But if you look at this piece of black cloth on the wall, you will, perhaps, have a better notion of what a seam of coal is; for, in fact, this piece of black cloth does in width represent in correct dimensions this seam of coal at Haswell colliery, where the accident happened. This is the seam represented in the lower part of this section, which gives you from the surface downwards 900 feet to that black spot, representing the coal they are working, and which, enlarged in size and thickness, is, in fact, a portion of the seam in which the accident happened Therefore, four feet six inches, is the height of the coal, and at the bottom of the seam it is five feet. The inclination I have given here is just the inclination at which the coal falls, being one in twenty-four. Having opened a shaft 900 feet deep, and gained access to the coal, they begin to work it. Of course, it is all in darkness; they have not the earth open; their operations being like those of a mole. Having gained the seam they then work forward. It is worked at the width of five yards, cutting away the coal and going straight forward, perhaps twenty-five yards; then they work right and left along the passages which I have drawn there, and which are themselves five yards wide. Therefore, supposing this or that to be the coal, they work up fifteen yards, which I represent by this opening; when they have gone twenty-five yards in this direction, then again they work right and left by a passage of five yards. Others, again, work by another passage in this direction, and so on, in the solid coal. Of course, when they have cut away the coal, it leaves a series of passages.

Observe what the intention of all this is. These are the passages giving access to the coal, and are called "the ways." These masses standing here are denominated "the pillars." I think, in common usage, nobody would understand what "a pillar of coal" was, unless he saw it: he would fancy a certain round thick prop, placed in the middle of the mine, and not an enormous piece of coal like this.[1] They work up twenty-five yards before they turn the corner, and therefore you may suppose, that what they call the pillar, is an enormous mass of coal which is left there with these intervening passages Certain of these passages are made large and commodious for placing trams to run upon, and are called "trams," or "rolley ways;" the other passages being smaller, they are called "the mothergates;" but other terms are employed in different parts of the country. In the extreme part the miners are working up the solid coal; clearing, blasting, and cutting forward. I will not pretend to give you the names of these parts; I am only desirous of conveying to your minds the fact that they are working on into what are called the solid masses of coal, and are gradually cutting all away; of course having all the earth over them, which you can imagine, represented by the upper wall. When they cut away one portion or the other of the larger openings, they prop up the roof from the end by wooden props. These ways are required to be permanent, like rolley ways; they are the gateways to the ramifications of the mine; they are cut from year to year to keep them permanently in good order and safe. If an occasional fall happens, they make it

* We are indebted for the report of this very interesting Lecture to the "Repertory of Patent Inventions."—Ed. C. E. and A. Journal.

1 The lecturer referred to maps, diagrams, and models, showing the passages cut in a seam of coal, by which the relative quantity of coal got out and that left as pillars on the first working could at once be seen, and also the direction of the passages, each five yards wide.

good in this way: they can get in again to the same thoroughfare; then, when they have gone a certain distance, three or four boards—or ways, as they call them—they then begin to remove away the pillars, leaving nothing behind them. Supposing you were to take these pillars from the middle of one of the passages, working it all round,—they begin at this coal; they cut away a width, remove it, and prop up the roof with timber. Remember, that they are working at no greater height than this, in a vein of four feet six inches deep. The man is never higher than this in that part, where we have gone for eight hours at a time, in a stooping position, looking up and down at the black walls around us. Then they cut away this and prop up the roof; that is, they cut away the coal here, and leave an open space. They cannot, however, afford to lose the timber which supports this roof; neither would it be desirable to continue 100 acres of roof over their heads in that manner; and such is the extent of the mine, or something like it; they cannot leave that all remaining. It is, therefore, necessary to take away these props, and then let down the roof above it. Whilst the props are there, the coal being gone, it is called "a jud." You may have heard of "Williamson's jud," during the recent proceedings; that being the place where the fire originated by which the men were killed. Having taken away the coal, and also the props of the jud, it is then left to itself, and almost immediately, or in a very short time, the roof falls down under the rocks, which extend 900 feet above them, by its own weight. Having done this, they then go to the unbroken coal, so as to ramify and get farther out into the space under ground; thus the goaf increases gradually after them. It is to this particular part of the mine that I wish especially to call your attention. I have explained to you what the pillars are, and also the juds, and that upon these being removed they fall down; so that you understand that a goaf is only an accumulation of these juds, after the props—either timber trees or wood—are removed. I have also here given you on this board something like a notion of what a goaf would be. It must be a concourse of ruins, smaller or larger, according to the working of the mine, in the middle of the works. Imagine this to be a vein of coal, or ways, left behind in working it; in this part, where the pillar and jud have been drawn away, down falls the roof to a certain height: we cannot tell how much. It makes a mass of ruins, over which there is, of course, a very irregular cavity which contains it. You may conceive what the effect would be of a kind of mountain like this going in. When I use the term, "mountain," I am not far out. In this mine the goaf is thirteen acres in extent, in reality one and a half times the size of Lincoln's-inn-fields. Such is the extent of the goaf I am speaking of to-night, where this accident happened. This jud itself, therefore, must be rather larger in size than the great pyramid in Egypt. Whether it goes up in the same angle we know not at all; but the degree of the angle where we crept to it was, as far as I recollect, what I have taken here, which would be the same kind of thing, supposing it was very much cut out and in, which is the character of a goaf. As this settles down into masses, not quite so compact as the rocks before, it is very likely that here and there the roof rests on the goaf. Men have crept up these cavities, and gone a certain distance on the top of the goaf, as they call it. A friend of mine has been up in this very goaf I am speaking of, at Haswell, creeping some ten or twelve yards over the blocks of stone, and getting into it. There is great risk in doing this, unless a man knows what he is about, because a fall having taken place here, another fall may take place, and you may be there at the time. We ourselves had rather interesting experience of the manner in which these things take place, for while we were there, a fall of this description actually occurred, and cut us off from each other. Mr. Lyell happened to be a little in advance of the spot where it occurred, and I a short way behind. He heard the noise, but I saw the effect. But the interest of the coal owners and men is such that they do really venture up into these goafs at times when it is not safe to do so. Remember, then, that this goaf is a loosish mass of ruins, always, of course, having a vacant space in it, about equal to the amount of coal taken away: for you must bear in mind that all this ground was once solid. They have taken away coal equivalent to this space. The rocks fall down; and until the surface of the ground begins to settle, there must be a vacant space in the goaf somewhere or other of equal amount to the coal taken away. Think of the thickness of a block, equal in magnitude to that extent over a surface of thirteen acres, and that space left unoccupied by solid matter in this one goaf. There are some mines at Newcastle, or in the neighbourhood, with very large goafs; the largest that I have heard of is ninety-seven acres. Imagine ninety-seven acres in one mountain of ruins. This is the largest cavity which we have heard of in that neighbourhood. There are others which are very large at Whitehaven, in Lord Lonsdale's mines, but I must not go into that subject.

The point I wish particularly to call your attention to is the relation of the goaf to the fire-damp, which is the real subject I desire to bring before you. Fire-damp is hydro-carbon gas, a compound of hydrogen and carbon, formed during the production of coal. Those are part of the organic matter in its present state, and are retained in the coal under these circumstances until apertures are made for its escape. This gas mixing with the air of the mine makes an explosive mixture. For the purpose of representing fire-damp, I intend to night to use coal gas; which is not a bad substitute for that explosive matter. It is a gas which burns more brightly and powerfully than fire-damp, gives more light, contains a greater quantity of carbon, and fires sooner. In these respects it differs from, but in others it agrees very well with, fire-damp. In no one point are the existing differences material. In all the points in which I have to consider it to-night it may fairly represent coal-damp or fire-damp.

The first thing which I point out to you, then, is this fire-damp, which, when mixed with the air, forms what we call an explosive mixture. I will show you what its nature is. If I take a jar, which now contains air only, and mix a certain amount of coal gas with it, it will soon give you a notion of the kind of explosive mixture formed in the mine. I have here a little measure, (lines marked upon this jar,) by which I can tell when I have six, seven, eight, or nine volumes, if I may so term them, of air. At present there are about six, and I will use that number. Now, if I take a volume of this gas, as well as I can, and mix it with air, I have no doubt you will see the explosive mixture formed by the combination of fire-damp and air. (The lecturer proceeded to mix coal gas and air, and proved its explosive nature.) This is perhaps one of the most explosive mixtures which can happen in a mine from fire-damp; for the proportion of gas and air is stronger than would usually be found there. One of gas to five of air, or one of gas to fourteen of air will form an explosive mixture, or any numbers between the two; but either less or more will not effect the object. When this gas is burning the products resulting are water and carbonic acid. If I burn a portion of gas in this way I can very soon show you both the water and the carbonic acid. (Burning some gas under a glass.) You will there see the evidence of the water at once; for the moment I place this glass over the lamp I shall have the water produced by condensation. You perceive that the glass is even now becoming quite dim, not with dirt, but with water produced by the gas; the hydrogen combining with the oxygen and forming water. As the combustion proceeds more and more water is formed. Besides that, I have here also carbonic acid, which I will prove to you by putting in a little lime water, which, upon being shaken up with it, immediately becomes milky in appearance. You have now before you a proof of the two things evolved from the gas, the milkiness evidencing the presence of carbonic acid, and also the water produced from the combination of the gas with the air. The effects which I have now shown you from experiment are the same as those which take place from the combination of the fire-damp with the air conducted into the mine. I need not take up your time by pointing out the fact that the same effect is produced by respiration. You will take it for granted that when the air is breathed exactly the same change takes place as when gas is burnt. I merely mention the circumstance to point out to you, that as in breathing the air we cause it to become of a bad quality, so the same effect is produced in air burnt in combination with gas, whether fire-damp or coal gas, it will make the air as bad for breathing as though it had been breathed itself. I will take this jar and breathe into it, and when I throw the air from my lungs into it you will see how bad it is. The air which is now in this glass is so bad that it will extinguish a light. It is now unfit to breathe, and so also is the air combined with the coal or fire-damp in the mine. (The lecturer showed these effects by experiments.) This is one reason why so many lives were sacrificed, and the accident was so extensive, by the recent explosion at Haswell colliery. The circumstance of the combination to which I have referred in the mine produces the very same kind of bad air as produced the explosion I showed you from the mixture of coal gas with air, which certainly seemed a very tame explosion. Before we went down into the mine in the first instance it was exceedingly difficult to account for so large a number of deaths as ninety-five taking place, when, from the report of men who had come out of the pit only an hour or two before, there was little or no gas in the mine. Miners who had only come out about an hour and a half before the accident gave evidence before us that there was no gas in the mine. It was therefore a difficult thing to account for the deaths of so many persons. Some of these unfortunate individuals were burnt, but a great many were not; the former evidently died from burning and suffocation, the latter from suffocation only.

I will show you a little experiment which illustrates the manner in which when a fire does happen in a mine, the evil increases and grows up to a most enormous extent. You see I burn this gas fairly, merely giving it an opportunity of mixing with the air gradually, and so, getting the right and just proportions, it burns very brightly; but if I mix it with air first—which is always the case in a mine—it does not burn in the same character. I have here a lamp of wire gauze, upon Sir Humphrey Davy's principle; it will not allow the flame to go through; it will allow the air to go in and the gas to go out; consequently, if I let the gas into this wire gauze, it will mix very much in the same manner as it does in the mine before the miner by accident sets fire to it. In setting a light to this, I shall, therefore, have a very different effect to what I had before. You perceive that I have now a combination, not of air only, but of air and gas burning together; this would explode, were it not that the wire gauze prevents any such consequence taking place. We see here the combination which takes place of coal-damp and air down in the mine; but that is not all which occurs there, for, in my belief, by far the greatest portion of combustible matter burnt in a mine, upon such occasions, is the coal-dust which rushes up the passages when the explosion has happened. When we went down, we found, near to the place where the explosion occurred, all the columns plastered with coal-dust taken up from the floor and driven forward by the blast, forming a fiery stream passing through the passages, part of it coking, other portions being converted into gas, and some cemented to the walls; clearly showing the direction which the explosion had taken, because one side was plastered half an inch thick, while there was none on the other side, indicating fully both the chemical and mechanical effects of the explosion. If I take a little coal-dust, and mix it with that flame, you will soon see what a difference there will be in the combination. The danger arises not merely from the combination of air and fire-damp, but from the kind of mixture which I am now going to make. I have thrown a little powdered coal into this apparatus, and you see how much stronger the combustion comes on. The gas, first of all, commences the evil, and then lights up this combustible matter (the dust of coal), of which the whole place consists; floor, roof, walls, and every part being composed of it. The fire thus gathers energy, and goes on ramifying through the mine. It is only upon this principle that we can account for the extraordinary extent of injury by choke-damp, the result of combustion, causing ninety-five deaths in what was considered a very safe mine.

Now, with regard to the coal gas; for I must really shorten my observations for the purpose of bringing you at once to the point in relation to the goaf and the coal-damp. Fire-damp is light; and we may very well use an experiment or two here, for the purpose of pointing out by coal gas what its effect is. Coal gas is really, in many cases, when made in London, not far off in its degree of gravity from the fire-damp. Now, here you would not understand in a moment the principle, but these experiments and demonstrations make it far more impressive to the mind. (The lecturer then showed various experiments, to prove that coal gas, and therefore the gas of the miner, if accumulated under a vessel, or chamber open below, but having no outlet above, would remain at the upper part, and when mixed with atmospheric air would, if a light be brought near, ignite and explode.) The consequence is this, that if the blower, or any gas in the blower, can get into a place of this sort, it will remain there some time. I will not put a light there, because it might shake the thing to pieces. If I come here two, three, five, or even ten minutes, after I have filled it with gas, I shall find the fire-damp remaining there. (*Experimenting.*) There it is. You perceive that I had to carry my light up a certain distance; I could not find it lower down, but there we found it, because of its lightness. So light is this gas and this fire-damp, that it flies from one thing to the other. I have one very important point to show you with regard to the operation of these coming immediately into action in the goaf. This gas is always to be found at the upper part of any cavity where it may exist. If you will allow me to consider this as a model goaf, (an oblong inverted vessel), for the purposes of our illustration, you will soon see the effect of its lightness in determining the gas to one place or the other; for if I let a little gas into this goaf, which I can do from this jet, whichever end of this goaf I incline up there the gas will be found; it will not remain in one place, but will oscillate from side to side, according to the position of the vessel, in consequence of its lightness; being, in that respect, comparable, in an inverse ratio, to water, which, of course, will flow from side to side in the vessel, because of its heaviness. Whatever you can imagine in fluids you may suppose also in regard to gas. I will let gas into this goaf. Although I have a great number of drafts, and I myself make a considerable motion in the air, I dare say in this place we shall be able to make the experiment. (The lecturer then shewed by experiment that the gas was at all times in the upper part of the inverted vessel, and that it moved from end to end, according as one or other end was raised.)

In a mine, there appears to be a tendency to the evolution of this light hydro-carburet fire-damp. It seems to be oddly given forth at times. A man will come upon the blower, and enter a little cavity; then there comes a rush of gas from a place the size of my finger, rushing out, perhaps, and taking fire by his candle: if it happens without any serious injury to the man, it will burn away like a great torch. At other times it will creep up to every part of the coal; then an accumulation will take place with the atmosphere from these blowers, but still equally dangerous. There was a case in which the gradual evolution of fire-damp from the coal produced this effect. A vessel, laden with coal, having come part of its voyage, the gas from the cargo came out and made the hold of the vessel explosive: a sailor happened to go down below with a light, and the place blew up, exactly in the same manner as the explosions take place in these passages of the mines. This shows under what circumstances the gas comes out of the coal during the working of a mine. If there be any evolution of gas in a mine, which at any time causes the conveyance of gas into a cavity of the goaf, it will, as you have seen in this experiment, tend to rise to the upper part. It is a light gas; every mixture of it is lighter than air, and the light gas will tend to rise to the higher part. There is, therefore, every reason to believe, that if this goaf opened into an upper stratum, and you will find there are five, six, or more strata above that which they work in reality, from the opening of small seams and beds, or whatever cause it be, it will open passages from that to the upper strata of this, to the fire-damp contrined in the goaf itself. There is not the least doubt that any vents of this sort would tend to become resting-places for the gas, which would run into it at different times and under different circumstances, and there remain in larger or smaller degrees. There can be no doubt that the goaf is a very convenient place for the gas to accumulate in; that there is a tendency to that in the goaf from the ventilation, the arrangement of which I must not go into, but it is very beautiful. There are two deep pits; the one has a furnace at the bottom, so that the first becomes a chimney. There is an immense draft up this pit, and there is a great mixture of air and gas. They ventilate most carefully the space of coal where they are working, because there they are ever coming to new reservoirs of gas, and new apertures open into it. They ventilate the goaf also, in some degree, but so feebly, that the air there is almost stagnant. They cannot afford to have a sweeping current all over the whole of the mine. Whenever a mine contains 100 acres, any quantity of air which goes down a cavity 12 ft. diameter cannot be made to extend over the whole of that space. The gas goes through the apertures which are left; so that in such places the air must be regarded as really stagnant. Much more are the cavities within the goafs stagnant. These goafs are loose masses of rocks falling together. If you take a sponge in a gale of wind, the air sweeps away all from the outside; it would not touch the cells, or inner side. These cavities then become, in fact, reservoirs for fire-damp, if they have access to the goaf It will contain fire-damp just as well as any other part. Any previous part of the goaf may be made subject to fire-damp, if there is any in the goaf of the mine.

Now let us look at the effect of the goaf under certain circumstances. First of all, if it be no generator, it opens to one place where the fire-damp is evolved; but we think it does evolve it. There is plenty of proof that the goaf is a very dangerous place. Not many weeks after we came away an accident happened. A man put his candle up a cavity of a goaf, and said, "See, here is no damp here!" when an explosion immediately took place, and four men were killed, proving, very unfortunately for the men themselves, that the goaf is a very dangerous place. Whether the fire-damp is evolved there or not we cannot positively say; but if not, it is quite clear that any gas evolved in any part of the coal in excess will gradually creep into the goaf. There are certain mines, we were informed, which to this day are involved in this condition; although they ventilate carefully, as well as they can, all through the mine, still they are obliged to adopt regular periods for firing the residue of the mine, "firing off," as they call it, for the purpose of clearing away, by burning, the fire-damp. Sometimes they are obliged to do this three times a-day for the purpose of getting rid of the fire-damp. Such gas as that, however, must always be dangerous. The goaf, therefore, is perpetually liable to be a reservoir of gas, even though it may not itself be a producer. If there be any gas in the goafs, it will be in the upper parts. If there be any cause which may increase the quantity of gas in the goaf, or lead to any further influx of it into the goaf, it will flow off at the upper part. There are some very extraordinary causes which tend to make the gas ascend. First of all, bear in mind what I told you before of the manner in which the men proceed in working the mine, taking away pillar after pillar, and then at last, drawing the juds. Imagine a pillar here; he props the roof up; takes away the pillar, and so converts it into a jud; at last he withdraws the jud and then what happens? Part of the roof falls down, and extends the goaf, But mark the consequence; it will not merely have made the goaf larger by, spreading the basin yet more, but the edge of the basin becomes a little higher. Now, supposing a goaf of thirteen acres to be full of gas, or an explosive mixture, down to a certain level, that the ventilation had carried off all the gas up to that point. This breaking in of the goaf has the effect at once of altering the level one foot. Throughout the whole extent of that goaf a stratum of air in the interstices would pass off one foot in depth, flowing out at that one place. The whole of the adjustment of the ærial strata in that goaf would be altered in that maner, just as though if you were break off one foot of the edge of a pond of water, you would let out one foot of its depth. This is a very serious matter.

There is, however, one other point which I must notice, and that an extraordinary one, namely, the effect of the pressure of the atmosphere. The philosophy is very well known to scientific men, though not generally understood. The atmosphere will vary as much as 3 in. in the barometer, fluctuating from 28 to 31 in. in its weight, It often happens in a single day, that it will drop one inch, falling from 30 to 29. What do you think would occur in a goaf of that size, a small one, if the barometer descended to that extent in one day? The enormous quantity of air in the goaf, equal to the bulk of coal taken out, would expand, and occupy a larger space; then, of course it would overflow at the upper edge of the goaf in proportion to the fall of the barometer. The gas becomes squeezed by the superincumbent atmosphere into every crack. It retreats into the solid coal itself; into the cells of the coal; the blowers all cease in some degree, or diminish in action. The air in the goaf retreats up, and takes a smaller space; fresh air is poured

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down the shaft, because the pressure of the atmosphere above is greater. When the barometer is rising, the men are comparatively safe, because the enemy is retreating from them; but when it falls, all this explosive matter comes forth into the mine from the goaf. Then, of course, when the barometer falls, there is an overflow, or rather, an underflow of gas from the goaf into the workings of the mine, making it explosive. Even the men themselves do not know anything of this fact. I will make an experiment to show you how this acts by taking a porous substance, and exhausting the atmosphere from it. I am using only a piece of charcoal, which is a bad thing, because it is by no means sufficiently porous. If I increase the pressure of the atmosphere, I expect you will soon see the gas, or fire-damp, creeping out of the cavities of the charcoal. You will now perceive it rushing out of all these cavities, even with a very moderate diminution of pressure of the atmosphere, and under very unfavourable circumstances as compared with the enormous cavities in the mine. You see it does not it come out and overflow. (The lecturer showed this by suspending the charcoal in water under the receiver of an air-pump.) Once in a thousand days, or any other time, a period would come round in which this space would serve as a receptacle for fire-damp, being full of the explosive mixture which comes forth when the barometer falls. When these ninety-five men were killed, it was actually by the drawing of a jud; it was at the very edge of the jud. It was in a mine well ventilated, and free from gas as mines go. The underviewer actually declared that he never saw any gas in it in his life. The gas, however was found by others. They were drawing that jud at the time of the accident; whether the jud or stones had broken the Davy lamp, and so set fire to the gas, we cannot tell. We saw some lamps at the very place; but yet we cannot tell accurately how it occurred. All we know is that they were enlarging the edge of the goaf in that part when the accident took place. Another explosion took place. Some of the men were choked; others were choked and burnt; but they were all killed by suffocation, so that there were two causes.

Without saying whether this was or was not the cause, we venture to think that the ventilation of the goaf should be attended to by itself, apart from the rest of the mine. We were not fitting judges of the fact as to whether the mine was or was not sufficiently ventilated; those who are qualified to give an opinion on the matter say that it was. But as regards the goaf, we venture to say that was not ventilated enough: it was a very feeble current of air, not carried forward to the extent to which it ought to have been in a mine, where there is a liability to the action of fire-damp. The safety of the miners hangs upon a change in the barometer, a sudden increase of gas in the mine, and various other circumstances.

Wishing to make our examination as quietly as possible, and to have our Report as complete as we could, we proposed upon general principles the following plan for the prevention of these sad calamities. That a pipe should be laid from the goaf into the upcast shaft, or into what is called the return way, and either by a draft, or some mechanical means, to draw off the air from the goaf. That the pipe shall be thrust up into the goaf, then carried to the upcast shaft, and exhausted by machinery. Now my notion was without any mechanical means, merely by the draft of the upcast shaft, if connected with the goaf, that such an arrangement would be sufficient to ventilate the goaf. I am going to shew you that that draft is sufficient to ventilate the goaf. Here is a pipe entering the chimney; I have carried off this pipe a certain distance; part of it is made of glass, another portion of waterproof cloth carried out at the further end, at which place there is such a draft that a candle can hardly be kept lighted there. It is just that kind of draft which I propose to use in the removal of the gas from the goaf. That is what we call the return way, and this the upcast shaft: not that I mean to say that the return in the mine is all air, because such is not the case. Our proposition is to have in such return way a pipe laid down purposely to proceed to the goaf. But I must show how it is such a small fire creates so great a draft. The velocity of the air in the mine is measured by smoke from the explosion of a little gunpowder; and I will imitate their process for the same purpose; the draft which I have here, being of course very small, compared with that which exists in the mine, although about in the same proportion to theirs. They have two fires in the upcast; and they informed me that there was half-a-ton of coals on each. These fires are always kept up, so that there is continually a ton of coals in combustion in them. You may imagine from that fact, how great the draft must be. A little gunpowder will now be fired at the other end, which will enable you to judge of the velocity of the draft. (This was done, and the passage of the smoke through the pipe could be seen through the glass.) You now perceive the beautiful manner in which the smoke passes from end to end. Now it is here; then it is at the middle of the pipe; and now again it is gone out at the end. This will give an idea of the application of this plan, and will show how a draft of this kind could draw the gas out. Were I to give an account of the number of cubical feet drawn out in one hour, you would be perfectly astonished. I will now show how sound these principles are in theory, I cannot at present see any difficulty in practice. Here is a mere register hole going into a flue. The register hole is applicable in principle and also in practice. (The lecturer showed how the model goaf could be cleared of gas by a pipe passing up into it, the other end of the pipe entering a flue of a fire-place, representing, for the time being, the upcast shaft, which clearly proved that no gas could remain at a lower point in the goaf than the end of the pipe introduced into the goaf.) The principle cannot fail to answer. It merely requires a pipe of any sort carried into a place, with a reasonable draft in it. Draft, of course, is absolutely necessary. There is an objection which occurred to myself, and I dare say to both of us, and most likely also to the coal-owners. Indeed the papers, with that infallibility which belongs to them, have at once declared that our plan would do no good; that every coal-owner, without exception, was satisfied that it would not answer. The difficulty which I allude to is this; there is in a mine what they call the creep. When a mine is in work, and the pillars exist, these ways creep. Our proposition is to lay down iron pipes which will reach to the upshaft, or return way, by a flexible extremity; but then there is the creep. That is to say, when the pillars are still standing the superincumbent weight of the earth would squeeze them bodily into the ground; the earth would ooze in, and this they call creeping. The whole earth is like a little bit of sealing-wax with a candle brought together in this sort of way. Of course, that would destroy any arrangement, as to anything let in the earth, like the water or gas-pipe of London. I have since proposed a pipe hung up in the air; but, I believe, that a pipe of that sort, a flexible air pipe would do, and you might have access to it at any time. I think it possible that they might block up one of these ways in the pit, and keep the pipe safe from failure or harm. Upon the plan of the Haswell mine there would be no difficulty at all in conveying such a pipe from the goaf. I cannot tell what the plans in other mines are, but I am satisfied that 50*l.* would lay down a very good pipe from the return to the goaf. At least, that is my conviction: I am perfectly sure that the principle is correct, although the practice may show difficulties; but still, I think, not such as are insurmountable. I was observing that the pipe might be temporary, but I might say, it does not need that; the pipe might go in. There is an objection made to this, that they cannot form their goafs entirely at will. We do not want to do so. If a pipe of that sort went about six feet up into a goaf, no variation of the atmosphere would ever bring the fire-damp into the mine. Well, then, having got six feet into the goaf, they may go on 30, 40, or 50 feet, in the further working of the mine, before they need change the position of that pipe, or before the outer extremity would be below the highest point of the edge of the goaf. We are not bound to find with mathematical exactness the highest elevation in the goaf; all we have to do is, to keep the pipe within the part where the fire-damp is, which would be an easy thing to do. We have no idea that this process can be anything so perfectly mathematical, or that if it intermits for an hour, it can do harm. My notion is this, that if it work one day in three, it would keep the mine perfectly safe by removing the fire-damp entirely out of the way. That is my impression; whether it will prove so or not, I cannot at all say; that must depend a good deal on the circumstances of each mine individually. The great point with us is to draw the air away. I have said already, that one of fire-damp will render fourteen of air explosive. The general process of ventilation is, to drive air into a mine and goaf, mixing it altogether, and thus making an explosive mixture. We should ventilate the goaf by drawing off the fire-damp, and therefore I prefer this principle of drawing out its contents to sending air into it. We do not want to carry fresh air into the goaf; we would rather keep the poison out of the system, than send in a great flood of water to drive it out afterwards. The thing is, to prevent the evil; and if you take away one measure of gas, you prevent the chance of fifteen explosions afterwards; whereas, throw in one measure of air into the goaf, and you throw out a measure of gas, which will make fifteen measures of explosive mixture. Everything, therefore, points to the withdrawal of the gas rather than the throwing in of the air.

This principle of withdrawing gas, I am glad to find, is not new among the coal-owners. Mr. Ryan's method of ventilating mines is one which essentially depends upon drawing or draining off the gas from the mine. To my mind his principle seems very beautiful, and cannot but be most valuable in very many cases, although in some it is said to have failed. I know that a man may fail twenty times in a good thing, and yet succeed in numerous instances afterwards.

There was another gentleman, of the name of Taylor, who proposed, many years ago, to ventilate mines by drawing out gas from the mine by a particular apparatus. Our proposition has been limited entirely to the goaf; by going to that part which is not ventilated by the common means. It is in the goaf that we would lay this drainage. We do not venture so far as to say; it would certainly succeed in practice in the mine; but it does seem to us, that a cavity like this should have some attention paid to it for the removal of the fire-damp from it.

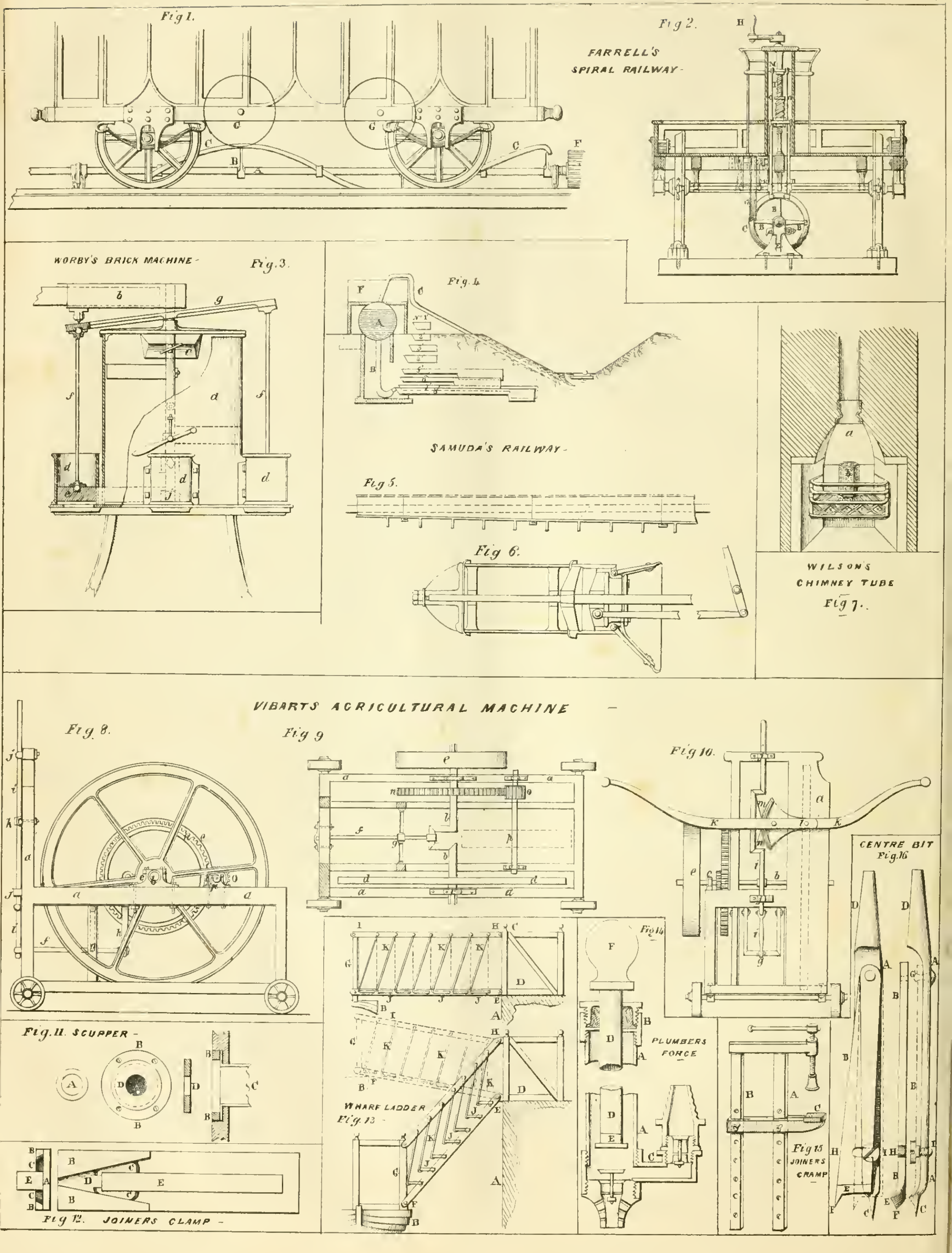
Fig 1.
Fig 2.
FARRELL'S
SPIRAL RAILWAY
WORBY'S BRICK MACHINE
Fig. 3.
Fig. 4
SAMUDA'S RAILWAY
Fig 5.
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Fig 12. JOINERS CLAMP

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

ATMOSPHERIC RAILWAY.

JACOB and JOSEPH D'AGUILAR SAMUDA, of Southwark Iron Works, engineers, for "*improvements in the manufacture and arrangement of parts and apparatus for the construction and working of atmospheric railways.*"—Granted April 30; Enrolled October 30, 1844. *See Engraving, Plate IX.*

This patent has several distinct objects: the first is a new method of exhausting the main pipe of an atmospheric railway, and is thus described: a large, close, water-vessel, or tank, A, is placed by the side of the line of rails, as shown in the drawing, fig. 4, and this contains two or three times as much water as equals the capacity of one section of the main line of pipe. The water vessel, A, has a pipe C at its upper side, connected to the main-pipe, to exhaust the air through, and the vessel itself being full of water, then, when it is required to form a vacuum, a pipe B, is opened at the under side of the vessel A, and the water descends by its gravity in the pipe B, and by its velocity passes the curved lower end of the pipe, and ascends in a jet as high as the partial vacuum in the vessel allows it; and at different heights are placed troughs, Nos. 1, 2, 3, 4, 5, 6, 7, and 8, which catch the water and conduct it into reservoirs, Nos. 1′, 2′, 3′, 4′, 5′, 6′, 7′, and 8′, whence it is pumped back again by a small engine into the vessel A, being also assisted by the partial vacuum remaining in the vessel when the train has passed. The branch pipes connecting the vessel with the main-pipe having valves, which are shut just before the train-piston in the main-pipe reaches the branch, and the water in the upper one or two vessels, when the vacuum is high enough, may be forced back again into the vessel A, through a pipe, by the pressure of the atmosphere acting on the surface of the water; and the valves in these pipes being then closed, no air will follow them, and the remainder of the water will be pumped up by the small engine ready to form the vacuum for drawing the next train.

There seems here considerable misunderstanding of the principles of hydraulics. In the first place there is no gain but rather a loss of power by allowing the water to ascend from the curved end of the pipe in a jet. It is a fact of common observation that the water of the fountain never rises so high as its source; whereas the water of conduit-pipes will always ascend to exactly the level of its source. The height to which the water of the tank A would rise, if conveyed throughout in a pipe, would be proportional to the exhaustion of the air above A; when, for instance, that exhaustion had been carried so far that only $\frac{1}{3}$ of the atmospheric pressure remained, we should have, on the principle of the barometer, the height of the column sustained in the tube; or taking 33 feet to be the height of water corresponding to the atmospheric pressure, the level of the water in the tube would be 22 feet below the level of that in the tank. But if the tube were not continued upward to the reservoirs, but the water flowed in a jet, the level which it would reach would be still lower. The elevation of the reservoir of the great fountain at Chatsworth is 381 feet, and the height which the water attains from the fountain is 280 feet.

Another mistake is the employment of several reservoirs to catch the water. The object of this is stated to be "to prevent the water descending lower than is absolutely necessary, and thus avoid the cost of pumping it back from a lower level than requisite." Now if this plan were found to produce the effect proposed, we must conclude that the labour of working a common pump would depend on the depth to which the supply-tube descended into the water. But on the contrary, the effort required for raising the water depends wholly on the height to which it is raised above its source; and would be no greater if the supply tube descended to the bottom of ocean than if it reached only just below the surface. In the case before us therefore the labour would be just the same whether the water were raised from several stages by different supply-pipes, or from one general reservoir by a pipe reaching to the bottom of it. The most simple and effective plan, and that which perhaps the patentees will adopt when they have ascertained the merits of their present invention would be to pump the water at once from the tank A into a higher reservoir from which the water could flow back when the train had passed.

Another part of the patent is the disposition of the different sections of the main pipe in one continuous tube, and the following arrangement of the order of working the air pump.

5   4   3   2   1

Suppose the train starts from 1; "when the train starts, No. 1 engine is stopped, Nos. 2 and 3, are at work drawing the train along No. 1 section of pipe, and No. 4 engine is started to exhaust No. 3 section of pipe. When the train passes the branch-pipe leading to No. 2 engine, the latter is stopped, and No. 5 engine is started to exhaust No. 4 section of pipe, while Nos. 3 and 4 engines draw the train along No. 2 section of pipe; on the train passing the branch leading to No. 3 engine, that engine is stopped, and No. 6 engine started, Nos. 4 and 5 engines drawing the train along No. 3 section of pipe, and so on."

By this system and a certain arrangement of stop-valves within the main pipe the train can be drawn in either direction. At 2 for instance, two stop-valves worked by hand are placed in the main-pipe, one a little to the right and the other to the left of the engine, so that the tractive force of the engine 2 may be exerted either towards 1 or towards 3; if therefore a train be drawn towards 2 from 1, the right hand valve at 2 is opened and the left hand shut; if a train be drawn from 3 to 2, the left hand valve is open and the right hand shut.

Another object of the patent is the gradual enlargement of the bore of the main-pipe as shown in fig. 5, where the steepness of gradients renders additional force necessary for the propulsion of the train. The piston is so arranged as to be capable of expanding to fill the enlarged pipe, and again contracting when the pipe is reduced to its usual diameter. The method by which this piston is to be constructed is not very clearly expressed in the specification, but the main feature of the plan seems to be that the expanding piston shall be formed of a bag of leather or other flexible materials, which is to be distended by a lever, see fig. 6, controlled by the conductor of the train.

There are other minor improvements specified, but the above are the principal.

DRAIN PIPES AND TILES.

WILLIAM FORD, of Lawn End, South Lambeth, Surrey, Drain Tile Maker, for "*improvements in the manufacture of tubes for draining land and for other purposes, and in drain tiles.*"—Granted July 30, 1844; Enrolled January 30, 1845.

The objects of the invention are improvements in the machinery for making drain pipes and tiles, and a mode of forming sockets on the pipes. The machine is portable and complete within itself, and its movement is horizontal, a piston working within a clay chamber being pressed forward to force the clay through the moulding orifice, and the pipe or tile thus formed cut to the required length by a simple operation. The improvements consist of a fixed chamber, that can be filled with clay very expeditiously, having a hinged cover and a lever apparatus, which is released from a spring catch by a tappit on the piston rod, that acts the instant all the clay is discharged from the chamber, throws the driving pinion out of gear, and prevents injury to the working parts of the machine.

The cylinder for forming sockets on the pipes is parted in the centre longitudinally, and hinged at one end is a stop, and at the other a mould of the external form of the socket, and the pipe being placed within, with its end against the stop and the cylinder closed; a mandrill, at one end of which is a mould of the internal form of the socket is passed through it, and an excess of length of the pipe is driven into the socket mould, and a socket is thus formed so accurately, the inventor states, as to render the pipe fit for many other purposes besides draining.

BROOM PAPER.

MOSES POOLE, of Lincoln's Inn, Middlesex, for "*Improvements in the manufacture of paper.*"—Granted July 10, 1844; Enrolled Jan. 1845. (A communication from a foreigner.)

The improvements consist in the employment of the broom plant, reduced to a pulpy state, for making paper, in the following manner. The common broom is the one most preferred by the inventor, it may be used either green or dry, by being first steeped in water or not; the branches of the broom are crushed or bruised; during this process the plant should be immersed either in hot or cold water and continually changed; the woody parts are then separated from the filamentous parts—the former are again ground before they are mixed with the latter—the crushing is continued until the water flows away without any colour. Afterwards the pulp is submitted to great pressure to force out the water, and then submitted to a *lessive* of about 10 lb. of lime and 2 lb. of soda to 200 lb. of pulp. It is next put into a washing mill to have the pulp untwisted and thoroughly washed, and at the same time all the woody particles that may float on the surface removed. The pulp is again pressed and divided into small parcels for the purpose of bleaching, and is exposed to the action of chlorine, either in vapour or in a liquid state, for about 25 minutes; $\frac{1}{4}$ lb. of muriatic acid is used for every 200 lb. of pulp. The pulp after it has rested for 6 hours is ready to be made into paper.

The claim is for the preparation and employment of a pulpy matter obtained from the broom plant to the manufacture of paper.

SMOKE COMBUSTION.

WILLIAM BEDINGTON, Junior, of Birmingham, "*for improvements in the construction of furnaces.*"—Granted July 10, 1844; Enrolled January 10, 1845.

The objects of this invention are the more perfect combustion of fuel and the prevention of a great discharge of smoke. It is proposed that the gases and smoke after leaving the furnace, shall pass into a chamber below the furnace and at the back of the ash pit, which is constantly supplied with air, and be there deflected by a "hanging-bridge" so as to mix intimately with the atmosphere and be inflamed by it.

CAULKING SHIPS.

Sarah Coote, of Clifton, for "*improvements in caulking ships and other vessels.*"—Granted July 24, 1844; Enrolled January 24, 1845.

Under this invention the use of flax and hemp is discarded and shorn wool substituted. This substance is first picked and then saturated with paint of white lead. After the paint is strained off, the wool is ready for use.

FARRELL'S ARCHIMEDEAN* (SPIRAL) RAILWAY.

This is a scheme for propelling railway carriages by stationary steam engines. Mr. Farrell is an architect of Dublin, and his patent bears date Nov. 14, 1844. The principle of the invention is similar to the well known contrivance of turning a cog-wheel by placing its cogs in gearing with the thread of the revolving screw. An endless screw is laid down between the rails, the whole length of the railway. This endless screw is turned by stationary engines, and two wheels fixed to the foremost carriage of the train are acted upon by the thread of the screw, which thus gives motion to the train.

Fig. 1, Plate 9, is an elevation of a carriage and a portion of the railway. The screw propeller is keyed to the shaft A by wrought-iron arms B, to the end of which the spiral is bolted at C. The shaft is divided into lengths of about 12 feet each, and the two ends of each length turn on bearings attached to the cross-sleepers. The lengths are connected at the bearings so as to turn together. Fig. 2 is a cross section, A the shaft, and B the connecting arm as in fig. 1. C the circle which any point of the spiral describes in its rotation; G G the wheels which bear on the thread of the spiral and communicate motion to the carriage; H, M, I, refer to mechanism for disconnecting the pair of wheels from the spiral when the train is to be stopped.

The following passages from Mr. Farrell's published account of his system seem the most material.

"The shafting is proposed to be formed [of iron] tubing 4 inches diameter, and half an inch in thickness; the weight found by accurate calculation and proved by experiment as sufficient to twist such a shaft if applied to the periphery of an 18-inch pinion fast on it is 22,196 lb.; now, as half the breaking weight may be applied without producing any deflection, we have a shaft to which we may apply 11,100 lbs. at the periphery of an 18-inch wheel with perfect safety, without producing any tortion whatever. Now the power required to turn a mile and a half of screw propeller from a state of rest is 1,600 lb., which is about one-seventh of the power that may with perfect safety be applied to the 18-inch pinion, or, in other words, the shafting might be extended to seven times the length I have proposed without being subjected to any tortion whatever."

It will be observed that it is here assumed that the length of spiral experimented upon does not affect the liability of torsion. Now it may be very true that the half dozen yards experimented upon by Mr. Farrell took 22,196 lb. to twist them, but we question whether a much less force would not have twisted the spiral if it had been 50 yards long.

"With respect to the power required for this system, it has been shown that 1,600 lb. applied to the periphery of an 18-inch pinion will be sufficient to overcome the inertia of a mile and a half of propeller, and set it in motion round its axis. Now, suppose the pitch of the screw to be 12 feet, then every revolution it makes on its axis impels the train 12 feet, and 154 revolutions per minute will impel the train at the rate of 21 miles an hour; to obtain this speed we require a spur-wheel $5\frac{1}{2}$ times the diameter of the pinion, or 8 feet 3 inches in diameter, making 28 revolutions in a minute. If this spur-wheel is turned by a 2-feet crank, the radius of the wheel being 4 ft. $1\frac{1}{2}$ in., it follows, that in order to apply a power equal to 1,600 lb. at the periphery of the spur-wheel, we must apply twice and $\frac{1}{16}$th of that power, or 3,300 lb. to the crank; this power would be afforded by a condensing engine 24-inch cylinder, 4 feet stroke, and making 28 strokes per minute, or 18 horses power."

"The foregoing calculations are made without any reference to the provision spoken of for bringing the propeller gradually into motion; but as such provision is made, and it is known that *half the power that is required to set a machine in motion is sufficient to continue that motion*, we may safely calculate on one-half the power above stated, or 800 lb. as available for the purpose of propelling the trains."

We quote this passage to direct our readers to the parts marked in italics, which will serve to show the accuracy of Mr. Farrell's mechanical notions.

The following appear to us insuperable objections to the system.

1st. Taking Mr. Farrell's own calculation that a mile and a half of the screw propeller weighs 80 tons, 50 miles of the screw would weigh about 2700 tons. So that to dispatch a train from London to Brighton not only would the train have to be set in motion, but 2700 tons of metal beside. If therefore we take the weight of the train at 27 tons, we multiply the load to be set in motion 101 times! And in every railroad the load *maintained* in motion would be quadrupled, as it would consist of one length of spiral weighing eighty tons + the train propelled by it.]

2nd. Engines would have to be maintained in working every three miles.

3rd. Every engineer knows that the endless screw is a most inefficient mechanical agent, on account of the waste of power which it causes from friction: and it is seldom used except in musical boxes and mechanism of a similar nature.

4th. The strength of materials must be enormous to prevent a tube a mile and a half long being twisted and broken by a force which causes it to revolve rapidly.

5th. There must be great difficulty in obtaining a retrograde motion of the train corresponding to the action of reversing locomotive engines.

These considerations will, we think, satisfy our readers as to the value of the invention. We cannot help regretting that Mr. Farrell should have spent his time and money in patenting a scheme so hopeless futile.

BRICK AND TILE MACHINE.

William Worby, of Ipswich, for "*Improvements in the manufacture of bricks, tiles, and other articles from plastic materials.*"—Granted June 24; Enrolled Dec. 1844. *See Engraving*, fig, 3, *Plate IX.*

The machinery represented in the engraving Plate 9, consists of a pug mill *a*, containing an upright shaft with six or more spirally arranged knives, worked in the ordinary manner by a horse or other power attached to the beam *b*; the clay is put into the pug mill through the hopper aperture *c*, at the top, and gradually driven down to the bottom of the pug mill through apertures into separate chambers *d d d*, on the outside of the pug mill, of which there may be three, four, or a larger number; each is furnished with a closely fitted piston *e*, worked up and down by vertical rods *f*, attached by ball and socket joints at top and bottom, at the top to a cross beam *g*, with a conical formed collar in the centre through which the shaft of the pug mill passes; on the beam *b*, there is a small wheel *h*, which as the beam revolves depresses one piston at the same time the corresponding piston is raised, so that by a complete revolution of the beam *b*, the pistons in all the chambers are once raised or depressed, at the same time the tempered clay is forced through the openings in the bottoms of the chambers, which are furnished with dovetailed plates to receive dies or plates with orifices of the required form that the clay is to be moulded; the apertures leading from the pug mill to the chambers are furnished with slides *j*, regulated by a lever so as to close the opening or any portion of it. The entire machine is supported on four legs.

The claim is, the so arranging machinery that a suitable pug mill shall have separate cylinders or chambers, each with a piston and moulding orifice combined therewith, by which a succession of bricks, tiles, or other articles may be made.

CHIMNEY TUBES.

General George Wilson, of Cross Street, Islington, Middlesex, machinist, for "*Improvements in the construction of chimneys, or fireplaces generally.*"—Granted July 24, 1844; Enrolled Jan. 1845. *See Engraving*, fig. 7, *Plate IX.*

The construction of patent stoves, grates, chimneys, flues, &c., under this patent is as follows:—suppose a register stove made air-tight, instead of the usual flat or bevil top, has an oval shaped canopy gradually contracted upwards to a circular tube about 10 inches high, *a*, with a contraction or swelling inwards of about three inches in the centre of its height, the top of this tube opens into the shaft of the chimney. When fixed the whole of the atmospheric air of a room pressing at the focus causes a simultaneous draft, particularly when assisted by the heat of the fire. It has the same effect as when a door is shut, and the whole of the atmosphere pressing against the door finds the key hole the means of escape, and the aperture being small increases its velocity. The second improvement is the introduction at the back of the grate of a tube *b*, perforated with holes to feed the back of the fire with oxygen, and at the same time assist the up draft and prevent the necessity of blowing or stirring. The contracted tube may be also introduced at the foot of the vertical chimney of a steam boiler or furnace.

AGRICULTURAL MACHINE.

James Vibart, of Chilliswood House, near Taunton, Somerset, Lieut. R.N., for "*Improvements in the means of obtaining and applying power for working or driving thrashing machines, mills, chaff cutters, and other machines or apparatus.*"—Granted Sept. 12, 1844; Enrolled March, 1845. *See Engraving*, figs. 8, 9 and 10, *Plate IX.*

This invention consists in the application of the principle of the lever to the construction of an engine or machine for obtaining motive power for

* The term "Archimedean" is a misnomer, which is becoming very popular. The term is applied in all book of mechanics to the tubular pumping screw, the invention of which, every one acquainted with hydraulics ascribes to Archimedes.

driving agricultural and other machines. Figs. 8, 9, and 10, show a side view, a plan and an end view of one of the machines; it is mounted on wheels or rollers, to facilitate its transportation from one place to another and its adaptation to various kinds of work; it has a strong wooden or iron framing *a*, which carries a horizontal crank shaft *b*; one end carries a large fly wheel *d*, and the other end a band or driving wheel *e*. There is also a horizontal lever *f*, connected at one end by means of a vertical rod *h*, to the crank of the shaft, and at its opposite extremity to the lower end of a vertical rod *i*, which is moved up and down in guides *j*, fixed to the framework of the machine by means of vibrating arms or levers *k*, and chains or straps *m*. The patentee proposes to increase the speed of the engine by gearing consisting of a large toothed wheel *n*, on the crank shaft, which takes into and drives a pinion *o*, on another shaft *p*, which carries a band wheel to drive thrashing or other machinery, in place of the band wheel on the before-mentioned cranked shaft. The levers have a vertical action of 35 to 40 strokes per minute. The fly wheel revolves on anti-friction wheels; which nearly prevents all friction. The power is attached to the machine by means of a clutch on the driving shaft *b*, to which is affixed a driving rod, universal joint, and friction couple; the friction coupling is to prevent the machine being injured, should any hard substance get into it, in which case the coupling revolves round the shaft without driving the mill. The drum for a thrashing machine driven by this power is two feet six in. in length, and 18 in. in diameter, and can thrash 120 bushels of barley or oats in 10 hours, and a proportionate quantity of wheat, according to the yielding and length of straw. The specification shows other modifications of the machine in one, there are two cranks shown on the driving shaft *b*, by which means a regular and powerful motion is communicated to the machine, one of the levers being alternately in full action.

GLASS QUARRIES.

ARTHUR POWELL and NATHANIEL POWELL, of Whitefriars Glass Works, London, glass manufacturers, for "*Improvements in the manufacture of quarries and other panes of glass for windows.*"—Granted July 30, 1844; Enrolled Jan. 1845.

Instead of blowing glass into globular or cylindrical forms by the ordinary process, the patentees propose to make quarries or other panes of glass either plain or ornamental by casting the glass "metal" into iron or brass moulds with a sinking of the proposed ornament, and afterwards pressing it under a fly press, when a quarry or pane with a plain surface on one side and an ornamental surface on the other is produced; the glass is then annealed in the usual manner, and the rough edges trimmed.

The claim is for the manufacture of quarries, or panes of glass, with plain or ornamental surfaces for windows by means of dies and pressure.

MACHINERY FOR CARVING.

A patent having been taken out some time since for a method of carving wood and stone by machinery, a large manufactory has been established by Mr. Platt, of Bond Street, at Pimlico, for the purpose of working it. The uses to which it is at present principally applied are to carve elaborate foliated tracery, crockets, finials, &c., required for external and internal paneling in wood and stone for churches. The rapidity and consequent economy with which the work is effected are astonishing. We saw, on a recent visit a small piece of trefoil panelling in stone finished in 15 minutes, which by the ordinary processes would employ a skilful workman a whole day. Nor is the rapidity of execution detrimental to the accuracy and finish of the workmanship. We carefully examined a great number of the specimens, and were satisfied that the materials were not susceptible of more perfect finish. In the crockets, finials, bosses, and other solid work, indeed, much has to be done by hand after the mechanical work is finished, The mechanism here only cuts away the larger parts, and prepares a ground for the hand of the carver. But in panelling little or nothing is left to manual skill; all that is requisite is to retouch some of the acuter angles of the tracery.

The machinery by which these wonderful processes are effected is, like all valuable machinery, very simple. Many of our readers have probably seen the experiment, which used to be performed in the Adelaide Gallery, of cutting through the hardest steel files by a circular disc of soft iron which revolved with very great velocity. This principle of increasing the efficiency of cutting tools by making them revolve with great rapidity is utilised in the present patent. Drills of various shapes are caused by steam power to revolve rapidly in a vertical position. The extremities of the drills are serrated, and it is therefore obvious that they will rapidly cut through wood or stone when presented to them. By guiding the wood or stone in a proper manner the drills may be made to cut them into any form required.

This is the general principle. The following is the manner in which it is carried into effect for carving an oak panel. A slab of solid oak is firmly fixed to a flat table which is capable of turning on its centre. On the slab is closely screwed a template of iron, in which apertures are cut corresponding in form with the parts to be incised in the oak. The revolving drill is supported by a radial bracket, which can swing horizontally, and can be raised or lowered as may be desired when set to work. The workman depresses the drill and brings it to bear on one of the portions of the slab which appears through the apertures of the template; and by slightly turning either the bracket of the drill or the table, he can bring the drill to act on any part of the slab. Consequently by guiding the drill all round the edge of the aperture of the template, he speedily cuts away the wood to an uniform depth and of the exact shape of the pattern. The wood has now been pierced through to the requisite pattern, but the edges of the parts incised are plain and perpendicular to the sunken. These plain edges must be converted into mouldings, and for this purpose fresh drills are substituted, the template still remaining. These drills vary in shape according to the moulding required; they are, as before, worked round the edges of the pattern, and by under-cutting laterally produce the desired forms.

The invention is capable of extension to many purposes beyond those to which it is at present confined; chimney pieces, furniture of elaborate pattern, and articles of slate may be produced at a greatly diminished cost. Carved furniture and panelling which have hitherto been confined to the palace and the mansion, may by these means find place in far humbler dwellings.

The mechanism which Mr. Pratt has constructed for such important objects must be valuable in every respect; and we deem it no small part of the benefit arising from the construction of a great public work like the Palace at Westminster, that men are thereby stimulated to the discovery of such inventions as the present. We should state that the invention is due to a Mr. Irving, who attends to the working of the machinery. Mr. Pratt is now engaged in constructing a roof for Great Malvern Abbey, full of tracery, including the tie beams and spandrels; the dimensions of the roof are 90ft. in length and 30 ft. in breadth; the cost, including the wainscot, will not be more than £1500, and it is to be finished within 8 months after the order was given. The cost of such a roof constructed by manual labour would be at least from £5000 to £6000. A piece of tracery containing 2 square feet and 2 inches thick will not cost more than 14*s*., including the oak. We must not omit to mention that Mr. Pratt has engaged Mr. Billings, well known by his works connected with Gothic Architecture, to attend to the architectural department.

We are informed that the principal part of the decorations in oak of the interior of the New Houses of Parliament is to be executed by the aid of this machinery.

VANGUARD STEAM SHIP WRECK.

This magnificent vessel, the property of the Dublin, Glasgow and Cork Steam Packet Company, which was wrecked on the south coast of Ireland, has happily been rescued from her perilous situation; she was on her passage from Dublin to Cork when the unfortunate occurrence took place. The moment the Captain discovered the proximity of the vessel to the rocks, from the breakers a-head, an order was given to reverse the engines, but a heavy sea striking her at the moment, threw her with fearful violence on a sharp reef of rocks, which so injured her that little hope was entertained of getting her off; it was the opinion of several naval men who saw her, that from the exposed position in which she lay, together with the injuries she had received, all endeavours to save her would prove futile. In consequence the cargo was discharged as quickly as possible, and every thing that could be removed, even her cabin fittings, were taken away. In the mean time the agents to the Company arrived from Dublin, and solicited the assistance of several neighbouring shipwrights to get off the vessel; some, however, conceived it impracticable whilst others refused to undertake it for less than 4 or 5000*l*. In this state of things, Captain White, the Harbour Master of Cork was applied to, in consequence of his having succeeded on former occasions in getting off vessels very similarly circumstanced. On his acceding to the wishes of the agents, the following plan was put into execution under his direction; it may be well to premise that the Vanguard is built of iron, and fitted with three water-tight bulk-heads; the latter much facilitated the subsequent operations. On ascertaining the amount of injury the vessel had received, which was principally in the stern, the stern-post being carried away, and the bottom much broken, it was deemed advisable to put in her a false timber bottom from the stern-post to the first bulk-head, this was well caulked and shored down by means of cross pieces and struts from the beams above; under this false bottom was placed a number of empty bags, which were on board the vessel, these being well trampled down, stopped some of the smaller holes, and thus assisted in keeping out the water; from the extreme narrowness of the stern it was difficult to stop thoroughly all the leaks, in consequence one of the ship's sails was lowered over the side filled with oakum, and being drawn under the bottom of the vessel as far as possible, was there secured. The leaks which occurred further aft were also staunched, and where the rock protruded it was broken away.

The pumps being now set to work by the vessel's own engines, the sail and oakum was drawn into the leaks by the pressure from without, and kept the vessel perfectly dry; every thing being ready, preparations were made to heave her off; the cables which were got out astern and on the larboard quarter, in order to keep her off a dangerous reef of rocks on the starboard side were hove taught; at high water the Victory steamer arrived in order to steer the Vanguard when got off, she being unmanageable, having her rudder unshipped; at the top of high water a continual strain was kept on the cables, when a heavy sea struck the vessel, raising her off the rocks, she receded with it and glided off with the velocity of 8 or 9 miles per hour, she was then steamed by her own engines until a considerable way inside Cork harbour, when she was run upon a sand bank, and allowed to remain until next tide, when she was brought up to Passage to undergo repairs. The expense of getting her off did not, it is believed, exceed 200*l*. The vessel cost 25,000*l*. only 12 months previously. She was insured for 15,000*l*.

SELECTIONS FROM THE TRANSACTIONS OF THE SOCIETY OF ARTS,
For the Session 1843-44.

ANNULAR SCUPPER-MOUTH FOR SHIP'S DECKS.

The Silver Isis Medal was presented to Commander H. Downes, R.N., of Ladbroke Terrace, Notting Hill, for his Annular Scupper-mouth for Ship's Decks. Fig. 12, Plate IX.

The improved scupper-mouth originated in 1831, from Commander Downes having seen a frigate's main deck on the coast of Africa constantly flooded during heavy rains, owing to the gangway-scuppers being unable to carry off the water fast enough. In 1837-8, a model was presented to the Admiralty. when they were fitted in H. M. S. Pique, and a favourable report was made thereon.

Figure 11, Plate IX. shows the scupper-mouth in ordinary use, with its aperture A, and the plan and sections of the scupper-mouth. as improved by Commander Downes, and which are drawn to a scale one-sixteenth of the full size: The new scupper-mouth consists of two copper rings; the largest, B, is let flush into the deck, and screwed down thereto over the scupper C, being four times the area of the old one; D is the smaller ring, which is moveable, and fits accurately into B. When the deck is required to be washed, or in times of heavy rain, the ring D is taken out, and thus the aperture is rendered sufficiently large to enable the water to be carried off rapidly. It would be dangerous, however, to leave so large an opening in the deck. except when required as above. And thus the small ring D is rendered necessary in order to prevent accidents.

IMPROVED CLAMP FOR JOINERS.

The Silver Isis Medal was presented to Mr. Bowery, of Bermondsey, for his Improved Clamp for Joiners. Fig. 12, Plate IX.

Figure 12, Plate IX., shows an end elevation of Mr. Bowery's improved clamp for joiners. &c., which consists simply of a wooden bed, of oblong shape, having fixed on the top thereof, and towards one end, two cheeks, B B, of the same material: the inner sides of which are fixed at an angle of 27° to each other, and chamfered inwards to receive two moveable wedges, C C, by which the piece of wood E intended to be planed is fixed. Several pieces of wood, placed edgewise, may also be planed at the same time.

SELF-ADJUSTING STEP-LADDER FOR WHARFS.

The Silver Isis Medal was presented to Mr. P. Lucas, of 19, Hyde Park Gardens, for a Self-adjusting Step-ladder for Wharfs. Fig. 13, Plate IX.

A model of Mr. Lucas's self-adjusting step-ladder for wharfs, quays, &c.. to or from which persons may conveniently ascend or descend, by a series of steps, or walk along a plane surface, whether the vessel be either above, below, or on a level with the wharf, is placed in the Society's Repository. The railed plank in present use is in general, when the tide is low, very inconvenient to ascend; so much so, that an upper and a lower quay. communicating with each other by fixed steps, are always necessary to lessen the acclivity of the inclined plane, but which lower quay can be entirely dispensed with by using the adjusting ladder.

It may also be advantageously applied in place of the small ladders usually attached to ships, the height of which, with regard to the wharf, must be constantly altering, from the variation of the tide and the weight contained in the vessel.

The construction is as follows:—A series of steps of wood, of about the usual proportions, is placed in a straight line, so as to have the appearance of a long plank of wood, as the steps J J J shewn in fig. 13*, which represents a side elevation of the ladder in a horizontal position; each step is supported at one end by pins fastened into two parallel rods or bars of wood, one of which E F, is represented in fig. 13*; these pins act as axes to the steps, the other ends of which are supported by rods or bars K K K, attached to two parallel pieces of wood, forming the rails of the ladder, of which H I represents one, which is kept parallel to E F by the pins as above while in motion. As H E F I, figs. 13 and 13*, is a parallelogram, the steps can be fastened at right angles to H E by means of the rods, or bars K K K in such a position that the dotted lines between the points of support of each step are always parallel to H E, by which, if the bar H E be kept perpendicular, the steps will always be horizontal in whatsoever position the rest of the ladder be placed.

The height of the steps from one to the other will depend upon the proportion that their respective widths have to the whole length of the ladder. When the tide is high, the ladder moves as represented by the dotted lines in fig. 5, where the steps apparently fall; they cannot, however, act to such an extent as in the former case, being prevented by the slanting bars touching the succeeding steps. This is of comparatively little consequence, as the surface of the vessel can never be much above the wharf.

When it is essential that the barge should be kept close to the wharf-side, the ladder must not be placed at right angles to the wharf, but parallel thereto and secured to overhanging supports, it being evident that the ladder will take up much more room in the former than in the latter position, of which the width of the barge will not always admit. The model sent is applicable in either way.

IMPROVED PLUMBER'S FORCE.

The Sum of Three Pounds was presented to Mr. A. W. Franklin, of Fleet Lane, for his Improved Plumber's Force. Fig. 14, Plate IX.

Mr. Franklin's improved force consists of a piece of inch-iron gas-pipe A A, from 12 to 14 inches in length, on one end of which is screwed a proper stuffing-box B, and on the other the valve-box C. The plunger, or piston, D D, consists of a brass triplet-drawn tube, having a solid brass plug E fixed in at the bottom, and furnished at the top with a wooden knob to form a handle F; the plunger works through the stuffing-box B, which is packed with cotton-yarn, soaked in tallow. The leather hose is attached to the bottom end of the force in the ordinary way.

IMPROVED CRAMP FOR JOINERS.

The Silver Isis Medal was presented to Mr. S. Nicholls, 19, Harrold's Row, Green Bank, St. George's East, for his improved Cramp for Joiners and others. Fig. 15, Plate IX.

The improvement on the ordinary cramp, as effected by Mr. Nicholls, consists in dividing the weight of metal usually put into one bar, as at B, into two distinct bars, A and B, which are set perfectly parallel with each other, the object being to give additional strength to the instrument and to prevent racking, to which the ordinary cramp is liable. The jaw C is at right angles to A and B, and has two perforations through which the parallel bars A and B move freely; it has also two circular holes through which are passed pins to secure it to the parallel bars at different distances, to suit timbers of various sizes, the bars having corresponding holes perforated at equal distances.

EXPANDING CENTRE-BIT.

The Silver Isis Medal and Two Pounds were presented to Mr. J. Franklin, of 91, Goswell Road, for his Expanding Centre-bit. Fig. 16, Plate IX.

This invention consists simply of two arms, A and B, working close to each other, and connected together towards the end D, to be inserted in a stock by a rivetted pin G, the shorter arm containing the cutter E F, the longer one the centre-pin G, on which the bit works. The arm B has a perforation H to admit the screw I. In order to regulate the exact size of the hole to be cut by the bit, the user applies his rule between the centre-pin and the lip of the cutter E F. so as to get the radius of the required circle, at the same time loosening the screw I, which is fastened into the longer arm, and works in a chase in the shorter or cutting arm, the head of the screw keeping the two arms tightly together when set for an operation. Three of these bits constitute a set. The first, or smallest one, being calculated for holes of from ¼ of an inch to ½ an inch, the second from ½ an inch to an inch, and the third from 1 inch to 2 inches. The ordinary bits to answer the above end, would cost the user from 11*s*. to 12*s*., whereas this complete set is furnished at 4*s*., thereby effecting a saving of upwards of 60 per cent.

CHANTER'S MOVEABLE FIRE-BARS AND SMOKE-CONSUMING APPARATUS.

The object of the moveable fire-bar is to prevent the accumulation of clinker in the grate, and to keep the air-channels at all times open; it consists in moving the alternate bars longitudinally in contrary directions by a system of levers, moved either by hand or by a connexion with a steam-engine. For a 30-horse boiler, ½ h. p. is required to effect the regular and continuous movement of the bars.

The "Smoke-consuming apparatus" is applied in a variety of forms to different kinds of boilers. Instead of cold air, Mr. Chanter introduces jets of warm air behind the bridge of the furnace.

A PLAN OF FORMING A FIXED BREAKWATER.

By J. Johnston, Esq.

The plan is as follows. A series of distinct and separate caissons, each representing in external form one half of the pier of a bridge, with its cut-water presented to the sea, is to be formed in five to six-fathom water, according to any particular locality. Each caisson is to consist of cast-iron plates of large size, coated with coal-tar in order to prevent corrosion, and bolted together by means of four-inch flanges; the whole to be filled with concrete, granite, or other suitable material: the lower part of each caisson, to the height of thirty-two feet, having a foundation platform of wood, to be completed on shore, and, when prepared, to be launched and towed out to its destined position (as were the caissons of Westminster and Blackfriars' bridges), and then lowered into their final position: the whole to be secured to the bed of the sea by means of cast-iron piles, driven through tubes of the same material. As the upper part of the caisson is put together, so is the interior to be filled up with the solid materials: a coping of well-cramped masonry is to be fixed all round each caisson. The weight of each caisson complete would be about 4500 tons, and the cost of a breakwater on this principle, extending to nearly a mile in length, is estimated at 297,800*l*.

HIGG'S IMPROVED MONOCHORD.

In this instrument measurement has been applied to sound, and the actual relation of one tone to another is shewn on an accurately divided scale of two feet. The open note c being precisely the length of the organ-pipe, from which the same sound is obtained, the proper and exact length of every organ-pipe may be ascertained. The diatonic and chromatic scales are deduced by mathematical divisions alone, without the assistance of the ear, but, being tested by that organ, are found to be perfectly correct. It will be seen, by an attentive examination of these scales, that a string being divided into two equal parts gives the octave of the original note; into three parts, the fifth of the scale; into four parts the fourth; five parts will give the major third; six parts the minor third; in fact, this investigation thus carried out is eminently calculated to afford insight into the nature of concords and discords. The explanation thus far relates to the diatonic and chromatic scales only: the next portion belongs to the enharmonic divisions, and demonstrates the exact relation of the thirty-two intervals in the octave, to express which the thirteen keys of the organ or pianoforte are used; it will, therefore, practically explain the meaning of the term temperament in reference to those instruments, and it will prove the absolute perfection of tone to be expressed by such instruments as the violin and violoncello. The last scale is that marked pianoforte temperament, and is intended for the assistance of persons in remote parts, where the aid of a skilful tuner cannot be obtained; for by it any lady or gentleman possessed of a correct ear, though totally ignorant of the art of tuning, may put an instrument into perfect order. The instrument may be said to be capable of facilitating the practice of singing, the teaching of theory, and the tuning of organs and pianofortes.

ON A PLAN OF ECONOMISING FUEL IN THE BOILERS OF LOCOMOTIVE ENGINES.

By C. Tetley.

The evaporating power of a boiler, observes the author, is dependent chiefly on three causes:—1. The amount of boiler surface exposed to the reception of heat. 2. (And very materially) On the shape of the boiler; and 3. On the intensity of the heat.

The heat derived from that part of the boiler immediately over and about the fire, I call (according to usage) *radiating heat*, while the heat derived from the tubes or flues I call *carried* heat. The improvement in boilers for the rapid evaporation of water, and for the economy of fuel, consists in dividing the boiler into two or more compartments, of different heating temperatures, having channels for feeding the compartments from that or those containing water of a lower temperature. The first partition is placed vertically over the water-space at the back of the boiler, the top of which reaches somewhat above the water-line, and the bottom below the level of the firebars, but leaving a passage for the water beneath it. The second partition reaches from the bottom of the tubular part of the boiler to a little above the level of the fire-box, and removed but a short distance from the first partition. The third partition is placed in the middle of the tubular boiler, and, as the first, runs up above the water-level. A communication is formed for the supply of water by a pipe running from the compartment nearest the chimney-box into the middle compartment, the top of such pipe being fixed just below the water-level, and the bottom thereof at a point near the lower part of the middle compartment.

"On evaporation taking place, the steam will diffuse itself over the top of the partitions nearest to the fire-box and that nearest to the smoke-box, so as to maintain the same pressure on the surface of all the water; thus the water contained over the top, and in the water-spaces at the front, back, and sides, of the fire-box, is all exposed to the direct action of the fire, or to *radiating* heat, and separated from that which receives only *carried* heat. On the other hand, the water contained in that part of the boiler between the partition introduced nearer to the fire-box and the end of the boiler by the smoke-box is exposed only to the reception of *carried* heat, or heat of a lower temperature than in the part last described; the consequence is that evaporation commences, first in that part over the fire-box, and, as the water there becomes wasted, more to supply its place passes from the second compartment down between the two partitions nearest the fire-box. Now, as this feed-water to supply the first division is received from the surface of the water between the partition nearest the fire-box and that nearest the smoke-box, it will be charged with heat almost or entirely at the evaporating point before it enters the first compartment, because as the separate particles become heated in the second division above the surrounding portion, they rise to the surface, and, as the middle partition has its upper edge below the water-level, the surface-water passes over it, and descends to the bottom of the fire-box partition and passes under it. As the water leaves the second compartment, either by evaporation, or to feed the first, that loss or waste is replaced by water descending from the upper regions of the water in the third compartment down the pipe or channel, by virtue of its tendency to preserve its own level. The third compartment is again fed through another pipe by a force-pump, or other usual means; this pipe may be joined in any convenient part of the said compartment, but it is preferred that it should be at or near the bottom. Any suitable number of partitions may be similarly introduced, although in this description of boiler, when of moderate length, I am of opinion that two compartments are enough to serve all purposes of economy.

If we examine, for the sake of contrast, what takes place in the same boiler when constructed without such divisions, we shall find an operation to take place as follows: the boiler being filled to its proper height with water, and the fire lighted, the water immediately surrounding the fire-box receives its heat with greater rapidity, in the proportion of 3 to 1 of each square foot of the fire-box, as compared with the same extent of the tubular part; now, as each particle of water around the fire-box becomes charged with heat, it becomes specifically lighter, and, therefore, rises into the higher regions, and intermixes with the water in the tubular part, until at the last the whole is brought up to the evaporating point. The engine being then set to work, a continual injection of fresh water takes place to supply the loss arising from evaporation. This feed-water, being colder than that already heated in the boiler, is of greater specific gravity, in virtue of which it will find its way to the lowest level in the boiler, namely, around the fire-box. A circulation is thus established by which a current of the coldest portion of water is continuously driven into the spaces around the fire-box, there receiving a surcharge of heat, the excess of which converts a portion of the water into vapour, while the remaining portion, not converted into steam, ascends into the tubular part. It is evident that the feed-water by this process is charged with heat to the evaporating point by the fire-box, and not by the tubes; that is all feed-water entering the boiler after the engine is set to work. The tubular part is therefore supplied continuously with water heated in the fire-box. Now the question is, what loss of fuel arises from this?

To solve this, let us call to mind the circumstance, that the quantity of heat contained in a pound of steam never varies; it is always the same in quantity, whatever be the density and temperature of such steam, and about 1200° is fully more than the average allowed by different experimenters. Now let us suppose the feed-water to be injected at a temperature of 60°, and also that the steam be drawn off at a pressure of 60 lb. per inch, which would give a temperature for the water in the boiler of 305° before evaporation could proceed; the water in the whole boiler, the tubular part as well as around the fire-box, would have received 305°—60° for the temperature of the feed-water, or 245° from the fire-box. The water surrounding the tubes being thus charged with heat by the fire-box, till it reaches the temperature of 305°, it could receive no further accession of heat from the tubes, unless their temperature exceeded 305°; but, if the tubes did exceed that temperature, then the water would be ready to abstract the excess above 305°; therefore 305° must always be deducted from the actual temperature of the flues, as waste for heat which is passing into the chimney unabsorbed by the water. But if the operation be reversed, and the feed-water injected at the said temperature of 60°, and kept separated from the water surrounding the fire-box, then it will abstract all the heat of a higher temperature than 60°. Hence it is evident that 245° more heat is now abstracted from the tubes than was abstracted in the former case. In the former case 245° passed into the chimney which is now passing into the water. If this water, which in the last case abstracted 245° from the tubes, be now conducted into the spaces around the fire-box, it will require 245° less to convert it into steam. If a total heat of 1200° is required for its constitution as steam, then deduct 60° from 1200° and we have 1140° as the amount of heat required from the fire-box. If out of 1140° we effect a saving of 245°, we save 21 per cent of fuel.

By this improvement, therefore, we prevent the deposit of sediment amongst the tubes to the same extent that we remove the evaporation from that part to the fire-box, which latter may be more easily cleaned and repaired, if constructed with that view. Secondly, we get up steam much more rapidly. Thirdly, we have in one compartment water free from turbulent emotion, in consequence of which the action of a float for regulating a feed-apparatus will be much more certain. And, lastly, we have an important saving in fuel.

ON WROUGHTON'S SELF-ACTING GLASS VENTILATOR.

Wroughton's self-acting glass ventilator consists of a mahogany vertical frame, seventeen inches high, and fourteen inches wide, standing on a platform fourteen inches long and eighteen inches wide. In the frame is fixed a plate of glass, in which are ten horizontal apertures, each two inches and a half long, and half an inch wide. On the internal side of the glass are four vertical brass slides, in which work as many pieces of glass, fixed in a brass case, as there are apertures in the plate, but somewhat larger, in order entirely to cover them when necessary. The two sets of glass covers are suspended from a small brass beam, working on a pivot attached to the glass. A small ivory piston, working with a nut and screw in a glass bent tube, is attached to one set of glass covers. The glass tube contains a column of mercury, altogether about twelve inches in length, but divided at top into two arms, over which are two vertically placed glass tubes, about ten inches in length, and bent over at top, and returning down to the bottom of, and close to, the first tubes; these tubes are filled with spirits of wine, which, when expanded by heat, acts in conjunction with the mercury (with which it is contact) to elevate and depress the glass-covers, so as to admit fresh air in proportion to the amount required to keep the temperature of the apartments at a fixed point, which is ascertained by a scale marked on the glass plate.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SOCIETY OF ARTS.

February 26.—B. Rotch, Esq., V.P., in the Chair.

"*On Improvements in the Manufacture of Glass for Optical purposes.*" By Mr. Claudet.

Heretofore the manufacture of glass fit for the purpose of the optician has been a matter involving great uncertainty and difficulty, and in fact it was not till the year 1744 that it was accomplished with any degree of success. About this time, however, a Swiss named Guinand, in making some experiments in the constructioo of the telescope, found the extreme difficulty of procuring glass fit for lenses; the difficulty led him to endeavour to make glass for himself, and from his labours arose the first process by which glass could be made with certainty sufficiently good in quality for the construction of optical instruments. With the death of Guinand his secret was partially lost. The invention which forms the subject of Mr. Claudet's paper is founded upon the process of Guinand, and is due to a French glass manufacturer named Bontemps, whose attention was first drawn to the subject by the son of Guinand himself. The chief defect in optical glass consisted in striæ and spots; these arose from the great difficulty of properly mixing the materials wheo in a state of fusion; it was impossible to stir the melted mass, because the temperature was so high as to destroy instruments of metal, and besides by introducing them into the glass it would have been tinged with colour, according to the nature of the metal employed. The method used by M. Bontemps is to introduce the iron rod used in stirring into a clay cylinder closed at one end, so that the glass is entirely protected from the injurious action of the iron; the ingredients are thus effectually mingled; the glass is then suffered to cool gradually, the crucible broken with care, and the mass sawed transversely into slices, so that lenses may be obtained of the diameter of the crucible. Very large lenses have been produced by these means, and two of a metre in diameter are now in progress of manufacture for the Royal Observatory at Paris.

March 5.—J. Hume, Esq., M.P., V.P., in the Chair.

"*On the Construction of Models for an Ethnographical Museum, and the materials best suited for the purpose.*" By Mr. E. Dalton.

The object of the paper was to bring forward the advantages of such an institution, and the result of inquiries and experiments as to the material best suited for the construction of models suitable for carrying out this design. The possibility of casting *entire* from the living model is not perhaps generally known. The late Sir Francis Chantrey effected this upon a Negro man. The specimen is lodged at the College of Surgeons, and presents a faithful representation of the original. The model of a New Zealander, of the Ngatiawa tribe, now in London, was exhibited as an example of the illustration of the different races of man proposed to be collected by the Ethnographical Society. The head and arms of this specimen consist of wax, and were cast separately and then attached to the body. The hair is removeable, so as to allow of an inspection of the conformation of the skull. The time required for completing this model was about fourteen days, and its cost, including costume, is estimated at £20, whereas a similar model *undressed*, and cast *entire*, would amount to about £40. The wax of this model has been painted in oil colours so as to represent the tints of the flesh and render it capable of being cleansed without affecting the surface.—A small figure of the same material executed by a Mexican artist was placed on the table.—Besides wax the author mentions papier mâché, the Cannabic composition, wood, and a particular description of clay, found at a depth of 150 feet below the general level of London, as substances which might be used. The two former, however, require *iron* moulds for the casts, which would render their expense considerable. The expense of models constructed of wood is also against that material. Several models by Mr. Sangiovani were placed on the table, all of which are made of the clay above alluded to; which, in some respects, assimilates to the pipe-clay used by modellers, but has more substance and is less fragile; indeed when dry it is so hard as almost to resist the file. In appearance it is similar to hard stone or metal, particularly when oiled over. It takes oil colours in a permanent manner. The figures in the Chinese Collection are constructed of clay and papier mâché, or layers of paper stretched over clay moulds, and then painted in a kind of distemper.

THE ROYAL SCOTTISH SOCIETY OF ARTS.

February 24, 1845.—The President in the Chair.

The following communications were read:—

1. (Part II.) "*Remarks on the Trade Winds, and other Currents in the Atmosphere, at Barbadoes; with an attempt to develope the Causes of Hurricanes in the West Indies.*" By Robert Lawson, Esq., Assistant-Surgeon, 47th Regiment. Communicated by Alexander Bryson, Esq., V.P. The concluding part of this paper exhibited in detail the observations made by the author while stationed at Barbadoes, the results generally indicating the influence of the sun and moon on the currents of wind, in modifying, and, in some instances, changing its direction. These changes are inexplicable by the theories either of Hally or Redfield, and must be referred to other influences than the calorific. It is remarkable that the phenomena connected with hurricanes—the most awful calamity, certainly, to which that locality is liable—should have so long failed to attract the attention even of those who were most deeply interested; a failure which must, in a great measure, be ascribed to the too prevalent spirit of attributing every thing remarkable to the action of some mysterious agency, instead of looking for its cause in the operations of nature.

2. "*Sequel to Dr. Warden's Description of the application of a Totally Reflecting Prism to the investigation of Disease in the open cavities of the Body.*" Communicated by David Stevenson, Esq., V.P. After stating the very great facilities which his prismatic auriscope was found to afford for the successful treatment of deafness, the doctor referred to his first series of cases published in Dr. Cormark's Medical Journal. The prismatic instrument for investigating diseases in the other open cavities of the body, he had still farther improved, chiefly by the introduction of a *third* and magnifying prism. The application of the prism to the examination of strictures was next spoken of. The doctor had been enabled to submit to ocular inspection the puckering of the mucous membrane at the strictured part, and to recognize the precise condition of disease, so as to be able to discrimioate the treatment which was appropriate. The use of the prism was then pointed out in uterine and other diseases of females; also in the unforeseen difficulties which sometimes occur in the extraction of the stone in lithotomy; in the attachment of ligatures to polypi; the treatment of fistula, &c. Lastly, there was exhibited and described the new instrument for surveying the regions of disease in the throat, so as to facilitate the removal of foreign bodies, and for the treatment of ulceration and other affections of the glottis and gullet.

Thanks voted, and referred to a committee.

3. "*Description of his Method of preparing the Metallic Plates, and Printing from them Music, in raised characters, for the use of the Blind.*" By John Alston, Esq., of Rosemount, F.R.S.S.A.

A Model, with Specimen of the Metallic Plates, and Music Book for the Blind, were exhibited.

Thanks voted, and referred to a committee.

4. "*Description of a Fire Escape.*" By Mr. George Marshall Mather, Miniature Painter, 63, Queen Street, Edinburgh. A Model was exhibited.

Referred to a committee.

5. "*Description of a Portable Scaffold or Machine for elevating the Hose of a Fire Engine, &c.*" By the same. A Model was exhibited.

Referred to a committee.

The following Donations were laid on the table:—

1. Journal of the Geological Society of Dublin, from the commencement (excepting Vol. I, Part I.) down to Vol. II., Part V. Presented by the Society.

2. The Civil Engineer and Architect's Journal, Nos. 88 and 89, for January and February 1845. Presented by William Laxton, Esq.

3. Report of William Fairbairn, Esq., C.E. (Manchester), on the Construction of Fire-proof Buildings. with Introductory Remarks by Samuel Holmes, Liverpool, 1844. Presented by William Fairbairn, Esq.

Thanks voted to the Donors.

OXFORD ARCHITECTURAL SOCIETY.

A paper was read by Mr. Patterson on "*The Application of Colour to the Internal Decorations of Ecclesiatical Buildings.*"—He observed that there were evidences of some use of gilding and colour even in the earliest ages. After mentioning examples in Constantinople, Rome, and Venice, he observed that he might name a majority of the churches of Italy, from the fourth to the fourteenth century, as affording specimens of internal coloured decoration by means of mosaic. He proceeded to notice the early introduction of painting to the same end, in Italy, Germany, and France; and then went on to mention some facts regarding the history of polychrome in England. By a canon of the Second Council of Calcuith, held in 816, every bishop was enjoined to paint the saints to whom a church is dedicated, either on the wall, on a board, or on the altar, before consecrating it. Gervasius (de Vit. St. Dunst.) describes St. Dunstan as a skilful painter; and the same writer, in his Chronica, mentions the "cœlum egregie depictum" of the old cathedral built by Lanfranc, at Canterbury. Mr. P. then read an extract from Mr. Dawson Turner's work on the topography of Norfolk, in which the author throws out a hint that the position of that county may have given rise to the decided resemblance to the elder Dutch school which characterises many of these works. He proceeded to enumerate various frescoes from several churches figured in Carter's Ancient Sculpture and Painting in England. As an instance of the ancient practice of colouring monumental brasses, he pointed out a remarkably fine one in Elsing Church, Norfolk, given in Carter, and noticed the traces of colour remaining on the lectern in Eton college chapel. He also noticed the use of tapestry in decorating churches, adopted in most countries to this day. In conclusion, Mr. Patterson coincided with a remark which fell from Mr. Freeman at the last meeting of the Society, that Overbeck, Cornelius, and the Munich school should be our models, as affording, to his own mind, a combination of the best characteristics of the later ecclesiastical style, with those of the great secularizers, Raffaelle and his successors; he would go so far as to deprecate any but a sparing use of half-tints, and even of chiaro-oscuro, in any attempts to restore polychrome to its legitimate position in this country.

Mr. Freeman presented some drawings *"of St. Mary's, Leicester, giving an account of the church,"* which is a highly interesting one, originally of Romanesque character, of which style the old chancel, with its magnificent sedilia, a rare feature at that date, is a valuable specimen. In the nave, early-English arches have been cut through the Romanesque walls, and a very large aisle added to the south. He called the attention of the Society to the church at the present time, on account of some restorations being in progress, which he could not approve, although he would attribute their deficiencies rather to the want of skill and funds, than to any lack of gooid spirit on the part of those concerned. Among other errors, he more particularly alluded to the patching the noble oak roofs with deal, and to the intention of setting up a fine parclose screen, (already taken down,) as a reredos to the altar, which is about to be moved from its present position in the great south aisle to its correct place in the chancel. He implored all members who had any influence in Leicester or its neighbourhood to use it without delay in endeavouring to rescue a venerable and already much abused building from further disfigurement.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

The Institute have resolved that the Medals of the Institute be awarded next year to the authors of the best Essays on the following subjects:—

1. On the Adaptation and Modification of the Orders of the Greeks by the Romans and Moderns.

2. On the History and Manufacture of Bricks.

Each Essay to be written in a clear and distinct hand, on alternate pages, and to be distinguished by a mark or motto, without any name attached thereto.

That the Soane Medallion be awarded to the best Design for a Royal Chapel, with seats for five hundred persons inclusive of the suite, attendants, and choir; the building to be detached, and in a classic Roman, or Italian style.

The drawings of the elevations and two sections, to be to a scale of ¼ of an inch to the foot,—the plans and perspective view to ⅛ of an inch to the foot, and tinted with India ink or sepia only.

The competition is not confined to Members of the Institute.

DIRECTIONS FOR CANDIDATES.—Each Essay and set of Drawings is to be accompanied by a sealed letter, containing the name of the writer within, and on the outside the same motto as that attached to the Essay or Drawings; this is to be enclosed in a sealed envelope, containing an address, to which a communication may be sent of the decision of the Institute, and directed—

"To the Honorary Secretaries of the Royal Institute of British Architects.
Essay for Medal (or) Drawings for Medal (Motto)."

The packet, so prepared and directed, is to be delivered at the Rooms of the Institute, on or before the 31st of December, 1845, by 12 o'clock at noon.

The Council will not consider themselves called upon to adjudge a premium, unless the Essays or Drawings be of sufficient merit to deserve that distinction; and, if the best Drawings should be by a candidate who has been successful on a former occasion, the Institute reserve to themselves the power of adjudging such other adequate reward as they may think fit, and of awarding the medals offered to the second in merit. The Essays and Drawings, to which premiums are awarded, become the property of the Institute, to be published by them if thought fit. In case of the papers not being published within 18 months after receiving the medals, the authors will be at liberty to publish them.

Further information may be had on application to the Secretaries.

DECORATIVE ART SOCIETY.

Feb. 26.—" The Interior Decorations of the celebrated Collegiate Chapel of St. Stephen, as finished by Edward III. in his Palace of Westminster, A.D. 1348. By Mr. Crabb, V.P.

The information contained in this paper was derived from Mr. Crabb's acquaintance with the original painting, and with Mr. Lee, who for twenty-five years was the officer in trust of the building that had formed the ancient palace. In 1800 the Act of Union rendered it necessary to provide accommodation for the Irish members, and in taking down the wainscotting it was discovered that the walls of the House of Commons were covered with paintings and gilding. Copies of those at the east end were taken and published by Mr. Smith, in 1807, as also by the Antiquarian Society. Extensive discoveries were subsequently made, and Mr. Lee eventually obtained sufficient information to trace out the original plan of the painted decorations which had adorned this chapel, and to restore them in a miniature series of water-colour drawings. Mr. Crabb described the localities of the ancient palace, the decorations of various apartments, particularly the chamber of the Holy Cross, built by Henry III. and adorned with historical paintings, and which continued to be used as a council-room to the time of Queen Elizabeth; also many precepts of this king. In one, he directs "that a list or border shall be made, well painted with images of our Lord, and Angels with incense pots scattered over the border, also the four Evangelists." Another was thought to justify the inference that the paintings ordered to be done in a certain low chamber in the King's garden were intended to be representations of the siege of Antioch, taken by the Christians in the first crusade, 1098, as a book in French on that subject is ordered by a former mandate to be delivered to "Henry the keeper of the wardrobe, for the Queen's use." The ceiling of the painted chamber of St. Edward's was flat, and curiously designed with scroll work and the heads of the Prophets, and the seraphim with seven wings, from Isaiah. The walls had been painted with subjects, part of which were battle pieces, taken from the two Books of Maccabees; these were certainly as old as 1322, probably older, for in a M.S. of Simon Simson and Hugo the Illuminator, in the year 1322, preserved in the library of Benett College, (C.C.C.) Cambridge, there is the following passage:—"At the other end of the city (London) is a monastery of Black Monks, named Westminster, in which all the Kings of England lie buried, and immediately joined is that most famous palace of the king in which is that well-known chamber on whose walls all the histories of the wars of the whole Bible are painted beyond description, and with most complete and perfect inscriptions in French, to the great admiration of all beholders, and with the greatest regal magnificence." Many other records exist where the name of Master William the painter, a monk of Westminster and of Florence, is mentioned, and thus we know he was an Italian. Henry III. was an admirer and encourager of the Fine Arts, and by the Exchequer Mandates we obtain an insight into the nature of the painted decorations in use at this early period, and by the enumeration of the items in the Exchequer Rolls of Edward I., relative to the first chapel of St. Stephens, such as white lead, red lead, vermillion, azure, gold and silver, *oils* and varnishes, we have further proof that oil painting was in use as early as the thirteenth century.

Mr. Crabb then proceeded to mention, that in conformity with the ancient custom of attaching a chapel to every residence of importance, the first chapel for the use of the palace of Westminster was founded by Stephen, A.D. 1150. And upon Edward III. and his Queen Philippa's return from their conquests in France, they determined to rebuild the chapel with the utmost magnificence in a style that should surpass whatever had been previously attempted in any land. The principle of design upon which the arrangements and decorations of the chapel were made, was explained—with observations upon the richness of dress at the period, and the interest attached to these peculiarly illuminated edifices, raised at a time when the Arts, struggling for existence, yet appear to have held no inconsiderable power over the warlike taste of the period. Bearing in mind this feeling for magnificent effect, we can easily understand the desire for its extension to buildings and architectural embellishments by an assimilating sumptuousness of style in coloured decorations—and much more easily the plan of the design adopted for his Chapel Royal, produced on the principle that no work of beauty "should be void of signification," the architectural design would be formed in conjunction with the sculptured and pictorial embellishments. The chapel consisted of a nave without aisles, the roof rising to a very high pitch, the five windows on each side were remarkably enlarged by deep splayings, and thus a striking and peculiar effect was obtained. The piers narrowed, richly painted, and relieved by grey purbeck marble shafts, embellished with thousands of gilt pateræ, continued one successive, varied, but unbroken effect of magnificence along the whole side, again carried upwards by the coloured and gilded cornice and timber roof. In the piers it was proposed to place the statues of our kings from the Norman Conquest down to Edward III. Upon the walls, under a superb canopy of open tracery and slender clustered columns, were painted figures of angels, each bearing a mantle, emblazoned, and of different colours, being the armorial bearings of noble contributors, and the Holy Knights, to whose honourable keeping the edifice was particularly intrusted: at the east end upon each side of the altar were to be introduced the king and his family kneeling; and upon the walls themselves, together with the windows, were to be depicted the history of the Bible, all the leading events from the Creation to the death of the Apostles. The quarterings of the French Arms and English Lions were to be freely introduced, as also the Fleur-de-Lis and French Lily, as marks of Edward's supremacy. Thus the general notion will be understood as one to create an apartment of magnificent size, adorn it with a picturesque roof, rich architecture, elaborately sculptured, and to fill the walls and windows with a connected series of historical paintings of our faith, and the minor portions with single figures, emblazonry, gilded and painted tracery work. The habiliments of the priests were also provided, and of the richest materials, and others for the Court to wear during mass. The paintings were peculiarly treated, and the most careful finish pervaded the whole.

The chapel was suppressed and its wealth transferred by Henry VIII. Mr. Crabb traced its history down to 1800, giving the authoritities upon which his descriptions were founded, and quoting the existing Exchequer Rolls relating to its first erection and subsequent repairs by different kings. And he concluded by saying, "That magnificent example of Italian ecclesiastical Art, I recently had the pleasure of bringing before you, should not be forgotten on the present occasion. The rebuilding of St. Stephen's resulted from a vow made by Edward and his Queen during the French wars, and was finished in eighteen years—1348. The *Certosa of Pavia*, whose sumptuous decorations were continued with equal taste, spirit, and expense, during three centuries, and form a perfect chain and example of the Fine Arts in Lombardy, was commenced A.D. 1396. Those who are disposed to pursue for themselves the inquiries which were thus hinted at, will discover the close connexion of the fundamental principles of design exhibited in each building with its peculiar purpose. The Chapel of St. Stephen, intended for a sumptuous temple, fit for princes to worship in, was a space uninterrupted by pillars of rich and elegant Gothic architecture,—every ingenuity being used to increase richness by the aid of an unusual breadth of light, gilding, and colour. Its roof, pavement, walls, and windows, combined to produce an apartment suitable for the chapel of a royal palace, and the most magnificent which the arts of the era could produce. The church of the Certosa was later. Art was then advancing with giant strides towards the age whose illustrious men yet continue to shed an undiminished lustre over their country. This building was for a different purpose. The interior, with all its profusion of rich expenditure, was to impress the spectator by its solemnity: its massive columns, wide-spread arches, subdued light, quietly illuminating the lengthy vista of marble walls, and rendering dimly visible the sparkling of gilded stars from its deep azure-coloured vaults,—with ideas of the infinite and sublime; and, by the beauty of its details and their harmonious effect, to soothe the turbulent and stormy passions."

Mr. Crabb concluded by observing "It may not be exactly within my province to notice, but there does appear something greatly to be admired in the idea of a Temple of Worship exhibiting the perfect production of every ingenious Art which the bounty of the Creator has pleased to bestow upon Man. A religion, thus exhibiting in its churches a combination of studied magnificent effect as a whole, and an endless application of the highest excellencies in the detail, must be allowed to speak an intelligent language plainly indicative to the general people of that perfection required in the worshipper. Let no labour or expense be thought too great which will contribute to the honour and embellishment of the House of Prayer, was the precept of those men whose works we have this evening been considering."

MEMOIR OF THE LATE H. R. PALMER, F.R.S., &c.

Mr. Henry Robinson Palmer, F.R.S., V.P. Inst. C.E., was born at Hackney in 1795, and was educated at the academy of his father, the Reverend Samuel Palmer. About the year 1811 he was apprenticed to Mr. Bryan Donkin, in whose works he acquired a practical knowledge of the use of tools and of mechanical drawing. In the year 1816 he was engaged by Mr. Telford, who soon became so much attached to him as to entrust him with his confidential business, and he was employed upon most of the engineering works then under Mr. Telford's direction. He completed many elaborate surveys at that period, and his accuracy as an observer was such that the details of the experiments on the Grand Junction Canal (in 1822), were placed entirely in his hands. It was for these experiments that he first improved the Dynamometer, by adding a piston working in a cylinder of oil, so as to diminish the vibration of the index point. About this time he invented the "Suspension Railway," for which he obtained a patent, but which was only tried on two short lengths at Cheshunt, and in the Victualling Yard at Deptford. He also invented and patented the system of constructed roofs, &c., of corrugated wrought iron, which principle he subsequently extended to cast iron, and constructed a bridge on that plan at Swansea. The wrought iron roofs have been extensively used. He also introduced a modification of the system as applied to porcelain tiles for roofs. In 1826 he left Mr. Telford, on being appointed resident engineer to the London Docks, which position he held until the year 1835. During that period he designed and executed the Eastern Dock, with the warehousing sheds, the Shadwell entrance, lock and basin, the communication lock from the basin to the Eastern Dock, with the requisite lock gates, bridges, &c., and several other works.

After the completion of the works at the London Docks, he removed to Westminster and became extensively engaged in parliamentary business, in surveys for canals and railroads, the improvement of harbours, and in the designing and execution of works of magnitude, among which may be mentioned, the surveys for the South Eastern and the proposed England and Ireland Union Railways; the design and execution of the new harbour and lock of Port Talbot, South Wales; the Ipswich Docks; the improvement of the Harbours of Penzance and Neath, and the project for the intended ship canal to Manchester.

The action of tides, with their effects upon beaches, was to him a favourite subject and he contributed some able papers on tides and on the movement of shingle, to the Royal Society, (Vide Phil. Trans. 1831, p. 209; 1834, p. 567), of which he was elected a Fellow in 1831.

Mr. Palmer was a great advocate for the formation of scientific societies, and, even during his apprenticeship, about the year 1813-14, he organized at Bermondsey a society of workmen, composing practically a Mechanics' Institute, so many of which have been subsequently formed.

In the latter end of the year 1817, Mr. Palmer conceived the idea of assembling a few young men occasionally, to discuss scientific subjects. He communicated his views to his friend, Mr. James Jones (who subsequently became his assistant in his principal works). Mr. Field was then consulted, and on his entering cordially into the project, Messrs. William and Thomas Maudslay, Charles Collinge, James Ashwell, and John Thomas Lethbridge were assembled, and on the 2nd of January, 1818, the first meeting was held; an address was read by Mr. Palmer, and from that meeting origioated the "Institution of Civil Engineers." In 1820 Mr. Telford became interested in the welfare of the infant Society, and became its first President. In 1828, through his instrumentality, the charter of incorporation was obtained, and at his death he munificently endowed it. Mr. Palmer was always devotedly attached to the Institution, and, as long as his health permitted, his attendance as a Vice President was unremitting; he contributed several good papers. and he seldom failed to take part in the discussions, which he considered the most valuable feature in the proceedings.

Since Mr. Palmer's decease, which took place on the 12th of September, 1844, Mrs. Palmer has liberally presented, through your Vice President, Mr. Field, the greater part of Mr. Palmer's drawings, M.S.S., and models, which, when arranged, will be found to contain much interesting matter, indicative of the excellent talents he possessed. His memory will be long esteemed by his friends, and by the members of this Institution he should always be remembered, as its founder and constant friend.

WESTMINSTER NEW PALACE (THE NEW HOUSES OF PARLIAMENT.)

Copy of the Architect's Report as to the Present State of the Works, with Estimates.

"The centre and curtain portions of the river front are roofed in. The north wing is up in readiness for the roofs, part of which are already fixed, and the remainder are being put on. The south wing is nearly up to the level of the roofs, which are prepared, and in readiness for being fixed.

"A considerable portion of the north flank of the building is now being roofed in, and the south flank is up to the level of the roof, which is being prepared, and will soon be ready for fixing. The remainder of the north and south flanks, together with the turrets and pinnacles surmounting them, will be completed in the course of the present year.

"The Victoria Tower is carried up to a height of 38 feet, and the clock tower is at a height of 36 feet above the ground.

"The House of Lords is roofed in, and the ceiling and other fittings of that chamber are in hand. The central tower is carried up to a height of 28 feet above the ground. The House of Commons is about 30 feet above the ground, and will be roofed in during the present year.

"The other portions of the building are, upon an average, 30 feet above the level of the ground, some of which are in readiness for the roofs (now nearly ready for fixing,) while others are being roofed in.

"The alterations directed to be made at the Victoria Tower and Gallery and the Queen's robing-room have been carried into effect.

"A contract has been entered into for the finishings of the entire building, and those of the House of Lords, and the rooms provided for the business of that House are in hand.

"Some delay has taken place in the fixing of the ironwork of the roofs, owing to the unsettled state of the iron trade, and difficulties with workmen.

"The stone for the exterior of the building is still continuing to be supplied in great abundance, and of most excellent quality.

"*January* 3. "Charles Barry."

Lincoln.

	£	s.	d.
Sum stated by Mr. Barry in evidence before the Select Committee of the House of Commons of last session .	1,016,924	12	9
Deduct for purchase of premises and miscellaneous expenses	90,605	6	6
	926,319	6	3
Add for alterations at Victoria Tower, &c. . .	800	0	0
And for residence of Clerk of Crown . .	1,794	0	0
	928,913	6	3

Estimate of the total cost of the building, according to the latest plan approved £928,913 6*s.* 3*d.*

Lincoln.

METROPOLITAN CHURCHES.

Cost of building New Churches, and the number of Sittings they contain.

Parish.	Name of Church.	No. of Sittings.	Cost. £
Camberwell,	St. Mary Magdalene,	1,080	4,000
Ditto,	St. Paul's,	700	7,000
Chelsea, Upper,	St. Saviour's,	1,198	5,400
Ditto,	St. Jude's,	850	3,500
Hackney,	St. James's	1,200	5,597
Ditto,	St. Philip's	1,200	5,301
Islington,	St. James's,	1,084	5,800
Ditto,	All Saints,	1,100	4,256
Ditto,	St. Stephen's,	892	4,302
Kensington,	St. John's,	1,440	8,500
Lambeth,	Trinity,	1,070	4,147
Ditto,	St. Michael's	1,210	4,000
Ditto,	All Saints,	1,480	6,468
Limehouse,	St. James's,	1,040	5,729
Paddington,	St. James's,	1,500	10,000
Rotherhithe,	Trinity,	1,000	
Ditto,	All Saints,	1,002	4,008
Shoreditch,	St. James's,	1,234	5,597
Ditto,	Christ Church,	1,054	4,245
Stepney,	St. Peter's.	1,400	5,694
Ditto,	St. Thomas's,	1,100	6,408
Ditto,	All Saints,	1,111	5,400
Ditto,	Trinity,	1,213	6,630
St. Bride's, Fleet-street,	Trinity,	1,100	4,398
St. George's, Hanover-square,	St. Paul's,	1,700	15,000
St. George's, Southwark,	St. Mary's,	1,200	4,627
St. Luke's,	St. Paul's,	821	5,640
St. Margaret's, Westminster,	Christ Church,	1,550	8,600
St. Pancras,	Christ Church,	1,700	8,000
Ditto,	All Saints,	1,280	6,500
Whitechapel,	St. Mark's,	1,000	5,758
Extra Parochial,	St. Thomas Charter-house,	1,016	7,602
Ditto,	Kensal-green,		3,100
Bethnal-green,	St. Peter's,	1,130	*6,515
Ditto,	St. Andrew's,	1,006	5,436
Ditto,	St. Philip's,	1,112	5,422
Ditto,	St. James the Less,	1,143	*6,407
Ditto,	St. James the Great,	1,000	*7,069
Ditto,	St. Bartholomew's,	950	5,157
Ditto,	St. John's Chapel,	800	704

* This cost includes the Parsonage-house.

MODE OF COLOURING DAGUERREOTYPE PICTURES.

(By C. G. Page, Prof. Chem., Columbia College, U.S.)

In the month of December, 1842, I instituted a course of experiments to determine the effects of oxidation upon the surface of Daguerreotype pictures; and arrived at some beautiful results in fixing, strengthening, and colouring these impressions. Numerous and arduous duties of a public nature have prevented me from investigating the subject as I wished; and I therefore present the facts, for others to adopt as the basis of what promises to be a most interesting course of study and experiment. First, a mode of fixing and strengthening pictures by oxidation:—The impression being obtained upon a highly polished plate, and made to receive, by galvanic agency, a very slight deposit of copper from the cupreous cyanide of potassia, (the deposit of copper being just enough to change the colour of the plate in the slightest degree,) is washed very carefully with distilled water, and then heated over a spirit-lamp, until the light part assumes a pearly transparent appearance. The whitening and cleaning up of the picture, by this process, is far more beautiful than by the ordinary method of fixation by a deposit of gold. A small portrait fixed in this way, more than a year since, remains unchanged. As copper assumes various colours, according to the depth of oxidation upon its surface, it follows that if a thicker coating than the first mentioned can be put upon the plate without impairing the impression, various colours may be obtained during the fixation. It is impossible for me to give any definite rules concerning this last process; but I will state, in a general way, that my best results were obtained by giving the plate such a coating of copper as to change the tone of the picture,—that is, give it a coppery colour, and then heating it over a spirit lamp until it assumes the colour desired. I have now an exposed picture treated in this way at the same time with the two above mentioned; and it remains unchanged. It is of a beautiful green colour, and the impression has not suffered in the least by the oxidation. For pure landscapes, it has a pleasing effect; and by adopting some of the recent inventions for stopping out the deposit of copper, the green colour may be had wherever desired. In some pictures a curious variety of colours is obtained, owing to the varying thickness of the deposit of copper, which is governed by the thickness of the deposit of mercury forming the picture. In one instance, a clear and beautiful ruby colour was produced, limited in a well defined manner to the drapery, while all other parts were green. To succeed well in the first process, viz., that for fixation and the production of the pearly appearance, the impression should be carried as far as possible without solarization, the solution of the hyposulphate of soda should be pure and free from the traces of sulphur, the plate should be carefully washed with distilled water, both before and after it receives the deposit of copper,—in fact, the whole experiment should be neatly performed, to prevent what the French significantly call *taches* upon the plate, when the copper comes to be oxidized.—*Silliman's Journal.*

RAILWAY FROM BOMBAY TO THE GHAUTS.

It is with great pleasure that we find that the spirit of commercial enterprise which is now so generally directed towards Railway speculations is about to be extended to India, as advocated by us some time since. This, of all our colonial possessions is that in which the construction of railways may be expected to have the most beneficial tendency both in a commercial and political point of view. The density of the population, the form of the country presenting enormous inland districts far remote from the sea, the limited extent of fresh water communication—for the rivers of the Deccan are comparatively few and unnavigable—the difficulties in travelling which arise from the excessive heat of the climate, all concur in demonstrating the immense advantage of railway communication in India. The labours of those who make India the field of pecuniary speculation have hitherto been directed almost solely by a desire of aggrandisement, and scarcely at all by any wish to permanently benefit the country of their temporary residence. "It is our protection that destroys India," says Burke, "our conquest there, after twenty years, is as crude as it was the first day. The natives scarcely know what it is to see the grey head of an Englishman. Young men (boys almost) govern there, without society, and without sympathy with the natives. They have no more social habits with the people than if they still resided in England; nor indeed any species of intercourse but that which is necessary to make a sudden fortune, with a view to a remote settlement. Animated with all the avarice of age and all the impetuosity of youth, they roll in, one after another, wave after wave, and there is nothing before the eyes of the natives but an endless, hopeless, prospect of new flights of birds of prey and passage, with appetites continually renewing for a food that is constantly wasting. Every rupee of profit made by an Englishman is for ever lost to India. With us are no retributary superstitions by which a foundation of charity compensates through ages to the poor for the rapine and injustice of a day. With us no pride erects stately monuments which repair the mischief which pride has produced, and which adorn a country out of its own spoils. England has erected no churches, no hospitals, no palaces, no schools. England has built no bridges, made no high roads, cut no navigations, dug out no reservoirs. Every other conqueror of every other description has left some monument either of state or of beneficence behind him. Were we to be driven out of India this day, nothing would remain to tell that it had been possessed by any thing better than the ouran-outang or the tiger."

The severity of truth contained in this eloquent passage is much diminished in our own times. Still however the mercenary spirit of English adventure is but too apparent even now, and every effort to render our domination beneficial by the construction of great public works, must be considered for a long time to come not so much the conferring of a favour as the reparation of an injury.

We have been led to these remarks, which are perhaps almost too speculative for the nature of our subject, by the receipt from a correspondent in India, of a supplement to the Bombay Government Gazette, containing the report of a Committee appointed by the Indian Government in Council, to examine the scheme of a projected railway between Bombay and the Thull and Bhore Ghaut Roads, laid down by Mr. G. T. Clark, C.E. We extract the following part of the report, which gives a correct idea of the route of the line.

It is proposed to recover from the sea beach between Warree and Chinch Bunders, a space of 1,800 feet long and 300 feet wide, for the Bombay terminus. From this spot the line commences on the level of the adjoining roads, and crossing the Warree Bunder-road passes through the large field used for stacking timber, it then crosses the Mazagon-road near the entrance to the Police-office, Nesbit-lane, near Mrs. Nesbit's chapel, and the Parell road near the three miles stone, whence, passing on to the flats to the north of the Byculla Tank, it skirts the private lands adjoining the Parell-road, and crossing the Mahim and Dharavee roads, joins the Sion Causeway, near its south-western extremity. It then crosses twice the causeway, and three times the present line of the Tannah road, nearly following its course to within a short distance of Koorla, where leaving it to the west, it passes near the villages of Neopara, Ghat-Kooper, Ircooly and Bhandoop, and rejoins the Tannah road near the 20 miles stone; Mr. Clark has not yet determined on a site for a bridge across the Tannah river, but he has stated his belief, that a little below Tannah there is a more favourable spot than at Tannah itself, and that by adopting it, the line will avoid entering the town of Tannah altogether. From Tannah the line passes round Persick Point, to a village about four miles distant, called Dynhoolie, to which point only Mr. Clark proposes having a double line of rails. From Dynhoolie one branch runs through Culliao, crossing the Cullian river about four miles above the town, to Purgah, on the Thull Ghaut road, and the other branch following the general course of a road projected by Major Peat, from Tannah to the 6 miles stone on the Poona road, which it cross, descends into the valley of the Apta river, and again approaches the Poona road near the 18 miles stone, and runs nearly parallel with it to Kapoolee at the foot of the Bhore Ghaut.

In order that the reader may clearly understand the nature of the project, it is necessary to remind him briefly of the geographical position of Bombay. Bombay is situated on a small island to the west of the main continent, and separated from it by a narrow creek; the most contracted part of this channel is at the town of Tannah; at or near which town the railway is intended to cross to the main land. It then branches off in two directions, one northwards, the other southward. Both branches run somewhat parallel to the range of mountains, the Ghauts, which extend along the whole western coast of India. The length of railway proposed is 79 miles, namely, 28 miles of double, and 51 of single rails. The termination of the northern branch is at Purgah, near one of the Ghauts called the Thull; the southern branch would facilitate communication with the important town of Poona, and we believe, by it with Madras. The travelling distance from Bombay to Poona is 98 miles.

It will be seen that the benefits expected from this railway are principally local, and affecting local traffic; we presume however that it would be made serviceable for facilitating communication between the three great presidencies and the interior of India. At least, as the commencement of railway undertakings in India, it will greatly stimulate the desire for those great connecting railroads which we may hope to see one day accomplished in that country.

The following extracts are from the report of the Committee, of which we have given the commencement.

It must be borne in mind, that not only has no part of the line of the proposed railway been surveyed, but that not a single level has been taken, with the object of ascertaining its merits for a railroad; indeed, one portion of it has not even been seen by any party whose evidence, written or verbal, we had the opportunity of obtaining. It is clear, therefore, that any estimate for a railway, formed on such imperfect data must be liable to contain very extensive errors.

Among the most expensive works connected with railways, are the vast cuttings and embankments frequently found necessary; Mr. Clark assumes, and for a considerable portion of the line we think he is likely to prove right, that an embankment of an average height of four feet, will carry the rails over the whole distance on a level, or with gradients so trifling as to be unimportant; but until a section of the country is taken, it is impossible to foresee to what extent cutting and embankment may prove necessary.

The opinion above expressed in favour of Mr. Clark's assumption, that an embankment four feet in average height will be sufficient to carry the rails on a level, over a considerable portion of the line, is based on the following facts; from the Bombay Terminus to the flats, the line passes over a portion of the island formerly overflowed by the sea; from Byculla along the flats to Sion, an embankment will be necessary, but 2 feet will keep the rails clear of the floods, and it will depend on the general level of the line how much higher it may prove necessary to raise it, but in the deepest part it probably would not exceed 4 or 5 feet. A little beyond Sion some cutting will possibly be necessary, but the distance is very short, and the amount unimportant; on approaching Koorla the land is nearly on the level of the higher parts of the flats of this island, viz. a few feet above high water mark, as is proved by the tide flowing up to the road side. From Koorla to the twentieth mile stone the line runs nearly parallel with the western bank of the Tannah river, it has been surveyed by Captain Crawford of the Engineers for a road, and he states, that, along the whole of this line there need not be a rise of 10 feet; from the twentieth mile stone to Tannah the line passes over an extensive tract of rice fields; from Tannah to Cullian the line again skirts the bank of a tide river over singularly flat country, and from Dynhoolie to the sixth mile stone on the Poona road; the line has been surveyed by Capt. Estridge of the Engineers, who has informed us that in the whole distance there is only one hill, and that, he thinks, may be turned or avoided altogether. Beyond the sixth mile stone on the Poona road, we fear that some undulating country will be found, but Mr. Clark, who has examined it, is of opinion that by following the course of the Apta Valley the difficulties may be avoided.

The rate in the Department of Public Works at the Presidency for excavating foundations is 12 annas (about 18*d.* English)* per 100 cubic feet ($3\frac{2}{3}$ cubic yards), but considering the increased difficulty of working in a confined cutting, that labour in the Concan is cheaper than in Bombay, and that parties are readily found to contract for less than engineer officer's estimates, it has been assumed, that the work may be performed from side cuttings for 10 annas (about 15*d.* English), per 100 cubic feet ($3\frac{2}{3}$ yards).

Mr. Clark proposes to convey all merchandize by horse power, but passengers, coolies and their loads, cattle, sheep, &c. by locomotive power at high rates of speed, and to have two trains a day in each direction. From calculations we have made, we are of opinion, that for the estimated passenger traffic at the average speed prevailing on railways in England, ten locomotive engines including spare ones will not be found too large a number.

The report enters into a minute detail of the traffic that it is assumed will come upon the line of railway, which appears to us to be founded upon rather too low a scale, but even by the Commissioners cautious calculations, it appears that the project will yield near 5 per cent. profit on the capital to be invested.

Sketch Estimate of the probable expense of the proposed Bombay Great Eastern Railway, calculated by the Committee of enquiry appointed by Government, upon the data contained in the accompanying report, and the information afforded by* G. T. CLARK, Esq., C.E.

One mile of double line of Railway between Koorla and Tanna.

718080 feet cube earth-work as per plan, 34 feet broad and 4 feet deep.	
79786 ,, add $\frac{1}{9}$th for settlement.	
797866 ,, total filling in embankment from side cuttings	£498
3490 feet run masonry culverts per mile	174
21120 feet cube ballasting for blocks, 4 feet wide and 1 foot deep	105
42240 ,, metalling for horse tracks, 8 ft. wide & 1 ft. deep	211
No. 5280 stone blocks hammer dressed with setting and bedding chairs, 6 feet × 2 feet × 1 foot	1584
1320 joint chairs with pins and keys weighing $17\frac{3}{4}$ tons, at £10 per ton	177
3960 intermediate chairs with pins and keys weighing $44\frac{1}{4}$ tons, at £10 per ton	442
21120 feet run wrought iron rail 65 lb. per R. yard, at £9 per ton	1838
Tools	25
9000 ,, drain tiles for surface drainage, with fixing	29
	5086
Add 5 per cent. for sidings	254
Estimated cost of one mile	5341
Ditto ditto of 28 miles	149,553

One Mile Single Way as above.

422400 feet cube earthen work as per plan, taken at 20 feet wide and 4 feet deep.	
46933 feet cube, add $\frac{1}{9}$th for settlement.	
469333 feet cube filling in embankment from side cuttings	£293
2326 feet run masonry culverts per mile	116
10560 feet cube ballasting for blocks, 2 ft. wide and 1 ft. deep	52
21120 ,, metalling for horse tracks, 4 ft. wide & 1 ft. deep	105
No. 2640 stone blocks hammer dressed with setting and bedding chairs, 2 ft. square and 1 ft. thick	792
2640 joint and intermediate chairs weighing 31 tons, at £10 per ton	310
10560 wrought iron rail 65 lb. to running yard at £9 per ton	919
Tools	12
	2601
Add 10 per cent. for sidings	260
Estimated cost of one mile	2861
Ditto ditto of 51 miles	145,956

Forming a Terminus in Bombay.

31200 feet cube excavating foundation	62
144600 ,, stone and chunam masonry to wharf wall	2602
29400 feet super Khankee facing of wharf	1470
4320000 feet cube filling in with earth	12960
Estimated cost of Bombay Terminus	17,095

Crossing Sion Marsh.

Estimated expence in addition to ordinary mileage	1870

Bridges.

Tanna Bridge	12000
Taloga Bridge 200 feet long and 12 feet wide	2100
Ditto small ditto, 60 feet long and 8 feet wide	600
Nowrá Bridge, 140 feet long and 15 feet wide	1700
Assoot ditto, 40 feet long and 8 feet wide	400
Khapoole ditto, 96 feet long and 10 feet wide	1000
Kolapoor ditto, 120 feet long and 9 feet wide	1500
Ditto small ditto, 40 feet long and 9 feet wide	400

* Sixteen annas are equivalent to 1 rupee, which we have taken as equivalent to 2s. in English money.

* The amounts in the original are given in Rupees; but we have here given the corresponding sums of English money.

Choke Bridge, 148 feet long and 11 feet wide	£1800
Small Bridges from Pursick Point to Callian	1000
Ditto ditto from Callian to Purgah	1000
Callian Bridge	20000
	43,500
Termini Stations and Goods sheds.	
Terminus Station in Bombay, 60 ft. by 56 ft. and 18 ft. high	672
Seven station houses at other termini and intermediate stations	280
Engine-house and fitting-shop, Bombay, 70 ft. by 50 ft. and 18 ft. high	700
Two ditto at other termini, 32 ft. by 20 ft. and 18 ft. high	192
Carriage building shed, 60 ft. by 40 ft. and 12 ft. high	360
Ditto ditto	240
Shed for warehousing goods by Bombay, 300 ft. by 80 ft. and 18 ft. high	3600
Four ditto ditto outstations, 100 ft. by 30 ft. and 18 ft. high	1800
Enclosure walls of termini	500
Fitting up sheds	2000
Estimated cost of termini station-house, &c.	10,344
Supply of Water.	
One tank in Bombay for 50,000 gallons	350
Four ditto at stations, each 25,000 gallons	700
A well in Bombay	180
Wheels, pumps, &c.	120
Estimated cost of supplying water tanks	13,500
Locomotives, Carriages, Wagons, &c.	
10 locomotive engines including spare gear, at 1500*l.*	15000
14 tenders at 300*l.*	4200
5 first class carriages at 460*l.*	2300
75 second ditto ditto at 150*l.*	11250
500 wagons at 60*l.*	30000
45 sheep wagons at 70*l.*	3150
8 cattle wagons at 70*l.*	560
Total estimated cost of carriages, &c.	664,600
Horses, &c.	
334 horses at 40*l.*	13360
334 sets of harness at 5*l.*	1670
Total estimated cost of horses and harness	15,030
Turn Tables.	
5 per cent on cost of rails	4918
Switches 4 per cent on cost of rails	3934
	8,852
Engine Lathes, Tools, &c.	
Eight horse power engine, H. P.	300
Middle sized lathe	300
Smaller ditto	100
2 hand lathes	40
Small planing machine	250
Drilling machine	40
Punching machine	40
Tools for the above	30
60 feet of shafting with driving drums	120
A circular saw bench with saws	100
A portable crane	200
2 forges with fanblast, anvils, &c.	60
A set stocks and dies	26
An anchor-smith's anvil	20
Vices, benches, drill braces, &c.	40
Estimated cost of engine, lathe, tools, &c.	1,666
Surveying and drawing instruments	570
Establishment for management for three years	5,155
Establishment[2] for superintendence for three years	9,727
Establishment for surveying for three years	6,048
Compensation and expenses of purchasing land.	13,523
Gates and Porter lodges at 20 crossings on the level	1,080
Total	497,782
Contingencies 10 per cent	49,778
Grand total	£547,562

[2] Exclusive of salary of the superintending engineer which is left for the consideration of the other authorities.

ARCHITECTURE AND THE BUILDING ARTS IN MANCHESTER AND ITS NEIGHBOURHOOD.

We have occasionally had opportunities of noticing the progress which has been making in different localities in Architecture and the Building Arts, and have thought it desirable to take advantage of personal visits to important towns to give a sketch of what has fallen under our observation likely to be of interest to our readers.

We have recently enjoyed a visit to the neighbourhood of Manchester, and have been gratified in observing the progress making there. Either from economical restrictions on the part of those who employ architects, or from the poverty of conception of the architects themselves, or, most probably, from both causes combined, the erections in this district have, until recently, been generally deficient in architectural beauty, we therefore rejoice to discern a manifest improvement in the style of the edifices lately built or in course of completion. The requirements of the railway system have introduced into Manchester two stations of great magnitude, one at Hunt's-bank and another in Store-street, the latter is a work of very considerable architectural merit, and the former successfully rivals in extent the far famed station at Derby.

Near the Hunt's-bank railway station we noticed a new hotel, called the Palatine, which is worthy of mention, as well for external design as for the admirable adaptation of the internal arrangements to the purposes to which the building is devoted. Messrs. Holden are the architects, and they have certainly made the most of the awkward piece of ground with which they had to deal. A novelty in this edifice is the main staircase opposite the entrance; the whole of the stairs and landings (with the exception of the mahogany hand-rail) is of iron; each step (riser and tread included) is in one piece of cast iron, which is attached to a wall-plate and depends therefrom; the whole has a remarkably light and elegant appearance, and is an instance of the good effect which may be gained by a judicious use of the material. In the event of a fire, a staircase of this construction would be invaluable, as it would afford a means of escape to the inmates which would not be liable to destruction. The total cost of the building was about £7,000.

The new premises for the Manchester Branch Bank of England are to be erected in King-street, nearly opposite to the Town Hall, from the designs of R. Cockerell, Esq., of London. The ground is now being cleared preparatory to commencement, and Messrs. Pauling and Henfrey have contracted for the building, which is expected to cost between £17,000 and £18,000. The same contractors have undertaken the new Theatre Royal, from designs by Messrs. Irwin and Chester.

The Moral and Industrial Training Schools at Swinton, a few miles from the town, now erecting for the education of the pauper children of the Union, is a building which makes a very considerable and creditable addition to the architecture of the neighbourhood. It is in the Elizabethan style, designed by Messrs. Tattersall and Dickson (now Mr. Dickson), of Manchester. The materials used are red brick with stone dressings. The general plan of the building forms a quadrangle, and the arrangements are upon a very extensive scale, embracing schools for boys, girls, and infants, class rooms, dining and work rooms, sick and fever wards, with domestic offices, chapel, &c. The principal front is 460 feet in length, divided into five compartments, in the centre of which is the principal entrance, which forms a very prominent feature. Its general appearance is marked by great simplicity, and yet with an architectural character in its minutest parts which cannot fail to arrest the attention of the most cursory observer. It is now nearly completed, and the *tout ensemble* intimates at once that it is erected for the purpose of a large public institution. The whole buildings cover a space of four acres of ground, and are expected to cost between £35,000 and £40,000. A few miles further from Manchester is Worsley Hall, the splendid mansion of Lord Francis Egerton, now almost completed, from designs by Edward Blore, Esq., of London. The general character of this building is late Elizabethan, mingled with so much Italian ornament as to give it the date of James the First. Much of the detail is lost to the observer from its minuteness, which, however, will well repay a close inspection. Great license seems to have been indulged in by the architect, whose varied mouldings and enrichments partake of a wide range of architectural character. To the interior decorations the same observations will apply. The building is faced with Staffordshire stone, and is not unworthy of becoming the residence of a noble English family.

The majority of the new churches in Manchester is far from what we should desire, and we are inclined to attribute this, partly to the fact that sufficient funds are not placed at the disposal of the architects, and partly to the evils of the competition system. In contradistinction to the generality, we are glad to mention the church of the Holy Trinity, which, with the endowment, is the gift of Miss Atherton. A description of this beautiful church will be found in Vol. VI., page 286, of this

Journal. The dissenting bodies of the town seem to be making considerable improvement in their erections for worship, and it is a curious circumstance that they are adopting an ecclesiastical style, whilst the churches are assuming the plainness which used to characterize dissenting chapels.

The introduction of the bonding system in Manchester has rendered necessary large warehouses for bonded goods, and a company has been formed which has taken very spacious premises, which are being altered to suit the purpose under the direction of Mr. Alexander Mills, architect. It is expected that the building trades will receive a great impulse for the next year or two, in consequence of the want of bonding warehouses. We trust that the experience of late years will have taught its lesson, and prevent the erection of warehouses on the false principle of economy, which has proved so disastrous to property in Manchester and Liverpool in cases of fire. In Church-street we observed a large warehouse, now being erected, completely fire-proof; and in the new mills round about they are adopting the same plan. Iron cornices and facings are in some quarters being substituted for the old wooden ones, but altogether we should pronounce Manchester behind Liverpool in the adoption of fire-proof material.

The Manchester and Leeds Railway Company have recently erected an extensive pile of workshops, for the manufacture of locomotive engines, about a mile from town. Mr. Bellhouse was the contractor for the building, which has been completed at an expense of about £17,000.

It may be incidentally remarked that upwards of £30,000 have been subscribed for the purchase of sites for the public parks and walks; and it is intended immediately to lay out four large parks, with lodges, &c., in different parts of the town. This measure will be a great boon to the people, as such breathing places have been much required in such densely populated neighbourhoods.

Upon the whole, we may congratulate the inhabitants of Manchester upon the progress of improvement in their town, and we do so the more earnestly as we know that the amount of public revenue to be devoted to these purposes is comparatively small; so that the result must be attributed to the public spirit of the inhabitants of this (in more respects than one) great community.

P.S. Since writing the above we learn that the Town Council of Manchester have purchased the Manorial Rights from Sir Oswald Mosley, for the sum of £200,000, and that it is purposed to build markets on a scale commensurate with the wants of the large and increasing population.

E. C.

GWILT'S GLOSSARY.

Sir—Your correspondent P. Hill has fallen into a mistake in saying that Gwilt has omitted the term "Antefixæ," but there is some excuse for his having overlooked it, because it is misplaced, owing to its being mispelt, viz. Antifixæ. However, though there is so far one omission the less, there are numerous others which your correspondent has not pointed out, and some of them are remarkable ones, especially if we consider the copiousness and the minuteness which Mr. Gwilt seems to have aimed at by introducing a great number of terms which hardly belong at all to a technical *glossary*, though exceedingly proper for an Architectural Dictionary in which *real* information as well as *verbal* definition is sought for. It is surely puerile to insert words which every child knows the meaning of,—such as Bedchamber and Cottage. So far too, is Mr. Gwilt from having shown any industry, that he does not appear to have availed himself, as he very easily might have done, of many preceding and even recent Glossaries. Had he condescended to look at that in Loudon's Encyclopædia of Cottage and Villa Architecture?

Among the omissions by Gwilt that have been passed over by your correspondent, there is one which will just now be thought a most extraordinary—a positively stupendous one, viz. Credence-Table! Pity! that Sir Herbert Jenner Fust did not think of consulting Gwilt's Encyclopædia, for he would then have discovered that a Credence-table must be something so very nonsensical that the author was absolutely ashamed of mentioning it at all. The same appears to have been the case with regard to the following terms, which together with those specified by your other correspondent make up a rather formidable list.—Altar tomb,—Bartizan tower,—Bell turret,—Benetier,—Bird's-eye Perspective,—Buhl,—Clock tower,—Concha,—Encaustic,—Fald-stool,—Gablet,—Gargoyle,—Gateway,—Graining,—Hypertithedas,—Isometrical Perspective,—Lettera,—Lift (for raising trays, &c. from kitchen to upper floors),—Louvre,—Orthostyle, Perspective Elevation,—Penthouse,—Pinacotheca,—Prie-Dieu,—Postera,—Riding-house,—Roman Cement,—Sand-dashing,—Satin-wood,—Sgrafitto—Still-room,—Stove,—Studio,—Tank,—Tulipwood,—Vertical Bond and Wall-straps.

On the other hand, among those words which do not require any *verbal* explanation, we find "Kitchen" thrust into this Glossary; yet neither there nor in the body of the work do we obtain from Mr. Gwilt any information at all as to the fittings-up of Kitchens, and all the various articles of culinary apparatus according to the latest improvements; to say nothing of various contrivances introduced of late years into domestic offices and household economy, all which matters it is highly important to the practical architect to be conversant with. Moreover in a specific *Encyclopædia* of architecture, particularly one in which many matters that do not rightly belong to it, or which might have been left out without occasioning any apparent deficiency, are brought in,—something of the subject of internal decoration, furniture, the ornamental colouring of rooms, &c., would have been by no means supurfluous. It is strange that he should not have been *put up* to treating of matters of the kind by the example of Loudon's Encyclopædia; or if he considered them quite *infra dig*, and beneath the attention of an architect, he might at least have told his readers where they could obtain some account of them; instead of which, the only notice he takes of Loudon's work at all, consists in merely inserting the title of it in the list which he gives of publications on architecture, without a syllable in recommendation of it. In fact that list is by no means so serviceable as it might have been rendered, because it serves as no sort of guide in the selection of an architectural library, unless people can discriminate between valuable and worthless publications by the titles alone; and that some of the works inserted in it are any thing but cordially admired by Mr. Gwilt is very certain, those of both Schinkel and Klenze being among them, the two German architects whom he had taken some pains to decry, not very long before. Further in regard to that List, a more industrious or a more liberal bibliographer would have introduced into the "Miscellaneous" section of it some notice of architectural periodicals, both English and foreign: for instance Loudon's "Architectural Magazine," Daly's "Revue Generale, &c.," and Förster's "Bauzeitung." But instead of being indicated by Mr. Gwilt, if they are indexed by him at all, it must be in his own private *Index Expungatorius*.

Your's, &c.

C. Harford.

ARCHITECTURE IN IRELAND.

Sir—Unusual as it, no doubt, is to express a wish of the kind in this manner, I certainly do very much wish that your Correspondent Dr. Fulton, would supply some information on a subject as to which there now exists a lamentable dearth of it, by giving us some account of what has been done of late years, in architecture at Dublin or elsewhere. Though the brilliant period adorned by a Gandon may have passed away, I presume that architecture is not wholly extinct in Ireland; and further trust that if there are such wretched specimens of it as the "Conciliation Hall," there are also worthier productions,—some in regard to which silence is injustice.

For all that is to be gathered from English architectural publications, whether Encyclopædias or others, it would seem that there has been no such place as Ireland during the present century. Yet surely there must have been several buildings not wholly unworthy of notice erected in Dublin itself since Malton published his Views of the principal ones existing at that time. And to his work we are mainly indebted for any knowledge of them—but imperfect and limited knowledge at the best, because nothing more can be understood than what can be made out from the exterior alone, as seen from a certain point of view; for, unfortunately, Malton's work exhibits no interiors, notwithstanding that he might easily have found many highly interesting subjects of that class,—at least if verbal description of them is to be trusted.

Having ventured thus to call upon him to do so, I hope that Dr. Fulton will now endeavour to contribute what he can on the subject of modern Irish Architecture, and Irish Architects, in doing which he can, if he thinks proper, confine himself strictly to matter-of-fact, without bringing forward his own opinions as to the merits or defects of the respective buildings.

I remain, Sir,

Your's, &c.,

Philo-Hibernicus.

COLONNA AND COCKERELL.

Sir—Professor Cockerell's strange rhapsody about Colonna in one of his late lectures, has no doubt excited the curiosity of others as well as myself in regard to a newly found out worthy whose name has been hardly heard of at all among us, although his writings are now all at once held up to us for admiration, as calculated to inspire with an ardent enthusiasm for the study of architecture. I have therefore turned to Milizia to ascertain what sort of character he gives him; and as the article is exceedingly short, and expressive enough, I here transcribe the whole of it from the English translation of his "Lives of Celebrated Architects."

"Frencesco Colonna neither merits the title of an architect, or (nor) a writer on the subject of architecture. It is true he composed a large book, which, although compared by his commentator to that of Vitruvius, is too full of absurdities to be read with patience. As well might the term 'architectural' be applied to the writing of Ariosto, Tasso, or any work of fancy."

Nagler does not treat Masser Francesco more ceremoniously, for he briefly calls him "ein viel verlachter Mann,"—a man who has been very much laughed at, and no wonder if he wrote such monstrous and extravagant stuff as that which your Correspondent "Common Sense" described.

If the Professor thought that he might indulge in rhodomontade before students, with impunity, he is perhaps by this time of a different opinion, and has found out that for addressing a mixed auditory like his a little discretion is required. He may think himself well off if he does not obtain the *sobriquet* of Colonna Cockerell. Literary studies are no doubt highly becoming in an architect, yet unless they are directed to something better than the poring over obsolete crotchety writers, minute inquiries into the text of Vitruvius, and other matters which besides being of no practical value whatever are most wearisome and stale,—they are neither valuable nor interesting. For my part, I am inclined to think that inquiries relative to what belongs to the mere archæology of architecture might very well be deferred till a later period of professional education, when the student shall have qualified himself for taking up the history of architecture by having learnt the elements of the art, and the leading forms and characteristics of the styles whose history and development he may then explore. There is a most excellent Essay entitled "Outlines and Characteristics of Styles," in Part III. of Weale's Quarterly Papers, which enters more fully and intelligently into the rationale of the Greek and Roman orders, than any thing else I have met with on the same subject, which hackneyed as it is, is there treated with very great freshness. The writer seems to know exactly both what ought to be chiefly urged at the outset upon the student's attention, and how to communicate instruction interestingly, without formal dryness on the one hand, and without rhetorical "magnification" and mystifying of the subject, on the other. Whereas some writers, and perhaps some lecturers too, seem to be not so much solicitous of convincing us of the merits of architecture or of particular styles in it, as determined to *bully* us into admiration. Many of them, besides, show very bad taste and any thing but tact, in puffing architecture in such an outrageously pompous and silly way that any one would suppose that it had got a very bad character, and needed witnesses to come forward and clear it.

I remain, &c.,

P. Hill.

P.S. In my former Note, page 79, Κειμαρ should have been printed Κειμαι, and Κοιμοω, Κοιμαω,

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Electric Clocks.—Extract of a letter from Mr. Finlaison, of Loughton Hall, in the *Polytechnic Review*:—"Mr. Brain has succeeded to admiration in working electric clocks by the currents of the earth. On the 28th of August he set up a small clock in my drawing-room, the pendulum of which is in the hall and both instruments in a voltaic circuit as follows:—On the N.E. side of my house two zinc plates, a foot square, are sunk in a hole, and suspended to a wire: this is passed through the house, to the pendulum first and then the clock. On the S.E. side of the house, at a distance of about 40 yards, a hole was dug four feet deep, and two sacks of common coke buried in it; among the coke another wire was secured, and passed in at the drawing room window, and joined to the former wire at the clock. The ball of the pendulum weighs nine pounds, but it was moved energetically, and has ever since continued to do so with the self-same energy. The time is to perfection and the cost of the motive power was only 7*s.* 6*d.* There are but three little wheels in the clock, and neither weights nor spring; so there is nothing to be wound up."

STEAM NAVIGATION.

The Samson Steam Frigate.—This Government War Steamer recently made a trial of her engines, whilst at her moorings in the East India Docks, in the presence of the Government engineers and several naval and scientific gentlemen. The engines were constructed by Messrs. Rennie, and we can safely say that we never saw engines of such a magnitude more beautifully finished in every respect, and that worked better. They are of the direct action principle, the two are of the nominal collective power of 450 horses, but by the indicator card her effective power proves to be nearer double that power. The method of reversing the valves to go a-head or a stern appeared to us to be quite new, as far as regards Marine engines, although we believe somewhat the same principle, is adopted, in Locomotive engines; in addition to the usual eccentric on the shaft for working the valves, there is another eccentric fixed on the side of it with an arm demitting, at the lower extremity of this arm there is a small cog or pinion wheel which is embraced by an endless chain nearly horizontal, this endless chain also passes over a corresponding pinion wheel supported by a vibrating standard, and turned by a capstan lever; when it is desired to alter the motion of the engines, a man turns the capstan with the pinion, which causes the endless chain to draw towards it the corresponding pinion attached to the eccentric rod before described, and thereby reverse the motion of the valves. The operation is performed by one man in less than half a minute. The following are the dimensions of the engines: cylinder 80½ inch diameter, length of stroke 5 ft. 10 in., number of strokes per minute 18. The boilers are upon the flue principle, there are four of them, each with four fires, they are placed in pairs athwart ship and back to back, and occupy a space of 26 feet in width and 20 feet in length, the grate surface is 254 feet super., and the total heating surface 4800 feet; each boiler is furnished with distinct steam valves, so that any one can be used without interfering with the other if it be required to work only part of them. The paddle wheels are 27 feet diameter and 9 feet over the float.—The total weight of the machinery is 263 tons.

The Herne Steamer.—A very successful alteration has just been made upon this iron-built steamer for the purpose of increasing her accommodation by lengthening her bow 15 feet. This has not only given greater space for the fore cabin passengers, but it has also greatly increased her speed. The trials made last month in the presence of the Directors of the Company to whom the vessel belongs and several gentlemen was most satisfactory, and showed that in the ensuing season she will be a match for the fastest steamers on the river Thames. She performed the trip from Blackwall to Herne Bay in three hours and 45 minutes. The credit of this alteration is due, we believe, conjointly to Messrs. Ditchburn and Mair, the builders of the vessel, and Messrs. Boulton, Watt and Co., the constructors of the engines.

The Ondine.—A new iron vessel recently built by Messrs. Miller, Ravenhill, and Co., has been making some astonishing trips as to speed, although the power of her engines are only 50 horses, she performed a trip from Blackwall to Dover in 5 hours 50 minutes, and brought over an express from Boulogne to Folkstone in 1 hour 55 minutes, and another express from Dover to Boulogne, against tide, in 2 hours 10 minutes.

Launch of the Terrible War Steamer.—This magnificent war steam-vessel, the largest ever built for the Royal Navy, was launched on February 6, at Deptford. She was designed by Mr. Oliver Lang, master-shipwright at Woolwich, and has been built on a principle introduced by him, of such a valuable nature, that she would actually swim if launched with her ribs only put together, they are so accurately fitted and well joined to each other. The Royal Albert, of 120 guns, building at Woolwich, is put together on the same principle, and now has assumed a most magnificent form, being at present nearly all framed, and well worthy of being visited. She is 700 tons larger in dimensions of tonnage than the Trafalgar. The following is a correct detail of the dimensions of the Terrible war steam-vessel:—

	Ft.	in.
Length from the fore part of the figure-head to the aft part of the taffrail	246	0
Length between the perpendiculars	226	0
Length of the keel for tonnage	196	10½
Breadth extreme	42	6
Breadth for tonnage	42	0
Breadth moulded	41	2
Depth in hold	27	4
Burden .. .. 1,847 7-94 tons.		

A Monster Bell.—The restoration of York Minster is now completed, and furnishes another illustration, if any were wanting, of the architectural skill and celerity in execution of the present age. It will be remembered, that in the year 1830 a religious fanatic, named Martin, set fire to the Minster, upon which occasion nearly the whole of the interior of the choir was destroyed. Shortly after its restoration a second (accidental) fire in the belfry destroyed the nave. The whole is again entirely restored to its pristine beauty under Mr. Sydney Smirke, at a cost of nearly 90,000*l.*, which sum was raised by subscription. A separate fund has also been subscribed for a bell, which in vastness exceeds anything of the kind hitherto attempted in this country. Some idea may be formed of its size, when we state that it weighs nearly 13 tons, and with the stock 16 tons, and is 9 feet 6 inches in height; the clapper, which is of wrought iron, weighs 4 cwt. The bell was cast by Messrs. Mears, who prepared 17 tons of metal, and ran it in seven minutes and a half; it took 14 days cooling before it could be uncovered, and is one of the most perfect specimens of gigantic casting known. It is to be rung with two wheels, 14 feet diameter each, and will require 12 men to ring it. So great an interest has been excited about this bell that the committee, after much solicitation, have determined upon its exhibition in London, where it is to remain a short time. It has been removed to the Baker-street Bazaar, where the public will have an opportunity of seeing this gigantic specimen of art.

The Thames Tunnel Surpassed.—The following account is from a letter from Marseilles in the *Débats*:—"There has been long known, or believed to exist, at Marseilles, a tunnel or submarine passage, passing from the ancient Abbey of St. Victoire, running under the arm of the sea, which is covered with ships, and coming out under a tower of Fort St. Nicholas. Many projects for exploring this passage have been entertained, but hitherto no one has been found sufficiently bold to persevere in it. M. Joyland, of the Ponts-et-Chaussées, and M. Matayrss, an architect, have however not only undertaken, but accomplished this task. Accompanied by some friends and a number of labourers, they went, a few days ago, to the Abbey, and descended the numerous steps that led to the entrance of the passage. Here they were the first day stopped by heaps of the ruins of the Abbey. Two days afterwards, however, they were able to clear their way to the other end, and came out at Fort St. Nicholas, after working two hours and 20 minutes. The structure, which is considered to be Roman, is in such excellent condition that in order to put it into complete repair a cost of no more than 500,000f. will be required; but a much larger outlay will be wanted to render it serviceable for modern purposes. This tunnel is deemed much finer than that of London, being formed of one single vault of 60 feet span, and one-fourth longer."

Petrifying Animal Substances.—At the *Academie des Sciences*, at Paris, a communication read announced that the Abbé Balduccooi, conservator of the Museum of Natural History of Sienna, has discovered a means of petrifying animal substances. The process consists in the immersion of the substance to be hardened, for a long time, in a strongly-charged solution of twelve parts of bichloruret of mercury, and one or two parts of hydrochloruret of ammonia. By this process the natural colour of the object is preserved, which is not the case if the bichloruret of mercury be used alone. With the latter announcing this fact, was forwarded the liver of a dog preserved, retaining its natural form and colour.

The Royal Academy.—At the close of the Academic Session on the 29th ult., one hundred of the students presented to Mr. Jones the Keeper of the Royal Academy, a large Silver Etruscan tazza to testify their gratitude for his kindness towards them at all times. The eldest son of Mr. Cowper, R.A., was deputed by the students to present the memorial on their behalf.

The Gravesend Terrace Pier.—This pier constructed under the direction of Mr. Redman, C.E., and described in the Journal, was opened to the public on Monday, the 24th ult.

NEW PROJECTED RAILWAYS.

The Decisions of the Board of Trade.

(Continued from Page 96, March Journal.)

RAILWAYS IN ENGLAND.

Railway Communication between London and York and in the intermediate districts to the East of the present lines of railway.

In favour of the—	*Against the—*
Bedford, London, and Birmingham,	Barnsley and Goole,
Cambridge and Lincoln,	Direct Northern (as to the portion between Lincoln and London),
Direct Northern (as to the portion between Lincoln and York),	Eastern Counties — Cambridge and Huntingdon,
Eastern Counties—Brandon and Peterborough Deviation,	Eastern Counties—Ely and Lincoln Extension,
Eastern Counties—Hertford and Biggleswade Junction.	Ely and Lincoln,
Great Grimsby and Sheffield,	Goole and Snaith,
Midland Railway—Syston and Peterborough.	Hull and Gainsborough,
Midland Railway—Nottingham and Lincoln,	London and York,
Midland Railway—Swinton to Lincoln (as to the portion between Swinton and Doncaster),	Lincoln, York, and Leeds,
Tottenham and Farringdon-street Extension.	Midland Railway—Swinton to Lincoln (as to the portion between Doncaster and Lincoln),
Wakefield, Pontefract, and Goole;	Rotherham, Bawtry, and Gainsborough,
	Sheffield and Lincolnshire,
	York and North Midland, and Doncaster,
	York and North Midland, and Goole.

Also in favour of the—

Aberdare.
Brighton, Lewes, and Hastings—Keymer Branch,
Cockermouth and Workington,
Dunstable, London, and Birmingham,
Erewash Valley,
Manchester, Sheffield, and Midland Junction,
Newark and Sheffield,
North Wales Mineral Railway—Extension,
Preston and Wyre—Lytham and Blackpool Branches,
Shrewsbury, Oswestry, and Chester,
Sunderland, Durham, and Auckland,
Wear Valley;

And recommending the postponement until a future period of the—

Ely and Bedford,
Launceston and Tavistock,
South Devon and Tavistock.

DALHOUSIE,
C. W. PASLEY, G. R. PORTER,
D. O'BRIEN, S. LAING.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM MARCH 3, TO MARCH 28, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

William Smith, of Snow-hill, "Improvements in gas meters and gas meter cases"—(Communication.)—Sealed March 3.

George Miller Clarke, Albany-street, Regent's-park, "Improvements in the construction of lamps and apparatus to be used therewith." (Communication.)—March 3.

Thomas Schofield Whitworth, Salford, Lancaster, "Improvements in machinery, for preparing, spinning, and doubling cotton-wool, flax, silk, and similar fibrous materials."—March 3.

John Tomes, Mortimer-street, "Improvements in making artificial teeth, gums, and palates."—March 3.

Henry Fox Talbot, Lacock Abbey, Wilts, "Improvements in obtaining motive power, and in the application of motive power to railways."—March 3.

William Palmer, Clerkenwell, "Improvements in pressing tallow and other matters and substances and fabrics."—March 3.

Samuel Knight, of Spotland, near Rochdale, "Improvements in machinery or apparatus for scouring, washing, cleansing, and other similar purposes."—March 3.

George Ellins, Droitwich, "Improvements in manufacturing salt, and in apparatus for manufacturing salt."—March 3.

William Shaw, Liverpool, "A machine for paging books and numbering documents consecutively and otherwise, and for printing dates, words, marks, numbers, or impressions, in an expeditious manner."—March 3.

Alexander Gordon, Westminster, "an Improvement or improvements in producing motive power by the action or agency of heat, and in the application of that power to purposes of locomotion or navigation."—March 3.

Robert Frederick Browne, Knightsbridge, "Improvements in the construction of chairs and couches."—March 8.

George Selby, Birmingham, "Improvements in the manufacture of pipes or tubes of that class or kind which are formed by welding skelps of wrought iron."—March 8.

John Sykes, Hollingwood, Lancaster, and Adam Ogden, of Ashton-under-Lyne, "Improvements in machinery for preparing and cleaning wool, cotton, and similar fibrous material."—March 8.

Thomas Wright, Thames Ditton, Esq., "Improvements in apparatus for the production and diffusion of light."—March 10.

Thomas Grubb, Dublin, civil engineer, "Improvements in Bank notes, and in machinery connected therewith, parts of which are also applicable to cheques, bills, and other documents."—March 10.

Archibald Richard Brooman, Fleet-street, gent., "Improvements in the preparation and application of artificial fuels, mastics, and cements."—March 10.

George Fergusson Wilson, Belmont, Vauxhall, gent., George Gwynne, Regent-street, gent., and James Pillans Wilson, Belmont, Vauxhall, aforesaid, gent., "Improvements in the manufactures of candles when palm-oil is used."—March 13.

Robert Barr Parbrick, Tonbridge, Kent, engineer, "Improvements in certain apparatus used in the manufacture of sugar, which apparatus is commonly called sugar-pans or coppers."—March 13.

John Blyth and Alfred Blyth, St. Anne's, Middlesex, engineers, and George Parker Hurbuck, Ponder's-end, Middlesex, engineer, "Improvements in steam-engines, steam-boiler, and machinery for propelling vessels, which improvements in steam-engines and steam-boilers are for the most part applicable to other purposes for which steam-engines or steam-boilers are or may be used."—March 13.

Abel Siccama, Finsbury-pavement, bachelor of arts, "Improvements in the construction of flutes and other wind musical instruments."—March 13.

Moses Poole, the Patent Office, London, gent., "Improvements in lithographic presses." (Communication.)—March 13.

Henry Jones, Broadmead, Bristol, baker, "A new preparation of flours for certain purposes."—March 13.

Thomas Dunn, Manchester, engineer, "Improvements in, or applicable to, turn-tables to be used on, or in connexion with railways."—March 13.

Pierre Armand le Comte de Fontainemoreau, Skinner-place, City, "Improvements in the process of, and apparatus for, distilling and rectifying." (Communication.)—March 13.

Christopher Nickels, York-road, Lambeth, gent., "Improvements in the manufacture of elastic webs and cords, and in the mode or modes of manufacturing articles from the same."—March 13.

John Ainslie, Redheugh, N. B., farmer, "A certain improvement or certain improvements in the apparatus and arrangements for the manufacture of tiles and similar articles from clay or other plastic matter."—(This patent being opposed by caveat at the Great Seal, was not sealed till March 15, 1845, but bears date, per order of the Lord Chancellor, 18th of January last, the day it would have been sealed had the said caveat not been lodged against it.)

Constant Champion, city of London, merchant, "Improvements in burning animal charcoal." (Communication.)—March 17.

Pryce Buckley Williames, Llegodig, North Wales, gent., "Improvements in the manufacture of artificial stone."—March 17.

John Sellers, Jun., Burnley, Lancaster, Cotton Spinner, "Improvement in looms for weaving.—March 17.

John Cleveland Palmer, East Haddam, Middlesex, gent. "Machinery to be used in manufacturing certain kinds of tools for boring wood or various other substances."—March 17.

Henry Grissell and James Lewis Lane, Regents Canal, Iron Works, engineers, "Improvements in weighing machines, and also in steel-yards."—March 17.

Edwin Hill, Bruce Castle, Tottenham, gent. and Warren De La Rue, Bunhill-row, manufacturer, "Improvements in the manufacture of envelopes."—March 17.

William Lloyd Caldecott, Esq., Bath, Somerset, "Improvements in the manufacture of soap."—March 17.

Augustus Coffyn, Paris, gent., "Improvements in pumps."—March 17.

Stephen Perry, Woodland's-place, St. John's wood-road, gent., and Thomas Barnabas Daft, Birmingham, manufacturer, "Improvements in springs to be applied to girths, belts, and bandages, and improvements in the manufacture of elastic bands."—March 17.

Thomas Drew, St. Anstell, Cornwall, chemist, and Edward Stocker, of the same place, merchant, "Improvements in the production and manufacture of naphtha, pyroligneous acid, or other inflammable matters."—March 17.

Francis Molineux, Hackney, gent., "Improvements in apparatus for cutting and dividing sugar."—March 18.

Henry Samuel Rayner, Alfreton, Derby, gent., "Improved means of preventing accidents to carriages on railways and common roads."—March 18.

Anna Maria Stowell, Glocester-place, Islington-green, straw bonnet manufacturer, and Thomas Little, Hoxton Old Town, manufacturer, "Improvements in the manufacture of ladies' bonnets or hats."—March 18.

Louis Theodore Maillard Kochet, Paris, gent., "Improvements in the construction of ovens, applicable also for the purposes of economizing fuel in furnaces generally." (Communication)—March 20.

John Thurston, Catherine-street, Strand, "Improvements in parts of billiard-tables."—March 26.

Richard Archibald Brooman, of the Patent Office, 166, Fleet street, London, gent., for a thread made from a substance not hitherto applied to that purpose, and also the application of it to the manufacture of piece goods, ribbons, paper, and other articles, (being a communication.)—March 27.

Henry Tylor, of the firm of Tylor and Pace, Hackney, gent., "Improvements in fabrics used for, and applicable to curtains, screens blinds, and other like useful purposes."—March 28.

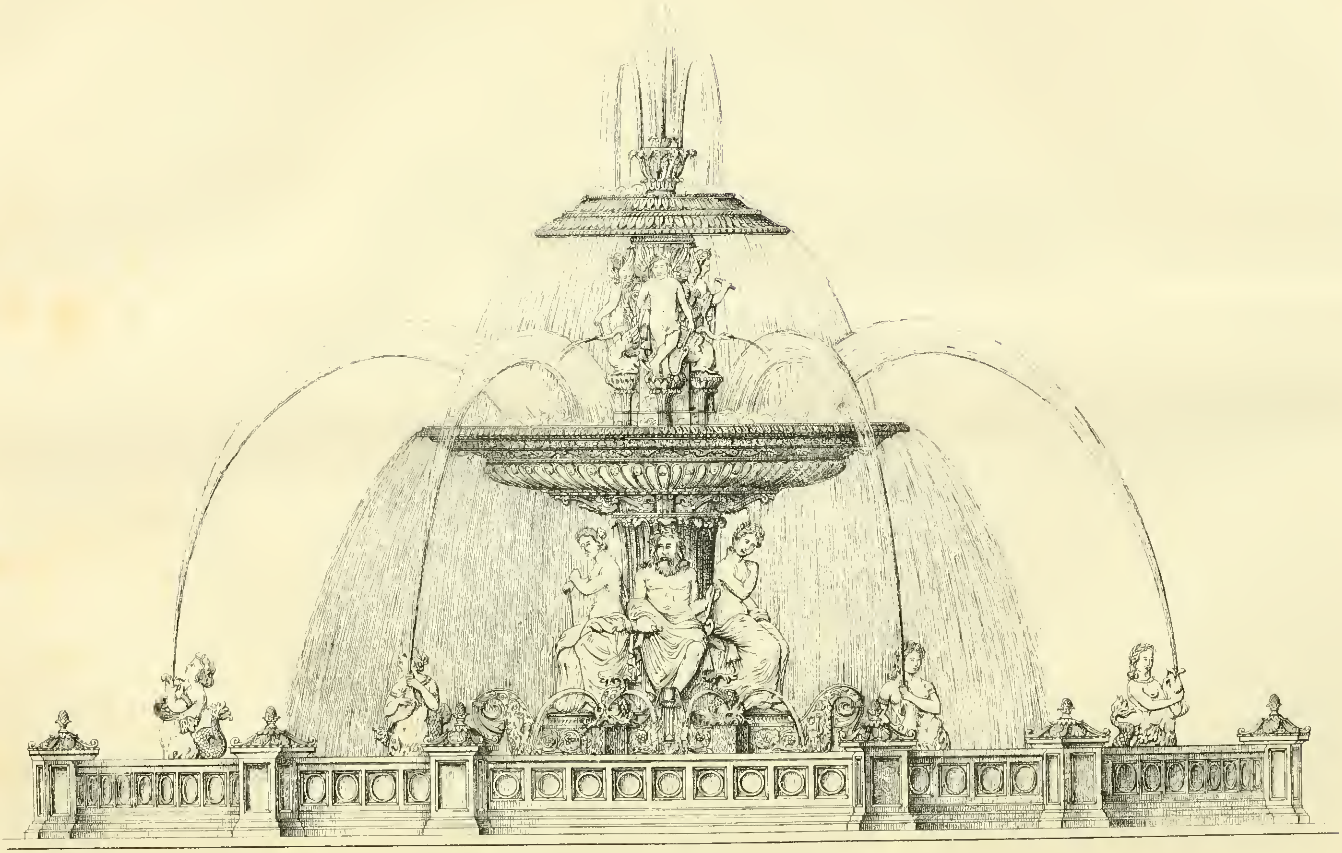
NOTICES TO CORRESPONDENTS.

Inquiries respecting subjects connected with Engineering, Practical and Theoretical Science, Architecture, and Patent Laws must be addressed to the Editor by the 18th of each month, to obtain answers in the following number of this Journal.

Mathematicus.—Your difficulty in assuming $2\cos\theta = x + \frac{1}{x}$, because every numerical value of x makes $\cos\theta$ greater than 1, will vanish on considering x a quantity partly rational and partly irrational. For instance, assume $x = (1-a)^{\frac{1}{2}} - (-a)^{\frac{1}{2}}$, then since $1 = (1-a) - (-a)$, we have $\frac{1}{x} = (1-a)^{\frac{1}{2}} + (-a)^{\frac{1}{2}}$, and therefore $x + \frac{1}{x} = 2(1-a)^{\frac{1}{2}}$. This is merely one instance, but your own ingenuity will suggest many others.

E. B.—One of the best works treating on mechanics, without the use of mathematics, is that of the Society for Diffusion of Useful Knowledge. If you mean by a "popular" treatise, one by which you may learn without study, there is no such work extant: no royal road to learning has been yet discovered.

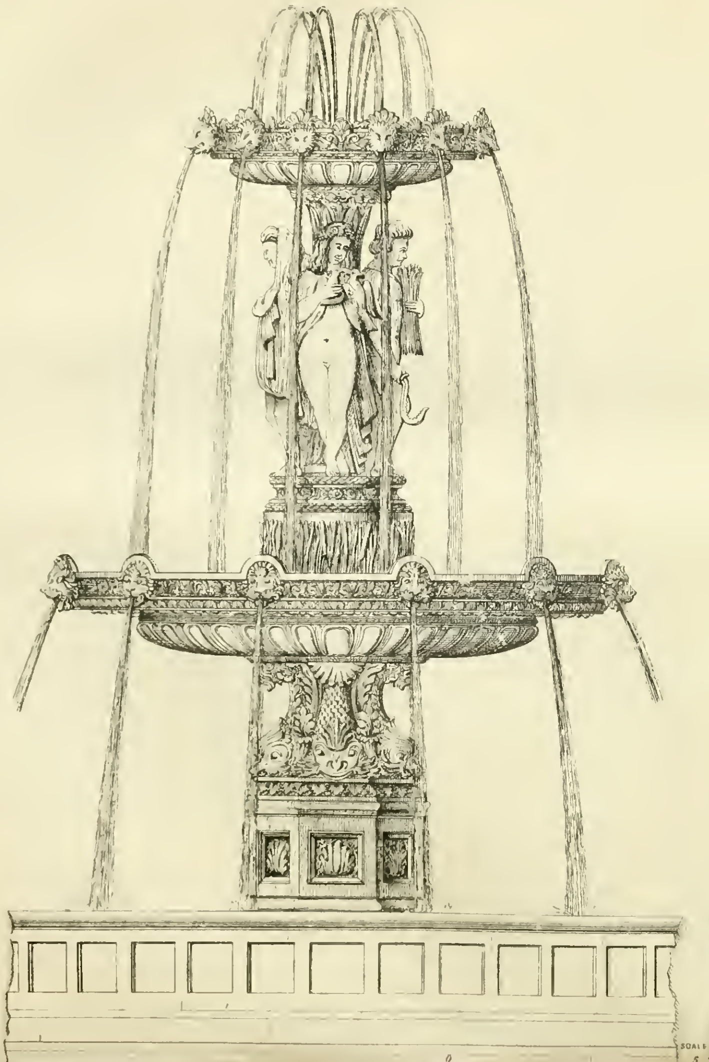
M.—By far the easiest way of calculating compound interest for a great number of years is by aid of logarithms. The method is fully detailed in books of logarithms.



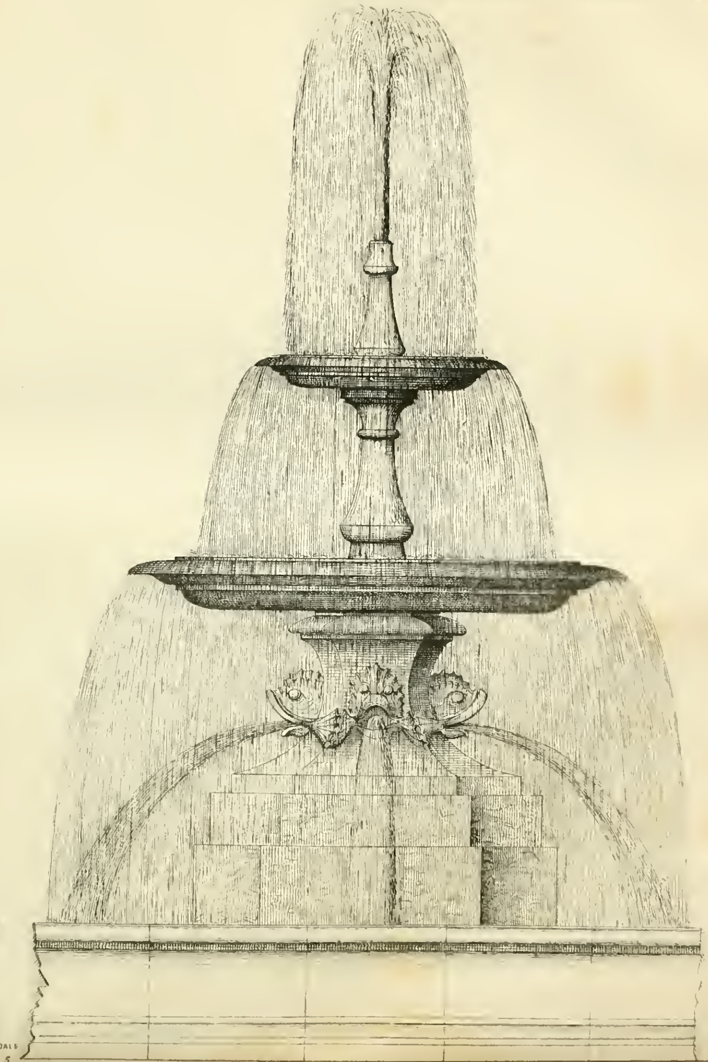
FOUNTAIN IN THE "PLACE DE LA CONCORDE"
PARIS.

12 6 0 1 2 3 4 5 6 7 8 9 10 FEET

PL. XI



FOUNTAIN 'DES SAISONS' PARIS



FOUNTAIN TRAFALGAR SQUARE LONDON

THE FOUNTAINS OF LONDON AND PARIS.

(With Engravings, Plates X. and XI.)

We present our readers with a geometrical view of one of the fountains in Trafalgar Square, and compare it with two others which are probably equally well known to them—a fountain of the *Place de la Concorde*, and the fountain *Des Saisons*, in the Champs Elysées, at Paris.

The fountains in Trafalgar Square are made of red granite highly polished, and are in themselves very beautiful specimens of workmanship; they stand in the centre of a large stone basin, on a level with the square, and consist of a granite pedestal with four heads of dolphins projecting therefrom, and supporting a tazza 10 feet diameter and another above, 5 feet diameter, in the centre of which is something like a fire-plug, from which issues the water to the height of four or five feet. The resemblance of these fountains to dumb-waiters with the tops knocked off was made the subject of a witticism at the first erection; but the resemblance is far too exact to be a matter of joke. Their intense ugliness cannot be better exposed than by the comparison in the engravings, although our artist has given to the fountain in Trafalgar Square a much ampler appearance of water than there really is, as they are now played.

For the purpose of supplying the fountains with water, and also the Government Offices and the New Houses of Parliament, two wells have been sunk at the distance of 380 feet from each other; one close to the front of the National Gallery, and the other a considerable distance in the rear: the well in front is sunk to the depth of 170 feet then a boring has been made down to the chalk, to a farther depth of 225 feet, making a total depth from the surface of 395 feet; the other well is sunk to the depth of 175 feet, and then by a boring into the chalk 125 feet more, this well was the first one completed, in which the pumps are fixed, and which was done before the water from the other well was admitted; the supply from the latter is conveyed by a tunnel of 380 ft. long, and 6 ft. diam. By this admirable arrangement the supply is drawn from two different portions of the chalk, and by the aid of the tunnel a large reservoir of water is always kept ready,* the water is pumped up by the aid of steam-engine power into two reservoirs, one, considerably the highest, is intended for the supply of the public offices, and the other for the supply of the fountains. There is now sufficient force to supply 500 gallons per minute to each fountain, 40 feet high, but the supply is only 250 gallons per minute. It has been objected to an increased play of water, that a lofty jet scatters a profuse shower of spray by the action of the wind. This defect might, however, be remedied by a proper distribution of the water. If the jets were to play from the circumference of the basin inwards the evil complained of would not exist, and the fountains would gain that effect by breadth which they cannot obtain by height. The water, after it has played through the jets, instead of being allowed to run to waste, is conveyed back by a 15 inch pipe to the engine house, and again pumped up to the reservoir, so that any quantity of water can be supplied that the engines are capable of lifting, and as the lift is of a short distance the expense of raising any additional quantity that may be required for the improvement of the fountains will be of trifling importance. We must observe that the works supplying the fountains are admirably arranged, and do credit to all parties engaged, particularly to the engineers, Messrs. Easton and Amos.

The fountains of the Place de la Concorde at Paris are two in number, and they are both of the same design, of elaborately chased bronze. The lower basin of each fountain is of stone of a circular form, 52 feet diameter, in the centre is a group of colossal seated statues representing the Ocean Deities, and above an elaborately enriched plateau, 20 feet diameter, in the middle of which a group of children and swans surround the ornamental support of a reversed tazza of 10 feet diameter, on the summit of which issue jets from a centre flower. At the circumference of the lower basin there are six full sized figures representing Tritons and Naids, holding each a fish or a shell, from which by a beautiful arrangement water is thrown inwards into the large tazza above. By this arrangement, and the addition of numerous smaller jets, a great diversity of effect is produced, giving an idea of breadth and amplitude, and a pleasing appearance of complexity, while the annoyance of a scattered shower of spray is avoided. This idea might be most successfully borrowed for the improvement of our own fountains. The effect of them, especially when viewed from a slight distance, is beautiful in the extreme. Many of our readers are aware of the beauty of the magnificent vista (certainly without rival in Europe), which, commencing at the grand Corinthian façade of the Chamber of Deputies, comprises, in a perfectly straight line, the bridge of Louis XVI., the two fountains and the statues of the Place de la Concorde, the obelisk of Luxor, the avenue of columns formed by the buildings of the Garde Meuble, and terminates with the incomparable Madeleine. We said that this vista was unrivalled; if it have a rival, it is in that which intersects it at right angles, and which, commencing at the centre gate of the Tuileries, contains, in a straight line, the grand avenue of the garden of the Tuileries with its innumerable statues, the obelisk of Luxor (at the intersection with the former vista), the grand avenue of the Champs Elysées, and terminates at the vast triumphal arch of the Barriere de l'Etoile. Those only who have actually seen these incomparable perspectives of fountains, statues, foliage, porticos, vases, orange trees, gilded balustrades, and marble terraces, can have even a faint idea of its gorgeous beauty, or feel adequately the humiliating comparison which our own specimens of pigmy art present.

Paris abounds in fountains; they profusely decorate every quarter, almost every main street of the city. Besides the fountains of which we have given representations, the *Fontaine de Grenelle*, the *Fontaine des Innocents*, the *Chateau d'Eau*, and nearly *sixty* others, attest the estimation in which these beautiful objects are held by the Parisians. They are almost all of them large and elaborately ornamented. In London, on the contrary, there are only about three or four, and all of them of the most puny dimensions. Indeed, except the small jet in the Temple Gardens, and that in St. James's Park, and the fountains of Trafalgar Square, we do not remember any others in this metropolis.

We had hoped to have given a view of the immense "Emperor" fountain at Chatsworth, but are afraid it will be too late to do so this month. This fountain, by far the highest in the world, consists of a simple vertical jet rising from the surface of a lake to the height of 267 feet! The reservoir is a natural lake on a hill, and is elevated 381 feet. When this reservoir is full the fountain is expected to play to the height of 280 feet! The next highest fountain in the world was that of Wilhelm's-hœhe, in Hesse Cassel, playing 190 feet; it is now out of order. A fountain at St. Cloud plays 160 feet. The height of the towers of Westminster Abbey is 225 feet.

We fain would hope we have drawn comparisons sufficient to induce the Commissioners at once to apply to the Parliament now sitting for an additional grant to make the Fountains worthy of the Nation, or at once to remove them from the sight of our Continental neighbours who may visit the metropolis. As long as they remain in their present state they will be the derision of every observer.

We wish to say a very few words on the general design of the Nelson Memorial, of which these fountains form a part. We think that the share Mr. Barry has had in the design is one of the least happy of his efforts. In the first place, the erection of an enormous column to support a statue, or rather to put it out of sight, is a gross architectural solecism, of which the only existing examples have been erected in degraded periods of art. It is an unnatural—a foolish idea: this we affirm unhesitatingly, despite the authorities against us. A column is the support of the roof of a building—that is its purpose, its SOLE IDEA. It was never intended to be degraded into a mere window-moulding—nor to be exalted into a unity by constituting of itself an edifice. The first method of employing a column is as much below, as the second is above, the real standard of its dignity.

Architectural beauty—again and again we have to reiterate the obvious maxim—*can never be dissociated from architectural use*. Alas! how forcibly are we told of the gross debasement of modern architecture, when even such men as Mr. Barry have to be reminded of truths so painfully obvious!

Then again—the ample space devoted to the Memorial in Trafalgar Square, instead of being displayed boldly and effectively in all its extent, has been frittered away in small compartments distinct from each other. Beginning on the side next the National Gallery, we have a broad terrace parallel to the public pavement, but to prevent all idea of continuity and perspective, separated from it by a row of ugly granite posts. On the other side of this terrace we have a stone fence to obstruct the view of the lower area. The same posts and the same division into compartments recur on the side next Charing Cross—so that the space actually left for the monument is reduced to as small limits as ingenuity could easily devise. Then the grateful effect on a sunny day of the dazzling glare of sunshine reflected from a flat unvaried surface of stone pavement!——

But it is idle to pursue the subject further. The mischief has been done; the abortion has been brought into existance; an enduring type of deformity has now been bequeathed by us to our posterity—and future critics will wrangle and dispute whether the designer of the architecture of the area of Trafalgar Square *could* have been the architect of the palace at Westminster.

"Lysides, a young Athenian, has just returned to us from a voyage

* The wells and tunnel, when at rest, hold about 122,000 gallons of water, and after pumping 300 gallons per minute for 30 hours successively it only lowered the water 50 feet, and then left a reserve of 91,000 gallons.

in Thrace. . . But Lysides will appear to you to have assumed a little more than the privileges of a traveller, in relating that the people have so imperfect a sense of religion as to bury the dead in the temples of the Gods, and the priests so avaricious and shameless as to claim money for the permission of this impiety. . . He told us furthermore of a conqueror to whom a column has been erected, sixty cubits high, supporting his effigy in marble! Imagine the general of an army standing upon a column of sixty cubits to show himself! A crane might do it after a victory over a pigmy; or it might aptly represent the virtues of a rope-dancer, exhibiting how little he was subject to dizziness. I will write no more about it, for I begin to think that some pretty Thracian has given poor Lysides a love potion, and that it has affected his brain a little. . . .

"The mistake is really ludicrous. The column, you must have perceived at once, was erected not to display the victor but the *vanquished*. A blunder very easy for an idle traveller to commit. Few of the Thracians, I conceive, even in the interior, are so utterly ignorant of Grecian arts as to raise a statue at such a height above the ground, that the vision shall not comprehend all the features easily, and the spectator see and contemplate the object of his admiration as nearly, and in the same position, as he was used to do in the Agora." —*Pericles and Aspasia.*

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXIV.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. Among all those who have extolled St. Stephen's Walbrook, not one has adverted to a circumstance which is certainly not a little in its favour, although passed over as if it were either quite a matter of course, or else nowise affected the building. Nevertheless it is one which constitutes a marked difference between that and Wren's other churches, or, indeed, nearly all other churches here. And now, having said this I ought to leave people to find out what it is, which any one who has been in the building, or has seen a view of the interior ought to be able to do instantly. It would be but a poor compliment to their sagacity to attempt to help them out any farther in discovering what is at once so obvious and so simple; still, lest I set their wits rambling quite wide of the mark, I must, I suppose, say in plain terms what is the circumstance I allude to; therefore, all that it is, is that the church is not blocked up with galleries,—wherefore it is strikingly distinguished from others of the same period. While this has been overlooked, the merit of the plan has, on the contrary, been overrated, since the latter is marked rather by irregularity than by symmetry of arrangement, it forming neither a Greek cross nor a Latin one, nor a simple square with the columns supporting the dome inscribed within it equidistantly from every side. That exact regularity, which the architect appears to have aimed at as his leading idea, is just missed; the dome is neither over the centre of the plan nor over a distinctly pronounced division of it, the portion at the west end —if end it may be called—being much too short for the character of nave. Moreover, instead of being regulated by the intercolumniation of the order, whereby the space between the columns and walls on the north and south sides would have been the same as at the east end, those parts are not above half the width, which occasions not only a want of correspondence between them and the rest, but also a crowded appearance. The want of pilasters against those walls, to receive the ends of the entablatures extending from the columns, is, if not a positive defect in itself, a serious deficiency as regards consistency of decoration. Even the effect of the dome is greatly impaired in comparison with what it would have been, if instead of the present small lantern there had been a glazed aperture of such diameter as to afford sufficient light to the whole of the space beneath, if not the whole church. In that case another good effect would have resulted, because all the windows, except perhaps those of the clerestory or over the entablature, might have been dispensed with,—and they are so very far from being ornamental as to be absolute blemishes,—so ordinary and vulgar-looking as to be in utter contradiction with classicality of style. Those apertures, moreover, exhibit no fewer than five different shapes and sizes, including a series of oval holes fit only for a stable or rooms in a garret.—However, I do not wish to put folk in a passion: those who think that I have most unwarrantably slandered this masterpiece of architecture, may take their revenge by proving that what I have pointed out as defects are only so many beauties. Were they to do that they might enlighten many others besides myself, for I have never yet met with any one who did not confess *sub rosâ* that he thought St. Stephen's Wallbronk had been praised greatly beyond its deserts.

II. The writer of the article on Ecclesiastical Architecture in the last number of the Quarterly Review, might have expressed his opinion of the church of La Madeleine at Paris somewhat more in the tone of criticism than by applying to it the merely abusive and not very precise term of "a monstrosity,"—the very one almost of all others with which it cannot be reproached *architecturally*, since so far from being a monstrosity as a building, it is singularly correct and classical, nothing either more nor less than a direct transfer or *cast* from an antique Corinthian peristylos, nearly free from any modern alloy. Of course the interior does not profess to be strictly in the same manner, because for that there was no direct precedent to be followed, and it was necessary to accommodate it to the express purpose of the building, but the difference does not amount to any positive incongruity or "inconsequence" of style, it being no more than what amounts to a natural and almost necessary distinction between internal and external character and design. Some credit besides is due to the manner in which all internal accommodation has been secured, without any sacrifice of external beauty or unity of expression. That the exterior is a truly beautiful object must be admitted, unless all received theories and opinions are now to be upset and reversed; since it fully realizes, upon an imposing scale and in a worthy shape, the ideal of Greek architectural beauty. Yet although on the score of beauty it may be perfectly safe from reproach, it is open to the allegation of being false in expression—avowedly putting on and even ostentatiously parading the semblance of a pagan temple. Either then ought we to abandon the idea of adopting in its purity what has ever been considered the perfection of that style—the temple form of the Greeks, or we must apply it to places of religious worship. To object to such particular form for the mass of the structure, and also to the style, as partaking of paganism, is sheer prudery: columns, entablatures, pediments are indifferently at the service of all religions and all sects. Almost as well might we call stone and marble pagan materials, and restrict ourselves to the use of brick and timber alone for churches. Besides, of all false creeds and doctrines there is the very least danger from paganism. So utterly is the paganism of the Greeks extinct, that what in the early Christians was a natural abhorrence as of a foe to be resisted and overcome, would now be imbecile dread of an enemy after he had actually been slain. A convincing proof how little abhorrence the early Christians felt respecting pagan architecture is, that the earliest types of Christian architecture were essentially pagan in their origin.

III. If it be merely the misapplication of style and unsuitableness of character that the Quarterly Reviewer condemns in the Madeleine, he ought to have qualified his censure by explaining himself to that effect. Considered merely æsthetically, without reference to purpose, the structure cannot possibly be called a "monstrosity,"—certainly not without stigmatizing by the same injurious epithet a great number of others which have hitherto been marked for admiration, although infinitely more hybrid in their composition, and more medley and motley in the taste they display. With far greater propriety of language might the Reviewer have characterized by such epithet very many of the basilicas and other ancient ecclesiastical edifices, of which his paper gives us an interesting historical muster. Of course neither historical nor archæological interest—which frequently gives such value and importance to things intrinsically devoid of beauty—attaches at present to the Madeleine, yet that is no reason for passing summary and unqualified condemnation upon it. A critic interested in the subject might at least have pointed out, for our instruction,—had it been only in a foot-note—what constitutes the monstrosity complained of, and in what respect the building is at variance with the purpose for which it was erected, and deficient in that expression which a Roman Catholic church *of the nineteenth century*, should possess. Neither would it have been amiss had he let us known whether he be better satisfied with those other modern churches which have been lately erected in professed imitation of the ancient basilica plan, viz., Notre Dame de Lorette, and St. Vincent de Paul at Paris, and the so-called Basilica at Munich. It would have been worth while for him to have dwelt even somewhat at length on those modern instances, (giving at the same time explanatory plans of them—only three in addition to the illustrations of the kind which enrich the article in the Quarterly), in order to satisfy us whether the adoption of such type have been attended with decided improvement upon the former system of modern continental church-architecture, and if so, whether the improvement has been carried to the fullest extent.

IV. Not the Madeleine alone, but the Walhalla and Canova's Greco-Roman church at Possagno, must, it may now be presumed, be set down as "monstrosities," true as they are to the æsthetic spirit at least of the pure antique. The Bavarian like the Parisian edifice may incur the reproach of not being perfectly homogeneous, inasmuch as the strict temple form and character are kept up only for the exterior, which accordingly does not indicate beforehand the style and embellishments of the interior, which is a splendid hall, instead of a mere *cella*, without other light than what is admitted from the entrance door, or else obtained by a considerable part of the plan being left unroofed. At any rate, however, the inconsistency, if such it be, is on the right side; it is not of a kind to cause disappointment by the most disaggreeable disparity between exterior and interior which takes place, when the latter falls altogether short of the promise made by the former. Or if nothing less than thorough consistency both within and without will satisfy us, what are we to say to the Temple Church, whose interior embellishments—quite as much of "boudoir" character, by-the-by, as those of the Madeleine, although in a very different fashion,—do not *at all* harmonize with the severe and somewhat sullen aspect of the outside?

HARBOURS OF REFUGE.

The following observations on the Report of the Commissioners appointed by Her Majesty to survey and examine a part of our coast, for the purpose of determining alterations suitable for Harbours of Refuge, will be acceptable at a time when public attention is strongly directed to the important subject.

It has been suggested that an inquiry should be made as to qualifications of certain of the honourable gentlemen who comprised that commission; by this means it would be ascertained that some of them had not any experience in the matter confided to them, and those who had, in some important instances failed in their attempts to accomplish the object sought.

It is quite obvious, and now admitted by many scientific and intelligent men, that a knowledge of the construction and improvement of harbours, (I confine the remarks to bars, &c., at the entrance to harbours: as the interior parts offer comparatively little difficulty) cannot be obtained but by practice, hence the repeated failures in theoretical science as applicable to this subject; hence the cause of our unprotected coasts remaining unprovided with safety harbours. The Downs, Dover and Dungeness harbours offer incontrovertible proof of these facts, and of the want of correct information on the part of those who have had the management of harbours. The parts of the coast here alluded to have a prior claim to the establishment of refuge harbours, and on the east coast Orfordness, Lowestoft and Yarmouth call for the immediate attention of the legislature.

It has also been stated by a recent writer, "that many hundreds of thousands of pounds have been expended on Dover harbour in *fruitless* attempts to keep its entrance free from bar." On the importance of a good harbour as Dover, especially in time of war, Sir Walter Raleigh wrote to Queen Elizabeth in 1590, at which period, according to the records of that ancient town, there was a greater depth of water at the entrance of the harbour than there is at present. In the report of Her Majesty's Commission of 1840, (and shortly after an expenditure of about £40,000,) it was stated, that "the harbour has been considered inaccessible at times for several weeks together. It should be observed, that the sluices, although efficacious to a certain extent, (we have no proof of this,) are not capable of removing the obstruction altogether, the force of the water which at its exit from the culverts is great, (so it was at Lowestoft, and yet that scheme was a failure,) loses its impetus as it spreads over a large surface, and forces the shingle to a *small distance* where it forms a bank:" certainly it does, and so it does the same at Bow creek in the Thames, and at the disemboguing point of all harbours, rivers, or creeks throughout the world where soil is held in suspension by the water, and therefore all expenditure to increase or produce a scouring power is *useless* and injurious.

More than 20 years prior to the sentence being placed on record by the commissioners, I had satisfactorily developed this important fact to many intelligent men, and it has been known to those who have continued to pursue the path of error. If candour had led to the admission of the common fallacy, and the adoption of that course which will eventually prevail, this would have prevented the loss of many valuable ships and cargoes, many *hundreds of human lives*, and all the miseries entailed on the numerous families consequently left destitute.

I have been favoured with a copy of the Commissioners' Report, dated August 7, 1844, and accord with the opinion of Sir W. Symonds "that the mass of evidence was in favour of Dungeness;" for that place I gave a plan for a Harbour of Refuge, and endeavoured in my evidence to sustain the eligibility of the site and plan. This plan does not appear in the Report.

I do hope that the Government will pause ere they commence such a work as is proposed for environing Dover Bay. The building out a pier from Cheeseman's Head will arrest the ebb tide in its western progress, and cause that part of the bay to fill up rapidly, and it will injure in the same ratio the entrance to the present harbour so essential for the welfare of the town. In a short time after the proposed western part of the pier shall be extended into deep water, the beach eastward of the present piers may be expected to be drawn into the sea, and place the buildings thereon in imminent danger.

The Commissioners also recommend improvement at the entrance to Harwich Harbour. I cannot understand how this is to be effected; the cause of the loss of the only good entrance into this, one of the finest harbours in the world, is not understood; the channel referred to, which was between Languard Fort and the Alter, was filled up by a similar cause to that by which many ancient harbours have been.

With much respect for the intelligence of the Harbour Commissioners, I am of an opinion that they should have been assisted in the investigation by some merchantmen long accustomed to harbours, in justice to the great problem, and of the honour of science, and the real question "What are the only means or plan that will accomplish the long sought for object, viz., the forming an eligible and adequate Harbour of Refuge, free of ingress and egress at all times, and under all circumstances of wind and weather." (?) The answer is only to be obtained by a committee of the House of Commons, where the subject would be impartially investigated: and in place of interested parties sitting as judges on their own procedure, they should be required to account for the enormous sums that have been *fruitlessly* expended. Those who sit on such an enquiry have an opportunity of obtaining a knowledge of that which has caused others a long, arduous, and expensive attention.

I will conclude by stating that the plan now proposed relative to Dover, a harbour with a double entrance without an artificial scouring power, was, in the principle and plan, a suggestion of my own.

Henry Barrett.

REMEDY FOR FRAUDULENT COMPETITIONS.

Were they reckoned up, the number of Competition designs and drawings that have been made for Churches and Chapels alone, during the last ten years, would be quite startling. Taking them as an average computation—and it is but a very moderate one—for that period, twenty competitions per annum, with twenty-five sets of six drawings sent in to each, amount to no fewer than *Thirty-thousand* drawings only for buildings of that class. Profitable work for—the manufacturers of drawing paper, and capital exercise for architects! One is really puzzled to know what becomes of such a vast number of drawings, for they cannot, like old picture-canvasses, be made to serve for fresh subjects.

The tax to which architects are thus subjected, is a most onerous one, and quite peculiar to their profession. It is true, it is incurred voluntarily,—if that can be said to be voluntary which, though they feel it to be oppressive, men submit to out of sheer necessity, and because they have no other alternative than that of submitting to it, or foregoing the chances of obtaining practice. Formerly competitions were of rare occurrence, and were to be regarded as exceptions to the usual course of practice, but they have now grown up into a system which the profession cannot either direct, or resist, but in which all must join save the few who have sufficient private practice to enable them to relinquish the toils and struggles of competition to others less fortunate than themselves. According to the actual system and extent of competition, it is not merely the casual interests of a few individuals that are concerned, but those of an entire profession; and so loudly do the abuses and malpractices which are perpetually complained of, call for correction, that if it be found that the profession are really unable to help themselves, it becomes a question whether they ought not to apply to the legislature for some protective enactments against fraudulent competitions. Among other measures, it might perhaps operate as a wholesome check, were it made imperative that in every competition by public advertisement, the names of all the committee should be given either in the advertisement itself or in the programme of instructions furnished to the architects; and that the whole of the competitors should be entitled to demand an inspection of the chosen design.

If building-committees chuse to appoint their own architects, or even to apply privately to two or three individuals to send them in designs, the case is altogether different; but surely they have no right—none at least morally—to call publicly upon a whole profession for the aid of their talents and labours, without affording very strong guarantee for their own sincerity, and good faith. In Public Competitions by public advertisement, publicity ought to be preserved throughout the whole business, and NO SECRESY AS TO THE PROCEEDINGS OUGHT ON ANY ACCOUNT TO BE ALLOWED. It is not to be expected that Committees themselves—of however "honourable" and "respectable" persons they may be composed, will of their own accord yield up the conveniently arbitrary and irresponsible authority they now exercise; therefore it ought not to be left to their own option, their discretion, or their generosity, whether they will fulfil or evade their impliedly pledged engagements with the competitors. Unless the rank abuses and evils complained of be greatly exaggerated, it is high time that they should be put a stop to, and if no other adequate remedy can be found, they ought to be brought under the cognizance of parliament. Government thought fit to interfere in Art-Unions, let it now turn its attention to Architectural Competitions, for, as at present managed, the latter are no better than *lotteries*—perhaps not even so fair and honest,—not so much matter of mere chance as of intrigue, and chicanery. So if nothing else will do, if no other remedial course can be devised, let the omnipotence of an Act of Parliament be resorted to as the *ultima ratio* of the profession with Competition Committees.

COMPETITION.

Sir—How much more, architects will patiently endure before they attempt to bring to their senses those who advertise for Competition drawings, I am quite unable to guess. Could the secret history of Competition be fairly exposed, it would bring to light many cases of thorough-paced rascality, and double dealing; but even letting alone all the vile and ugly matters which are carefully kept out of sight behind the curtain, there is frequently a prodigious deal of stolidity and impudence also on the very surface of some Competitions. Conceive the sum of Five Guineas—aye, actually *Five Guineas!* being lately offered for a set of drawings and specifications, including survey of ground and drainage, that noble sum—which would be hardly five shillings per day for his labour to the *fortunate* architect, being intended as remuneration in full for the drawings, which are to become the property of the Committee, and be handed over by them to any one whom they may think fit to employ on the job! Perhaps next the odd Five Shillings will be considered—remuneration.

Such offers are truly disgraceful to those who make them; and not only that, but they tend in some degree to throw discredit upon the Profession itself, as being filled with needy drudges to whom they are a temptation.

If the matter be such a trifling and paltry job that more cannot be afforded, then to make a Competition of it, and advertise it accordingly is truly farcical, although no joke to those who find out on inquiry what sort of a chance they have the precious opportunity of striving for. If often most insultingly niggardly towards Competitors, Committees are full as often or oftener most stupidly blind to their own interest, otherwise they would not act so preposterously as to allow the absurdly limited time they generally do for preparing designs, since how can they expect to obtain any thing that is the result of actual study on the particular subject,—any thing better than the first hurried and random ideas that occur,—if no time for study or mature consideration be granted? Consequently they in a manner defeat their own purpose—at least their pretended one—for where there is such excessive hurry without the slightest occasion for it, it may shrewdly be suspected that the Competition is mere moonshine and make-believe, the real business being all the while snugly settled beforehand by the two or three in the secret, and that it matters little what sort of hurried things the other designs are that are sent in.

Where no pains are taken to avoid the most suspicious appearances, the most sinister suspicions are both natural and justifiable. Yet Committees do not seem at all disposed to act so as to put themselves quite beyond the reach of suspicion. It may be that they are satisfied with the proud consciousness of their own integrity, yet it would be as well to make that integrity a little more evident, for then other people might be satisfied also. One thing, however, seems certain—that whether all honest men or not, whether all intelligent persons or noodles, Committees are invariably *unanimous* in their decisions, for were not such the case they would no doubt have the honesty to declare by what sort of majority the approved design was chosen. It surely makes a material difference whether that majority be merely the *minimum* of one—a single vote more,—or be half a score.

Even Professional Umpires are not to be trusted to too implicitly; whenever one is called in, there ought to be some check upon him: accordingly in every such instance the designs ought to be publicly exhibited before he be allowed to pronounce his decision, and when he does so, that decision ought to be fully stated in writing, duly specifying the particular merits which induced him to award it his preference. He who would shrink from giving such explanation is unfit for the office, however well qualified he may be in other respects; for though the evasion may look like delicacy, it is surely the refinement of impudence to say—though not in words—"I am *infallible*, be content therefore with my wholesome opinion, but as to my reasons for it, allow me to keep them to myself."

I remain, &c.

Argus.

HOPE'S ARCHITECTURE AND ARCHITECTURAL DESCRIPTION.

Sir—Those who pretend to describe buildings are apt to be exceedingly vague and careless in their language, as if they took it for granted that what is well understood by themselves must be clearly intelligible to every one else, no matter how indistinctly and confusedly their account may be worded. A most glaring instance of verbal obscurity—such a one as in Vitruvius would have exercised the ingenuity of a host of commentators—occurs in Hope's work on Architecture. And I will quote the passage both as a literary curiosity, and also in the hope that some one of your readers will be able to interpret it for me. Speaking of the Church of St. Gereon at Cologne, he says: "The body presents a vast octagon shell and cupola, the pillars of whose internal angles are prolonged in ribs, which centering at the summit meet in one point, and lead by a high and wide flight of steps, rising opposite to the entrance, to an altar and oblong choir behind it."

How the ribs "which meet in one point" can "lead to a high and wide flight of steps," quite passes my comprehension,—indeed the whole passage seems to me no better than arrant nonsense. If there be an error of the press here it is not corrected in the list of errata—rather a formidable one, by the by, and showing some most extraordinary blunders—such as could hardly have been typographical. I was therefore anxious to ascertain if the passage above quoted had been altered in the Second Edition of the book, but no,—there it stands the same, in its original obscurity. Probably the Editor could make nothing of it, and so thought it as well to let it go without attempting to make sense of it. Or perhaps, there was no editor at all employed, great as was the occasion for one, if not to enlarge the text, to supply in notes much wanted information relative to very many edifices which Hope himself merely registered in a dry catalogue of them. Should there now ever be another edition of it, the work might be materially improved not only by such additions in the form of notes, but by reference to various graphic publications which illustrate many of the edifices referred to by Hope; for instance Villa Amil's "Espana Artistica," and Mr. Gally Knight's two most interesting series of architectural illustrations of Sicily and Italy.—One thing which renders Hope's book far less satisfactory than it might have been, is that there is no scale to any of the buildings shown in the plates—a strange omission, and one that does not say much for the care bestowed in the getting up of the work. In fact, the plates do not seem to have been finished or finally prepared for publication, there being no figures or letters of reference to any of the ground plans, one of which is besides very strangely represented, what is an octagonal dome over the building, instead of being expressed by dotted lines, being shaded as dark as the walls and pillars, so that it gives the idea of a separate octangular structure built up from the floor, within the larger one. I myself took such to be the case, and wondered that such a *singularity* should be neither explained nor noticed in the text, till meeting with another plan of the same building, I perceived at once what a very strange mistake had been committed, and still remains in the second edition, which probably had no revision bestowed upon it, nor received other improvement than the addition of an Index. That there was nothing of the kind to the first edition, was wholly unpardonable, since an Index might have been made by any one, and because without it the book was comparatively useless as a work of reference.

I remain, &c.

Lector.

TRANSITIONAL CHURCHES BUILT OF LATE YEARS IN AND ABOUT LONDON.

The following are extracts, in a condensed form, from a paper in the *Ecclesiologist* reviewing the architecture of those metropolitan churches which exhibit a progress in the knowledge of mediæval architecture; these churches are rather happily called "Transitional." We have taken the liberty of marking in italics some of the solecisms and inaccuracies of language which appear in the original notice. This we have done, not in an invidious spirit—for the architectural criticisms we for the most part highly approve of—but because it seems intolerable that a work having the academical character which the *Ecclesiologist* possesses should be disgraced (as by the by are most of the writings in any degree attributable to the Cambridge Camden Society), by constant violations of the rules of English grammar.

"*St. Paul's, Knightsbridge*, is a most commendable instance of liberality on the part of its incumbent, which, had *it* been met as it should have been, *standing* as *it* does in perhaps as opulent a region as the wide world contains, by similar munificence from others, and by adequate experience on the part of those to whom the constructional part appertained, might have been a fair and admirable monument of the Christian zeal of the Nobles of the greatest empire of modern days. And yet it would be wrong to deny that it is a very great thing for the fashionable inhabitants of Belgrave Square to have a church of the degree of goodness which thus has attained, to resort to, and to have so many opportunities of so doing. And there certainly is something striking in the view of the interior of this building, when we remember what London congregations are for the most part condemned to. To consider this church more systematically, one cannot but at once perceive that the nave and chancel are totally disconnected, though both assuming to be 'Third Pointed,' that the latter is most obviously an after-thought appended to what for its own sake was totally undeserving of such an addition, and of *whose* demerits the worthy priest who has made the church what it is is totally guiltless. As no one, we trust, will think of imitating or of admiring the nave, a vast be-galleried hall, we pass it over *sicco pede*. The chancel we need hardly say is wanting in depth, though of praiseworthy height (to the exposure of the dimensions of the nave), and it differs from ancient chancels in the absence of any side light to relieve the east window.—The service is not performed in the chancel, but in a sort of long narrow peninsula projecting from it into the nave, [*and*] containing the prayer-desk and the lettern, the former *looking* south and the latter west, beneath and opposite which are seats for the choir, a crowded and unchurch-like arrangement; and on the south side stands the pulpit, of carved oak.—The east window of the church is to be entirely filled with stained glass representing Scriptural pieces in many small compartments, and arranged in a chronological order; among which, from the drawing of it as it will be when completed, now hanging up in the vestibule of the church, we perceive the Crucifixion occupying a most obscure corner. The men of old would never have done such a thing. The remainder of this window, and those in the nave, are glazed with a sort of opaque golden coloured glass, which is at least an improvement upon the old ground glass heretofore employed in modern churches. The material of the church is white brick. To conclude, St. Paul's, Knightsbridge, is a remarkable and gratifying 'fact,' but at the same time quite unserviceable in all respects as a model for future church builders.

Christ Church, Broadway, in Westminster.—A modern church rebuilt on the site of a former chapel, consisting of an apse, nave, aisles, and north-west tower, of the First Pointed style. The arrangement of the west front is very faulty, consisting of an Early Middle Pointed window, of three lights, surmounted by a First Pointed triplet. The roof however is of a good pitch; the church is lofty, measuring sixty-eight feet to the summit of the cross, and open internally to the top, and the material is stone,—all gratifying things to tell. Entering, as perforce we must, at the west end, the nave piers first attract our attention, from being of cast-iron, almost of the bulk of stone, raised on blocks, so as to show their pedestals above the seats; more we need not say about them; as a set-off however the seats are not only all open, but alike in construction, ornament, and comfort, for rich and poor,—a very gratifying proof of Christian feeling, and one as yet but little regarded elsewhere in our 'Transitional' churches, *e. g.* the area of St. Paul's, Knightsbridge, is apportioned between long pews and open sittings, and as we shall see, St. Gile's, Camberwell, has two classes of open sittings. The galleries have open iron fronts, to make them lighter,—an experiment which we think has totally failed; and to accommodate them, liberties of an unjustifiable nature have been taken with the aisle windows; those at the side (couplets very broad, and to describe them by an expressive bull, splayed at right angles to the wall) being depressed below the level of the galleries; and to diminish still more their height, their heads, which are externally marked by a blank trefoil, being internally left perfectly bare, and the single lancets at the east end of the aisles being pushed up so as to enlighten the aerial portion of the congregation. It is really intolerable to see an architect spoil his church for ever to accommodate these intruding eye-sores; better let the galleries span windows which may some day be emancipated, than leave the indelible brand of disgrace upon them even should the cause of it be ever removed. The prayer-desk and lettern are in the nave, on the south side, with the pulpit (unpretending by the way, and therefore not bad, though standing disjointedly, when it should have been attached to a pier) facing them. The church terminates in an apse, an arrangement, we need not repeat it, unauthorized in an English parish church, but one which in this instance was adopted in consequence of the church being rebuilt in an old burial ground, and considerable jealousy existing even about the encroachment which the apse made upon it. The apse being assumed, we must allow great credit for the prominence given to the altar, a most redeeming point. Approached by a flight of several steps, it forms the crowning point of the church, and by its height is defended from painful proximity which, when a good chancel and a protecting screen cannot be attained, is the thing which should be aimed at. (In this respect St. Paul's, Knightsbridge, is deficient: there is no screen, and yet the altar is non-apparent.) The altar itself is remarkable for the richness of its embroidered ante-pendium, a good attempt, but reprehensible in that the central monogram is worked in black, an unheard-of colour for such an object. The apse is enriched with decorative colour, chiefly by Mr. Willement, and one window glows with his painted glass. We understand more will very soon be added as a further instalment. The mural cross is of praiseworthy dimensions. The seats in the chancel are of the same nondescript character as those which we found fault with in Christ Church, Albany Street. On the whole we think that this church displays more Catholic feeling on the part of its than any projector other new parish church in London.

College of St. Mark, at Chelsea, for the training of schoolmasters. The college chapel is one of the most complete instances we have yet observed of considerable ecclesiastical feeling in the original conception, unaccompanied by sufficient ecclesiological knowledge on the part either of originators or of architect to give that feeling a satisfactory development, and as it were translate it into grammatical language. After this general character, it would be unkind to the excellent proposers of St. Mark's college to enter very deeply into an architectural examination of the building. Something however most be said. The style adopted is Romanesque. The plan of the chapel is cruciform, consisting of a nave and transepts, without aisles, and an apsidal chancel, with an aisle running all round it, the apse being circular. One great and obvious defect is that the breadth of the chancel (which is raised) together with its north and south aisles, is precisely that of the unbroken nave, thus showing the stilted butt-ends of aisles to the nave in a way nowhere, we might almost venture to assert, seen in an ancient church; a ludicrous turning to account of this bad arrangement shall soon be told. The chancel is, we said, raised, and no one can be other than pleased with the dignity given to the Holy Altar, which is indeed the redeeming point of the internal arrangement. Altogether the chancel fails from over-ambition; neither in height, breadth, nor length does it come up to what the chancel of a small parish church should be, and yet this tiny space contains all the features of the eastern limb of a vast cathedral; it has its apse, its encircling aisle, its triforium, its clerestory, and its vaulted roof. All these of course are on a microscopic scale, and the altar-chairs and pulpit, being perforce of the natural size, make a rather ridiculous contrast; the two former well nigh fill up the apse, and the latter is fitted into the butt end of the northern aisle. The windows however of the chancel are nearly all filled with stained glass, and this, combined with the gloominess of the day, gave, we must honestly confess, a solemn appearance to the chancel the last time we visited the chapel, not but that it was then that we realised to the full the mistakes of this arrangement. At the extreme west end of the chapel, to the right and left of the door, stalls are placed, showing by their position that the designer had not clearly realised the distinction between nave and chancel. Indeed the whole building manifests a confusion between those two very dissimilar structures, a college chapel and a parish church. It is true that St. Mark's fulfils the double purpose; but would it not have been better to have given each object its legitimate development, than to have attempted an impossible union of *their* distinctive features? The nave might well have been reserved for the laity, and the members of the college have been provided with a spacious and correctly-arranged choir, from which, day after day would have ascended with increased beauty that solemn service which so honourably distinguishes the college of St. Mark.

"*St. Giles', Camberwell*, a large cross church, with aisles, north and south porches, central spire, and well developed chancel, of the Middle Pointed style. The altar is of stone, and of the correct shape of a table standing upon legs; unhappily however, instead of the rich canopied sedilia we might have looked for, it is flanked with altar-chairs. The reredos, which is of stone, is over heavy. The risers of the altar are panelled with porcelain. The east window is as yet but partially filled with stained glass. The chancel, which is paved with encaustic tiles (with which however we were not quite satisfied,) has stall-like benches for the choristers (and a *quasi* episcopal throne for the incumbent); *these choirters?* are failures, being of heavy workmanship, and unreal, inasmuch as they have a range of canopies over an unbroken bench. The rood-screen is lacking here, as in every other modern London church. The organ is placed in the north transept, greatly choking it up. The end windows of the south transept, and of the nave are filled with stained glass. The pulpit stands against the north-west pier of the lantern, and is not too high. It is of wood, panelled with porcelain, enamelled with sacred effigies on a gold ground. This is a very good idea, and one perfectly legitimate, although modern; porcelain indeed is a species of enamel painting. In this case, however, the conception has surpassed the execution. The prayer and lesson-desks, which are opposite the pulpit, are not satisfactory. The piers of the nave, which are alternately circular and octagonal, stand upon blocks, to raise them above the seats, and the seats, though all open, are very unsatisfactory, from adopting the invidious distinction of having two side rows of 'quality' sittings, and a very broad open area between, filled up with inferior seats for the Church's especial and dearest charge, the poor. The genteel seats have stall-ends, carved by Mr. Pratt's newly invented machine. We do not like them; they are heavy and tame. The roofs are open, and of a good pitch. The font is incorrectly placed, being directly opposite the west door, and is of insignificant dimensions considering the size of the church, besides which it wants a canopy, and a base to stand upon. The west window is rather weak. We are a good deal amused at the galleries (for the church contains galleries), because in the first place they are the least offensive galleries we have ever seen, and in the second place because they have purchased this inoffensiveness at the expense of a great part of their practical utility, that of holding people. They nestle behind the piers of the nave, at some distance from them. The internal walls of the church are plaistered, and there is a raised platform in the south transept which might as well have been spared. Externally the roofs are of a good pitch, and the spire is lofty, so that the church has an imposing appearance, though too much that of a cathedral in miniature. The tower spire and north porch labour under an excess of ornament, the result of which in the end is only to diminish the general effect of the church. The worst fault however of the church remains to be told, that it has *got* a show side. The north side, from facing the street, is much more elaborately decorated than the opposite one; the clerestory, *e. g.*, on this side is arcaded of three, and on the other is simply pierced, and the south porch is wonderfully subdued, compared with the other. We need not say how much we disapprove of such an attempt at display. However we flatter ourselves that it has defeated its own object, and that the south side, from its greater sobriety, is in truth the more pleasing composition. After all, however, no one can help being much pleased at so noble and, considering all things, so complete an attempt at better things, raised in the same town, and during the life-time of the same generation which saw the building of St. Pancras, St. Marylebone, and All Souls.

"In the adjoining parish of Dulwich is another church, which exhibits a great struggle after the realization of ecclesiastical decency and magnificence, *which is as creditable* to its projectors *as it is lamentable to behold* how they have been in a great measure frustrated by the incompetency of their architect. We mean *St. Paul's, Herne Hill.* This church consists of a west tower and spire, nave and aisles, north porch, and chancel without aisles, of the Third Pointed style. The altar is of stone, and of the correct shape, a slab on legs; the different roofs, and the spandrils of the nave arches are all covered with enrichment; and every window in the church, including the clerestory (with one exception, which we fancy we see the reason for, and that it will be soon remedied), is filled with stained glass: and all the chancel, and part of the nave *is* (!) laid with coloured tiles; the pulpit of stone, with porcelain panels, stands at the north-east angle of the nave, and all the seats look east, and are very low. Who does not warm at this description? But unhappily in many respects the intention, not the execution is to be praised. The stained glass particularly is of a cold and unartistic character, and the side windows are heraldic, with cyphers of the benefactors of the church, which is not the most appropriate decoration for the Lord's House. The east window, *which is scriptural,* is very unsatisfactory, and the reredos is poor, and there are altar chairs as in the church of St. Giles'. The tiles and porcelain are the gift of the same munificent individual who presented similar ornaments to St. Giles'. We wish they had a more ecclesiastical character. The chancel is far too short in proportion to the nave, and the roofs are of a very low pitch. Externally the design is miserable; the roof is surmounted with a very poor battlement, broken with a row of the poorest pinnacles, such as those to be seen on the frontispiece of Mr. Pugin's Contrasts, and in plasterers' shops in the suburbs, and alternately tall and short, the latter standing without any apparent reason in the centre of each bay. The west end, and more particularly the door, are contemptible. We are really pained to have to use such language about a structure, which is clearly the fruit of much liberality.

"*Christ Church, Belton Street,* in the parish of St. Giles-in-the-Fields, consists of a nave, aisles, and very short chancel, north-west engaged tower, with stone broach, and clerestory to nave. The style is First Pointed; and at the east end is a triplet, which however, from the cramped dimensions of the site, only receives light through a wall cut in the adjoining workhouse, *whose* proximity cramps the chancel, and indeed the whole church. The reredos is arcaded, and the chancel is to be bounded by parcloses, though destitute of screen. There are galleries. All the seats however are to be open, and the roof is of a fair pitch. The piers, which are octagonal and made of blue lias, are (we observe with satisfaction,) not stilted. Externally however there are faults to be found. The west window consists of five lights, the central one raised above the others, which are of the same height. From the comparative uselessness of the east window, and the south aisle being destitute of light, it was doubtless necessary to throw as much in at the west window as needful, though at the same time we think they have made the west end unnecessarily glaring, otherwise we cannot at all approve of this arrangement at the west end of a small church, which has only a triplet for its eastern light. The west door, which is trefoiled, looks strange and overdone. The tower is too thin, and the north door, which it contains, is not well managed. The spire however, taken by itself, is of elegant proportion. The clerestory and aisle windows are rather long and bare. Great allowances must be made for the confined extent of the ground on which it was necessary to build the church, which makes it, especially as it is rather lofty, look rather humped externally. We think the architect might have derived some useful notions from foreign town churches, remarkable as they are for their height, in the treatment of this subject, without of course, vitiating the strict form of English Pointed."

SUGGESTIONS FOR FORMING A MUSEUM OF CASTS OF THE ARCHITECTURE OF ANTIQUITY AND OF THE MIDDLE AGES.

By C. H. Wilson, Esq., Director of the Government School of Design, &c.

A Paper read at the Royal Institute of British Architects, April 14, 1845. (Abridged.)

Amongst the various subjects which occupy the public mind, there is no one more interesting than that of the nature and extent of the encouragement which an enlightened government should afford to the Fine Arts. There are many points of view in which this subject may be considered; but this paper will treat only of the means to be taken to provide models of pure art.

A paper upon this subject was read by the author before the Royal Society of Arts for Scotland, on the 28th of March, 1838, and two committees were then formed, one of members of the Hon. Board of Commissioners for Manufactures, and one of members of the Royal Society of Arts, who reported in favour of the plan, and recommended it to the attention of the government of the time. Since then several similar propositions have been brought forward, and there appears to be a strong probability that some plan for carrying into effect the object proposed will be adopted.

While the English, French and Italian schools of arts are essentially imitative, the German alone exhibits that spirit of originality which is the chief cause of the influence exerted by it on taste throughout Europe. To take a striking instance of the different view which Germans take of ancient art to other nations,—the sculpture which decorates a Gothic church in Germany, whilst style is strictly adhered to, is more perfect in the forms and details as the more advanced state of the art admits of improvement: the artist does not think it necessary to copy the clumsy disproportioned forms and ugliness of immature art, as we too frequently do; and in the stained glass the Germans are surely right in exhibiting correct forms and beauty of feature, instead of slavishly imitating the distorted productions of an age which, although it inherited a good principle of design, possessed but little power of developing it. In reality, this slavish system of imitation may easily be accounted for, notwithstanding the affected jargon about symbolism, (a well drawn saint would surely be more agreeably symbolical than forms which are sometimes too apt to remind us of a very different region),—but it is often found convenient to imitate exactly, where it proves difficult to design effectively.

We see in the admiration, which these close imitations excite in some minds the influence and effect of models, especially of those with which interesting associations are connected, and is not the very existence of this taste, defective though it be, a ground of hope that it may be corrected and purified by the exhibition of higher and worthier models? There does not appear to be much difficulty in determining what models should be provided. In the first place, if we look around us in the civilized world, we cannot fail to be struck with that wonderful unanimity of opinion which gives a preference to the arts of certain periods and schools.

With casts from, or copies of these works our provincial galleries should in the first place be filled; we should not forget the influence of such models and that which the many precious monuments of ancient art (excavated from the soil with which protecting time had covered them), exercised upon the minds of the great artists of old.

Mention may now be made of the remarkable gallery of casts existing in Edinburgh, in the Academy or School of Arts and Design, conducted under the auspices of the Hon. Board of Commissioners for Manufactures. This school was established about three-quarters of a century ago, and is in all probability the first school of design of which we could boast. It existed before the opening of the Duke of Richmond's small collection to artists, in 1770, although it contained at that time a very indifferent collection of models. It comprises about 700 pieces, reckoning the portions of the Panathenaic frieze in the separate pieces. Many of the casts are unique, as the Hon. Commissioners readily embrace suggestions made by competent judges of art for the purchase of casts, and at different times specimens have been obtained direct from the Vatican and other great galleries. The collection contains specimens of the art of every important period down to the time of Thorwaldsen and Canova. At first the collection was entirely composed (or very nearly so) of statues and busts and other portions of the figure, and although avowedly established for the instruction of designers for manufactures, as the system of teaching the drawing of the figure only was followed, it became a school of fine art rather than of design as applied to manufacture.

As the purchase of casts in Italy was at all times attended with considerable expense, Mr. Andrew Wilson, who was generally applied to to procure them, suggested that, as the expense would not be much greater, the Hon. Commissioners should buy the moulds at once, and this suggestion led to the production of the paper then read before the Royal Society of Arts, and the proposal to government to form a casting establishment.

It is well known that such an establishment, (*two* such in fact), exist in Paris, one in the Louvre, and one in the Ecole des Beaux Arts,—a plentiful stock of moulds has been accumulated, and the whole of France has been for years supplied with casts at a cheap rate. The advantages to artists are evident; schools are rapidly supplied,—private dwellings are decorated with casts,—the shops of artizans are made into museums from the same source. It may be mentioned, to show the active spirit of our neighbours, that in 1836 they spent in Florence alone the sum of 14,000 dollars, equal to £3,111 or thereabouts. It may, however, be stated that notwithstanding their acuteness and care they have been enormously cheated by the Italians, many of the moulds being worthless. No one is allowed to cast at Florence but the government caster, who therefore charges a very high price, and, when employed to make moulds for the French, he took casts from them and then sent the moulds in a bad and injured state to Paris. He sold three of these casts, viz. one of the celebrated door by Ghiberti, one of the St. George of Donatello, and one of an Adonis ascribed to Michael Angelo, to the Commissioners in Scotland for the large sum of £200, a sum which proves their liberality, whilst the moulder's proceeding is a warning to us should any analogous plan be adopted. The French were able to take one cast only from the mould of the door, upon which they have formed another excellent mould, a first cast from which has munificently been presented to the Government School of Design.

It need hardly be stated that the Italians make two kinds of moulds, one, the cheapest, is chiefly of clay, and it yields one good cast, or at most two:—it is therefore quite evident that in the event of any transactions with such slippery individuals, casts of this description should be obtained and preserved in stock to make moulds from.

To return to the gallery at Edinburgh—of late years a fair collection of architectural and ornamental casts has been added, but the most remarkable and interesting purchase has unquestionably been that of the unique and noble collection of antique busts. The author of this paper suggested the formation of a collection of classic portraits, and in the course of his enquiries was informed that a very complete collection of casts, about 250 in number, existed in Rome. It had been formed during a long course of years by two sculptors, father and son; it contained casts from busts now scattered over Europe in various museums, but which had been cast previously to their sale in Rome, and of which no such collection could again be made except at a great cost. This collection was of great service to Visconti in the compilation of his celebrated "Iconographie Grecque et Romaine," and the drawings for many of the engravings were made from these casts. The purchase was suggested to Government,—an artist, now deceased, was consulted; he however did not approve of it, and the Hon. Commissioners purchased the collection for their school in Edinburgh at a cost of £500, whilst the expences of transit, commission, &c., amounted to considerably more.

From the opening of the Museum in the Hotel Cluny we derive an useful lesson; it contains, as is well known, a collection of ancient furniture, painted glass, manufactures in metals, and in fine a great variety of specimens of the arts of the middle ages. We all know the effect produced upon the minds of manufacturers and designers by the sight of these objects of vertu;—an upholsterer may have lived all his life amidst casts of fragments of fine sculpture without improving the form of a table or chair, but set before him a piece of fine old furniture, and he will at once start off in a course of improvement. This familiar fact points out the importance of forming such museums, but unless the designer be accustomed at the same time to beautiful models, and be taught to draw from them, he will copy the imperfections of his old piece of furniture and miss its beauties;—in many fine specimens of French manufacture we have striking illustrations of the advantage of education in art, and the formation of such collections as that alluded to.

It is likewise of the last importance in forming galleries of casts, that the specimens, instead of consisting of mere fragments, of the use of which in their detached state we can have but a very imperfect idea, should, whenever practicable, be casts of entire monuments.

As an example, let us imagine the immense advantages of a gallery of casts for the instruction of students of architecture, wherein, instead of a heterogenous collection of fragments and pieces of mouldings, the entire entablatures of the finest specimens of the ancient orders, with their respective capitals and bases, and portions of the shafts of the columns, are arranged in their proper positions and heights from the ground, together with numbers of important monuments, of which entire casts could be made and put up, —as one side of the pedestal of the column of Trajan, together with a section of the base; the entire of one side of the arch of Titus even, (meaning of course the antique part only,) and other monuments that might be mentioned. A series illustrating the whole history of art might be formed at no great cost; the doorways, shrines, Baldæchini, and monuments of the middle ages might be cast. Such is the collection of the Ecole des Beaux Arts, and there can be no doubt of the powerful impression which such a collection would make on the mind of the public here. It would also be invaluable to students of architecture, as they would have every opportunity of seeing the effect produced by certain combinations which they are now only acquainted with by means of prints or drawings.

It has been objected that the formation of a government or some other great public casting establishment would be the ruin of all the casters established in London; is it so in Paris? it may be *asserted safely* that there are two moulders and sellers of casts in that city to every one in London, and of the immense superiority of their casts there can be no doubt. There is no great city in Europe, perhaps, where worse casts are sold than in London, and as for architectural casts they are hardly procurable at all; we are compelled to go to Paris, where to our surprise we may purchase casts from our own monuments which we probably could not procure in London.

The best way of furnishing our towns with casts is by the formation of a great central casting, as by this means only proper moulds can be procured: no private individual could afford to procure them, and no proper choice of the objects to be cast could be otherwise secured, whilst it is also obvious that casts could not be procured at all of many precious monuments of art, except by the aid and through the all-powerful influence of the British Government. Operations in England would lead to this desirable result,—that the French would willingly provide fine casts for our moulding establishment in exchange for casts from our moulds, and an immense saving would be effected by these means.

THE EARL OF ROSSE'S GREAT TELESCOPE.

We offer our readers an account of the performance of the Rosse Telescope, which we have as far as possible condensed from a valuable and interesting memoir published in the *Times* newspaper of April 15, by Sir James South. We make no apology for the reprint, as we are anxious to have a systematic record of all that affects the advance of science, and feel also that though most of our readers may have seen the original account, this condensed form of it will perhaps invite a reperusal.

"In the *Times* of September last I had the gratification of announcing to the public that the construction of the large telescope by the Earl of Rosse was so far advanced that the instrument had actually been directed to the heavens, and that, too, with satisfactory results.

The great speculum, however, as then used, had been only approximately polished, and was inserted in the tube merely to ascertain if its focal length coincided with that which it was designed to give it.

The diameter of the large speculum is six feet, its thickness five inches and a half, its weight three tons and three-quarters, and its composition 126 parts of copper to $57\frac{1}{2}$ parts of tin; its focal length is 54 feet—the tube is of deal; its lower part, that in which the speculum is placed, is a cube of eight feet; the circular part of the tube is at its centre, seven feet and a half in diameter, and at its extremities six feet and a half. The telescope lies between two stone walls, about 71 feet from north to south, about 50 feet high, and about 23 feet asunder. These walls are as nearly as possible parallel with the meridian.

In the interior face of the eastern wall a very strong iron arc, of about 13 feet radius, is firmly fixed, provided, however, with adjustments, whereby its surface facing the telescope may be set very accurately in the plane of the meridian—a matter of the greatest importance, seeing that by the contac with it of rollers attached to one extremity of a quadrangular bar, which slides through a metal box fixed to the under part of the telescope tube, a few feet from the object end of the latter, whilst its other extremity remains free, the position of the telescope in the meridian is secured, or any deviation from it easily determined, for on this bar lines are drawn, the interval between any adjoining two of which corresponds to one minute of time at the equator. The tube and speculum, including the bed on which the latter rests, weigh about 15 tons.

The telescope rests on an universal joint, placed on masonry about six feet below the ground, and is elevated or depressed by a chain and windlass; and, although it weighs about 15 tons, the instrument is raised by two men with great facility. Of course, it is counterpoised in every direction.

When completed its range will embrace an arc between 10 degrees of altitude towards the south and 47 degrees north; so that all objects between the pole and 27 degrees south of the equator will be observable with it; whilst in the equator any object can be viewed with it about 40 minutes of time on either side of the meridian.

The observer when at work stands in one of four galleries, the three highest of which are drawn out from the western wall, whilst the fourth, or lowest, has for its base an elevating platform, along the horizontal surface of which a gallery slides from wall to wall by machinery within the observer's reach, but which a child may work.

The telescope lying at its least altitude can be raised to the zenith by the two men at the windlass in six minutes; and so manageable is the enormous mass, that give me the right ascension and declination of any celestial object between these points, and I will have the object in the field of the telescope within eight minutes from the first attempt to raise it.

When the observer has found the object, he must at present follow it by rackwork within its reach. As yet it has no equatorial motion, but it very shortly will, and at no very distant day clockwork will be connected with it, when the observer, if I mistake not, will, whilst observing, be almost as comfortable as if he were reading at a desk by his fireside.

The night of the 5th of March was, I think, the finest I ever saw in Ireland. Many nebulæ were observed by Lord Rosse, Dr. Robinson, and myself. Most of them were, for the first time since their creation, seen by us as groups or clusters of stars; whilst some, at least to my eyes, showed no such resolution. Never, however, in my life did I see such glorious sidereal pictures as this instrument afforded us.

Although, however, the power of this telescope in resolving nebulæ into stars hitherto considered irresolveable was extremely gratifying, still it was in my mind little more than I had anticipated; for experience has long since told me that a telescope may show nebulæ, even those resolvable by it, very well, whilst, when directed to a bright star, with a very moderate magnifying power, its imperfections will be actually offensive.

Perfection of figure, then, of a telescope must be tested, not by nebulæ, but by its performance on a star of the first magnitude. If it will, under high power, show the star round and free from optical appendages, we may safely enough take it for granted it will not only show nebulæ well, but any other celestial object as it ought. Regulus on the 11th being near the meridian, I placed the telescope on it, and with the entire aperture and a magnifying power of 800 I saw, with inexpressible delight, the star free from wings, tails, or optical appendages; not indeed like a planetary disc, as in my large achromatic, but as a round image resembling voltaic light between charcoal points; and so little aberrations had this brilliant image that I could have measured its distance from, and position with, any of the stars in the field with a spider's line micrometer, and a power of 1,000, without the slightest difficulty; for not only was the large star round, but the telescope, although in the open air and the wind blowing rather fresh, was as steady as a rock.

On subsequent nights', observations of other nebulæ, amounting to some 30, or more, removed most of them from the list of nebulæ, where they had long figured, to that of clusters; whilst some of these latter, but more especially 5 Messier, exhibited a sidereal picture in the telescope such as man before had never seen, and which for its magnificence baffles all description.

Of the moon a few words must suffice. Its appearance in my large achromatic, of 12 inches aperture, is known to hundreds of your readers; let them then imagine that with it they look *at* the moon, whilst with Lord Rosse's 6 feet they look *into* it, and they will not form a very erroneous opinion of the performance of the leviathan.

On the 15th of March, when the moon was seven days and a half old, I never saw her unillumined disc so beautifully nor her mountains so temptingly measurable. On my first looking into the telescope, a star of about the 7th magnitude was some minutes of a degree distant from the moon's dark limb. Seeing that its occultation by the moon was inevitable, as it was the first occulation which had been observed with that telescope, I was anxious that it should be observed by its noble maker; and very much do I regret that through kindness towards me he would not accede to my wish; for the star, instead of disappearing the moment the moon's edge came in contact with it, apparently glided on the moon's dark face, as if it had been seen through a transparent moon, or as if the star were between me and the moon. It remained on the moon's disc nearly two seconds of time, and then instantly disappeared, at 10h. 9m. 59·72s. sidereal time. I have seen this apparent projection of a star on the moon's face several times, but from the great brilliancy of the star this was the most beautiful I ever saw. The cause of this phenomenon is involved in impenetrable mystery.*

The only telescopes in point of size comparable with Lord Rosse's 3 feet and 6 feet, are Sir William Herschel's 20 feet and 40 feet Lemairean's. The 20 feet had a speculum of 18·8 inches diameter, and the 40 feet one of 4 feet. †

The Lemairean of 18·8 inches diameter in point of light is equal to a Newtonian of 22 inches and a half diameter.

The Lemairean of 4 feet diameter is equal to a Newtonian of 57 inches and 4 tenths.

The Lemairean of 3 feet is equal to a Newtonian of 43 inches.

And the Lemairean of 6 feet is equal to a Newtonian of 86 inches.

By substituting then the Lemairean form for the Newtonian, the present 3 feet Newtonian will be made as effective as if it were 43 inches diameter, and the 6 feet as if it were 86 inches in diameter; or the quantity of light in each telescope, after the alteration, will be, to its present light, as 7 to 5 nearly, or almost half as much again as it now has.

Seeing, then, that the change from the Newtonian to the Lemairean construction will be attended with such an accession of light, Lord Rosse, having determined geometrically the form of the curve requisite to produce with it a definition of objects equal to that which each of the telescopes at present gives, is devising mechanical means for producing it; but, as he is in about a fortnight coming over to England to attend his parliamentary duties, it is probable that this important desideratum will scarcely be effected till autumn comes upon us.

What will be the power of this telescope when it has its Lemairean form it is not easy to d vine;—what nebulæ will it resolve into stars; in what nebulæ will it not find stars;—how many satellites of Saturn will it show us; —how many will it indicate as appertaining to Uranus;—how many nebulæ never yet seen by mortal eye will it present to us;—what spots will it show us on the various planets; will it tell us what causes the variable brightness of many of the fixed stars;—will it give us any information as to the constitution of the planetary nebulæ;—will it exhibit to us any satellites encircling them;—will it tell us why the satellites of Jupiter, which generally pass over Jupiter's face as discs of nearly white light, sometimes traverse it as black patches;—will it add to our knowledge of the physical construction of nebulous stars;—of that mysterious class of bodies which surround some stars, called, for want of a better name, "photospheres;"—will it show the annular nebula of Lyra merely as a brilliant luminous ring, or will it exhibit it as thousands of stars arranged in all the symmetry of an ellipse;—will it enable us to comprehend the hitherto incomprehensible nature and origin of the light of the great nebula of Orion;—will it give us in easily appreciable quantity the parallax of some of the fixed stars, or will it make sensible to us the parallax of the nebulæ themselves;—finally, having presented to us original portraits of the moon and of the sidereal heavens, such as man has never dared even to anticipate,—will it by daguerreotypic aid administer to us copies founded upon truth, and enable astronomers of future ages to compare the moon and heavens as they then may be, with the moon and heavens as they were? Some of these questions will be answered affirmatively, others negatively, and that, too, very shortly; for the noble maker of the noblest instrument ever formed by man "has cast his bread upon the waters, and will, with God's blessing, find it before many days."

* Would not this appearance, it is asked with great submission, indicate a refracting atmosphere which the telescopes hitherto constructed have not been able to detect? If this hypothesis turn out correct, it will be easy enough to determine the extent of the atmosphere, by observing in sidereal occultations the time of a star's passing from the moon's apparent edge (namely, the limits of her atmosphere), to her real edge. Since the above was written, a letter from Sir James South has appeared in the Times, in which it is stated that the phenomenon occurs both at immersion and emersion. Is not this a powerful confirmation of our hypothesis?—Ed. C. E. and A. Journal.

† Sir James South intends here, we presume, to draw a comparison between 'reflecting' telescopes only.

Architectural Novelty.—The new theatre which is building at Livorno, 'Anglice' Leghorn, will differ altogether from any other structure of the kind, inasmuch as it will be available for performances by daylight as well as of an evening, since instead of the usual ceiling, the auditory, i. e., the pit or portion surrounded by stage and boxes, will be covered by an open glazed dome. Ingenious as seems the idea—whose we are not informed, the architect's name being as usual suppressed,—and singular as will be the effect, it may be questioned whether it will be found any improvement upon the present system, but rather a sort of 'amphibious' contrivance, neither fish nor flesh, nor particularly advantageous for either day-time or evening. If the morning performances are to be merely concerts daylight will suit well enough, but not for dramatic representations with scenery and dresses, if only because the stage itself would be in obscurity compared with the rest of the house, unless it were to be lighted up as usual by "foot-lamps," and from the wings, in which case the mixture of daylight and artificial light together would be exceedingly disagreeable. Again, has the effect then attending a large domed skylight been well considered for evening exhibitions? At such times, it must show only as a dark void over-head, except perhaps of a fine moonlight night, when Madam Luna could peep in from above upon the spectators and the performances. To render it ornamental and architecturally effective, the dome ought to be glazed with coloured glass—either diapered or plain—and lit up externally, within a space for the purpose, between the dome and outer roof; or perhaps gas lamps with reflectors, on the ribs of the dome would answer the purpose.

ON OBELISKS, WITH SOME REMARKS ON EGYPTIAN ARCHITECTURE.

By Henry Fulton, M.D.

The ancients have left us few examples of monuments such as are suited to endure our climate in an "unhoused condition." To Egypt we are indebted for the pyramid and the obelisk, although, indeed, we can scarcely consider pyramids in the light of monuments, for they are rather edifices of mere utility, or at least were so considered by those who erected them, and who appear in other matters to be too well instructed in the principles which constitute beauty and grandeur in æsthetic composition, to flatter themselves that these enormous structures had any claim to admiration on these grounds. Be this as it may, the pyramids offer no models for us, nor need we regret that they are beyond our reasonable efforts, because the end would not be worth the cost. The only pyramid of any account in Europe is that of C. Cestus at Rome, and it is not probable that we shall ever have another.

It is true there is Pompey's pillar in Egypt, but it is not *of* Egypt, it may rather be classed with those of Trajan and Antoninus, though, for reasons which we shall state, the columns of the two emperors have stronger claims on our admiration than that which is distinguished, on somewhat doubtful evidence, with the name of the consul, and which may be said to enjoy a monopoly as a model in the practice of modern architects; and, indeed, judging from the late exhibitions at the Royal Academy, we might almost venture to conclude that in future we shall have nothing else, although isolated columns are very objectionable. Poetic feeling denies the existence in the wilderness to more than one pelican, and rejects any number of swans save two on the tiny lake: the poetry of architecture (if I may so speak) repudiates the word column in the singular number, and can only consider it, no matter in what locality, as part of a range; such is the column of Pompey (which some suppose did form part of a range), and that of Santa Maria Maggiore (which was taken out of the Temple of Peace), and such are all those of which they are the types.

In this utilitarian age, we are prone to forget that *est modus in rebus*, there is a fitness in the form of things, which should not be lost sight of in matters of taste, however convenient it may be to do so when we aim at no such elevated object. I do not know whether those who have written on taste have referred to this or not, but it appears to me that good taste must look with suspicion on a thing used for a very different purpose from that with which it naturally is, and ought to be associated in our minds; for instance, some things which are placed as ornaments and objects of curiosity in the saloons and cabinets of the wealthy in Europe, were, as I can vouch, made in Asia for ignoble purposes; and again, some of our own manufactures, differing in nothing but shape from our most highly prized specimens of table china ware, have been in the East exhibited on the festive board along with plates and dishes: in such cases ignorance is surely bliss, and no doubt in the eyes of an ignoramus a monstrous column, like the York or Nelson, supporting a statue, or like that of the monument of the great fire of London supporting nothing, may appear wondrous fine, although to others not so blessed it must appear as much out of place as Wedgewood's china ware did in the eyes of the Nizam's horror-struck European guests at Hydrabad. Mr. Hosking, in his excellent treatise on architecture, in comparing the London monument with the lofty shot tower near the south-west angle of Waterloo Bridge, justly says, "they are both of cylindrical form; but the one is crowned by a square abacus, and the other by a bold cornice which follows its own outline, the greater simplicity and consequent beauty of the latter is such as to strike the most unobservant." The learned professor might have added that the former was a tasteless perversion of a Greek order, the latter *almost* a copy of an Irish round tower, and that the "consequent beauty" depends not so much on the figure as the application of the thing, for a range of shot towers would exhibit as little beauty asan isolated column.

The columns of Trajan and Antoninus at Rome, and that of Napoleon in the Place Vendome at Paris, are not so liable to the objections urged, as the sculpture which encases their shafts partly removes them from the class of edificial columns: but to support a statue even such examples are perfectly useless, inasmuch as they necessarily raise the figure far beyond the point of sight, so that neither its resemblance nor proportions can be distinguished, and the highest praise that can be given to them under such circumstances is that they are very convenient asylums for ill-executed statuary. But with whatever interest we may view the sculptured columns just alluded to, no such feeling can exist when we inspect one which has merely their cold and dry outline, like the Nelson in Dublin and the Melville in Edinburgh.

The last column erected in this country is the one in Trafalgar Square, London, and it is by no means an exception to the rule. Why an obelisk did not suggest itself to the minds of those who had the direction of the testimonial, as particolarly appropriate to celebrate the achievements of the hero of the Nile is not easily to be accounted for, if any credit for classical association or taste be given to them, unless it were that none of those heretofore elevated in Europe had been supplied with suitable bases or pedestals, and that the shaft rising abruptly from the ground, as they would appear to do in the views of those still remaining in Egypt, was not desirable or according to our received notions and practice in other cases.

In order to obtain some insight into the mode of erection as practised by the ancient Egyptians,—and happily for the cultivation of taste the architecture of that people is (with the unaccountable exception of obelisks) better illustrated than that of any other, not excepting Greece itself,—I have consulted upwards of fifty books of travels and description relating to it, and although all of them speak of obelisks, as indeed how could we expect to find any work assuming to treat on its antiquities which did not, yet the information to be gleaned from any such source, as far as I am acquainted, is scanty in the extreme and only whets the appetite for investigation: some of the books go so far as to give the exact measurement of every external stone of the great pyramid, yet only give information, and that imperfect, whether the obelisks had bases or not, and in all the views the soil appears to be so much raised at the base of the shaft that we connot make anything out from them. In Captain Head's "Description of Eastern and Egyptian Scenery," the pedestal of the obelisk at Alexandria, called Cleopatra's Needle, is stated to have been seven feet high (which is the same as the diameter of the shaft at its base), and nine feet broad, but whether or not this pedestal was a mere foundation stone does not appear, and he says that the base has lately (1833) been broken up for building materials.

In a copy of some hieroglyphics in one work, an obelisk is represented elevated on a flat rectangular zocco, exceeding in length about one-third of the diameter of the shaft at its base, this is nearly the same proportion as that given by Captain Head, and we may reasonably presume was the usual practice of the Egyptians. Montfaucon gives a view of an obelisk, which he briefly designates as "that of St. Manto," but where that is I cannot say, never having heard either of the saint or the place before. I have examined the English, French, and Latin editions, and, judging from the context, perhaps it may be some place in Tuscany; this obelisk "of St. Manto" has a base precisely the same as that of the hieroglyphic alluded to. So low an elevation (about one-third of the diameter of the shaft at its base), would not accord with our practice or idea of the elevation which a monument should have, nor does it appear in any instance to have met with favour in the eyes of the Roman architects of the *cinque cento* school, but how those which they erected at Rome were placed by the old Roman architects when first brought from Egypt I know not, but Montfaucon, and those who have followed in his wake, in giving a restored view of a Roman circus, as he says it appeared in the sixteenth century, place obelisks on the spine, raised some on four balls and others on the same number of paws, just as cabinet makers occasionally do modern furniture, and these balls and paws rest on the square zocco; but the learned padre is not a very trustworthy architectural authority, at least for detail. The comparatively modern Roman architects, just as might be expected those professed *restorers* of ancient art would do, have given them spruce pedestals with Roman mouldings and surbase; the best of these pedestals are those which resemble the square altars of ancient Rome. The obelisk which is in front of St. Peter's was elevated by Fontana, and nothing can be worse than its details, if we except some of those of St. Peter's itself; the diameter of the shaft is given as eight feet four inches, and the height seventy-six feet, the height of the entire, including a cross on the apex, 126 feet. I believe all the obelisks at Rome have something or other of this kind on the apex—a practice as detrimental to effect, without being as useful, as that of placing weather-cocks in the same situation on the spires of churches in our own country. Both the spire and its prototype under such circumstances convey the idea that there was no object aimed at in their erection except that of supporting whatever is placed on the top.

The French architects who lately elevated the Luxor Obelisk at Paris in the arrangement of its base appear to have had no other idea than that of making almost an exact copy of those designed by Fontana, and such are all those which I have seen in this country, with the exception of the little one in Fleet Street, London, [and which I speak of from memory]. The architect who designed it felt the necessity of giving it an Eyptian base, in character at least, and has made the pedestal tapering, with an inclination corresponding to that of the shaft, and on the dado (if I recollect rightly), has placed an

Egyptian cornice: now although in theory all this may appear excellent, and both the pedestal and obelisk are strictly Egyptian in form, yet viewed together when realised they produce anything but a pleasing effect; in short, the effect is precisely the same as if we were to take a column diminished from the base, and having removed a portion of it some feet from the lower end then set up the upper resting on a cornice imposed on the lower part. Would not the eye in this case call for that which was removed? So it is with the obelisk alluded to. Another objection to this form of pedestal is that it only admits of sculpture in intaglio and not in relief, such as the Isthmian crown and bust on that of the example given in the plate.* The former is taken from the tail piece of the sixth chapter, vol. 3, of Stuart's Athens, and is one of the most beautiful circles which we have. No, the pedestal must be rectangular, which form suggests no such vacancy, but then to *ornament* it with either Greek or Roman mouldings is carrying the innovation further than is necessary, and the simplicity and harmony of the work are destroyed by a multiplicity of forms and figures.

In Ethiopia, as it appears from the highly interesting work of Mr. Hoskins, the reeded torus so frequently to be seen on the pyramidal propylea of the Egyptian temples, is to be found on the arris both of pyramids and obelisks, and in the former at least it has the effect of somewhat relieving the outline from that monotony so disagreeable in those structures of Egypt. On the obelisks, however, no such embellishment seems to be required. The Ethiopian obelisks are raised on a low zocco.

Perhaps it may strike some astute critic, if such there be, on architectural subjects, that in recommending the erection of a single obelisk I lay myself open to a charge of departure from the principles urged at the commencement of this paper, of being guided as far as possible by the example of the original projectors, as the Egyptians always erected them in pairs: and so they did, and so should we if we erected them under similar circumstances, that is at each side of the entrance in front of the propyleum, but as an obelisk does not, like a column, form part of an edifice, I therefore think that the most fastidious cannot object to the erection of a single one as an isolated monument or testimonial.

It would appear that the Egyptians were acquainted with only one form of moulding, which must be familiar to every one who has examined a sketch of an Egyptian temple, of course this moulding will suggest the most appropriate example when any cornice is to be given on the dado of the pedestal—and if the winged globe be also given it will be still more in character, but if the obelisk be on a large scale I should much prefer a plain rectangular dado without any kind of moulding, and I am satisfied that the obelisk at Paris would appear to much greater advantage if elevated on such a basement, for as it is, the footing of the shaft above the moulding, the sub-basement of the dado in three unequal parts, the upper sloped off to meet the middle one, all resting on a flat zocco or plinth, present a complicated outline which by no means harmonises with the simple and noble monolithic to which they are subsidiary. There are cases, however, where a cornice on the dado may be requisite—first, when sculpture is to be introduced in relief on its face, which without such a projection from above at least would look as naked as a picture without a frame; and secondly, where it is not possible to obtain either an entire block of stone of sufficient size, or to finish the joints so clean that they may be considered invisible and that the top course can be formed of a single slab, for it would not appear good workmanship to have the joints terminating on the upper arris of the naked dado, however clean they might be wrought.

The obelisk then may be considered as consisting of three parts, viz., the shaft, the rectangular dado, and a triple and equally graduated basement; as to the proportion of them much must depend on the locality, the rise of the ground and point of view, which must be left to the taste and judgment of the architect to provide for: I would suggest, however, that, contrary to the practice of Fontana, the rise and tread of every portion of the triple gradated basement should be of equal dimensions. The height of the entire of this basement might be equal to the diameter of the shaft at its base; this would make the lower member of the basement three diameters in breadth. The dado might be either a cube or higher, and its horizontal axis about one-third greater than the diameter of the shaft at its base. The height of the shaft should be from eight to ten diameters. The general custom is to give a footing to the shaft, no doubt something is gained in elevation by it, but I should prefer its being dispensed with, or at all events being made very low. Did I not know the strong predelection of some of my esteemed architectural friends for such ornaments, I should think it superfluous to remark that there ought not to be any surbase, or moulding at the base of the dado, which is as injurious in effect as giving a base to the column of the Doric order. Nor should the dado be pannelled, which if I recollect right is the case in some of the Roman examples. Of course it is very desirable that the dado shall consist of only one block, particularly where no moulding is to be given on its summit, although with half the labour necessary to produce that elaborate trifling called rustic work, the joints both of shaft and pedestal might be made so sharp as scarcely to be observed if the slab, or upper course, on which the moulding is usually defined were only one piece.

I trust that nothing here advanced on the adoption of obelisks may be used as a guide for the erection of *little* obelisks, the little conceptions of little minds; and I have seen such which at little cost do little honour to the little men to celebrate whose little achievements they were erected. No! anything which we do in the Egyptian style must appear to be the work of giants, not the effort of pigmies. At Donnybrook, near Dublin, there is a little wretch which almost seems as if it were intended as a burlesque on the larger monster in the Phœnix, Park on the other side of the city. This latter, although equally hideous in form, is Cyclopean in bulk, but the Polyphemus who designed it, if he had only a single eye it was not for the perception of the chaste and beautiful. George the Fourth pronounced this testimonial to be "a huge mile stone," his majesty might have added "and an ugly one," although he knighted its architect. We must, however, give the architect (whoever he may be) who designed the Donnybrook obelisk some credit, for the monument overlooks the green on which the far-famed fair is held, and the design is in right good keeping and perfect harmony in both size and shape with the dwarfs and minor monsters there annually exhibited; no doubt the architect of this classical production was influenced by the nomade "genii of the place," that whilst "at the small charge of one penny" admiring rustics may see a dwarf "made as if by Nature's journeyman," they may have a view gratis of what looks like a journeyman architect's opposition wonder, bearing the same relation to an obelisk that a monkey does to a man, or a balluster does to a column. Can it be that, according to the Shandean theory, names have a ruling influence over the prospects, fortunes, and productions of men, and that because the contiguous residence of an architect is called LILLIPUT its nomenclature fated that a pigmy obelisk should be placed in front of it; but I leave this to be settled by the learned of the Royal Institute of the Architects of Ireland, of which I suppose the architect at whose door the obelisk lies is a member.

Before concluding this paper, we may add some general remarks on the subject of Egyptian architecture—for although, taken as a whole, it may present to us few or no erections (with the exception of obelisks) which are calculated for our times and country, yet as a school were we may *unlearn* it is without rival, and there we may learn to esteem grandeur and simplicity for their own sakes; and these are qualities in which the architecture of our times is remarkably deficient; simplicity and grandeur not inconsistent with the most elaborate finish and detail; in short, even although it may afford us few or no models yet its study will teach us to get rid of the frivolities of the cinque cento school, and for this purpose a visit to Egypt, however desirable, is not absolutely necessary, for in the many works which we possess, particularly the most magnificent one perhaps ever published that of the Imperial Institute of France, we have ample delineations. It was a feeling of the magnificence of the style which induced me to suggest, in a former number of this Journal, the propriety of an Egyptian façade to the British Museum, if only as a study, and it must be admitted that in England we are sadly in want of something to elevate our tastes, and enable architects to do for architecture what the great masters have done for painting. I scarcely know of any example which we have in the horizontal style calculated to aid this object except Mr. Hardwick's Terminus of the London and Birmingham Railway. In the March number of this Journal may be found an attempt to form a new order by Grecianising an Egyptian capital, an inspection of the great French work alluded to, or even the minor and more accessible one of Denon, will shew many examples of capitals which might be thus treated and give us an endless variety, some of them of great beauty and well entitled to our admiration.

But the great difficulty is to unlearn, aye to *unlearn*, the false principles and vitiated taste acquired in the Palladian school: a study of Egypt illustrated and Greece delineated may enable us to do this, and where it fails the fault rests not with the study but the student. If the mere illustrations and delineations can do so much, what might we not expect from the originals in their sublimity and vastness. Yet, alas, so it is; men have gone and seen, but not conquered their prejudices. Adam, not he of Eden, but of the Adelphi, London, saw Pœstum, and Wilkins trod the Acropolis, yet the one preferred the miserable abortions of Spolatro, and the other designed the National

* A drawing of the pedestal of an obelisk as suggested was prepared, but it admits of being described so plainly, that it appears unnecessary to give a plate with this paper.—Ed. C. E. & A. Journal.

Gallery of London! The student should not, and the amateur in architecture cannot, conceal this from themselves, and it is necessary that they should both vie with each other in rising superior to the prejudices of early education. I believe that in all ages, and in all professions, there have been those who considered that they had nothing to learn; from the architectural section of this class nothing good can be expected, they never can soar above mediocrity.

Doubtless there are those who will raise the cry of "pagan and heathen" as applicable to the style we speak of. In one of the numbers of this Journal for the past year I endeavoured to call attention to the fact that to the Egyptians, or rather their neighbours the Ethiopians, is due the invention of the arch, both circular headed and pointed, which latter when grafted on the Gothic style gives it such powers of fascination, therefore however the "Ecclesiologists" may flatter themselves as to the purity of its source, it, as well as some of their institutions and ceremonies, names as well as things, are derived from pagan practice and pagan nomenclature. If this be the case, and I am ready to show that it is, the less they say about "heathen" architecture *as such* the more will they display their worldly wisdom. I refrain from enlarging on this topic, because I do not consider the pages of a scientific journal constitute a suitable arena for the discussion of theological questions, and it is much to be regretted that what seems so near akin to fanaticism of a certain class of religionists should have rendered any allusion to the subject necessary.

Clonmore, April, 1844.

P.S. In the last number of this Journal, a correspondent calls on me to give an account of the late erections in Ireland, *mais place aux dames*, I think I should make way for, and refer "Philo Hibernicus" to the Royal Institute of the Architects of Ireland, which was founded for the purpose of furthering "the Art as taught by Vitruvius and adorned by Palladio." Should they not take the subject up, perhaps I may answer the call at some period not very remote.

THE COLLEGE OF CIVIL ENGINEERS AT PUTNEY.

Various notices of the College at Putney have from time to time appeared in this Journal, and the topic has offered occasion for remarks on the inexpediency of a purely theoretical education for those intended for a profession so essentially practical as engineering. The increasing importance of every subject connected with the professional education of the engineer, and the removal of many of the above noticed strictures on the College of Civil Engineers, by the increased attention there given to practical applications of science, induced us on a recent occasion to pay a visit to the Institution, and we feel that we shall not be unprofitably employing the time of our professional reader by detailing to him the impressions left by that visit. We wish simply to give information as to the exact nature of the college, as far as this may be done without making our notice a mere prospectus or advertisement of its merits.

It is strange that the strongest prejudices against pure science should exist amongst those who are most indebted to it—the practical engineers: it is still more strange that the disciples of theoretical science should look coldly upon the men who by the practical application of scientific knowledge alone deserve the credit of giving science a real, tangible value. "He is a mere theorist, a speculator," says the engineer of the mathematician, "theory is all very well but it can never stand against practice—give me plenty of *facts*. I do not want to make my son a philosopher; I want him to be an engineer." And then, if our casuist be a well-read man, he fortifies his profound arguments with a quotation, and reminds you of Lord Bacon's apothegm, "examples give a quicker impression than arguments." "Ah," says the philosopher in turn, of the engineer, "he is a capital fellow for the workshop—quite at home among his cranks and wheels, but knows as little of the laws of motion as do the tools which he uses."

The fact is, gentlemen, you are both wrong and both right; you are looking on opposite sides of the gold-and-silver shield.

It seems almost incredible, seeing the experience we have of the assistance which science has afforded to the arts, that men should have been so long deluded with the senseless jargon about "theory being inconsistent with practice." If by this phrase be meant that theory makes deductions which practice proves to be incorrect, the assertion is essentially false: for all correct theoretical investigations contain a specific notice of whatever practical considerations are hypothetically excluded, and consequently the experimentalist has due notice of the corrections which he has to make in testing the accuracy of the theory.

Did it never occur to any of our readers that it was possible that an adequate knowledge of both theoretical and practical science might be attained by one and the same person: that a man might be truly, *systematically* acquainted with the laws of mechanics, and yet not be afraid of dirtying his fingers in a workshop. "Oh but," says the engineer rather testily, "I *am* acquainted with mechanics—I have been studying them practically, all my life-time; and that is better than all your theory." Pardon the doubt, Sir, but your practical knowledge is *not* better than all theory, though, it must be granted, a most indispensable accessory to it. We will tell you where your practical knowledge is defective—it is not SYSTEMATIC. From the nature of the occupations in which your life has been spent, it is quite impossible that you can have systematised your knowledge. You have picked up a scrap of information here and there as you have gone along, and from the results of your experience (often acquired at a terrible cost), you have at last come to certain conclusions which we will, if you please, call your mechanical creed. But supposing you had to put your creed to the test under circumstances quite new to you—are you quite certain that it would not fail? Are you quite sure that in the practical results on which your creed was formed there were not some circumstances different from those of the present case? Is it not just possible that there may have existed some circumstances so apparently trivial as to have been altogether neglected in the former cases, which yet may produce a powerful effect in the present?

So then you see, surely, what a gain it would have been to you, could you have *set out* with a *systematic* knowledge of mechanics, which would have served your stead for every case whether tried or untried, and have been quite independent of the imperfections of your own observations. Now such a knowledge is the mathematical theory of mechanics, which has employed the study and research of men of the most exalted genius for many, many centuries, and has been tested by infinitely more experiments than you will ever be able to conduct.

But perhaps it may be said that the greatest engineers that have ever lived were entirely unacquainted with theoretical mechanics; Watt and Brindley could exhibit the wonders of their mechanical genius without any knowledge beyond that which their own experience and reflection imparted.

But this is no real argument against the acquisition of theoretical knowledge. Granted that Watt and Brindley did wonders without such knowledge, does it follow that a preliminary course of study would have impeded their efforts? May we not rather think it would have facilitated them? Do we not know as a matter of fact, that those two great men constantly lamented their defective knowledge of science? And is it not also a matter of fact, that their deficiency led them to commit many errors which they would otherwise have avoided?

Were not the task an invidious one, it would be easy to point out many instances in the lives of even such men as Watt and Brindley where confessedly time was wasted, money wasted, talent wasted, to acquire that by experience which a very little theoretical knowledge would have supplied. But this is not the main argument. The genius of Watt lay principally, almost exclusively, in mechanical invention, and this requires a kind of talent which, it must be allowed, is in a great measure independent of systematic theoretical education. The judicious reader will apprehend that the faculties exercised by an inventor are the *perceptive*, that he requires not a logical process of deduction but intuitive powers of perception;—in the language of the metaphysicians, his mental processes are not anylytical but synthetical—æsthetic. But this is not the case of the engineer—he does not want to be an inventor. The inventor sets about his schemes independently (and sometimes too, in defiance) of systematic rules, but not so the engineer. He is constantly occupied in cases which demand careful deductive thinking, and frequently considerable scientific knowledge. Suppose, for instance, such a question as this were put to the engineer—a railway train of such and such weight is placed on an inclined plane of a certain inclination, and the resistance to motion is so many pounds to the ton, find the velocity with which the train will move and how far it moves before stopping; must it not be allowed that the engineer *ought* to be able to answer such a question? and yet the ability to do so implies an accurate knowledge of the science of motion. Take another instance: explain why a Gothic arch will bear a greater weight on the crown of it than a circular arch will, and determine how much weight is necessary to prevent the crown from rising: will not public opinion decide that the engineer ought to have some better answer for such questions than a shrewd guess? And how is he to answer accurately if ignorant of the principles of equilibrium?

Even the inventor, who, as we think we have proved, stands less in need than the engineer of scientific knowledge, often suffers severely for want of it. We have monthly to record in this journal lamentable instances of time and money wasted on patents which the slightest scientific knowledge would prove valueless. Not long ago a person took out a patent of which the principle was based on the idea that the pressure of fluids arose from the elasticity of the air contained in them! A thoroughly practical engineer told the present writer not long ago, that a bullet did not acquire its full velocity till some time after it left the mouth of the gun! And we have been gravely assured that the strength of the Thames Tunnel must be very great indeed, for it had to support not only the superincumbent water, but also *the enormous weight of the vessels floating in it*,—as if the weight of the vessels were not the same as that of the water displaced by them!

The scientific knowledge which would render these preposterous mistakes impossible cannot be acquired by the engineer while engaged in the busy occupations of his profession. The knowledge, if acquired at all, *must* be a part of his preparatory education. Of that we are certain:—The crude philosophy which he may form by his own observations in the workshop or engine-room can never compete with the systematic certainty of theoretical knowledge. Such philosophy it is the object of the College of Civil Engineers to impart; and we have the more readiness to applaud the object, because we find that the Institution no longer adopts the opposite, equally fatal, error of imagining that theoretical knowledge will supersede practical. Neither suffices without the other. The students are instructed in pure science, but they are familiarized also with the working tools of the engineer. The operations of turning and casting of metal, the details of the management of steam-engines, actual experiments on the strength of roofs and arches, the practice of surveying and levelling, all these are actually carried into effect by their own hands. It is not pretended that by these studies the student at once become qualified for the practice of his profession; but when he takes his next step, and enters the workshop of the engineer, he brings with him a large amount of knowledge, which infinitely increases the value of the instruction received under the working engineer, and which guides his efforts for the remainder of his life.

In conclusion—the College of Civil Engineers is under the principal guidance of one on whom *the very highest* academical honours have been bestowed, the Rev. W. Cowie, of whose attainments it would be presumption to speak here, and who to his scientific knowledge joins the practical information which can only be acquired by actual observation, and an ardent desire to advance the science of engineering.

THE GEOLOGY AND ARCHITECTURE OF IRELAND.

Practical Geology and Architecture of Ireland. By GEORGE WILKINSON, Architect. Illustrated with Seventeen Plates and Seventy-two Wood-cuts. London: John Murray, Albemarle Street, 1845. pp. 400, royal 8vo.

No science has in modern times made such rapid advances as Geology. Born but yesterday, it has asserted its claims at once so convincingly as to be recognized as second in importance to no branch of human knowledge by which the arts and operations of practical industry are facilitated: and to scarcely any branch of human skill is geology likely to afford more direct aid than to architecture. Mr. Wilkinson, the author of the work before us, is already favourably known to our readers by two lectures, delivered before the Geological Society of Dublin, one on Geology connected with Architecture, reported in this Journal, Vol. VI. p. 56, and the other on the Marbles of Ireland, reported at p. 83 of the present volume. It is the object of the present work to illustrate the importance of directing the choice of materials for building in Ireland by a due knowledge of the geological character of that country. The subject is considered under four distinct heads: the first is a general description of the different kinds of rocks found in Ireland, their arrangement and composition, and the purposes for which they are severally applicable. The next head is a review of the ancient architecture of Ireland, from the earliest specimens of cromlechs, cairns, and monolithal structures, to the debasement of Christian Architecture. Under this head considerable space is devoted to the subject of the Round Towers of Ireland, the distinctions between the Norman architecture of that country and our own, and to ancient domestic architecture. This part of the book is the largest, but it is not of a purely architectural nature: continual allusions are made to the durability and geological character of the materials of ancient buildings. The third part is a digest of the geology of each county of Ireland considered separately, and the work concludes with a large collection of tables recording the results of experiments on the strength of the principal building stones.

Having thus given a general view of Mr. Wilkinson's work, we will proceed to consider it more particularly, and will first take the liberty of extracting some of the remarks in which he points out the interest which architects have in the progress of geological knowledge. After showing the facilities which this knowledge affords for determining the suitability of different stones for various architectural purposes, he adds—

"Yet the architect, who is by his profession most interested, and whose first study should be directed to the acquirement of such information as would make him familiar with this portion of the operations of nature, the contemplation of which must imbue him with elevated ideas, is generally most neglectful of such a study, and contents himself with the possession of information with regard to the merchantable prices and qualities of the different stones which he finds in the stonecutter's yard, or which he sees others in the habit of using: it is then not surprising if with equal ignorance he perpetuate what is bad, or practises, by accident, what is good.

"In large cities this is particularly the case: specifications for constructive arrangements are often prepared almost by rote; and when a design has to be carried out in a country locality where the features are new, as well as the mode of using the materials, the architect is either too often the blind dupe of those in whose hands he has to entruct himself, or he commits some egregious error, or both." P. 3.

"Who can contemplate the imperishable and solid structures of the ancient Egyptians without entertaining impressions of those people which language would not produce? These connecting links in the history of the past and the present cannot fail to stimulate, in the most forcible manner, admiration of those whose minds conceived, and whose efforts raised the enduring monuments of a vigorous race! The present inhabitant of Egypt, Greece, and Rome, are greatly indebted for the sympathy of other nations, and for their wealth, to the grandeur of their architectural remains: in these, good and durable materials have been employed, without which we should have had but a mass of crumbled ruins, or indistinct piles of decomposed matter; the memorial of the valuable models of antiquity presenting beauty of design, a fit adaptation of construction, and elegant forms, perfected by a skilful people in the course of ages, would have been lost to us." P. 4.

We may here observe in passing that while geology is illustrating architecture, the art may, perhaps, in turn throw back a little light on the science. The present appearance of ancient structures, formed as they are of almost every kind of materials, is in effect a record of vast series of experiments, which the alchemist Time has been prosecuting on the nature of various stones, and a minute examination of the changes actually produced by time, might probably do much for the confirmation of geological truths. The following passages are introduced to give the reader an idea of the nature of the first part of Mr. Wilkinson's work.

"Granite is a compound of quartz, felspar, and mica. In its ordinary state these ingredients are in nearly equal proportions, the mica being less in amount than the other two. When hornblende replaces the mica, the rock is called syenite. Of these ingredients, the quartz is much the hardest and most durable, and is generally of a whitish colour, occasionally black or brown (Mourne Mountains); the felspar is not so hard, generally whitish also, but frequently of a red, green, or yellow tinge, as well as of other colours. The mica is a scaly, shining, and metallic looking mineral, varying in colour from greyish white to black, dark brown, or dark green. The two latter principally determine the durability of the stone, which commonly varies with its working quality, the most easily converted being also those rocks in which the felspar is soft or the mica abundant; the larger the grain also, the greater is the facility of conversion for common work, and the greater the disposition to decay." P. 13.

"Ireland at the present time derives the greater part of her supply of slates from Wales; but she possesses valuable quarries which, if rightly worked, and if duly encouraged, would speedily diminish the necessity for resorting to Wales, and many thousands of pounds which now flow out of the country in a direction from which no reciprocal trade arises, might be advantageously employed in the improvement and enrichment of the country." P. 28.

"The various marbles may be next considered under this division, although, in mineral character and chemical composition, several varieties contain much less of lime than of other earths. A great variety of marbles is met with in different parts of Ireland. Colour and facility of conversion are the two most important properties, and determine their value. The great partiality for the marbles of Italy, and the long-established trade in them, operate much against the use of the Irish marbles; and there are, doubtless, many varieties possessing great beauty, which will probably hereafter, as they become known, be more extensively used than at the present time. Many causes have operated against their conversion, and frequently, not the least, the mistaken views of the proprietors in either over-estimating their value, or raising them in an injudicious manner.

"In the present age, the same false feeling and bad taste which have been remarked on with regard to the construction of buildings, extend to the embellishment and more ornamental portions of the interior; scagliola and other imitations of marbles and ornamental stones being resorted to instead of the rock which nature has provided. When better taste and feeling prevail, the natural resources of the country will be more appreciated, and the employment of the people be extended.

"Almost every variety of marble is met with in Ireland; and though there are none of any extent known to be equal to the statuary of the Carrara quarries, or the black and gold, or the Bardilla, there are some which will well supply their place, and others, which, in many raspects, surpass those of Italy. The following may be enumerated as the chief varieties of marble met with in Ireland: Those of simple colours are the black, dark grey or dove-colour, mettled grey and pure white: of the variegated, the green serpentine, several syenitic and other varieties of varied marbles: of the fossiliferous, the colours vary from a dark black to a grey and warm sienna colour, the shells being either white, or partaking of the colour of the matrix in which they are embedded." P. 39.

The passage in the last extract alluding to the bad taste of employing imitative materials is very good. When will architects learn that their art is degraded by dishonest imitations? The true dignity of architecture consists in its reality—its truth. There is an essential vulgarity in the counterfeits of stucco and cement, which makes one suspect a corresponding vulgarity in the mind of the architect.

The second part of the work—the account of the ancient architecture of Ireland—commences with a description of structures resembling Stonehenge, consisting of large masses of stone put together without cement; we shall not, however, follow our author in this part of his subject, though he seems to have treated it in an interesting manner, as the topic is rather one for the antiquary than the architect, and embraces little which illustrates the construction of the models and types adopted by the latter.

The next subject, that of the nature of the Round Towers, like the former, offers an abundant field for hypothetical speculation. It has been to the antiquarian what perpetual motion is to the mechanist, quadrature of the circle to the geometrician, the philosopher's stone to the alchemist, or the translation of *simplex munditiis* to the scholar. But no one of these apparently hopeless investigations will appear very attractive to the practical student, or indeed any one else except the mere dilettante.

The following brief extracts will however, we hope, be found interesting.

"Generally the Towers, when perfect, vary in height from about 70 to 100 feet, some being nearly to 120; the average height, however, is that between 70 and 100 feet—The circumference of the Towers at their bas is generally from about 50 to 60 feet, and their diameter at the level of the doorway from 8 to 9 feet internally.—The walls are commonly 4 feet thick. The door is generally from 8 to 12 feet above the surface of the ground." P. 69.

"In remarking on the features of these Round Towers, the doorway, which is common to all, first demands attention. By the Table it will be seen that the circular arch of the doorway is by far the most prevalent, and that the masonry in several of the structures is of the exact character peculiar to Norman buildings. A more conclusive argument, and one that is more evident to the general reader, is, however, the elaborated execution of the masonry in some of the doorways, displaying some of the finest examples of Norman architecture and construction, and of a character exactly similar to that of doors of later churches in the localities of those buildings, whose construction in the style of Norman architecture, I presume, is not to be disputed." P. 82.

"It may, however, be asserted, and I believe it is considered by many, that these peculiar features of the Round Towers, which are in common with the architecture of the Continent, and, moreover, in common with the style of architecture in those early churches which by gradual change succeeded the Round Towers, are architectural features resulting from later causes, viz., the appropriation of these peculiar buildings to Christian purposes, and the insertion of doors and other features before remarked on in a style of architecture different from that originally belonging to them.

"It is, however, considered that such cannot be the case. For first, the masonry around the doors shews no sign of disturbance; and reasoning is altogether against these features having been altered; and doubtless, the masonry of these Towers is as originally construeted, except in some of the tops, which, from decay or otherwise, required renovation.

Fig. 1.—Ardmore Tower.

"The grounds on which it is contended that the doorways are original, is the universal custom of the Normans of using sandstone in their buildings, and of expending considerable labour in erecting their doorways—thechief feature in their structures. In the Round Towers the door-jambs are formed of sandstone, or very rarely of limestone; and always the former where there is any work on them. The later churches of the country are the same, and there is scarcely an instance in Ireland of any Norman remains in which any doorway or decorated portion is of the common limestone of the country, although for the common walls it is used, as being the material of the locality." P. 84.

The accompanying illustrations are views of the Round Tower at Ardmore, county of Waterford, and that of Roscrea, which display the Norman architecture spoken of in the extracts.

Fig. 2.—Roscrea Tower.

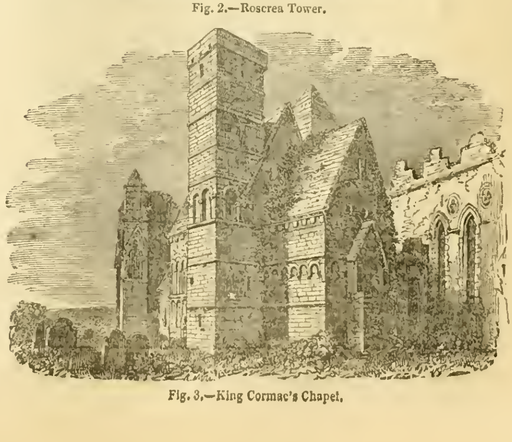


Fig. 3.—King Cormac's Chapel.

The view of King Cormac's Chapel, as shown in the annexed engraving, is a specimen, and an extremely beautiful one, of the transition from Norman to Pointed architecture. The square towers are in our author's opinion the result of a gradual change from the round towers. Mr. Wilkinson considers various distinctions in the Norman architecture of Ireland from that of England. The principal differences are, the rarity of intersecting circular arches, so common in English specimens, and a closer resemblance in the ornaments to the Lombard or Byzantine type.

"Of a style succeeding the Norman early pointed architecture, the Abbey of Timoleague (Fig. 4) presents a simple and interesting

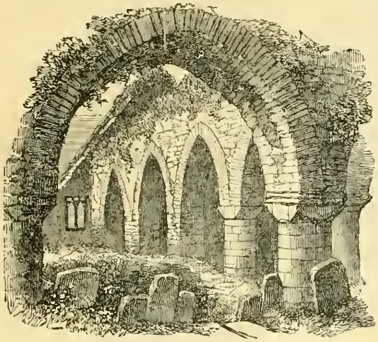


Fig. 4.—Timoleague Abbey.

example; constructed with the slate-rock of the locality, it shows in its simplicity, a great boldness and economy of construction by the excellent use made of the local material; the windows of the external walls are nearly all pointed." P. 109.

"In the Monastic edifices of Ireland there is much more of resemblance to the Continental than the English buildings, and they are of very much less extent: as an example of the general plan of these edifices, the accompanying ground-plan of Moyne Abbey, drawn to a scale of 60 feet to the inch (Fig. 5) is a fair illustration. It will be

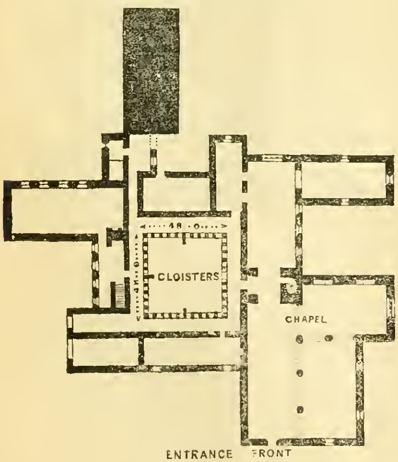


Fig. 5.—Plan of Moyne Abbey.

seen that the cloisters are very small, occupying a square of 48 feet, and are surrounded by the church on the north side, and by the offices on the other; the drawing here given of these cloisters (Fig. 6) is also a fair representation of the general design of the cloisters of the ancient Irish Abbeys. Their constructive character is very simple, composed of solid masonry, and each side of the arched portion of the stones is in one length." P. 111.

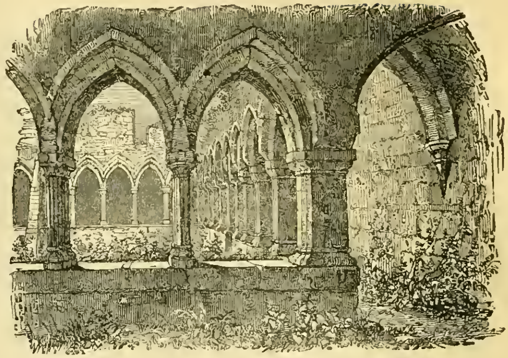


Fig. 6.—Cloisters.

"As an example of one of the towers of the monastic buildings last described, the accompanying sketch (Fig. 7), with a plan of the piers (Fig. 8), taken from the Abbey Rosserk, county of Mayo, represents

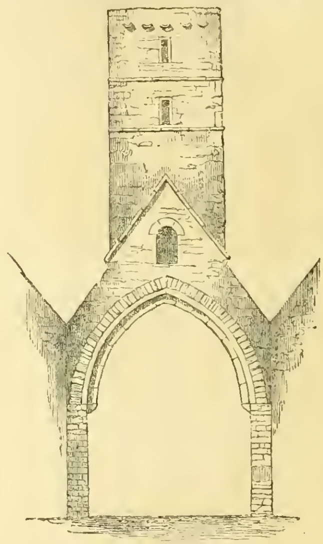


Fig. 7.—Abbey Rosserk Tower.

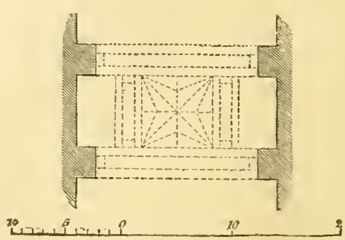


Fig. 8.—Plan of Piers.

the peculiar and inaccessible approach to these towers; an arrangement doubtless originated to obtain protection from assaults, and for the security of the bells or other treasures of the church, as before remarked in the observations made on the Round Towers. These towers are common to the abbeys which prevail near the sea-coast, there being two kinds of abbeys, those last described having the small tower peculiarly placed, and which apparently are additions in many instances, and those of a larger kind, as Cashel, Boyle, &c., before described, in which the central tower is carried on large arches at the intersection of the nave and transepts, and similar to the English and large continental cathedrals." P. 113.

The next section to that from which the above extracts are taken treats of the domestic and castellated architecture. We make no scruple in increasing the number of extracts, as a work like the present affords little materials for observations by the reviewer, who acts most fairly both to the author and the public by giving specimens of the work itself.

"After the invasion of Henry II., the Anglo-Norman chiefs extended themselves through a great portion of the country, and castellated edifices became extensively prevalent, and in many parts of very uniform character; square in plan, and of several stories or floors in height with narrow windows, and the best apartments placed in the upper part of the building, in the windows of which the best portions of the architecture were displayed.

"The buildings of this description, of which the accompanying woodcut (Fig. 9) is a fair illustration, are intermediate between the

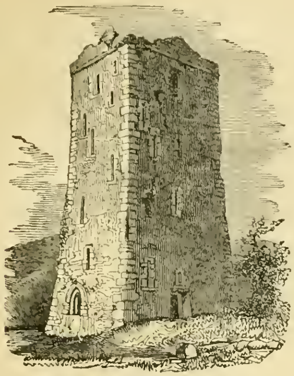


Fig. 9.

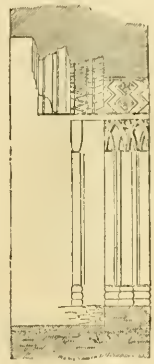
mansions erected in the later days of the Tudors, and the more fortress-like structures exemplified in the large early castles evidently intended for the reception of a numerous but less powerful class than the retainers of the great barons. In the advancing improvement of their age, buildings of this kind began to present the lightness and comfort of later domestic apartments, combined with a due regard to security; and this end is admirably accomplished by obtaining the

Fig. 10.

increased internal accommodation by adding to the height of the building, so as to present a small area only for defence.

"Buildings of this class are very numerous; many of them being frequently seen at a view from the same point of sight, and particularly amid the best lands of the southern portion of Ireland.

"Another illustration of a castellated structure, not uncommon, is here given (Fig. 10). The building, of which this is a drawing, commands the pass of a river, affording to the occupiers the power of exacting toll. The great height and comparatively small area of the base display a structure well adapted for the object of its erection. P. 118.



"The Kildare round tower has a circular-headed door of peculiar design, rather above the usual height from the ground. See section and plan of door, figs. 11 and 12.

PLAN

SECTION

Figs. 11 and 12.—Doorway.

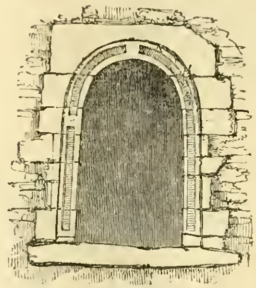


Fig. 13.—Doorway.

"Figs. 13 is a doorway from the tower at Monasterboice, county Louth, it is about five feet above the surface,—a band 11½ in. wide runs round it, and a 4½ in. sunk face, ¾ in. deep, being carried partially round,—the door is 2 ft. 3 in. wide at the base outside, and 2 ft. inside,—1 ft. 11 in. at springing, and 4 ft. 6 in. high to springing, and is semi-circular headed; the other openings are angle-headed.

"No portions of a building more conspicuously show the simplicity of means for producing a sound construction, and appropriate and picturesque effect, than the chimney shafts on the roofs of many old structures. The accompanying woodcut (Fig. 14) represents a plain old chimney shaft, which is a type of those common to the ancient buildings; and though exposed to the violence of many a storm, and frequently occupying the exposed gable point of some dismantled roof, they are yet sound and enduring. They are frequently constructed of the commonest rubble stones, roughly squared to form the angles. In several buildings the outline is much more varied, and often very picturesque, but yet the same simple construction prevails; and occasionally they are built with carefully dressed masonry, according to the circumstances of the locality.

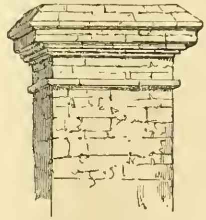


Fig. 14.—Chimney Shaft.

"The chimney shafts of ancient edifices generally present a great contrast with those of the present day. In most of the ordinary buildings of the Tudor or Elizabethan style, where something beyond the usual meagre-built shaft is required, some approved book-form is imitated,—a model from some English building, excellent in itself and suitable to the building to which it belongs, yet not necessarily so to all structures; and so established is this false system, and so little is the locality considered, or the principles of design rightly pursued, that the cement-makers find it a profitable trade to have such approved patterns kept ready-made in cement for forwarding to all places for indiscriminate use—alike on the roofs of the low gate-lodge and that of the lofty mansion.

"The chimney-pieces which were constructed in the ancient buildings are not less interesting examples of simple construction and bold design. Fig. 15 is one from a kitchen at Kilmallock Abbey, and selected as an example of bold and simple arrangement of common materials.

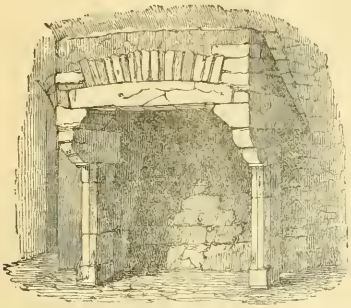


Fig. 15.—Chimney.

"Fig. 16, from Kilmallock domestic edifices; being of the ordinary limestone of the locality.

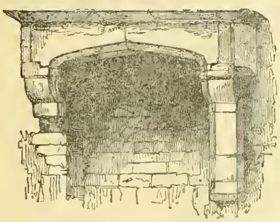


Fig. 16.—Chimney.

"The accompanying woodcut (Fig. 17), introduces us to another mode in which ancient builders applied stone different to what is attempted at the present day; it represents a portion of an abbey tower in the county of Mayo, constructed with the Moyne stone. The gable shown on the side of the tower is formed by an increase in thickness of the walling of about six inches, and on the outline of the gable a semicircular channel is formed with carefully walled stone; on this the ends of the slates rested, and instead of having lead, now usually employed, or plaster, to prevent the water from getting between the wall and the end of the abutting roof, the water was allowed to find its way into the channel, or gutter, which the slates or other covering overlapped — a mode of construction both ingenious and novel." P. 135.

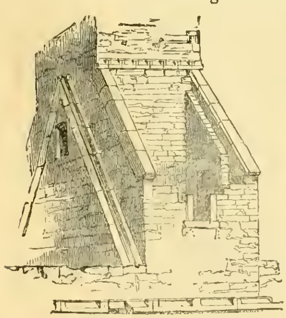
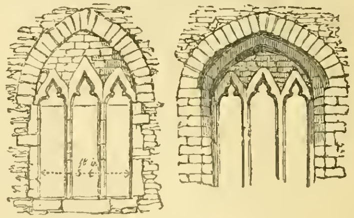


Fig. 17.—Gable stone channel.

"We should not so frequently meet with that reprehensible system so common at the present day, and which so strongly displays the absence of right feeling of construction, viz., a very common practice of constructing Gothic details, more particularly mullioned windows in wood; and so purely does this practice display the meagre imitation of the models of Gothic architecture, rather than the right feeling for design, and an appreciation of the principles which should influence it, that in Gothic edifices mullioned windows and traceried lights are actually made with perishable wood, or with cast-iron, in both cases deceptively prepared to imitate the toolings of the stone-work, and which, to heighten still further the deception, are painted and covered with stone-dust; this is to be more or less met with through all parts of Ireland.

"Such was not the practice in any one building of the past ages, or their interesting remains would not now abound; and how different was the practice of ancient builders, the simple woodcuts of a window, an exterior and interior view, (Figs. 18 & 19) here given, will display.



Figs. 18 and 19.—Window with stone mullions.

"Here is a common window selected as an example of the simplicity and soundness of constructive arrangement: here nothing but stone is employed; the larger arch constructed to relieve the mullioned divisions at once explains its purpose; the builders evidently imbued with right principles, knew what they wished to effect, and seeing around them flat bedded rocks suited to effect their purpose, have fashioned, with a pleasing form, the three pointed heads out of three separate stones selected from among those which were used for the other portion of the work." P. 136.

In the third part of his work Mr. Wilkinson treats of the geology of each county of Ireland separately, with very valuable observations on the durability of the building materials abounding in each, the cost, in each, of slate, lime, bricks, &c., and instances are adduced from ancient structures for the purpose of comparing the durability of different kinds of stone. At the end of the book are tables of the strength of the limestones, slates, and sandstones of various Irish quarries, with remarks on the mineral character of each substance. The experiments appear to have been made very carefully, but are so entirely of a practical nature that detailed extracts from this part of the work would possess no value, we must therefore recommend our readers to the work itself.

In conclusion, this work is evidently the production of a careful observer, well acquainted with the subject he has undertaken, and capable of explaining his views in perspicuous language. A book of this nature will not probably attract very great general interest, but it contributes its fair quota of information, and is written in an unassuming style, utterly free from the tone of affectation and self-complacency by which architectural works are too frequently disgraced.

HALLETTE'S ATMOSPHERIC RAILWAY.

(With an Engraving, see Plate XII.)

A pamphlet has appeared at Paris giving an account of the system of atmospheric propulsion invented by M. Hallette. The pamphlet commences with a history of atmospheric railways, and gives several extracts from the *Moniteur Industriel*, explaining the invention of M. Hallette and comparing it with that of Messrs. Clegg and Samuda. The following translation of some extracts from this pamphlet will no doubt be interesting, as the original not being published will not be very generally accessible.

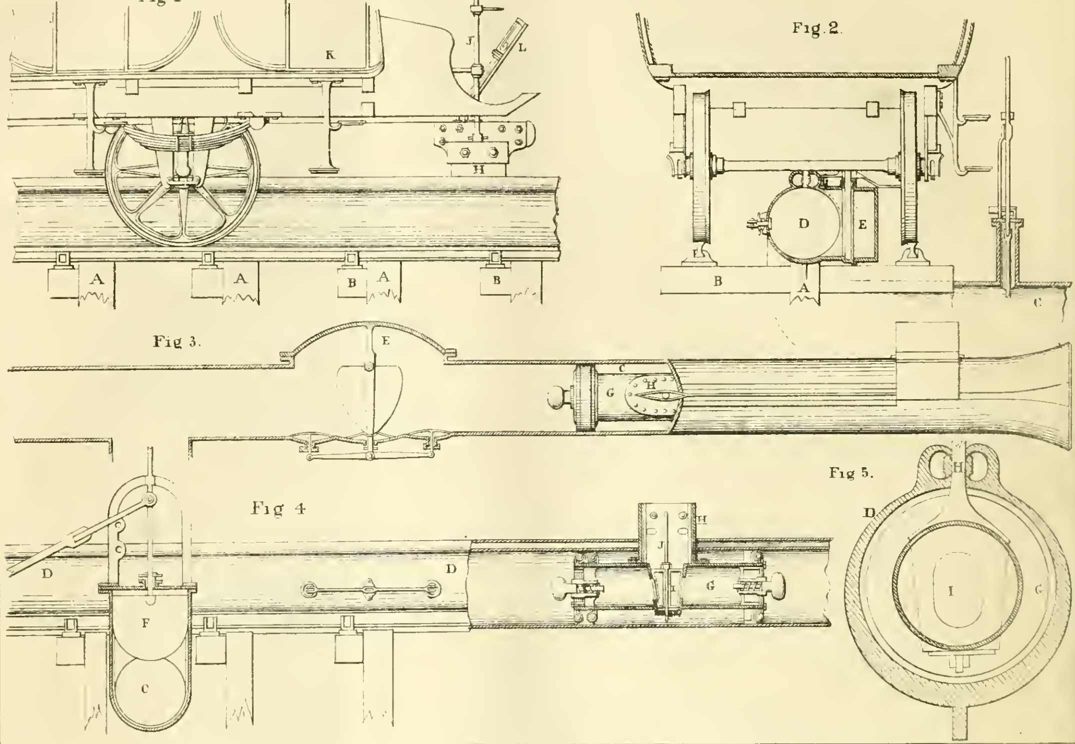
The annexed account of the history of the invention is in the usual self-laudatory style which makes French treatises on practical science so amusing to the English reader.

"The idea of making the rarefaction of air in a cylinder produce motion is by no means recent; it is French,—we owe it to Papin. It is as well to state that his claim to this honour is not disputed even by foreigners. In a lecture delivered by the English professor Vignolles before the Cornwall Polytechnic Society, and reported in the *Mining Journal* of Nov. 1842, there is the following expression: "It is now nearly two centuries since a philosopher of great genius, Papin, conceived the idea of producing motion by atmospheric pressure.'

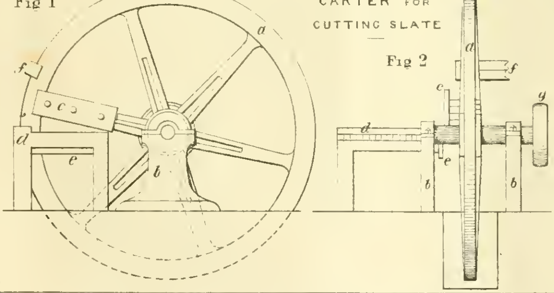
"The first useful application of the idea appears to have been suggested by the Danish engineer Medhurst, who, in 1810, proposed to transport letters and merchandize in a tunnel containing a road of iron or stone. Another project was that of travelling from London to Brighton in a tube. Failure and ridicule did justice to that idea.

"Medhurst perceiving the serious objection to placing travellers in the body of an air-pump, now made the first step towards the solution

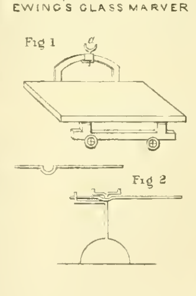
-HALLETTE'S ATMOSPHERIC RAILWAY-



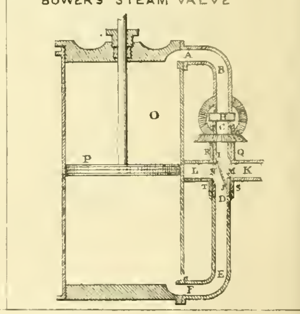
CARTER FOR CUTTING SLATE



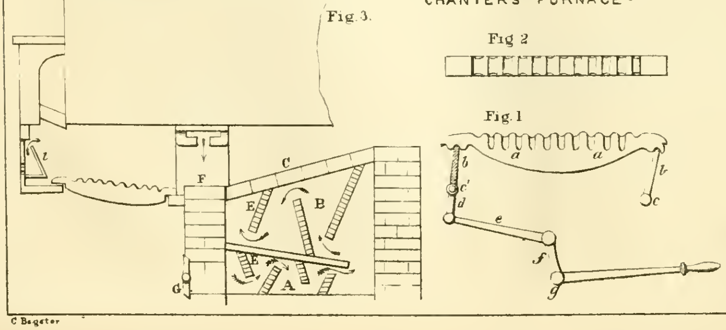
EWING'S GLASS MARVER



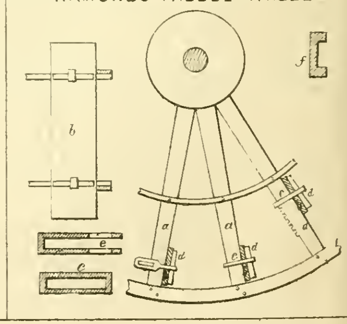
BOWER'S STEAM VALVE



CHANTERS FURNACE -



HAMOND'S PADDLE WHEEL



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of the problem. 'It must be more agreeable,' says he, with great *naiveté*, to travel in the open air than in a dark tube, setting aside the pleasure of seeing the country through which one is passing.' Medhurst proposed to transmit the action of a piston contained in the tube to carriages placed above it, by a longitudinal opening closed by means of an ingenious apparatus which he called the water-valve. This apparatus required that the tube and railroad should be on a constant level; it was abandoned.

"The American engineer Pinkus took out a patent in 1834 for a valve of rope, which did not succeed better than the water-valve.

"Lastly, Messrs. Clegg and Samuda proposed a new valve, tried at Chaillot in 1838, two years after with more success at Wormwood Scrubbs, near London, and more recently applied to a railway of about two miles in length from Kingston Dalkey, in Ireland.

"To resume, then, the history of the invention of atmospheric railways:—The first idea belongs to Papin: Medhurst opened the way to the complete solution of the problem: Messrs. Clegg and Samuda proved the *practicability* of the invention, to avail ourselves of an English term, also of French origin. We ourselves dare to claim the honour of having completed—of having realised the idea of Papin—of having UTILISED it.

"*Extract from the Report of the Sittings of the 'Academie des Sciences.'*

"M. Arago submitted to the Academy a small model of the new valve, invented by M. Hallette, for the pneumatic tube which forms the principal part of the apparatus of the atmospheric railways. M. Hallette places above the propulsion tube two longitudinal semi-cylinders, or rather two grooves, fixed alongside the slit or aperture of the tube, with their concavities opposite. Each of these grooves contains elastic tubing, to be filled with air or water. When these tubings filled with air are sufficiently expanded, they touch each other in part of their surface, act as the lips of the human mouth, and so, completely intercept the communication between the interior and exterior of the tube. When the piston is in motion, the arm, which unites it to the carriages, glides between the two elastic tubes, which close immediately after its passage. This arm, which penetrates by its wedge—form between the two tubes, passes between them with very little friction; nevertheless M. Hallette, to ensure their durability, covers those portions of the tubes which come in contact with leather.—M. Arago observed that a system of pneumatic tubes fixed along the quay of the Seine would cost much less to construct than a towing path, and that the employment of steam to draw boats had many great advantages over the employment of horses."

Explanation of the Apparatus.

"The propulsion-tube is always placed above the ground, exactly between the two rails; but the tube differs from that of Messrs. Clegg and Samuda, 1st. in form, 2nd. in dimensions, 3rd. in the manner in which it is attached to the ground, 4th. and principally, in the manner of closing the longitudinal tube.

"1. The form of the tube is indicated in the plate by a transverse section during the passage of the piston.

"2. The diameter is extended to 0*m*. 50 (about 1 ft. 7 in.) to make provision, in the first instance, for all future requirements.

"3. In place of being attached to the cross-sleepers which carry the rails, and which are consequently liable to be disturbed, the tube is isolated and independent of the cross-sleepers; it is fixed, as may be seen by the figure, on a line of piles, of a length and strength to be determined by the nature of the soil; the top of each pile has a groove cut in it which contains a blade projecting from the tube. It is therefore very easy to rectify the parallelism of the tube; to move the blocks a little on either side all that is required is to ram down additional earth; a blow or two on the head of the pile will sink it slightly; and a wedge placed under the vertical blade will raise it a little.

"4. The method of closing the tube is borrowed from nature, instead of being exclusively mechanical. Man has the faculty of breathing, and of retaining or breathing out the air. The respiratory orifices are opened or closed at will by the nostrils and lips. A pencil, or the stalk of a flower, can be placed between the lips without admitting the air. To follow this model it was necessary to introduce lips to the longitudinal orifice of the tube. On the edges of the opening in the propulsion-tube are placed two other small tubes, which would be tangent to each other if they were entire, but which are defalcated in the direction of their length, so as to form as it were two troughs with their openings opposite to each other. Into these troughs are introduced two hollow tubes, of some substance impermeable to air and water, and capable of retaining compressed air. When filled with either of these two elements, or both mixed, the tubes expand, touch each other in part of their surface, and exercise a mutual compression dependent on the degree of internal pressure, which may be always regulated as required. These tubes act as lips; they are artificial but real veritable lips, which permit without difficulty, and almost without friction, the most rapid motion of the arm of the piston without suffering the air thereby to enter the propulsion-tube. The tube is interrupted at the stations for the construction of siding tubes. Stationary engines are established at intervals of about 5 miles.

Reference to Engravings, Plate XII.

Fig. 1 a longitudinal view, and fig. 2 a transverse view, showing the connection of the carriage with the propulsion tube and the exhaustion tube. Fig. 3 is a top view of the propulsion tube, with part removed to show the entrance valve and the piston in its progress; the entrance of the tube is has a trumpet mouth, to allow of the entry of the piston during its passage. Fig. 4 is a side view of the propulsion tube, part being removed to show a section of the piston with its regulating cock. Fig. 5 is an enlarged section of the tube and piston.

A, are piles upon which the propulsion tube is fixed; B, cross sleepers to carry the rails; C, the exhaustion tube, furnished with a valve, F, like a sluice cock, to either close or open a communication with the propelling tube; D, the propulsion tube; E, the entrance valve; F, sluice valve; G, piston; H, the connecting arm; I, regulating cock; J, key to cock, regulated by the conductor sitting on the front seat of the carriage, K.

Operation.—Before the train arrives at the entrance of the propulsion tube, the valve, F, of the exhaustion tube is opened, and the engines are set to work the air-pump, for the purpose of exhausting the air from the propulsion tube to the necessary degree of rarefaction, this being obtained, the train is then put in motion by allowing the piston to enter the propulsion tube, which by its passage opens the entrance valve, and on its leaving closes the exhaustion valve without any assistant being required. If it be desired to arrest the progress of the train when coming to a station, or for any other cause, the conductor who sits in the front of the carriage opens the regulating cock, I, in the piston, G, which allows the air to rush in to the front of the piston and arrest its progress, and at the same time he applies the break. In a similar manner the conductor is enabled to regulate the velocity of the train going down inclined planes. When the train is not in motion the valves of the exhaustion tube at each end, and also the two entrance valves, are closed; the piston is kept in equilibrium on the entrance side by the pressure of the atmosphere remaining in the tube and the breaks, and on the other side by the natural pressure of the atmosphere. When the train is to start again the valve of the exhaustion tube on the advance side of the piston is opened, and the entrance valve at the opposite end is also opened, when the air is sufficiently rarefied, and the breaks released from the carriage, the train proceeds at the required velocity. The conductor is at all times enabled by the cock, I, to regulate the velocity of the train; there is also a barometer, L, placed before him, with a scale to indicate the state of rarefaction of the air in the tube.

Comparative Expense.

"The ten railways executed in France have cost on the average £30,000 per mile, according to M. le Comte Daru. The three great lines which have been completed have cost on the average £24,000 a mile, according to the *Memorial de Rouen*, cited in the *Moniteur Universel* of the 9th of February 1844. It is known that the estimate of £20,000 a mile adopted by the law of June 11th has been found too small. The railway by the present system would be laid down by the side of a public road or canal. The expense of moving earth would therefore be the same as for small roads. The construction of an ordinary road costs in France, according to M. Comte Daru, £960 a mile.

	£
Embankments, sleepers, rails	2,300
Stations and various buildings	640
Propulsion-tube and accessories	10,240
Engines, pneumatic apparatus £4,000 for every 5 miles; for one mile	800
Carriages	640
	£14,620

"Say £15,000 a mile. It will be seen that the real economy of the system is estimated below its true amount when taken at 30 per cent of the cost of railroads for locomotive engines."

The advocates of the atmospheric propulsion principle generally draw their comparison of the expenses by allowing only a single line of rails on the atmospheric principle, against a railway with double lines of ways on the locomotive principle. This is making a false assumption, for the atmospheric system, in order to obtain any degree of certainty in the traffic, requires a double line of ways, two engines at each station, and so forth: in such case the economy of the system at once vanishes; in fact the comparative expenses of the construction of the railways on the atmospheric and locomotive principles will be greatly against the former.

IRON LOCK GATES AT MONTROSE.

"*Description of a pair of Iron Gates constructed in* 1843 *for the entrance to the Wet Dock at Montrose.*" By James Leslie, M. Inst. C.E. (*Read at the Institution of Civil Engineers, Session* 1844.)

The frames of these gates are of cast iron, but have the lower bar and a false mitre of oak, so as to be more easily fitted and made water-tight, and they are entirely covered, on both sides, with wrought iron boiler plate. They are in all their dimensions very nearly similar to the gates of Earl Grey's Dock, at Dundee, which were constructed in 1834, also from the designs and under the direction of the author. The entrance is 55 feet wide in the clear, and the centre of the heel-post being 1 foot inwards from the face of the wall, the distance between the centres is consequently 57 feet. The gates are 22 ft. 6 in. in height, they have a pointing (or sally) of 10 feet, and the ribs have a curvature of 18 inches, on the hollow side.

The heel-posts, fig. 1, are of cast iron 1 foot 9 inches diameter,

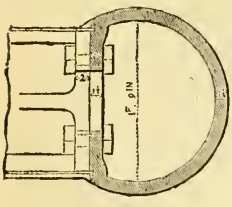


Fig. 1.—Horizontal section of heel-post, and plan of the end of a bar.

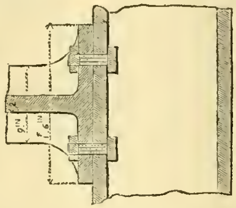


Fig. 2. Vertical section of heel-post and bar.

forming a segment of a circle, somewhat larger than a semicircle, which admits of their being accurately turned in a lathe; they are 1¼ inch thick, at the thinnest part when finished; but the straight faces are 1½ inch thick, and have snugs cast on them, fig. 4, for bearing up the ends of the ribs, or horizontal bars, and holes for getting in the hand, to screw up the bolts which fasten the ribs to the heel-posts.

The heel-posts have each a cast iron socket, fitted into the bottom, working on an iron gudgeon 10 inches diameter, cast on a sole plate 4 feet 6 inches long by 1 foot 9 inches wide, and 2 inches thick, dovetailed, sunk and riveted into the stone, after being keyed up, so as to press the heel-post hard into the quoin.

After the hollow quoins, which are of Kingoodie stone, had been dressed down and polished as nearly as possible to the circle, but before the gates had been framed together, the heel-posts were set in their places, and were kept turning round, backwards and forwards, and hard keyed up, while sand and water were poured in at the top, till the stone and the iron were made to touch throughout in the height, so as to be perfectly water-tight.

The mitre-posts fig. 3, are 18½ inches broad and 1½ inch thick, with snugs upon them for holding up the ends of the bars, and two flanches 1¼ inch in thickness for fastening the wooden mitres.

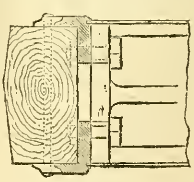


Fig. 3.—Horizontal section of the mitre-post.

Holes were cast in the mitre-posts for introducing an iron bar, to hold against the rivets of the last row of covering plates; but these holes were filled up, after the riveting was completed, by pins of iron, cast to fit them, and which were fixed into their places by corrosion.

There are eleven horizontal bars, figs. 4 and 5, to each leaf, distri-

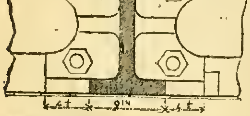


Fig. 4.—Transverse section of a bar, and elevation of heel-post

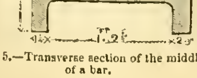


Fig. 5.—Transverse section of the middle of a bar.

buted so as to be closer together towards the bottom, than at the top; they are 2 inches thick, 16 inches broad at the ends, and 18 inches wide at the middle, with two double flanches 9 inches broad and 2 inches thick on the hollow side, and 1¼ inch thick on the convex side, excepting the lowest bar, which has only the upper flanch.

The bars have cross ends 18 inches in height and 2 inches in thickness, with four screwed bolts to each 1½ inch diameter, through the heel and mitre posts.

The clap cill is cast in two pieces for each leaf, it is 8 inches deep and 1½ inch thick, with dovetailed snugs cast on it, tailing 6 inches into the stone; the joint between the iron cill and the stone, is closely caulked in with iron cement, and the face of the cill is chipped and filed, where necessary, to make it quite fair for the bottom bar to fit upon; the height of the cill above the platform, is 15 inches.

The bottom bar is of oak 12 inches thick, 17 inches broad at the ends, and 19 inches broad at the middle; it is bedded on felt to the lowermost cast iron bar, and is fixed up to it by bolts 1¼ inch in diameter screwed into the timber.

The false mitres fig. 3, are also of oak, fitted closely into the cast iron posts, and fastened by bolts 1 inch in diameter, riveted through the flanches, and they are tongued down into the bottom bars.

Both sides of the gates are lined with boiler plates, arranged so as to break joint; the plates of the lower tier, averaging about 6 feet in height, are ⅜ inch in thickness, and all above them are $\frac{5}{16}$ inch thick; they overlap each other about 2½ inches, and are fastened by rivets ¾ inch diameter for the lower plates, and ⅝ inch diameter for the upper plates, all riveted while hot, and made to fill up the holes completely. The gates are perfectly tight on both sides, and were proved by having water filled into the inside.

The anchors are of cast iron 3½ inches square, dovetailed, sunk into the top hollow quoin, and run in with lead.

The wrought iron collars of the heel-posts are 4 inches by 2 inches, keyed through the anchors.

The roller segments, or railways, are 10 inches broad by 1½ inch and 4 inches thick, sunk and bolted down to the stone and bedded on felt and white lead; the upper surface is chipped and filed where necessary, to make it fair and straight.

The cast iron rollers are conical, 18 inches diameter and 5 inches thick, with steeled axles turned. The roller boxes are of cast iron 1¼ inch thick, moulded so as to suit the bevel of the gates, and are fastened by screw bolts, through the flanches of the horizontal bars; there are cast iron covers, to confine the roller blocks, which slide up and down within the boxes, by the action of the top screws. The roller bars are of wrought iron 3 inches diameter, keyed into the blocks at the bottom; each is steadied by three plummer blocks, and each bar has a coupling near the top, with a square threaded screw and a brass nut at the top, working in a strong cast iron bracket, which bears the whole weight of the outer end of the gate, and is fastened by screw bolts, through the flanches of the horizontal bars.

There is one sluice, measuring 3 feet by 2 feet, in each leaf of the gates. The sluice frames have faces 7 inches broad and 1¼ inch thick, and cheeks ¾ inch in thickness, going quite through the thickness of the gate, with a flanch on the two side cheeks, for riveting the boiler plate to.

The sluice valves are 1¼ inch thick, with flanches on the back, and both the frames and valves have raised margins planed and grooved so as to clap quite close. There is no brass about the sluices, but the backs are covered with zinc plates, and all the screwed bolts have zinc nuts, screwed over the iron nuts, so as by the galvanic action to prevent the iron from rusting.*

The sluice rods are 2 inches in diameter; they have a square threaded screw, and a brass nut at the top, worked by a wheel and pinion under the gangway, and bevilled gear with a crank handle nearly level with the hand-rail.

There is a gangway 3 feet 6 inches wide, supported on six cast iron brackets, for each leaf of the gates; there are fixed cast iron balusters and a wrought iron hand-rail, on the convex side of the gates, and wrought iron moveable stancheons with a chain along the other side, which is more liable to injury from vessels.

There is a small water-tight hanging valve in each leaf, a little above low water, for running off any leakage water from the interior of the gates, down to that level; and there is also a pump, with a brass chamber and boxes 2½ inches diameter in each heel-post, with a lead pipe down to the bottom, for pumping them dry; it is worked by a rocking shaft, fixed to the cast iron covers of the heel-posts.

To let the leakage water down to the pump, there is a hole 1 inch diameter in each horizontal bar except the lowest.

* Mr. Leslie has since examined the iron work of the Dundee Dock Gates, which was similarly protected, and he found that after three years' use the zinc had apparently lost its power of galvanic action, as corrosion of the iron nuts had commenced.—September, 1844. Sec. Inst. C.E.

The gates are worked by four double-purchase capstans, with gearing, and ⅞ inch chains. All the bolts were dipped in hot linseed oil before being driven, and all the surfaces of the iron, both inside, as well as those outside, received three coats of oil paint.

The timber, under water, except at the meeting of the cills and mitres, is all covered with scupper nails to keep out the worm.

The weight of the gates and the apparatus connected with them is as follows:—

	Tons.	Cwts.
Cast-iron work in the gates	64	14
Wrought iron in ditto	22	15¼
Brass	..	5
Zinc	..	1¼
Total weight of gates, exclusive of timber .	87	16
Cast-iron in segments, cills, capstans, anchors, and other fixtures . . .	19	4
	107	0

The dock is only about 3 acres in area, which is considerably less than what was originally intended, but owing to opposition, its size was reduced while the Bill was in Committee, which is to be regretted, as the river wall and the entrance, which are the most expensive parts of the work, remain the same, and the enlargement could have been executed, at a very small additional cost. At the suggestion, however, of Mr. Walker, (Pres. Inst. C.E.) a provision has been made for a future extension, by having an opening at the inner end of the dock, and filling it up in a temporary manner, with sheeting piles held back by iron tie rods, and puddled behind with clay; these sheeting piles may be made to form part of a coffer-dam, and an extension may be thus made, at any future time, without closing the dock.

The ground on which the dock stands, is sand, or sand and gravel, which is full of water, to within a few feet of the surface; and owing to the failure of an attempt to form a graving dock, in similar ground in the neighbourhood, about 50 years ago, great fears were entertained that it would be impossible to make a dock to retain water; therefore it was not thought advisable to proceed with the plan, until Mr. Walker's opinion was taken as to its practicability. His report being favourable, the work was contracted for in the spring of 1839. The result has justified the most favourable anticipations, for there have been no serious difficulties to contend with, and all parts of the work stand well.

The tide work, in founding the outer wall, was at first found to be very tedious, and expensive, owing to the great leakage, as the foundation was considerably below low water, until Mr. Smith, of Montrose, the contractor, had a steam-engine erected to work the chain-pumps. This was done by common ropes passing over sheaves, and so conveying the motion in a very simple manner, sometimes above 600 feet from the engine-house to the coffer-dams; the work then proceeded rapidly.

The coffer-dams were wooden boxes, about 25 feet long by 15 feet broad, sunk as far as they could be got down, and afterwards piled inside, with thin sheeting piles, to keep the sand from running in below.

The gates were contracted for, and made by Mr. Stirling, of the Dundee foundry (Dundee).

The dock was commenced in June 1839; the gates were completed, and the water was admitted in July, 1843. The whole expense of the dock and the gates, but exclusive of the Act of Parliament and the purchase of property, was about £40,000.

The dock enters from the river South Esk, which forms the harbour, and is kept open to the depth of 7 feet at low water, and 22 feet at high water, of ordinary spring tides, by a strong scour into and out of the basin at Montrose, an estuary of nearly four square miles in extent, immediately behind the town. The dock has a depth of 20 feet at high water of spring tides, and 16 feet at neap tides, and the entrance being as before stated, 55 feet in width, it can always receive at high water the largest steamers navigating the east coast of England and Scotland.

Rain in Algiers.—M. Don, who is charged with the operations of draining in Algeria, has transmitted the result of his observations since January 1838, to the Academie des Sciences, on the quantity of rain that falls annually at Algiers. M. Don divides his observations into periods of four months, setting out with the opinion in the country that rain falls during months of the year, viz. from the 1st of Sept. to the 30th of April. In the first three years this opinion appeared to be well founded, the average of May being greatly inferior to that of September; but in the three following years, the average of May was higher; and the observations of the average of seven years show that September is less rainy than May, so that the dry months are really only three—June, July, and August. M. Don states that the winter which has just ended was unusually severe. The quantity of snow that fell and remained for several days on the ground was unprecedented; but the thermometer never fell below 3 deg. centigrade under the freezing point.

ON IRON ORES.

"*Experimental researches into the properties of the Iron Ores of* Samakoff, *in* Turkey, *and of the Hæmatite Ores of* Cumberland, *with a view to determine the best means for reducing them into the cast and malleable states; and on the relative strength and other properties of cast-iron from the Turkish and other Hæmatite Ores.*"—By William Fairbairn, M. Inst. C.E. (*Paper read at the Institution of Civil Engineers, Session* 1844.)

In the smelting and manufacturing of the poorer iron ores, as they are commonly called, being those in which a large proportion of alumina, silica, and other foreign matters are contained, many important improvements have in modern days been effected; but in the reduction of the richer sorts—hæmatite ores, those more nearly approaching pure iron, with very little admixture of other substances, there has been scarcely any change from the old and expensive methods, which have for several centuries prevailed in this and other countries. It is remarkable, that the proprietors of the richer minerals should have allowed the makers of iron from ores of leaner quality, such as the blackband and kidney ores, to have so far outstripped them. Except the successful experiments of Mr. Heath, at the Works of Porto Nuovo, in the East Indies, and the attempts now making by the Cleator Company, near Whitehaven, there are few instances of improvements in the smelting of rich ores, either in this country or on the continent. It has been stated, that the Swedish iron manufacturers have introduced some alterations into their works, but they appear to be of minor importance, and to be scarcely entitled to the name of improvements, upon the old process used in that country for a long series of years.

It is to Mr. Ohanes Dadian, (Assoc. Inst. C.E.) an active and enterprising Armenian, in the service of the Sublime Porte, that we are indebted for the present inquiry; and by that gentleman's determination to surmount every obstacle, and to solve the doubts of some eminent chemists, the present results were obtained. Amongst other duties devolving upon Mr. Dadian in his recent visit to this country, was that of placing in the hands of competent persons, some samples of ores which were sent from Turkey, for the purpose of experiment. The first samples were small in quantity, but a more recent supply, accompanied with some specimens of bituminous coal, enabled the experimenters to enter upon the subject with increased confidence, and to pursue the inquiry with much greater prospects of success. In addition to this, Mr. Dadian had full power to engage persons duly qualified for the investigation, and whose skill and practical knowledge, would entitle them to the support and confidence of their employers. In consequence, Mr. W. N. Clay was engaged as a chemist and metallurgist, and Mr. John Hague as engineer.

As the greater part of the experiments were conducted under the superintendence of those gentlemen, their separate reports are given in the order in which they were made; and to prevent confusion the facts are recorded as they occurred, from time to time, in the experiments.

Previous to Mr. Dadian's visit to England, he had collected information relative to the fuel, limestone, &c., in the district of country where the ore is found; and from the abundance and quality of the materials, it is presumed that a moderately cheap iron of very superior quality may be obtained. From the description of the country, as given by Mr. Dadian and by Mr. Zohrab (Assoc. Inst. C.E.), who visited the locality some years since, it appears, that the ore is brought down the rivers from the higher districts, and is deposited in the lower valleys, at a short distance from the sea; extensive tracts of country are thus covered, to a depth to insure an almost inexhaustible supply.

Before any definite plan could be adopted for the reduction of the ores, it was deemed necessary to ascertain, by careful analysis, their composition and value, and for these objects Mr. Dadian, when last in Paris, consulted Monsieur Dumas, the chemist, and from that gentleman he received a favourable report: that report is not in the author's possession, but from statements received, it appeared only to have differed in a slight degree from that of Mr. H. H. Watson, of Bolton, whose analysis of one of the samples (which may be taken as a fair average of the whole) gave—

One atom of metal	28 + one atom of oxygen	8 = protoxide of iron.	
Two atoms of metal	56 + three atoms of oxygen	24 = peroxide of iron.	
	84	32	

84 metal + 32 Oxygen = 116 black oxide.

Then 116 : 84 : : 88 : 63·72 + quantity of metal per cent. in the ore in question by theory.

In this statement Mr. Watson observes, "that the oxide readily dissolves, when the ore is heated in powder with hydro-chloric acid," and by thus treating 100 grains of the ore, he obtained a solution of the oxide, and had 12 grains of silicious earth undissolved; the proportions would therefore be—

Protoxide of iron .... Peroxide of iron	88
Silicious earth..........	12
	100

From the above it is evident that the ores are nearly pure oxides of iron; they are rich in quality, highly magnetic, and may be easily separated from extraneous matter by the magnet. In some of the processes this separation may or may not be necessary, but in case the silica be found injurious, the process of cleansing may be effected by a series of magnets fixed on the circumference of a wheel, which in moving through the loose ore, would attract the iron and carry it round to a revolving brush, acting upon the periphery, and thus deposit the metal into a receiving box on the opposite side. This is probably the best method for obtaining the perfectly pure oxides; but the most expeditious mode would be to cleanse it with a fan, in the same way as farmers winnow grain, by blowing lighter particles to a distance, and allowing the metallic granules, as being of higher specific gravity, to fall short into a separate receiver. A third method would be, to wash the ore in a current of running water, and thus free it from all superfluous matter not required in the process of manufacture. But in these different cleansing operations, an excess of the silicious earths is assumed, and moreover that these mixtures are detrimental to the process of deoxidation, to be effected either before or after the change in the furnace. Now it is not altogether clear that such is the case, and in the absence of experiment it is reasonable to suppose, that instead of these earths proving injurious they might be found useful, in combining with the limestone as a flux, and thus vitrifying the silex at the same instant the deoxidating process is going on. These opinions are entitled to some weight, as the separate reports of Mr. Clay and of Mr. Hague (although their views are not altogether similar), still inculcate the necessity of adopting some effective process of deoxidation.

Before adverting to the experiments, it will be necessary briefly to state the opinions of several manufacturers, to whom the ores were submitted for inspection, and to whose sound practical views the country is indebted for many valuable improvements in the chemical as well as the mechanical process of the art. To the iron-maker and engineer, a minute chemical analysis is of less importance than a knowledge of the methods used in the treatment of similar ores, derived from experimental and practical research. It is true, that none of the iron ores of this country will bear a comparison, in point of richness, with those of Turkey, excepting, probably, the red ores of Lancashire and Cumberland, which, although varying in their chemical compounds, are in other respects comparative, and exhibit (with the exception of the magnetic properties) characteristics of a very similar description.

According to Dr. Colquhon, of Glasgow, the Ulverstone ore contains—

	Grs.
Peroxide of iron	90·3
Silica	5·0
Alumina	3·0
Lime, Magnesia	traces.
Water	6·0
	104·3

This, by calculation, would give an average of 62 per cent. of iron, of nearly the same degree of richness as the ores of Samakoff, which, from Mr. Watson's analysis, yields 63·72.

Dr. Colquhon, in his inquiry into Mr. Clay's new process, for making malleable iron direct from the ore, states, "that the red ores of Lancashire and Cumberland (which are a species of hæmatite), are exceedingly pure," and from an average sample, made up with great care, he found its constituents composed "of 62 per cent. of iron, 8 per cent. of earthy matter, and minute quantities only of lime and magnesia." In other respects the ores were entirely free from phosphorus, arsenic, and sulphur.

From this statement it is obvious, that the Ulverstone ores, operated upon by Dr. Colquhoun, do not widely differ from those analyzed by Mr. Watson; and viewing their other properties, they may be considered to approximate, irrespective of the quantity of metal produced in each.

Concerning the other iron ores of this country, unfortunately none of them are analagous to those of Turkey, either as regards their chemical constituents, or the process by which they are reduced. It is the opinion of all the practical iron masters who have been consulted, that in smelting, the latter would require a different treatment, from that pursued with the ores of this country; but in making malleable iron, they are all agreed as to its fitness for Mr. Clay's new process, and that large quantities of the finest quality might be made direct from the ore, at a moderate rate of charge.

On these points there is but one opinion, but the manufacturers are somewhat startled at the idea of a new process of preparation; the smelting being considered a work of difficulty, from the expense and trouble which must be incurred before the preparatory process of roasting can be accomplished. In fact, these opinions would infer, that the whole must be looked upon, for some time to come, as an experiment, and that more particularly as the material to be worked upon is entirely new, and may present features of an exceedingly obdurate and refractory character. To a certain extent these views may be correct, as an excess of silex might prove exceedingly troublesome, and even with every care in the process of smelting, instead of a carburet (by which the melting pigs of this country are so well known, and so justly appreciated), a silicate of iron might be the result. It is true, that a flux of lime and a certain proportion of aluminous clay might remove, or in a great degree neutralize, the effects; but that can only be determined by experiment, and with such obstacles in advance, it will be necessary to guard against them, and to arrange future operations with a view to their removal.

But supposing them to be overcome either by this, or by the cleansing process already alluded to, or by such other means as may be deemed expedient, it is then to be considered, how the minute particles of the ore are to be retained in the furnace, during the application of a strong and intense blast. It is clear that some process of calcination must be adopted, in order, not only to deprive the ore of part of its oxygen in the first instance, but to effect its carburation, and to hold it together until it is fused. For these objects the following experiments were entered upon, under the directions of Mr. Clay and Mr. Hague.

The first operation was to convert one of the cupola furnaces (4 feet diameter) at the Canal Street Works, Manchester, into a blast furnace; this was effected by lining it with fire-bricks to a height of 15 feet, leaving a hearth of 18 inches square, and 18 inches deep; it was made 2 feet 6 inches diameter at the boshes, and tapered to 18 inches at the top; with this furnace, and a moderately good fan blast, the experiments were made.

Mr. Hague's Experiments.

Previous to making the experiments at Manchester, Mr. Hague had tried the ores in various ways, and had subjected them to analysis and experiment. The first was made with only—

4 oz. of iron ore
4 oz. of chalk
3 oz. of bottle glass
¾ oz. of charcoal
½ oz. of clay
—
12¼ oz.

which, having been deoxidized in a close vessel, and melted in the crucible, produced a super-carburet of good No. 1 pig iron, and which worked freely under the chisel and file.

The next experiment was on a larger scale, and consisted of—

30 lb. of iron ore
10 lb. of bottle glass
8 lb. of clay
—
48 lbs.

This, after being roasted, was pulverised, and mixed with water; it was then formed into bricks, and subsequently melted, with a limestone flux, in the cupola, by a fan blast, and produced a hard white iron, of a quality varying between No. 3 and No. 4 pigs.

The last experiment was repeated, with the addition of 2 lb. of clay and 2 lb. of common salt; 10 lb. of scoria from the last melting being substituted for the bottle glass. The produce of this mixture was a white No. 3 iron, nearly the same as the last.

Other tests of a similar kind were made, with nearly the same success, but no change of any moment occurred in the quality of the iron, until experiments on a more extended scale were adopted. These are given in the words of the experimenter.

Mr. Clay's Report.

"*On the Iron Ore or Iron Sand of Samakoff in Turkey; and on the best means of reducing it into the states of cast and wrought iron, &c.*" By William Neale Clay, Director of Iron Mines and Works to the Sublime Porte; February 9, 1844.

Under the direction of Mr. Fairbairn, of Manchester, to whom the experiments on the Samakoff iron ores were entrusted, the writer was empowered to make such trials and experiments, as in his judgment, were most conducive to the full and perfect reduction of the ores into the cast and malleable states. Acting upon these instructions, no time was lost in making the necessary preparations; and from the facilities afforded, both at Manchester and the Backbarrow Iron Works, near Ulverstone, the most satisfactory results were obtained.

It would appear, that on a small scale, and at a great sacrifice of time, fuel, and labour, this ore had been long used by the natives, for the production of small quantities of wrought iron, by the ordinary primitive method; —namely, the mixture of the ore with charcoal in a deep hearth, and the employment of a weak blast.

The casting of ordnance being a great object with the Ottoman Government, more recent attempts had been made to convert the ore into cast iron, but without success; or at all events with so little, as only to produce a white iron, quite incapable of being remelted for common purposes. Very meagre information was obtained, as to how or where the attempts had been made; it being merely stated that every means had been tried, and that the iron produced could not be recast, even into a cannon ball. That these trials had been made in various countries, but always with like results, and the continuous failure in the production of iron fit for remelting, seemed to have produced a conviction that there was something inherent in the ore which prevented its being reduced, by any means, into cast iron of good, or even of common quality.

From the information obtained, it appears that the supply of this beautiful ore in the lower valleys of Roumelia, at a short distance from the sea, is almost inexhaustible. Although much smaller in its crystals than the celebrated Wootz ore from Porto Nuovo, in the East Indies, it is so similar, that probably, like it, it may be found in the mine, mechanically combined with quartzose crystals; if so, nature has nearly purified it, by the action of the torrents which have brought it from its bed; for when it is deposited in the valleys, the small portions of silex still commingled with the ore are readily separable by many mechanical means. When freed from its accompanying silicious earths, which amount to 12 per cent., it yields 72·4 per. cent of iron, a quantity which denotes its extreme purity; being the richest form in which the ore is ever found in quantity. When combined with the silex, the yield, by analysis, is 63·7 per cent., which is very nearly what was obtained by fusion with carbonaceous matter, and a flux, in the crucible.

Among the parties consulted, a difference of opinion has existed as to the necessity of having the silex separated. Some contending, that when vitrified by a due proportion of lime, the resulting glass was rather advantageous; while others maintained, that such a glass was not obtainable from silex and lime alone, and that the presence of the former, unaccompanied by clay, rendered many ores of iron comparatively valueless, there being much difficulty in reducing the silicated oxides of iron, which such ores would form when exposed, *per se*, to a high temperature.

It appeared to the author, that the investigation of the phenomena, attendant on the fusion of the earths generally found commingled with iron ores, was of the greatest importance, and that much of the successful practice of iron smelting depend on the proper vitrification of these earths; that an important analogy existed between the manufactures of glass and pig iron, and that in order to accomplish successfully the production of the latter, it would be necessary to study the theory of the former. When this was done, he conceived that, more particularly with reference to the richer descriptions of ores, the mists which were generally supposed to envelope the manufacture of pig iron, must be rapidly dispelled before the advancing light of science, and that many results, now looked upon as unaccountable phenomena, would be reduced to their more rational position, as calculable effects from appreciable causes.

[The author, after explaining the vitrification of silex, then proceeds to the more immediate details, and observes—]

On Reduction of the Ore.—Still looking at it in its scientific bearings, he cannot but think, that a magnetic iron ore is, as it ought to be, the most easy of reduction, if that reduction be prosecuted on sound chemical principles. He presumes that he may designate those as magnetic ores, which, like the Turkish, contain a proportion of protoxide of iron; but at present he would confine himself to the richer classes only. It seems singular, that this description should be the one universally used (as far as he can learn) in the old bloomeries, or in the improved form of that furnace,—the Catalan Forge. In America—in India—in Prussia, and in Spain, these ores alone seem to be used. Is it not probable, because their state of diminished oxidation renders their reduction more facile, and if readily brought into the metallic state by the crude action of the blast in the bloomery—*à priori*, why should not they, when once in that state in the high blast furnace, be as readily impregnated with carbon to make cast iron?

Rich Iron Ores.—He looks upon it, that the reason why the English iron-masters of the present day, consider the reduction of the rich ores a matter of such doubt and difficulty, is, because they have only tried them, and always treated them as of the same family as the leaner iron stones; and thus they practically find that they can use them but in small proportions. An extensive iron-master of Staffordshire told the author, that when he added more than one-fourteenth part of the rich Ulverstone ore, he always endangered the "gobbing up" of his furnaces. Now this was to be expected;—with the red ore he was using only the same quantity of carbon as if that much of some calcined "lean mine" had been used. When told that he must use more coke, he declined, on account of the extra expenditure of fuel, forgetting that the larger proportion of oxygen in the ore would require larger dose of carbon, both for its decomposition and the impregnation and smelting of the greater quantity of iron produced.

Smelting.—From all he can gather, the writer thinks that the only difficulties about the smelting of the Samakoff ore, are its specific gravity, and the fineness of its particles; it would thus be carried down too rapidly through the decomposing region, into the hearth of the furnace, and thus the carbon in the upper parts would be rendered inoperative. With furnaces of a more cylindrical form, he considers that this evil might be, in a great measure, avoided; there would not be that tendency to rapid descent of the portion of the "burden" in the centre, which the egg-shaped sides of the present charcoal furnaces seem necessarily to cause, but the whole charge would settle equally and regularly, as the portion below was reduced and consumed. Such shaped furnaces may suit ores, even as fine as those from Samakoff, but until they are fairly tried, there may be great doubt of the result, and it was to the alternative of the two evils,—a strong blast, which blew the ore out of the top of the furnace, or a weak one, which let it fall too rapidly to the bottom, that the defective quality of the iron previously made, was ascribed. To avoid all risk of suffering from either of these evils, the writer recommended a modification of the process, which he had invented for the production of wrought iron direct from the ore, (*See Journal*, Vol. VI., 1843, page 207,) and after trying it in a small way in a common foundry cupola furnace at Mr. W. Fairbairn's works, at Manchester, with encouraging success, a larger quantity of the ore was procured from Turkey, and the process was tried on a more practical scale at the Backbarrow charcoal furnaces, which the liberality of Messrs. Harrison, Ainslie, and Roper, had permitted him to use.

The writer now proceeds to detail the results of this trial, apologizing for the apparent prolixity of the preceding matter, trusting that the results of the experiments may be deemed more professionally interesting, particularly as bearing upon what must be an object of such vital importance in every branch of engineering,—the quality of cast iron.

Cast Iron.—1120 lbs. of the Samakoff ore, imperfectly freed from the silex by washing, were mixed up with half that weight of the riddlings of charcoal (a comparatively valueless residuum from the blast furnaces); this charcoal "breeze" being fresh washed, to free it from dirt, must have contained, at least, one-third of its weight of water. The mixture was thrown into a common puddling furnace, and lightly stirred about, every 5 minutes; at the end of 35 minutes, the mass having become pasty, and palpably "coming to nature," was withdrawn; on being cooled, it was found to weigh 867 lb., the loss of weight showing that the deoxidation had been pretty far advanced. The quantity was so small, that it was difficult to fix on any mode by which the product of the Turkish ore could be satisfactorily separated from the current burden of the furnace; after some consideration, Mr. Roper, junior, the manager of the works, decided on proceeding as follows:—

At six o'clock on the evening of the 8th December, 1843, the customary charges of hæmatite ore, in the Backbarrow furnace, were stopped, and "false charges," that is, charcoal, lime, and other flux, without ore, were continued to be used, till 10 o'clock; it was then considered, that a complete separation would be made by this great quantity of charcoal, &c., between the last ore charged and what was now to be used. The Turkish ore was then used, in like weights, with their customary charge, and the last charge was put in at midnight. About this time the furnace was tapped, and a charge of white iron run out.

No variation in the working of the furnace took place, until 10 o'clock A.M. of the 9th, when it was clear to the workmen, and was soon ascertained by Mr. Roper, that the furnace was working "light," *i. e.*, making little or no iron; in other words, that all the ore charged previous to 6 P.M. of the previous evening, or very nearly all, was then in a state of fusion, in the hearth of the furnace, as pig iron; it was consequently tapped,—less than the average quantity of iron (as was to be expected), but of grey quality was produced. The furnace still worked "light" for two hours more, say to half-past 12, when it began again to "make iron." No great change took place till half-past 3, when a cinder, quite novel in appearance, but by no means of bad quality, was tapped; it was also accompanied with the dust of the ore which had not (as usual) been separated by riddling; at four o'clock the hearth was tapped, and an excellent lot of very fluid pig iron was obtained. This had also some marked characteristics: after becoming comparatively cool, it was still fluid, and the workmen universally acknowledged appearances which they had never seen when false charges (as is frequently the case) had been used with the usual materials. The quantity rather exceeded in weight the deoxidized ore introduced; but this could scarcely be avoided, as furnace must have been making some iron from its old stock, between half-past 10 and half-past 12 o'clock. The opinions, both of Mr. Roper and his men, were unanimous, that both from the means used, and the phenomena exhibited, at least four-fifths of the iron made was from the Samakoff ore.

Bar Iron.—In the customary mode of making best charcoal bar iron, from charcoal pig, it takes very nearly 30 cwt. of such pigs to produce 20 cwt. of best hammered bar. Of this Turkish pig iron, it only took 26½ cwt. to produce a like quantity. That this remarkable difference is an effect of the preparation or deoxidizement of the ore is proved by the same results following a trial with the Ulverstone ore deoxidized; for 26 cwt. of pig, made in a previous trial from such prepared ore, in like manner produced 20 cwt. of bar. Time and opportunity have not yet been given to investigate the cause of this striking and important phenomenon; but the author thinks it will be found, that pig iron so made from deoxidized ore will contain no foreign matter but carbon, and all the silicon and other adulterative matter present in cast iron, as customarily made, will no longer exercise their prejudicial effects on the quality. He does not mean to propose, that all cast iron should be made from ore deoxidized in a previous operation, for the expense would be palpably too great, but as respects charcoal iron, there is rather an economy than otherwise, in so preparing the ore; for the deoxidation by means of the hitherto waste "breeze," and the coal for fuel in the puddling furnace will, in his opinion, save the consumption of one-half of the charcoal that would otherwise be used in the blast furnace. This is his conviction, and upon this he intends to act, when he undertakes the direction of the Sultan's Iron Works; but as he has not yet facts to refer to, he leaves for the present the further description of the subject.

Wrought Iron.—He then gives the result of the experiment for producing wrought iron direct from the Samakoff ore, (*Vide Journal*, Vol. VI., 1843, p. 82,) by the method invented by the author:—222 lb. of this ore and 77 lb. of coke dust, ground fine, were thrown into a furnace of Messrs. Rushton and Kersley, at Bolton; the mass was stirred about for 25 minutes, and then 222 lb. of Bowling pig iron were added: in an hour and a half from first charging, 317 lb. of excellent puddled bars were obtained. If the weight of the Bowling pigs be deducted, it will give 95 lb. of iron as the produce of the 222 lb. of ore, or 44½ per cent.; but if one-ninth be taken from the Bowling pig (a very moderate computation) for "yield," there remains 120 lb. as the produce of the Turkish ore—above 54 per cent.

Mr. Fairbairn having given a full account of Mr. Clay's treatment of the finer pulverized ores of Samakoff, and of those of Ulverstone, by his process of cementation in the reverberatory furnace, does not consider it necessary to recapitulate the observations as to Mr. Clay's success, in producing a perfectly crystallized grey pig iron; the facts adduced are proofs of the soundness of his views, and of the efficiency of the measures adopted for that purpose. It may, however, become a subject for consideration and experiment to ascertain, whether or not a cheaper and more direct process of deoxidation could be adopted; and as new discoveries, as well as new methods of application, are of vast importance in the conversion of the mineral products, it may not be improper briefly to consider the proposed method of smelting the fine ores, and further, to inquire into the nature of Mr. Clay's new system of producing iron in its malleable state (without the intervention of the previous process of smelting) direct from the puddling furnace. Taking them in their separate order, the first will be—

Smelting.—As the infusion of carbon, and the consequent expulsion of the excess of oxygen from the rich ores, may be considered a necessary, as well as a preliminary process, it is obvious, that the plan of stirring and roasting in a separate furnace, as adopted by Mr. Clay, is both tedious and expensive; and now that he is engaged by the Turkish Government, for the purpose of carrying out a more complete and comprehensive system of manufacture, it appears worthy of the skill and consideration of the chemist and metallurgist to cheapen the process, and, if possible, to effect the deoxidation of the ores by one direct operation on the top of the furnace. If the ores can be deprived of their oxygen in this way, by alternate layers of charcoal and coke, there scarcely exists a doubt, but that the finer particles of the pulverized ores, will receive their proportionate dose of carbon, previously to their descent to the point of fusion in the furnace.

In the preparations for smelting, the past experience of Mr. Heath, and the knowledge of his treatment of similar ores at the works of Porto Nuovo, insure great certainty in the operations under consideration. It is probable that the simple method of moistening the ores with water might answer every purpose of cementation, and by the introduction of the hot blast, the whole process of deoxidation and fusion might be effected in the furnace at one and the same time, without the intervention of a separate system of preparation. It is understood, that Mr. Heath adopted this method with complete success at Porto Nuovo, and provided it can be accomplished in the instance of the Samakoff and Ulverstone ores, it will effect a considerable saving in time, labour, and expense. Should it, however, not succeed, there is still in reserve the preparatory process in a separate heating furnace, as adopted by Mr. Clay. But a few trials of the carbonizing effects of the hot blast on the top of the furnace, will determine these matters, and will shortly point out the most direct and most economical process of carburation.

As respects the dimensions of the furnace to be used, it is decided to make it 40 feet high, 9 feet diameter at the boshes, and 4 feet diameter with a height of 6 feet 6 inches in the hearth. This will be looked upon as a small furnace, when compared with those used in this country for reducing the leaner ores; but when it is considered that the nature of the materials is different, and that charcoal with a slight admixture of lignite will be used, instead of raw coal and coke, it is probably of the best proportions that could be adopted for such a purpose. The small furnace has, in every instance, been used by Mr. Heath at Porto Nuovo, and the same description of charcoal furnace is now in operation under the direction of Mr. Roper at Backbarrow, near Ulverstone.

Puddling.—For the conversion of such iron ores, as the Ulverstone, and those of Samakoff, into the malleable state, it would appear, that Mr. Clay's new process is the cheapest, and probably the most efficient, that can be employed. On the old plan, when a superior quality of wrought iron is required, a long series of consecutive operations is necessary, and as these operations are both tedious and expensive, it becomes desirable to dispense with the process of the ponderous blast furnace, and to encourage the more direct action of the puddling process, as pursued by Mr. Clay. In the description given to the Institution of Civil Engineers on a former occasion, the operations of the old plan are stated to be:—

1st. Smelting in the blast furnace.
2nd. Refining.
3rd. Puddling, hammering and rolling
4th. Cutting up, piling and rolling.
5th. Cutting up, piling and rolling.

All these processes require a separate application of heat.—On the new plan, the operations are reduced to two, viz.:—

1st. Puddling, hammering and rolling.
2nd. Cutting up, piling and rolling.

This latter process, according to the author, brings out the iron superior in quality to the fifth operation of the old system, and with the advantages of saving a considerable portion of time, and a great quantity of fuel. The manufacture of this description of iron, direct from the ore, appears to be simple and effective. The requisite preparations would be four or six puddling furnaces attached to the rolling mill, and with a proper mixture of ground charcoal, the charges might be puddled and worked off at a comparatively low rate. After the balls or blooms are formed, they are brought under the hammer, and from thence to the rolls, where they are formed into rough bars; these bars are then cut up into lengths, and piled or shingled; after which they are again heated, hammered, and rolled into finished bars, and being cut at the end and straightened are ready for the market.

This appears to be the whole of Mr. Clay's process, except the pounding and cleansing of the ores, which require care and attention, previous to the mixing with the coal or coke.

In the Samakoff ore, the necessity of cleansing for this process will, it appears, be indispensable, as the silica will require to be removed, and the ore cleaned from impurities, before it is mixed with the ground charcoal; this is, however, a simple process, which is easily accomplished by the means already described.

During the experiments, for ascertaining the best and most effectual means for reducing the ores of Samakoff, frequent opportunities offered, for a similar inquiry relative to the ores of other districts, and amongst others, those of Lancashire and Cumberland. To these inquiries every attention was paid, and now, that an opportunity occurs for investigation, it may be useful in determining the transverse strength of the Turkish irons, to include those not before experimented upon, and to compare them with other experiments of the same kind, made some years since upon nearly the whole of the British irons. These experiments have been published in the 6th volume of the new series of the "Memoirs of the Literary and Philosophical Society of Manchester," and in order to render the general table of practical value, the more important parts of all the tables annexed to the paper* have been inserted, not only for the sake of comparison, but for practical purposes, in supplying the means of selecting such irons as may be required for the varied objects of architectural, as well as engineering construction. These tables have occasionally been found of great value, and the addition of new and richer irons will add to their utility, and remove all doubt, as to the selection of qualities necessary to be employed, for different mixtures in the arts.

STRENGTH OF CAST IRON BARS.

Table of Results, obtained from Experiments on the Strength and other Properties of Cast Iron, from the principal Iron Works in the United Kingdom, with the addition of those of Elba and of Samakoff (Turkey.)

Abbreviation—C. B. cold blast.—H. B. hot blast.

In the following Table, each bar is reduced to exactly one inch square; and the transverse strength, which may be taken as a criterion of the value of each iron, is obtained from a mean between the experiments upon it,—first on bars 4 feet 6 inches between the supports, and next on those of half the length, or 2 feet 3 inches between the supports. All the other results are deduced from the bars 4 feet 6 inches long, which have not been introduced into the Table. In all cases the weights were laid on the middle of the bar.

No. of Iron in the Scale of Strength.	Names of Irons and No.	Specific Gravity.	Mean breaking Weight in lb. (S).	Ultimate Deflexion of 4 ft. 6 in. Bars in inches and decimal parts.	Power of the 4 ft. 6 in. Bars to resist impact.	Colour.	Quality.
1	Ponkey ..3, C. B.	7·122	581	1·747	992	Whitish Grey	Hard.
2	Devon ..3, H.B.*	7·251	537	1·09	589	White ..	Hard.
3	Cleator .. C. B.	7·296	537	1·001	537	White ..	Hard.
4	Oldberry ..3, H.B.	7·300	530	1·005	549	White ..	Hard.
5	Carron ..3, H.B.*	7·056	527	1·365	710	Whitish Gray	Hard.
6	Beaufort ..3, H.B.	7 069	517	1·599	807	Dullish Gray..	Hard.
7	Butterley .. H.B.	7·038	502	1·815	889	Dark Gray ..	Soft.
8	Bute ..1, C. B.	7·066	491	1·764	872	Bluish Gray ..	Soft.
9	Windmill End ..2, C. B.	7·071	489	1·581	765	Dark Gray ..	Hard.
10	Old Park ..2, C. B.	7·049	485	1 621	718	Gray ..	Soft.
11	Beaufort ..2, H.B.	7·108	474	1·512	729	Dull Gray ..	Hard.
12	Low Moor ..2, C. B.	7·055	472	1·852	855	Dark Gray ..	Soft.
13	Buffery ..1, C. B.*	7·079	463	1·55	721	Gray ..	Rather hard.
14	Brymbo ..2, C. B.	7·017	459	1·748	815	Light Gray ..	Rather hard.
15	Apedale ..2, H.B.	7·017	456	1·730	791	Light Gray ..	Stiff.
16	Old Berry ..2, C. B.	7·059	455	1·811	822	Dark Gray ..	Rather soft.
17	Pentwyn ..2,	7·038	455	1·484	650	Bluish Gray ..	Hard.
18	Maesteg ..2,	7·038	454	1·957	886	Dark Gray ..	Rather soft.
19	Muirkirk ..1, C. B.*	7·113	453	1·734	770	Bright Gray ..	Fluid.
20	Adelphi ..2, C. B.	7·080	449	1·759	777	Light Gray ..	Soft.
21	Blaina ..3, C. B.	7·159	448	1·726	747	Bright Gray ..	Hard.
22	Devon ..3, C. B.*	7·285	448	·790	353	Light Gray ..	Hard.
23	Gartsherrie ..3, H.B.	7·017	447	1·557	998	Light Gray ..	Soft.
24	Frood ..2, C. B.	7·031	447	1·825	841	Light Gray ..	Open.
25	Lane End ..2,	7·028	444	1·414	629	Dark Gray ..	Soft.
26	Carron ..3, C. B.*	7·094	443	1·336	593	Gray ..	Soft.
27	Dundyvon ..3, C. B.	7·087	443	1·469	674	Dull Gray ..	Rather soft.
28	Maesteg (marked red)	7·038	442	1·887	830	Bluish Gray ..	Fluid.
29	Corbyn's Hall ..2, C. B.	7·007	442	1 687	727	Gray ..	Soft.
30	Pontypool ..2,	7·080	440	1·857	816	Dull Blue ..	Rather soft.
31	Wallbrook ..3,	6·979	440	1·443	625	Light Gray ..	Rather hard.
32	Milton ..3, H.B.	7·051	438	1·368	585	Gray ..	Rather hard.
33	Buffery ..1, H.B.*	6·998	436	1·64	721	Dull Gray ..	Soft.
34	Level ..1, H.B.	7·080	432	1·516	699	Light Gray ..	Soft.
35	Pant ..2,	6·975	431	1·251	511	Light Gray ..	Rather hard.
36	Level ..2, H.B.	7·031	429	1·358	570	Dull Gray ..	Soft.
37	W. S. S. ..2,	7·041	429	1·339	554	Light Gray ..	Soft.
38	Eagle Foundry ..2, H.B.	7·038	427	1·512	618	Bluish Gray ..	Soft.
39	Elsicar ..2, C. B.	6·928	427	2·224	992	Gray ..	Soft.
40	Varteg ..2, H.B.	7 007	426	1·450	621	Gray ..	Hard.
41	Colsham ..1, H.B.	7·128	424	1·532	716	Whittish Gray	Rather soft.
42	Carroll ..2, C. B.	7·069	419	1·231	530	Gray ..	Hard.
43	Muirkirk ..1, H.B.*	6·953	418	1·570	656	Bluish Gray ..	Soft.
44	Brierley ..2,	7·185	418	1·222	494	Dark Gray ..	Soft.
45	Coed-Talon ..2, H.B.*	6·969	416	1·882	771	Bright Gray ..	Soft.
46	Backbarrow .. C. B.	7·172	416	1·736	724	Gray ..	Soft.
47	Coed-Talon ..2, C. B.*	6·955	413	1·470	600	Gray ..	Rather soft.
48	Samakoff .. C. B.	7·216	372	1·160	418	Bluish Gray ..	Soft.
49	Monkland ..2, H.B.	6·916	403	1·762	709	Bluish Gray ..	Soft.
50	Leys Works ..1, H.B.	6·957	392	1·890	742	Bluish Gray ..	Soft.
51	Milton ..1, H.B.	6·976	369	1·525	538	Gray ..	Soft & fluid.
52	Plaskynaston ..2, H.B.	6·916	357	1·366	517	Light Gray ..	Rather soft.

The irons with asterisks are taken from the experiments on hot and cold blast iron made some years since by Mr. Hodgkinson and Mr. Fairbairn, for the "British Association for the Advancement of Science."—See Seventh Report, vol. vi.

The modulus of electricity was usually calculated from the deflexion caused by 112 lb. on the bars 4 feet 6 inches long.

The experiments were conducted under the superintendence of Mr. Eaton Hodgkinson, F.R.S., and in them, as well as in the others, he had especial reference to the decrease of elasticity, in verification of the law of defective elasticity, which was announced by him, to the last meeting of the "British Association for the Advancement of Science," at Cork. In the experiments,

* These tables are too voluminous to be published in the Minutes of Proceedings, but the results are given in the annexed table.

the same methods have been adopted as on former occasions; and in the annexed table, such weights, deflexions, and numbers, have been selected, as give a clear and succinct account of the methods adopted in the experiments. To each experiment, and to each iron, is appended a tabular form of results, with the values, reduced to those of bars exactly 1 inch square; the reduction being made, by supposing,—as is generally admitted,—that the strength of rectangular beams is as the breadth, multiplied by the square of the depth, the length being given, and that the ultimate deflexion is inversely as the depth. The power of resisting impact, in each iron, is reckoned by the product of the breaking weight, multiplied by the ultimate deflexion, and that, upon the supposition, that the elasticity remains unimpaired, and that the blow, in all cases, when the results are to be compared together, is given with the same striking body, upon beams, all of which are of equal weight. These suppositions, however, are not strictly true; but the bars being all of equal weight, the product above-mentioned, will give a comparative measure, sufficiently near for practical purposes. The modulus of elasticity, which may be taken as the measure of the stiffness of the iron, is given in pounds for a base of 1 inch square, and is calculated, from the deflexion caused by 112 lb. on bars of 4 feet 6 inches between the supports.†

Rule.

To find, from the above Table, the breaking weight in rectangular bars, generally calling b and d the breadth and depth, in inches, and l the distance between the supports, in feet, and putting 4·5 for 4 feet 6 inches, we have $\frac{4\cdot5 \times b\, d^2 S}{l}$ = breaking weight in lb., the value of S being taken from the Table above.

For example: What weight would be necessary, to break a bar of Low Moor Iron, 2 inches broad, 3 inches deep, and 6 feet between the supports?

According to the rule given above, we have $b=2$ inches, $d=3$ inches, $l=$ 6 feet, and S equal 427, from the table.

Then $\frac{4\cdot5 \times b\, d^2\, S}{l} = \frac{4\cdot5 \times 2 \times 3^2 \times 472}{6} = 6372$ lb., the breaking weight.

At the conclusion of the experiments on the British irons, as recorded in the "Manchester Memoirs," a compendium of the whole experiments (from which the preceding table is abridged), was calculated and brought at once under the observation of the reader. This compendium exhibited at one view, the results of each class of experiments, and being printed on a separate sheet, was found useful in the workshops of engineers, millwrights, and iron-founders, in determining the peculiar properties of irons, to which they might have occasion to refer. It is further useful, for the purpose of regulating the strength, flexure, and ductility of the different kinds of castings; and a single glance at the table, will enable the practised iron-founder to determine, with some degree of certainty, what sorts of iron to choose, in order to meet the various objects of his trade. After the numerous experiments made at different times, by writers on the strength of materials, and particularly those conducted more recently, on iron obtained by the hot and cold blast processes, it will be unnecessary, in this place, to extend the subject beyond a record of facts as obtained in the foregoing results. Much may, however, yet be done, not only in ascertaining, by a series of well-conducted experiments, the strength, deflexion, and elasticity of the different mixtures, but there appears a still more extensive field open for research, into the chemistry and mechanism of the process of the reduction and manufacture of the ores, which is probably of greater value than any other of the staple manufactures of this country. Considerable advances have already been made in these inquiries, and more particularly as recorded in the works of Mr. Mushet,* whose whole life presents an unvaried scene of experimental research.

Remarks.

Mr. Braithwaite eulogised the useful result of the labours of Mr. Clay, Mr. Hodgkinson, and Mr. Fairbairn, which had been so well recorded by the latter gentleman. It would be interesting to have, at a future period, an account of the practical manufacture of iron, on the large scale, from the Turkish ore, and he hoped that the cost of production would be given; for he conceived, that the great changes which had occurred in the processes of manufacture, must be, in part, the cause of the present considerable reduction in the price of iron, particularly in Scotland, where the influence of the use of the Blackband mine, and of the hot blast, was acknowledged.—It was stated, that by Mr. Clay's process, as good malleable iron could be produced direct from the hæmatite ore, by two processes, as by the usual five processes with argillaceous ores. The question therefore, resolved itself into a statement of the relative expense of the two methods of manufacture, and both in a scientific and commercial point of view, it was of great importance that clear information should be obtained.

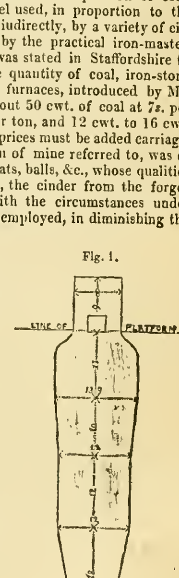
Mr. Vignoles agreed as to the importance of the cost of production being known, but thought that it must be sought for from the manufacturers. The attention of Mr. Fairbairn and Mr. Hodgkinson, had been directed to the qualities of the various irons produced, and the results of their experiments were of great practical utility.

Mr. Phillips said, that he had analyzed several kinds of Turkish ore, and it appeared that a great variety existed. He was less familiar with that of Samakoff than with other kinds. The Lancashire hæmatite and the Elba ore, were almost identical in composition, except that the latter was slightly magnetic.

Mr. Taylor stated, that the brown hæmatite contained manganese. He understood that large quantities of Elba ore were now conveyed to Corsica, for the purpose of being smelted cheaply, as charcoal was abundant in that island. Large quantities of Cornish hæmatite were sent to South Wales and to the other iron districts, for mixing with the argillaceous ores. The price, put on board, was about 9s. per ton. At the Birtley Iron Works, (Yorkshire,) about one-sixth part of hæmatite was used in the furnace.

Mr. Slate said, that the quantity of hæmatite ore used in South Staffordshire was not considerable; it was mixed with the lean argillaceous ores, and a limited quantity of it was understood to improve the quality of the iron, without producing any bad effect on the working of the furnace. The quantity which might be advantageously used was governed by the quality of the mine, the form of the furnace, the burden it was considered most profitable to carry, and the pressure of the blast; it was therefore nearly impossible to arrive at any general conclusion on the subject. The use of the hæmatite ore, however, could not be said to exercise any material influence on the iron of South Staffordshire. In using these rich kinds of ore, it was necessary to lighten the burden, which would of itself improve the quality. The quality of the iron was not a matter of chance, but was more a question of cost, being acted on directly by the quantity of fuel used, in proportion to the mine, all other things remaining the same, and indirectly, by a variety of circumstances, which were carefully attended to by the practical iron-master. The cost price of iron made from mine only, was stated in Staffordshire to amount to £3 or £3 5s. per ton. The relative quantity of coal, iron-stone and lime-stone, in the improved description of furnaces, introduced by Mr. Gibbons was, for each ton of iron produced, about 50 cwt. of coal at 7s. per ton, 50 cwt. of calcined mine at 12s. or 14s. per ton, and 12 cwt. to 16 cwt. of limestone at 4s. 6d. to 5s. per ton; to these prices must be added carriage, labour, and interest of capital. The description of mine referred to, was of the richer sorts, as gubbin, brown-stone, blue-flats, balls, &c., whose qualities were however very variable. In some furnaces, the cinder from the forges was mixed in an indefinite quantity, varying with the circumstances under which it could be obtained, or be beneficially employed, in diminishing the cost of the iron.

Fig. 1.



Interior form and dimensions of the Conegree Furnace.

The Conegree furnace, on the estate of Lord Ward, near Dudley, was constructed in a somewhat peculiar form, (fig. 1, shows the internal shape and dimensions.)

The proportions of materials to make a ton of pig iron, were:—

Coal	2 tons 5 cwt. (or 37 cwt. of Coke.)
Charred mine	2 ,, 5 to 10 cwt.
Limestone ..	13 to 16

Each charge consisted of—

Coke	9½ cwt.
Charred mine ..	12 ,,
Limestone	4 ,,

As much as 115 tons of cold blast, No. 3 pig iron, had been made at the furnace in one week.

The blowing cylinder was 72¼ inches in diameter, with a length of stroke of 7 feet. There were originally five tuyeres for the introduction of the blast; one muzzle was 2¼ inches, two others were 2⅛ inches, and the other two were 2 inches in diameter. These were subsequently changed to four muzzles, of the respective diameters of 3¼, 2¼, 2⅛, and 2 inches. The best working pressure of blast, was 2⅝ inches of the mercurial syphon gauge, which pressure was kept up when the engine made 8½ strokes per minute; with 7½ strokes the mercury stood at 2⅛ inches, and with 6¼ strokes, it fell to 1⅝ inch.

Mr. Durham presented a knife manufactured by him from steel, made from the Turkish ores brought over by Mr. Ohanes Dadian. He found, that the steel required to be worked carefully, and to be tempered at a low heat; but the quality was good, and he had little doubt of its being rendered still better, by careful manipulation, in manufacturing the iron whence the steel was converted.

St. Paul's Cathedral.—The porticoes of the western entrance of this cathedral are about undergoing a thorough cleansing and scraping with a view to removing the incrustation that has settled on the stone work arising from smoke and dirt. It has not yet been determined whether the whole of the western front, as also the other outer portions of the building, will be scraped and cleansed, the lower part being tried first by way of experiment; if successful, the whole of the western front, which forms the principal entrance to the cathedral, consisting of 12 Corinthian columns below, and 8 of the composite order above, surmounted by a pediment, on the tympanum of which the Conversion of St. Paul is represented, will undergo the same operation.

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† Vide "Memoirs of the Manchester Lit. and Phil. Society," vol. vi. (new series), page 273.

* "Papers on Iron and Steel, Practical and Experimental," by D. Mushet, 8vo. Lond. 1840, Weale.

THE ARTS AND MANUFACTURES OF FRANCE.

The *Scottish Guardian* gives an account of a meeting lately held by the Philosophical Society at Glasgow, when a variety of specimens were exhibited of French Art and Manufactures, purchased by Government at the last Exposition in Paris for the School of Design in London. The first noticed was a drawing or pattern for a rug, being a specimen of the manner in which French designs are executed for the manufacture of these articles. It might be about twelve inches long by about six or eight in breadth, and consisted of a series of figures of flowers, drawn and coloured with exquisite skill, finished with the minuteness and nicety of miniature painting, and showing an amount of labour which would be poorly compensated to the artist for fourteen guineas, the price at which the pattern was purchased. There were a number of specimens of pottery, and glass manufacture, and jars and vases cast in metal, remarkable for their classic elegance of form and beauty of design. Amongst these were the following:—A valuable bronze vase with an allegorical design, representing two groups of figures, the most prominent of which were Justice and Peace on one side, and Patience and Hope on the other, all the figures being produced with admirable sculpturesque effect. A jar in common Beauvais ware—the coarsest potter's clay, in fact—showed in a remarkable manner the value of Art in moulding forms of perfect grace and symmetry out of the most ordinary and inexpensive materials. One of these elegant jars might cost sixpence, and we believe that in France, as we have no doubt will soon be the case in this country also, they are much sought after for household purposes. A vase cast in argent-platina, of singularly fine proportions; the chasing elaborated with the minuteness of insect-work; produced in the *atelier* of M. Rudorf; cost forty guineas, being considered a perfect specimen of the art, and without its equal as yet in British manufacture. Glass-china vase, from the work called Choisi le Roi; value, 16*l*. In this specimen the classical proportions of the other vases were produced in a material of exquisite delicacy, combining the purity of crystal with the pearly whiteness and transparency of the finest porcelain, and affording a ground susceptible to the minutest shades of the pencil. Vases of this description are painted by the hands of ladies; and and the present specimen bore testimony to the industry and taste with which the paintings are executed. Two Terra Cottas moulded in common tile-clay, and intended for holding flowers;—both very pretty examples of the same union of taste and economy already noticed. Four specimens of enamelled ware, another cheap and beautiful invention, applicable to a variety of purposes, such as plates, dishes, and other articles made of earthenware. The figures are moulded in *intaglio* instead of *bas relief*, and the mould may be wrought by any man who can make bricks and tiles, and with equal ease and expedition. When the cast is hardened, it is covered with a coat of enamel or varnish in the usual way; and the lowest lines or hollows of the *intaglio* being designed to throw up the shaded parts of the picture, they receive the thickest coating of varnish, while the more elevated lines take on the least; and the mixture of light and shade thus produced is so well managed as to give the picture all the prominence to the eye of *bas relief*. Amongst the more finished and valuable specimens of porcelain manufacture was the Adelaide Vase, painted in enamel, in imitation of Middle-Age Art, the painting, as in a former instance, being done with the pencil. There was also a slab of lava, enamelled and painted in a beautiful manner; slabs of this seemingly impracticable material are now used in Paris for the purpose of painting on their enamelled surface the names of the streets. They are thus rendered impervious to atmospheric influence, and are considered indestructible. Amongst the other casts in metal were part of a bronze architrave of the door of the church of the Madeleine at Paris, and casts of ornamented outer plates of locks, in iron and in brass, cleverly designed and moulded; besides a variety of bronze figures, &c. Some ingenious specimens were also shown of carving in leather, in imitation of casting; and specimens of those ornamental flooring used in the houses in France, where they have no carpets. But the French are rapidly acquiring a taste for this domestic luxury, and have fairly commenced the manufacture of carpetting, which promises soon to become an item of great importance in the trade of the country. Considerable attention was paid to a specimen of their carpetting exhibited in the room, and which exceeded ours as much in the beauty of the pattern, as it fell short of the British manufacture in the fineness of the fabric. In like manner, the white damask table-cloth was unknown in France eight years ago, but is now both manufactured and used in the country; and a specimen exhibited on the present occasion evinced still greater progress than in the case of the carpet manufacture. But however deficient the French may be in the production of these articles, as compared with our own manufactures, the profuse display of gorgeous damask silk, from the factories of Tours and Lyons, must have challenged universal admiration by the superiority of their fabric and designs. Some of the richest effects were brought out in these manufactures by using glass thread, which is prepared so fine as to be capable of being tied in knots without breaking, and woven in every respect like ordinary thread. But the fabric which excited the strongest interest, both on account of its beauty and its novelty and ingenuity, was a large square of wool mosaic, or India-rubber cloth, a manufacture peculiar to France and some parts of Germany. The pattern was perhaps the most perfect in respect of design of any work of Art in the exhibition. The flowers and leaves were copies from nature, and were much admired for their botanical accuracy. Even the least prominent of the plants represented in the composition, such as the fronds or leaves of ferns, were delineated with so much fidelity as to enable botanists to distinguish the different species, and give them their specific names! The triumph of Art in this instance is the more remarkable, that after the design passed from the hands of the pattern-drawer, it was wrought into the fabric by one of the most complicated processes that can well be imagined. The pattern is in fact produced in the fabric by the *ends* of threads standing out transversely from the foundation of India-rubber cloth, and not as is usually the case by the threads being interwoven longitudinally. The cloth is sold at 5*l*. a yard.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE ROYAL SCOTTISH SOCIETY OF ARTS.

March 10, 1845.—ALEXANDER BRYSON, Esq., V. P., in the Chair.

The following communications were made:—

"*On the Registry of the Hourly Variations of the Thermometer, by means of Photographic papers.*"—By MUNGO PONTON, Esq., F.R.S.E. The author after explaining the difficulties attending the registry of the hourly variations of the thermometer, showed how this object might be obtained by means of photographic paper. He pointed out the manner in which the stem of the thermometer must be ground, so as to produce a distinct shadow of the filled portion of the bone capable of forming an image on the paper; also the mode of preparing the sensitive paper applicable to this purpose. The paper being put round a cylinder to be moved by a clock, exhibits at the end of every twenty-four hours a series of images of the stem of the thermometer, showing the position of the mercury during each half hour. These images are produced by artificial light. The instrument was exhibited.

The author also described the mode of preparing paper for portraiture. The materials used are nitrate of silver dissolved in pure acetic acid, with gallic acid dissolved in the oils of cassia and cloves, while sulphate of iron and gum arabic are used for developing the pictures. This process he stated to be more rapid than the calotype of Mr. Talbot, of which it is a modification.

"*On the Employment of Oxygen as a means of maintaining respiration in Diving Bells, and in restoring suspended animation.*"—By GEORGE WILSON, M.D., F.R.S.E. The object of this paper was to direct the attention of practical men to improvements recently introduced in the preparation of oxygen, which seemed to the author to admit of its employment for the purposes referred to in the title of his communication. The simple addition of a 5th or 10th of its weight of oxide of copper, of manganese, or of iron, to the chlorate of potass, is found to cause the evolution of the oxygen of that salt, when heat is applied, with such rapidity, that a hundred cubic inches per minute may be procured with even a small apparatus. Dr. Wilson suggested that a mixture of chlorate and metallic oxide should be kept ready made at our different hospitals and other institutions, such as the Humane Society's Receiving Rooms, along with suitable gasholders, and the necessary apparatus for inflating the lungs, so that, in cases of suspended animation, oxygen instead of common air might be thrown into the respiratory organs. There is good reason to believe that oxgyen would be much more efficacious than common air in causing resuscitation, and the rapidity with which it can be procured by the new process, appears to bring it quite within reach of the medical man. The same mixture admits of application to the maintenance of respiration in confined apartments, such as the chamber of a diving-bell, if accompanied by suitable arrangements for withdrawing the carbonic acid generated by the respiration of those within. Dr. Wilson is at present engaged in researches as to the best shape and size of the generating and receiving vessels to be employed for the evolution and preservation of the gas in hospitals and other institutions. The result of these inquiries will be laid before the public as soon as they are completed.

"*Experiments on Barker's Mill (first series).*—By Mr. JAMES WHITELAW, Engineer, Paisley. The result of this first series of experiments on Barker's Mill—ascertained by applying Prony's Brake—is 75 per cent. of the water power employed—the fall being 8 feet, and the diameter of the mill 15.6 inches. This is stated to be fully three per cent. above the best overshot water-wheels, which have never given out more than 72 per cent. It was stated that a second series of experiments had been received from Mr. Whitelaw, which will be read at next meeting, giving a still higher result.

(Second series.)—In these additional experiments, Mr. Whitelaw states that a result of 79·6 per cent. has been brought out, the per centage of the best form of overshot wheel being from 72 to 74.

"*Description of an Improved Cart, tending to give greater strength and durability, and to remove vibration from jolting.*"—By Mr. ÆNEAS LEVACK, Cart-wright, Thurso. The improvements consist, 1st, in introducing more iron and less wood into the framing of the cart, securing greater strength and less liability to decay, while the weight is not increased; and 2d, in a peculiar method of fixing the axle to the cart frame, so as to allow free play, and prevent accidents from sudden strokes or shocks from the wheels from being communicated to the body of the cart, and thus render it less liable to vibration and jolting. M. Levack accompanied his description with a well-executed model of his proposed improvements.

March 24.—The President in the chair.

The following communications were made:—

1. *Proposed plan for preventing the Abstraction of Letters, &c., from Boxes attached to the doors of Offices.* By Henry Graham, M.D., Edinburgh. The peculiarity of this Letter Box consists in its having an equipoised valve placed in the neck of the box, which is depressed by the weight of a letter falling upon it, but which immediately returns to its first position, thus preventing the letter from being abstracted.

2. *Remarks on Fire in Dwelling Houses, originating in the over-heating of the Hearth Stones, and suggestions for its prevention.* By James Tod, Esq., W.S., Sec. In this paper it was stated that many fires had originated in dwelling-houses, especially of late, from the overheating of the hearth; and that this happened through the very dangerous practice of placing *wooden* beams or joists beneath the hearth stones of our fire-places. These stones are frequently very thin; and from the great heat which they contract from large fires, especially in the *low* Kinnaird grates, which have of late become common (and which are, in other respects, so advantageous), are rendered so hot as to set fire to the joists on which they rest. A house in Northumberland-street took fire from this cause within these two months. The author happened to be passing. He saw the hearth-stone raised; it was very thin, and the wood lying beneath it was found to have caught fire, which would probably have issued in the destruction of the house had it happened a few hours later in the night. Another instance had happened at the corner of St. Andrew-street within a few weeks, which, it is understood, was from the same cause, and it was not known where it might stop.

In order to prevent similar accidents, the author recommended that in new houses the wooden beams should be kept at a proper distance from that part of the hearth which is apt to become so much heated; and if beams or joists be placed below the hearth at all, they ought to be of *iron*. And with regard to houses already built, he recommended that *ash-pans* be always used—not, however, as at present, resting on the hearth, but *raised on feet about an inch high*, so as to allow that space of intervening air which would effectually prevent the stone from becoming heated to a dangerous degree. These can be made at an expense of about 5*s.*; but where parties desire a cheaper article, a piece of sheet iron, bent over at right angles at the sides, and open in front, will answer the purpose quite well, though not so ornamental; the essential thing being, that a free space be left for air between the screen and the hearth-stone. This precaution seems doubly imperative where low or Kinnaird grates are used, as no one can tell whether there may not be wooden joists underneath his hearth, which, by becoming ignited, may cause the destruction of much valuable property.

3. *An improved Air Pump or Water Engine.* By Mr. Robert Ferrier. This Air Pump is driven by a handle, constantly turning in the same direction. This handle drives a pinion, working into wheels, the revolution of which elevate and depress the pistons in the barrels of the Air Pump. It is also double acting, and any number of barrels can be attached so as to produce quicker exhaustion.

4. *A Machine for Sweeping Chimneys from the top, in a more perfect manner than by the methods in common use.* By Mr. Alexander Scott. Thatcher, Selkirk. By this machine, the brush of which is of heather, Mr. Scott states that he has swept one or two bushels of soot from vents, which had apparently been swept clean by the common method.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

"On the Renaissance of France." By M. E. I'Anson, Jun.

The author of this paper first took a summary view of the state of architecture in the period which immediately preceded the introduction of the Renaissance style—particularly in reference to the high pitched roofs, of which he quoted several examples; he next drew attention to the remarkable state of transition which pervaded a large part of Europe during the XVI. century, both in literature, arts and religion, and briefly referred to the political state of France, in which the monarchy having been firmly established, the kingdom freed from dissensions and internal foes, the people were able under Charles VIII. to accomplish an invasion of Italy, which from various pretexts was continued under the reigns of Louis XII. and Francis I. These preliminary observations were made in order to shew the influence which the existing state of architecture had upon the new style, and further to shew what were the existing causes under which the Renaissance sprang up.

The author proceeds to show that the Renaissance was a genuine transition style, and that although derived from the fine works of Italy, which by that time had been enriched with the productions of Brunelleschi, Ammanalli, San Sallo, Michael Angelo, San Micheli, Raffaelle, and others, that it was imported into France and grafted on the then existing architecture of the country in a free and liberal spirit; and that, in fact, fine specimens both of the Renaissance and of Flamboyant Gothic were cotemporaneous, as is instanced by the North Transept of Beauvais, and the church of St. Eustache at Paris, one of the finest specimens of Renaissance extant—both works of the earlier half of the XVI. century. In the new style all the striking peculiarities of the old were not lost sight of, the lofty roofs and dormer windows, the central lofty entrance to the chateau in imitation of the fortified gate of the feudal castle, were all preserved, and the chimneys, so essential a feature in reference to climate, were treated as component parts of the design, in general with boldness and highly picturesque effect.

Although under Louis XII. some progress had been made in the style of the Renaissance, it was not until the reign of Francis I., after the termination of the Italian wars, that any works of magnitude were undertaken. This monarch, emulous of the glory of his cotemporary Pope Leo X., and of the Medici family, from whom this pope sprang, and who by their munificent patronage of letters and arts had enriched Italy with the noblest works of the cinque cento, and which have never been surpassed, devoted his constant attention in the chateau of Fontainebleau towards the accomplishment of a truly great and national work. The author of the paper dwelt at considerable length on the description of this palace, detailing its progress under the fostering care of Francis I., and he endeavoured to show by reference to the coincidence of style, as also by quotations from the works of Duardau, Benevenuto Cellini and Serlio, that the earlier works at Fontainebleau were the unassisted production of French artists, and that it was only when Francis I. anxious to introduce fresco decoration in the interior of his palace, and, well informed of the fine productions in this branch of art which existed in Italy, invited from that country artists "*qui sapesse luorare di pittura et di stucco*" —and these artists, once introduced, in great measure superseded the natives in the whole conduct of the work, an event which the author contended was greatly to be regretted, inasmuch as the early works at Fontainebleau were full of originality and vigour, and the artists by whom these works were erected would, if unchecked, have founded in all probability a school of art quite as striking and more original than that which has been produced. After describing this palace, the author alluded to the other works of Francis I.—chateaux he either entirely built or materially enlarged and altered, namely, the chateau of Saint Germain-en-Laye, that of Chantilly, of Chambord, Coussy, Colombray, of La Muetto, of Boulogne near Paris, and some others. The history of the Renaissance was then pursued in a description of the Chateau d'Ecouen, founded and built by the Constable de Montmorenci in 1540, the works being conducted by Jean Ballaut, who was also engaged on the Hotel Carnavallet at Paris, the tomb of the Constable Montmorency, that of the Valois family at St. Denis, &c. After referring to some minor works of this period, the subject is continued in a description of the additions made to the Louvre under Henry II., and the services to art rendered by Pierre l'Escot and Jean Gougon on that portion of the palace entrusted to their care.

The period of art embraced by the preceding observations extended over a space of about a century, from 1500 to 1600, and the author of this paper concluded his remarks in the following words—"After the year 1600 the direct influence of Italian art was lost, and under Louis XIV. it resumed that peculiar form known as the style Louis Quatorze. I have alluded to some of the chief buildings erected during the period of the Renaissance—they are neither few nor unimportant; there is considerable beauty, fine composition and grandeur in many of them, and a remarkably fine feeling for detail, some of which is of the highest class, and as long as the history of art endures the name and works of Jean Gougon will not be forgotten. I had intended, time permitting, to draw some comparison between the Renaissance and cotemporary art in other countries—with the Cinque cento of Italy, which certainly must be allowed to take the precedence—with the Elizabethan of England, which it as certainly exceeds in merit as it did in point of chronological development of classic form.

Whilst Francis I. was building Fontainebleau, Wolsey was at work on Hampton Court. Whilst the Renaissance of France abounds with beautiful and imaginative detail, the Elizabethan in England can boast of little in its details, and of still less bearing any impress of a high and intelligent feeling in art.

April 14.—H. E. Kendall, Esq., in the Chair.

A paper "*On the Formation of a Museum for Architectural Casts,*" by C. H. Wilson, was read. It is given in another part of the present Journal.

CHEMICAL LAMP FURNACE.

A hydrogen lamp furnace was lately constructed by the Rev. W. Vernon Harcourt, which, affording a steady uniform heat to a platinum vessel, sufficiently high to effect the ready fusion of vitreous substances by means of a fuel free from the innumerable objections to which that containing solid carbonaceous matter is open, consisted of a number of jets arranged round the crucible to be heated, which is suspended by three platinum wires from a watch movement, causing it to rotate slowly on its vertical axis, and insuring uniformity of temperature. The fuel employed was hydrogen, generated in a strong iron reservoir, and burnt under a pressure of from ten to thirty atmospheres. This contrivance, though very beautiful, was necessarily very expensive, and but ill adapted to general use. The invention, however, suggested to another gentleman, Mr. E. Solly, the possibility of constructing a lamp on a similar principle, but divested of its inconveniences—one that would at once be economical and simple. He accordingly constructed a lamp, consisting of two circles of jets, one vertical and the other horizontal—the latter being raised about two inches higher than the former. The vertical circle consists of a metal ring, about an inch in diameter, pierced on its upper side by six small holes or jets, the horizontal metal ring having an internal diameter of about three inches, with twelve holes drilled on its inner side, so as to form altogether a series of eighteen little jets of flame, six vertical and twelve horizontal, all converging to a common centre—the point, therefore, of the greatest heat. Knowing that a mixture of coal gas and a proportion of the atmosphere burns with a pale blue flame, containing no solid carbon, giving only a feeble light, but possessing a very high temperature, it occurred to Mr. Solly to employ this mixture instead of hydrogen in the jets above described, by the injection of air into the coal gas pipe. To the end of a common gas cock, connected with the street main, a piece of copper pipe is attached, four inches long and a quarter of an inch in diameter; outside this is another piece of copper tube, six inches longer, and with a proportionably larger diameter than the internal. The air which is to mix with the coal gas is admitted into this longer external tube—the quantity being regulated by cocks, the object being to effect the most favourable mixture, as a diminution of pressure would be caused if the two currents did not flow in the same direction—whilst by the present contrivance the pressure is partially augmented. When the lamp is used, the crucible to be heated is supported on the top of the horizontal circle of jets by a triangle of platinum wire, so as to place it in the centre of the greatest heat; it is thus heated by eighteen little blowpipes, and becomes brightly ignited in a few seconds, the heat increasing as the platinum becomes ignited; the furnace is rendered more complete by a thin cylinder of sheet-iron, three inches in diameter and two high, which is placed above the horizontal circle, to prevent the flames being blown about by draught of air, and a circular disc of the same metal, having a hole in its centre of an inch across, to place at the top of the cylinder—this causing the heated air to pass round the upper edges, and over the lid of the crucible, and thus bringing the whole to the same temperature. The heat is rather above the melting point of silver, and is, of course, equal to the fusion of mixtures of silicates with carbonete of soda —300 grs. or 400 grs. of a mixture of carbonate of soda and a silicious compound being perfectly fused in about eight minutes. The inventor considers this lamp superior to any other, whether as a simple and economical method of decomposing earthy silicates, or for other innumerable purposes where a bright red or yellow heat is required, and where an ordinary furnace is inapplicable; and, as it is an efficacious mode of heating a platinum crucible to bright redness, without exposing it to the contact of solid fuel, the attempt appears perfectly successful.—*Mining Journal.*

WILLIAMS AND SOWERBY'S SHOW ROOM, &c.

SIR,—Accept my thanks, and let the architect do so also, for giving us the plan of Messrs. Williams and Sowerby's new room. The having previously seen the apartment itself did not render the plan of it less welcome to me; on the contrary I was all the more desirous of having a drawing explanatory of various particulars that I could not trust to my memory for. The idea there produced is not only highly ingenious and novel, but valuable for its suggestiveness. Unborrowed and fresh, it is also stimulative, and calculated to excite invention, whereas the overweening and too exclusive study of what are usually received as correct and standard models for our direction, is, in my opinion at least, apt to keep the inventive faculty dormant, or to send it fast asleep, and to deter from the exercise of fancy by the dread of incurring from the dull the reproach of being *fanciful.*

We need now and then to have a few fresh ideas administered to us; even should they be rather rough ones they are still of worth, because they may all the more easily be improved upon, and be more fully developed and wrought out. There have been, I am inclined to believe, a great number of contrivances more or less ingenious, either arising out of sheer necessity, or else originating in mere "whims" and "fancies," which, instead of being preserved and turned to account in similar cases, are forgotten and lost because they have never been recorded in books. Multitudinous as are the publications of one sort or other upon architecture and architectural decoration which issue from the press, THE BOOK OF CONTRIVANCES remains to be written; before which could be done there would be the task of hunting out materials, and they are of a kind not to be compiled from books, since very little for the purpose is so to be gleaned. If, indeed, every one who could do so would contribute his mite—the contrivances that have come under his own observation, or such as have occurred to, if not been executed by himself, a highly useful and instructive work might be produced.

At present there is not a single work, either English or foreign, as far as I can find out, which treats systematically of interior decoration and effect, and goes into the *rationale* of those subjects. Of mere pattern-books of ornaments and individual architectural members and details in various styles there is no lack, and we occasionally meet with compositions for the entire embellishment of a room, but we also very much want a full treatise on the subject, wherein might be embodied all the desultory and scattered remarks that might be brought to bear upon it.

One thing relative to which I can find nothing is the mode of producing various striking effects by the arrangement of mirrors and compartments of looking glass. As an idea of the kind, I may refer to an instance where what was originally a mere lobby, about twelve feet by six, between a drawing-room and conservatory, was transformed in appearance into an elegant vestibule twenty-four feet in length by twelve in breadth, with an arched ceiling having twelve compartments, six on each side, filled in with stained glass, although there were in reality only three. Here was an effect which a man might study Vitruvius, Alberti, Palladio, Chambers, and all the writers of that class, without ever even so much as dreaming of: how was it contrived? It was merely—but no, I will not at present give the solution of the problem, because your readers will no doubt be able to find it out themselves, now that they are thus put upon the scent of it.

I remain, &c.,

L.

ARCHITECTURE AT MANCHESTER.

SIR,—It is not a little annoying to find those who have apparently both the means and disposition to afford information, perform their volunteer office listlessly and only by halves. Without imposing any additional trouble upon himself, your correspondent "C. E." might have been more communicative when he had his pen in his hand. He speaks of the Railway Station in Store Street, Manchester, as being "a work of very considerable architectural merit," yet without a single syllable further to afford us the slightest idea of what the design is, or even in what style it is. Accordingly, he seems to be of opinion that the degree of merit he would fain impute to it is, after all, not such as to entitle it to more than bare mention, and its architect not even to so much. It is precisely the same with respect to the "Palatine Hotel;" that also is praiseworthy for its "external design," although erected by some *nobody* without even a name—strange that there should be such a very general and unaccountable reluctance to let the public know the designers of buildings. Scarcely more satisfactory is what is said of Worsley Hall, there being not a word to convey any notion of its general form and size, or to point out to what building in the same style it most approximates in character. Does it, for instance, bear any resemblance to Burleigh, or to Hatfield, or to Holland House; or is it unlike them all, and equally dissimilar from all other examples of the kind? The writer might also have helped us to some notion of its size. Since he has not done so, my hope now is that he will take up his pen again, and furnish the information here asked for, as he certainly can do if he please, after having actually seen the buildings in question. Nor ought he to consider it too much trouble to reply to an inquiry which he might have anticipated by being a little more explicit.

I remain, &c.,

D. T.

VARIATION OF THE MAGNETIC NEEDLE.

SIR,—I beg to draw your attention to the omission from your Journal, for many months past, of the Variation of the Magnetic Needle. To myself, and I have no doubt to others of your numerous readers, regular information of the perodical variation is very interesting, and, what is more important, of great utility. I will instance to you the regular progress, for a series of twenty years, of mining operations in a certain seam of coal, of which operations a plan has been kept; the excavations being laid down upon it from time to time as the workings extended from the various shafts. Now the usual mode of keeping such a plan, is to procure in the first instance a plan of the surface, with the magnetic meridian of the time being accurately laid down upon it. The subterranean workings are afterwards surveyed from time to time, their bearings ascertained by the magnetic needle, and, with their lengths, laid down upon the plan. It is obvious, that unless the alteration of variation be ascertained by the surveyor, and allowed for in his subterranean survey, a discrepancy will gradually be generated between this and the surface plan, and between that of any particular year and those of the years preceding it.

On reference to Brewster's Treatise on Magnetism, I find that in the year 1823 the magnetic variation was 24° 9′ 40″. Now the last account I can find in your excellent work is of the variation during the months of January, February, March, and April, 1843, the average being 23° 8′ 23″, and the difference being 1° 1′ 17″ between the variation of 1843 and that of 1823. This variation would cause in a survey extending a mile in any given direction a discrepancy of 1·40 statute chains between such survey and the surface plan, and between such survey and any parallel survey taken in the year 1823, and laid down upon the plan. Such discrepancy might cause great inconvenience, loss of property, or even of life, in coal mines; and it is therefore highly important that mining engineers should have constant and ready access to an authentic account of the periodical magnetic variation.

I am, Sir,

Very respectfully yours,

Haigh Colliery, Wigan, William Peace, Mining Engineer.

April 7, 1845.

*** We shall be able to give our correspondent an answer next month.

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

INDIA RUBBER COVERING.

William Brockendon, of Devonshire Street, Queen Square, in the county of Middlesex, gentleman, for "*Improvements in covering the roofs of buildings, in covering the valves used for propelling by atmospheric pressure, in covering the sleepers of railways, and in covering parts of stringed and keyed musical instruments.*"—Granted July 24, 1844; Enrolled Jan. 1845.

This invention consists in the application of a preparation of india rubber as patented by Mr. Thomas Hancock. The india rubber is cut into pieces, and cleansed by being passed between rollers with water, and then combined with about ten per cent. of its weight of sulphur in powder; and for roofs of buildings and for railway purposes it is desirable to combine therewith calamine in the state of powder; for roofing purposes as much calamine by weight as india rubber may be used, but where more flexibility is required less calamine is used, for railway valves about one-half by weight of the india rubber is a good proportion. The sulphur and calamine is combined with the india rubber between rollers. For railways the mixture is produced in sheets from $\frac{1}{16}$ to $\frac{1}{8}$ inch thick, and afterwards subjected to heat. When working india rubber for railway valves the preparation may be formed into blocks in moulds, and then sheets cut off. For musical instruments the prepared india rubber is used without calamine. The patentee does not claim the use of calamine for such purposes; he says other matters may be used, mixed with the india rubber, to cheapen it, or india rubber simply prepared with sulphur and heat may be employed for all the purposes described. The sheets are submitted to a temperature of from 290° to 300° for about an hour.

1st. claim is for coverings roofs of buildings with thin sheets of the prepared india rubber spread evenly over the boarding, and overlapping about two inches and nailed down.

2nd claim is for forming the surface of the valves which close the longitudinal opening in the tubes of atmospheric railways with the aforesaid india rubber instead of leather.

3rd claim is for covering sleepers of railways between the rails, or the chairs, and the sleepers.

4th claim is for covering the hammers of piano-fortes with the preparation of india rubber instead of leather, and also the keys of flutes and other instruments having similar openings, and covered with similar stops acted on by keys.

INPROVEMENTS IN CROWN GLASS.

Alexander Ewing, of Dumbarton, Scotland, glass-splitter, for "*Improvements in the manufacture of crown glass.*"—Granted August 15, 1844; Enrolled Feb. 1845. (*See Engraving, Plate XII.*)

The object of the improvements is for giving to crown glass greater equality of thickness. The first claim is for the mode of operating in the manufacture of crown glass, as follows:—When the workman called the "gatherer," has formed what is called the piece on the hand pointing or gatherer's "marver," and is about to be pierced or perforated by the blower behind, the gatherer applies that part of the gathering near the tube to an iron cutter, fixed to a standard attached to the back of the marver, *a*, fig. 1, the gatherer and the blower then turn the piece round on the cutter whereby an incision is made, which displaces the metal from the nose of the pipe into the shoulder of the gathering, and ensures strong shoulders. The rim is thus made to any consistency, and after expansion an equality of substance of the table of glass will be the result, which will allow a more effectual standing in the annealing arches or kilns. The cutter is sharpened by a file and is fixed to the standard by a bolt, so as to be removed for the purpose of fixing cutters of various shapes. The patentee shows two other instruments for accomplishing the same object.

The second claim is for the mode of operating in the manufacture of crown glass as follows. At the time of perforation, the glass is taken to the "Pattison hole," and a heat being taken, it is marved on the blower's marver and then replaced in the Pattison hole, and when sufficiently heated it is taken to the stake or standard, as shown in fig. 2, to increase the size of the globe, and when the cutter is applied to the nose of the piece to prevent its swelling at the neck, and to effect a greater disunion of the piece from the pipe. The piece is taken to the bottoming hole and repeatedly heated and blown to the size desired, it is then taken successively to the "casher box," to the nose hole, the flashing furnace, and lastly to the annealing arch or kiln.

MINING SHOVELS.

William Brunton, Jun., of Poole, near Truro, engineer, for "*Improvements in the manufacture of shovels for mining purposes.*"—Granted August 29, 1844; Enrolled February 29, 1845.

The claim is for manufacturing of shovels for mining purposes, by casting them of an alloy of copper and zinc, or tin or both. The shovels are made similar in shape with those now used, the alloy when in a fluid state is poured into a mould of sand of the pattern required. The alloy preferred consists of 3 parts of copper, 2 of zinc, and 1 of tin; when desired to be hard and tough, 8 parts of copper and 1 of tin, without any zinc are employed; after the shovel is cast, it is to be slightly hammered upon a smooth anvil to consolidate it.

PUMP VALVES.

Moses Poole, of Lincoln's-inn, in the County of Middlesex, gentleman, for "*Improvements in pumps.*" (A communication from a foreigner.)—Granted August 29, 1844; Enrolled Feb. 1845.

The improvements consist in the arrangement of the valves, and placing them in a case separate from the body of the pump, in order that they may be more easily got at when out of order.

FURNACE BARS.

John Chanter, of the city of London, patentee and proprieter of patents, C.E., and George Lodge, of Leeds, engineer, for "*Improvements in furnaces, fire bars, hot air generators, and flues.*"—Granted Sep. 12, 1844; Enrolled March 12, 1845. (*See Engraving, Plate XII.*)

The first part of this invention relates to certain improvements in fire bars, and consists in the first place in arranging and constructing the bars in such manner as to move to and fro in a direction of their length; and secondly, in making the bars with lateral grooves, which join the notches or horizontal grooves formed in the upper edge of the bars, the object of the lateral grooves being to facilitate the introduction of air into the furnace from the ash pit, that is to say, between the bars. Fig. 1 shews a side elevation of a bar having lateral grooves, *a a*, which join the horizontal grooves or notches formed in the upper edge, these bars, when constructing a furnace, are supported by a cast iron frame in such manner that each alternate bar is a fixture, and therefore remains stationary whilst the intermediate bars have, by an arrangemement of levers, shown at fig. 1, a motion given them in the direction of their length, in the following manner—b b' are projections or arms upon the upper edge of which all the moveable bars rest, these arms are supported by axes or shafts, c c', upon which they move, to the shaft c' is attached a lever d, and to the lower end of this lever is attached, by means of a pin joint, one end of the connecting rod e, the other end being attached to the short arm of the cranked lever f, which moves upon a fulcrum g, the long arm of this lever is provided with a handle, by moving which up or down, which may be done by the stoker or the engine, every alternate fire bar will move to and fro in a direction of its length, which movements will have the effect of preventing clinkers; the only difference between this invention (if it may be so called) and that of a Mr. Miller is, that the patentees make the bars with grooves in the sides and give motion to every other bar, the intermediate bars being fixtures, whilst Mr. Miller causes all the bars to move; the object in the present case is stated to be a saving in power. Fig. 2 shews a plan or edge view of a fire bar.

The other part of these improvements consists in the construction of hot air generators, or chambers; and lastly, in the construction of flues for introducing the air into the furnace.

Fig. 3 shews a longitudinal section of the hot air generators, &c. A and B are two chambers situated beneath the flame bed C, in these chambers there are a number of deflective partitions, E E. F is the bridge, over which there is constructed an arch, made hollow and with a number of openings on the underside; this hollow arch communicates with flues leading from the chamber B. G is a valve for admitting air into the chamber A, which passes in a direction indicated by the arrows into the chamber B, and from thence through flues into the hollow arch, from whence it passes downward through the openings in the arch, and mixes with the flame as it passes from the furnace over the bridge.

Another arrangement for admitting air over the fire is by constructing the furnace double, so as to form a box, as shown at i; the air after passing through holes in the door escapes from the upper part of the box, as indicated by the arrow, and then passes over the fire.

SLATE CUTTING MACHINE.

JAMES CARTER, of Delabole, Cornwall, slate merchant, for *"Improvements in cutting slate for roofing and other purposes."*—Granted Sep. 27, 1844; Enrolled March 27, 1845.

These improvements consist in a machine for squaring or cutting the edges of slates for roofing; in the accompanying figures we have given a side elevation and end view of the apparatus, which consist of a fly wheel *a a*, mounted upon an axis supported by the frame *b b*; to the outer end of one of the arms of the fly wheel is firmly fixed a steel cutter *c*, which stands at about 6 inches distance from the face or arms of the wheel, the object of which is to give room for any inequalities on the edge of the slate when in an uncut state, *d* is a frame or rest, to the side of which is attached another steel cutter *e*; the frame *d* is divided into inches, beginning from the cutter; the two cutters are so arranged that their faces are about $\frac{1}{16}$ of an inch apart, and that the cutter c meets the cutter e at an angle of about 8°, *f* is a guide for preventing the fly wheel from vibrating, *g* we suppose to be a pulley keyed upon the end of the fly wheel shaft, for driving the same by means of a strap from some first mover, although the above is not stated. The action of this machine to those at all conversant with machinery is easy to conceive, notwithstanding we think it would have been quite as well if the inventor had described it, but such is not the case. The claim is for a mode of cutting roofing slate with the edges perfectly straight and at right angles to each other, also to avoid the shelling off of the underside of large portions of the slate, which is stated to be unavoidable in the old process.

WINDOW SHUTTERS AND BLINDS.

JOHN HARCOURT QUINCEY, of Old Street, City-road, gentleman, for *"Improvements in the manufacture of blinds and shutters."*—Granted Sep. 27, 1844; Enrolled March 27, 1845.

The first part of the improvements consists in the construction of metallic blinds or shutters, in the following manner. The shutters are made of bent plates of metal, that is to say, the plates forming the shutters are bent in a direction of their length, so as as to be concave on one side and convex on the other, these plates, which are fastened together by suitable hinges, have an axis at each end which passes through holes formed in the links of a guide chain; the plates forming the shutter are also made of different breadths, the narrowest plates being at the top and widest at the bottom, by this arrangement a greater length of metallic shutter can be wound on a given diameter than those of the ordinary construction,—another advantage the inventor states is that by making them of bent plates a great strength is obtained, moreover, should it be desirable a number of plates near the top may be perforated so as to admit light, without materially affecting the strength of the plates.

The second part of the improvements relates to a peculiar mode of constructing Venetian blinds, and consists in the application of perforated plates of metal or wood, and also in applying plates of glass or earthenware. In constructing Venetian blinds the inventor, in place of making the ribs or bars of solid pieces of wood, makes them of perforated wood or perforated zinc plates, which may either be a bent little in direction of their length so as to give them a greater strength, or they may be made flat with a raised border round the edge. Another method of making Venetian blinds, according to this invention, is to make the ribs or bars of metal and glass or earthenware, by first making a frame of metal equal in size to one of the ribs, and then fixing in the frame ground or coloured glass, or the frames may be so made as to receive two pieces of glass with a thin perforated metal plate between them, thereby producing very novel effects. In drawing up these blinds the inventor uses pullies of glass or earthenware.

The third part of the improvements relates to the manufacture of blinds which turn upon axes, and is similar in every respect to the method last described, viz. the application of perforated plates, or ground or coloured glass; the specification also describes the mode of making carriage blinds in the same manner.

The fourth improvement relates to apparatus for opening and closing folding shutters, and also in the construction of the same. The shutters are made of narrow bent plates of metal joined together in a suitable manner, which plates may if desired be perforated so as to admit light into the apartment; the mode of opening and closing the same is as follows,—each shutter is supported by two vertical axes upon which turns, upon the lower axis is keyed a small worm wheel; at right angles to this axis there is a short shaft which passes through the window framing or wall into the room. one end of this shaft is squared to receive a key, the other end having a worm or screw keyed upon it taking into and driving the worm wheel upon the lower axis of the shutter, by this arrangement it will be seen that by turning round the short shaft, by means of a key made to fit on the end thereof, the shutters can be opened or closed from withing the room.

The fifth improvement relates to a mode of constructing sliding metal shutters, and consists in making the shutters of rectangular plates of metal, each of the plates having a slot cut through it at each end, there is also a projection upon each end of the plate, beginning at the second plate from the top; these projections pass through the slots of the plates adjacent: thus supposing four of these plate to form the shutters, and the same to be placed side by side, and the whole to fit in a recess below the window sill, the first plate, which is raised by means of a chain, raises the second by means of the bottom end of the slot coming in contact with the projection on the second plate; this, as we have stated, fits into the slot; in this manner all the plates forming the shutter are raised so as to close the window, the upper edge of one plate lapping over the lower edge of the plate adjacent.

The sixth improvement consists in making shutters or blinds of plates of metal bent in a direction of their length, so as to give them additional strength, these plates, which may be perforated, are fixed to a suitable frame so as to form a shutter.

COMPOSITION FOR MOLDINGS.

JOSEPH EUGENE CHABET, of Paris. for *"Improvements in preparing materials to be used in making picture and other frames, and for architectural and other purposes."*—Granted Oct. 10, 1844; Enrolled April 10, 1845.

The materials employed in the composition for making picture frames and architectural purposes consist of glue, (which the inventor prefers to be made from rabbit skins, although other glue is stated to answer the purpose,) gelatine, oxide of lead, Spanish white, sulphate of lime, and sawdust, in the following proportions:—for every 36 parts the inventor takes 12 parts of glue, 1 part of gelatine, 4 parts of oxide of lead, 8 parts of Spanish white, 1 part of sawdust, and 10 parts of sulphate of lime. In preparing this composition the oxide of lead is to be put into a suitable vessel, and the glue, which has been previously melted, is to be mixed with it. after which the Spanish white and sawdust may be put in the vessel and the whole well mixed up together, should it be desired to add a little colouring matter, such as yellow ochre or lamp black, the same may be added at this stage; the sulphate of lead is now to be added to the other materials and the whole well mixed up together. The preparation may then be poured into suitable molds, observing to apply a little oil to the inside of the mould, after remaining about 5 minutes the same may be removed from the mould, and afterwards finished off as may be required.

PADDLE WHEEL FASTENINGS.

Sir GRAHAM EDEN HAMOND, Bart., K.C.B., Norton Lodge, Yarmouth, for *"Improvements in the mode of fastening on and reefing paddle wheels, float boards, or paddles."* (Being a communication.)—Granted Oct. 14, 1844; Enrolled April 14, 1845. *(See Engravings, Plate XII.)*

The improvements relate to the mode of fixing the float boards to the arms of the paddle wheel; instead of fixing them with bolts, screws and nuts, the inventor uses a square link *c*, which is put upon the arms of the wheel *a*: before the periphery or outer rim is fixed, a hole is made in the float board *b*, through which the link passes, and in the projecting part of the link at the back a key or wooden wedge *d*, is placed and driven in, which secures the float board to the arm of the wheel, as shown in the engraving; for large floats two of these links can be used to each arm; it will be perceived from this description that if it be desired to reef the paddles, it can easily be done by loosening the wedge, when the float may be drawn in. The inventor suggests cutting notches on one edge of the arms, which he states will hold the link firmer, and at the same time be a guide for the fixing the boards without measuring.

For old wheels, to obviate the inconvenience of removing the outer rim, the inventor has introduced a forked strap *e*, with an aperture in each side, the strap is put through the float and over the arms, and then a clamp *i*, is passed through the two eyes or apertures, and afterwards the link or tie is wedged up as before explained. To prevent the wedge slipping an iron pin is used to secure it to the float.

AMERICAN PATENTS.

A. D. CHILDS, Rochester, Monroe county, New York, for *"an Improvement in the horse power."*—May 6.

This horse power, like many before it, is on the general principle of the sun and planet movement; motion is communicated to a central vertical shaft provided with a mitre wheel near its lower, and a pinion near its upper end, the former driving the line shaft, and the latter receiving motion from three planet wheels arranged at equal distances around it, and each provided with a pinion on its arbor, the teeth of which take into cogs on the inner periphery of a permanent ring. The planet wheels turn on, and are carried round the central shaft by studs projecting downwards from a cap plate, (so formed as to make an entire covering to the whole machine,) which is guided and kept steady in rotating by means of rollers that embrace a flanch projecting from the outer periphery of the permanent ring, and others which bear against the inner periphery of the ring—the central shaft having its upper bearing in the centre of this cap plate.

Claim.—What I claim as my invention, is the method of sustaining the upper end of the centre shaft, and guiding the pitch of the planet wheel pinions by means of the cap, as described, which is guided by rollers on the studs of the cap, under the planet wheels, bearing and rolling on the inner periphery of the planet ring, by means of which a stationary centre is dispensed with, and the wheels are protected.

Jehu Hatfield, Glenn's Falls, Warren county, New York, for *"an Improvement on the machine for computing interest, measuring lumber, and for other similar purposes."*—May 6.

This machine consists of a vertical revolving cylinder, having on its outer surface vertical parallel columns of figures, or signs, representing the interest on the several sums shown in a stationary column on a surrounding case. There is also a circular scale, or dial, placed in front of the case in a vertical position, to indicate the days of the month, with an index hand, or pointer, which is operated by the cylinder—the two being connected together by mitre wheels.

Claim.—In the old revolving interest tables, says the patentee, there was a cylinder containing the interest, having the days and months stated at the head of each column, (instead of a dial and pointer,) enclosed in a round pasteboard case, or box, having an opening in front with the principal pasted on one side; the cylinder being made to revolve by turning the shaft at the lower end with the fingers; and, therefore, I wish it understood that I make no claim to any part of this arrangement, but what I do claim as my invention, and which I desire to secure by letters patent, is the before described combination of the revolving cylinder, containing the vertical columns of numbers indicating the interest, with the permanent vertical scale showing the principal, and the dial representing the days and months, for which the interest is to be ascertained, and the pointer operated in the manner and for the purpose set forth, or in any other mode substantially the same, by which analogous results are produced.

Charles Ross, Piqua, Miamia county, Ohio, for *"a revolving rule, for measuring surfaces, and particularly applicable to lumber."*—May 17.

A wheel, of one foot in circumference, is so arranged in a case, as to have a portion of its periphery project beyond the case, and a portion of its face visible through a hole, the edge of which is graduated to correspond with concentric circles on the face of the wheel, graduated in the manner of the common lumber rule. The shaft of this wheel is geared with the shaft of a cylinder, so that the latter will make one revolution to thirty-six of the former, there being thirty-six divisions to indicate the number of revolutions made by the wheel; and the shaft of this cylinder is geared with another cylinder, which makes twelve revolutions to one, to mark the number of revolutions made by the first cylinder. The scales on the wheel and cylinders are so arranged as to give the superficial as well as the running measure.

Claim.—What I claim as my invention, is the combination of the common board rule with the self-calculating cylinders, and their combined application to the measurement of plane surfaces in general, but more particularly to the measurement of the superficial contents of boards, plank, and lumber.

Elisha Reid, Columbus, Georgia, for *"an Improvement in oil boxes for preventing journals from heating."*—May 25.

Claim.—What I claim as my invention, is the prevention of heating journals and boxes, by surrounding the boxes with a reservoir of water, in such manner as to prevent the access of water to the oil box and journals, as described, thereby preventing heat, and, consequently, the drying away of oil, and wear of the rubbing surfaces, and the necessity of frequent oiling, using for the reservoir any material suitable, and any composition of metal for the bearings.

Stuart Perry, New Port, Herkimer county, New York, for *"Improvements in the engine, to be actuated by inflammable gas, or vapour."*—May 25.

"In my inflammable gas, or vapour, engine, says the patentee, the power which is to be obtained from it for the driving of machinery, is to be produced by the expansion consequent upon the combustion of vapour of spirits of turpentine, or of other evaporable inflammable liquids, or of gas, or vapour, or gas and vapour combined, obtained from undistilled turpentine, or from rosin, or such other substance as will produce inflammable vapour, carburetted hydrogen, or other inflammable gas, by the aid of atmospheric air, within a cylinder similar to that used in the steam engine. It is well known to engineers, that various attempts have been made to generate power by the combustion of explosive compounds within a cylinder; the expansive force of such compounds, when ignited, being in some cases allowed to act directly upon a piston, whilst in other cases, the compounds have been exploded for the purpose of obtaining a vacuum, into which the piston might be forced, by pressure induced on the other side of it; but such attempts have not resulted in the production of a machine which could be practically used with advantage.

Claim.—What I claim is the manner in which I have combined and arranged the air-pump, the reservoir, the retort, the air regulator, and the cocks which govern the admission of atmospheric air into the valve box, and their appendages, as described; by which arrangement I am enabled to supply the inflammable gas, or vapour, in regulated proportions, and to produce a pressure within the cylinder slightly exceeding that of the atmosphere, at the moment of opening one of the ignition orifices, which outward pressure is to be immediately succeeded by a draught inwards, this being effected in the manner and for the purpose described. I claim also the manner set forth, of heating the retort, by employing the heated air which escapes through the eduction tubes, so as to render such air effective in converting the combustible fluid employed into vapour.

Peter Von Schmidt, Washington, District of Columbia, for *"an Improvement in propelling steam ships and other vessels."*—May 30.

A wheel having naves in manner similar to a rotary fan blower, and a top and bottom plate attached to and moving with them, and extending from the ends of the naves to within such a distance of the shaft as to admit water to enter, is placed and works within a case in a recess in the vessel below the water line, and provided with tangent pipes leading and extending to the stern, bow, and sides of the vessel; these pipes are provided with shutters which can be closed and opened at pleasure. The rotation of this wheel produces a current of water, by centrifugal action, in, through the hollow centre, and out, through the tangent pipes of the case, so that by closing any of the pipes the vessel will be impelled in any desired direction.

Claim.—What I claim as my invention, is the employment of a wheel enclosed in a case, as described, having tangent pipes leading forward, back, and out at the sides of the vessel, in the manner and for the purpose set forth, the whole being submerged in a recess in the vessel, and acting in any direction at the will of the engineer, without reversing the motion of the wheel, or in any way checking the engine by means of shutters, or gates, arranged as described.

L. A. Stewart, Cross Plains, Robertson county, Tennessee, for *"Impovements in rotary steam engines."*—October 11.

This is for improvements on Murdock's rotary engine, patented in England some forty years since, in which the steam acts against the cogs of two wheels. The improvements are pointed out with sufficient clearness in the claims.

Claim.—What I claim is the manner of constructing, combining, and arranging the cap and cheek pieces, so as to embrace under the cap but a small portion of each wheel, employing the cap and cheek pieces, in lieu of the close case, or cases, hitherto used in such machines, and introducing the steam through the caps between each pair of wheels. I claim the combining with these caps the weighted levers for pressing them down on the teeth of the wheels, thus preserving them in close contact, without the necessity of any elastic packing. I claim the manner of preventing binding, or cramping, in said pairs of wheels, by the combined operation of the end play of the axles of two of them, and of the play of one of them in the direction of its revolution. I claim the using of the steam on a second pair of wheels, by conducting it from the first pair through the cap of the second pair, in the manner set forth.

Joseph Jones, Newton, Gloucester county, New Jersey, for *"Improvements in the machine for planting seeds."*—October 11.

We have here alleged improvements on that kind of planting machines in which the seeds are carried into the dropping tube from the hopper by means of a slide; and the first improvement consists in placing the rest board, on which the slide works, directly under the aperture in the hopper, so as to leave a passage into the dropping tube on each side of the rest board, that seed may be discharged on either side at each back and forward movement of the dropping slide. The covering roller has its bearings in two arms jointed to the frame, and to two segments provided with a set screw, by means of which the depth of the machine may be regulated.

Claim.—What I claim is, first, the method of combining the rest board with the spout and slide, by arranging the rest board over the centre of the spout under the slide, so as to leave a passage at either side of the board for admitting the seed into the spout on both the forward and backward motion of the slide; and in combination with said arrangement the method of adjusting the rest board by means of screws; second, the combination of the arms, segments, and screws, for adjusting the height of the roller for causing the plough to enter more, or less, as well as for rolling, as described.

Immense Blast Engine.—There is now erecting at Newmains Iron-Works the property of the Coltness Iron Company, an engine of the high pressure kind, of the largest dimensions, we believe, in the country. The pedestals on which it stands are composed of 1900 tons of solid mason-work; it has a high-pressure cylinder, 54 inches diameter, 9 feet stroke, with nozzles, and weighs 10 tons; with blowing cylinder, 122 inches diameter, 9 feet stroke, with top and bottom nozzles, and weighs 35 tons. The beam weighs 31 tons, and measures 36 feet long, with 6 feet broad in centres; the connecting rod works from the end of the beam, and gives a stroke of 12 feet, and 14 strokes per minute. The working part is supported on two columns and entablature, weighing 22½ tons. The fly-wheel is 30 feet diameter, crank shaft, 15¼ inches at journals, and weighs 35 tons, works at double beat valves, with steam pipes 21 inches diameter. All the parts are made to sustain 60 lb. on each square inch of the piston; it is intended to blow ten fornaces. It was made by Messrs. Murdock, Aitken, and Co., Hill-street Foundry, Glasgow.—'Mining Journal.'

BOWER'S STEAM VALVE.

(See Engraving, Plate XII.)

SIR—The accompanying sketch and description will convey an idea of a new system invented by me of admitting steam to the cylinder of the engine. If you think it has sufficient merit to entitle it to a place in your Journal, I will be most happy to see it there.

The invention is not protected by a patent. If any manufacturer will try the experiment, I will feel obliged if he will let me hear the result, and should it realize my expectations, I shall be most willing to let the public have the benefit of it.

I am, your's, &c.

JOHN C. BOYER.

Milford, Ramelton, County of Donegal, Ireland, January 28th, 1845.

A B C D E F is a pipe the form, situation and connexion of which with the cylinder are shewn in the drawing. It will be of capacity or sectional area necessary for admitting steam in the proper quantity to the cylinder.—It is shown in three pieces: A B C. and D E F are attached to and open into the cylinder at the top and bottom A F; the centre piece (coloured blue) is intended to revolve upon its own axis in the position in which it is shown, the end C within the upper part A B C, and the end D within the lower part D E F: the motion may be communicated from the crank of the fly wheel to the bevel wheels G; the vertical having its pivot in a fixed ring, H, of proper strength and dimensions, passing round the descending branch A B C, and the horizontal (of the same dimensions as the vertical) fixed upon the revolving part C D, by which means it will make one revolution for every stroke of the piston and turn of the fly wheel. Q R S T shows in section the sides of a vertical and cylindrical chamber within which the pipe C D revolves in the manner described, and into which, at opposite sides, the steam and eduction pipes are introduced. The revolving part C D is to be bored through the sides as shown by the dotted lines at M N (or as looking through the boring thus |O|.) The diameter of each hole to be one-fourth of the circumference of the pipe; and they are to be opposite to each other, and correspond with the openings of the steam and eduction pipes as shown in the drawing. But they are prevented from having any communication with each other by an oblique division I J between them, which as the pipe revolves gives an alternate direction (upwards and downwards) to the steam admitted to the cylinder L, and emitted from the cylinder to the eduction pipe K.

The engraving, Plate XII. shows the position of the parts, when the piston is in the middle of the upward part of the stroke, steam is rushing in through the open port N, from the steam pipe L, and forcing the piston *up;* while the steam from the upper part of the cylinder is escaping to the condenser, at K, through the open port in the revolving pipe at M. When the piston arrives at the top of the cylinder the motion is reversed, by the sides of the revolving pipe changing positions; and opening the lower part of the cylinder to the condenser, and the upper part to the boiler, until the piston descends to the bottom, when it is again reversed by the revolving of the pipe, and the motion is continued in the manner described.

TUBULAR BOILERS OF THE "TAGUS" AND "BRAGANZA" STEAM SHIPS.

Some erroneous statements having been made respecting the construction of the tubular boilers put on board the "Tagus," in the autumn of last year, by Messrs. Miller, Ravenhill, & Co., for the Oriental and Peninsular Steam Company, we have thought it our duty to ascertain the real state of the case, and have obtained the particulars of the quantity of fuel consumed during the last five voyages made by the "Tagus" when she had the old boilers on board, and during the only two voyages made with the new tubular boilers, which will shew a remarkable saving of fuel by the adoption of the latter. We are also enabled to give the consumption of fuel by the "Braganza," also fitted with tubular boilers of nearly the same length and breadth, the only difference being in the number of tubes; the boilers of the "Tagus" contain 180 tubes, and the "Braganza" 304 tubes, in both cases of brass 3 inches diameter.

A reference to the following tables will clearly show the saving of fuel in the "Tagus" since tubular boilers have been adopted, and also the importance of having the tubes of a proper proportion, not only as to size but also as to number, as shown by our talented contributor, Mr. Buck, in the *Journal* of last year, Vol. VII., p. 104.

The old boilers of the "Tagus" were partly tubular and partly on the flue principle, each boiler contained 4 furnaces in pairs *over* each other, the lower furnaces 8 feet long and the upper 1 foot shorter. The furnaces were made under the boilers in the front, from which the flame and heat passed between flues at the back on a level with the furnace, then returned along the centre to half way and back again through the tubes to the chimney.

The new boilers of both the "Tagus" and "Braganza" were constructed with furnaces under the boilers, the flame passing from the furnace to the back part of the boiler and then returning through the tubes to the chimney above the front of the furnaces.

The engines of both vessels are 62 inches diameter, 5 ft. 6 in. stroke, and of the nominal power of 280 horses collectively.

	Tagus. Old.		Tagus. New.		Braganza. New.	
Boilers, No. of ..	Three.		Four.		Four.	
	Ft.	In.	Ft.	In.	Ft.	In.
Length	24	3	10	0	9	9
Total length ..	24	3	20	0	21	0
Breadth	9	6	7	0	7	2
Total breadth with passage	22	8	15	0	17	0
Height	10	0	9	0	11	0
Ditto, including steam chest	14	0	15	6	14	0
Furnaces, No. each boiler	Four,		Two.		Two.	
Total number ..	Twelve.		Eight.		Eight.	
Length	7	6	6	0	5	10
Breadth	8	0	2	6	2	10
Tubes, No. each boiler	14		45		76	
Total number ..	42		180		304	
Length	10 ft.		6 ft.	6	6 ft.	6
Diameter		10 in.	3 in.			3 in.

Coal account of the Steam Ship "BRAGANZA," *voyage commencing 26th October, and ending 18th December*, 1844.

Voyage outwards.

	Coals. Tons.	Consumption per Hour. Tons.	Cwt.	Qr.	Lb.	Tallow. Cwts.	Oil. Galloos.	Hours under Steam	Speed per Hour.	Description and Quality of Coal.
Remains from last voyage ..									Knots	
Received at Southton ..	200					112 lb.	40			Mixed Welsh and W. Hartley.
Gibraltar ..	151	1	2	1	13	56	70	152	7½	Mixed, very dirty.
Malta ..	132	1	1	0	0			115	8½	Ditto.
Athens ..		1	1	3	0			67	8½	
Smyrna ..	50½	1	1	3	0			25½	8	Very bad.
Constantinople ..		1	3	2	0			40	7¼	
Total ..	533½					168	110	399½		
Remaining on hand at termination of voyage ..	85					56	46			
Consumed during the voyage ..	448½					112	64			

Voyage inwards.

	Coals. Tons.	Consumption per Hour. Tons.	Cwt.	Qr.	Lb.	Tallow. Cwts.	Oil. Galloos.	Hours under Steam	Speed per Hour.	Description and Quality of Coal.
Remains brought forward ..	85					56	46			
Received at Constantinople Smyrna ..	110½	1	0	0	0			32	8¾	W. Hartley, very fast burning.
Athens ..								25	8	
Malta ..	157	1	7	0	0	112	60	62	8½	Mixed, good.
Gibraltar ..	143	1	0	2	14			138	7¼	Ditto, very fast burning.
								156	7¾	
Motherbank ..										
		1	3	2	10					
Total ..	495½					168	106	413		
Remaining ..	9					112	42			
Consumed ..	486½					56	64			

Coal account of Steam Ship "TAGUS," *Constantinople, voyage commencing 25th November*, 1844, *and ending 9th January*, 1845.

Voyage outwards.

	Coals. Tons.	Consumption per Hour.	Tallow. Cwts.	Oil. Gallons.	Hours under Steam	Speed per Hour.	Description and Quality of Coal.
Remains from last voyage ..	70		½	63			Good Welsh.
Received at Southampton ..	134						
Gibraltar ..	80		1	100	138·30	9	Very good.
Malta ..	145				110·0	9½	Mixed, most Welsh, turned out very dirty.
Athens ..					72·30	7½	
Smyrna ..					28·30	7¾	
Constantinople ..					39·10	10 & 6	Slowed.
Total ..	429		1½	163	388·40		
Remaining ..	65		1	85			
Consumed ..	364		½	78			

Voyage inwards.

	Coals. Tons.	Consumption per Hour.	Tallow. Cwts.	Oil. Gallons.	Hours under Steam	Speed per Hour.	Description and Quality of Coal.
Remains brought forward ..	65		1	85			Welch rather old and dry.
Received at Constantinople	33½						
Smyrna ..	43				35·0	9½	Ditto, very good.
Athens ..					26·0	9½	
Malta ..	167				58·0	9½	Coal received at Malta, 57 tons good, the others very bad.
Gibraltar ..	110			70	120·30	8·6	
Motherbank ..					145·45	9	Coal at Gibraltar, two barges good and two very bad.
Total ..	418½		1	155	385·15		
Remaining ..	14		¾	65			
Consumed ..	404½		¼	90			

	BRAGANZA. Tons.	Cwt.	Qr.	Lb.	TAGUS. Tons.	Cwt.	Qr.	Lb.
Outward consumption per hour ..	1	1	3	19	0	18	0	22
Homeward ditto	1	3	0	8	1	0	1	27
Rate per horse per hour, ...	Out 8·7, Home 9·2				Out 7·1, Home 8·			
Laying and lighting fires of engine boilers	14	10	0	0	8	0	0	0
Cooking and cabin department ..	5	10	0	0	12	0	0	0

Consumption of Coals, &c. by the "Tagus," for voyages from Southampton to Constantinople.

Voyage.	Commenced.	Ended.	Under Steam. D.	H.	M.	In Port. D.	H.	M.	Coals consumed. Tons.	Cwt.	Tallow. Cwt.	Qr.	Oil. Gal.
			OLD			BOILERS.							
	1844.	1843.											
1st.	January 22	March 30	33	23	45	32	19	0	1034	11	2	2	143
2nd.	May 5	June 26	33	2	30	18	17	30	870				
3rd.	August 15	October 3	33	15	35	15	4	50	879				
	1844.	1844.											
4th.	January 20	August 6	32	2	0	14	16	10	787		1	2	135
5th.	August 24	October 9	31	20	5	14	0	55	810	10	1	1	147
			TUBULAR			BOILERS.							
		1845.											
6th.	November 25	January 11	31	20	5	13	6	25	768	10	0	2	168
	1845.												
7th.	February 3	March 14	0	0	0	0	0	0	764		0	1	208

NEW PROJECTED RAILWAYS.

The Decisions of the Board of Trade.

(Continued from Page 132, April Journal.)

RAILWAYS IN ENGLAND.

In favour of the—

Eastern Counties—Brandon and Peterborough Deviation,
West London—Thames Extension,
Newcastle and Darlington—and Brandling Junction Extensions,
Ashton, Stalybridge, and Liverpool Junction—Ardwick Extension,
Manchester South Junction and Altrincham,
Manchester and Birmingham—Macclesfield Extension and Junction Line with the Sheffield and Manchester,
Midland Railway—Darfield to Warsborough,
Midland Railway—Darfield to Elscar,
Midland Railway—Cherit to Horbury,
Midland Railway-Kenshaw to Wakefield,
Midland Railway—Ambergate to Crich,
London and Brighton — Horsham Branch,
Harwich Railway and Pier,
Richmond (Yorkshire) Railway,
Hull and Bridlington Branch,
Middlesborough and Redcar;
Birkenhead, Manchester, and Cheshire Junction,
Chester and Birkenhead Extension,
Blackburn and Preston (Alterations, Extensions, and Branch,
Coventry, Bedworth, and Nuneaton,
Eastern Counties (Finsbury Extension),
Huddersfield and Sheffield Junction,
Lancaster and Carlisle (Deviation in parish of Kendal),
Lancaster and Carlisle (Branch to Newcastle and Carlisle Railway),
Lancaster and Carlisle (Scotforth to Slyne),
Newcastle-upon-Tyne and North Shields (Tynemouth Extension and New-quay Branch),
North Union Extension to the river Ribble,
Sheffield and Rotherham (Branch to the Sheffield and Manchester Railway),
Norwich and Brandon (Extension into Norwich),
York and North Midland (Bridlington Branch),

Against the—

Dartford and Rumford,
Eastern Counties—Cambridge and Bury St. Edmund's Extension,
West London Knightsbridge Extension,
Ashton, Stalybridge, and Liverpool Junction—Guidebridge Extension,
Kentish Coast Railway,
Huddersfield and Manchester,
Harwich Railway,
Harwich and Colchester,
Ipswich and Harwich;
Liverpool and Manchester (Rainforth and Liverpool Branch),
Chester and Preston Brook,
Eastern Counties (Thames Junction and North Woolwich,
Great North of England (Clarence and Hartlepool Junction) Extension and Branches,
Grand Junction (Friar's Park to Dudley Branch),
London and Gravesend, via North Woolwich,

And recommending the postponement until a future period of the—

Colchester Junction,
Harrogate and Ripon Junction,
Leeds and Thirsk,
York and North Midland and Harrogate,
Liverpool, Ormskirk, and Preston,
Southport and Euxton,
Preston Brook and Runcorn Junction,
Epping,
Grand Junction (Potteries Branch).

DALHOUSIE,
C. W. PASLEY, G. R. PORTER,
D. O'BRIEN, S. LAING.

Fall of an Ancient Church.—An accident has happened to St. Julian's Church, King-street, by the falling in of the entire of the eastern wall, burying in the "débris" the communion table and one or two pews contiguous thereto. The church has about it many traces of extreme antiquity, the low round tower and heavy arch betokening early Saxon architecture.—'Norwich Mercury.'

MISCELLANEA.

The Rattler and the Alecto.—In the trials which were instituted by the Admiralty between these vessels, to test the qualities of the screw propeller ship Rattler and the paddle-wheel ship Alecto, the superiority of the Rattler has been fully shown. In one of the trials which took place on the 30th of March, during a perfect calm, from the Little Nore to Yarmouth Roads, 80 miles, the Rattler beat the Alecto 23½ minutes, although the Rattler, in consequence of a short supply of steam, was compelled to work the second grade of expansion throughout the day, and the engines only 23½ to 24 strokes per minute. On arriving at Yarmouth Roads they started again, both vessels having all sails set to a moderate breeze. They continued running until off Cromer Light, when the Rattler in 34 miles beat the Alecto by 13 minutes. From the bad appearance of the weather it was deemed proper to anchor for the night, during which it blew a complete gale from the N.N.W., and continued throughout the day, affording the very opportunity they were sent out to seek for trying the Rattler's powers in a head sea. In getting under way, the vessel pitching heavily, snapped her cable and lost her anchor. This race was one of about 60 miles, and the Rattler passed the Spurn Light 40 minutes before her competitor. On one occasion the Rattler lost steam, which allowed the Alecto to get alongside of her. This was at 10 o'clock a.m., and it was from that time to her anchoring that the 40 minutes were gained; although prior to that, when the sea was roughest, the Rattler gained more than half a mile on the Alecto in the first hour, the latter having had the start of the former. The 60 miles were accomplished in seven hours and a half, tide principally against them. The very lowest pressure exhibited "when the screw was out of the water" (as the opponents of the principle term it) was 34 lb. ranging up to 60 lb. on Salter's balance. Subsequent trials took place with still greater advantage to the powers of the screw; but the most conclusive results as to its superiority were proved when the vessels being fastened to each other, with their heads in opposite directions, the Rattler towed the Alecto, in spite of all her attempts to run away astern, at the rate of two miles and a half an hour.—'Evening paper.'

Her Majesty's River Yacht "Fairy."—This fine little vessel went down the river on a fifth experimental trip on the 12th ult., under the charge of Commander Smith, with the crew of the Black Eagle, and the marines of the William and Mary yacht. Mr. Lloyd chief engineer at Woolwich dockyard, and Mr. Penn, who constructed the engines of the vessel, proceeded in her at the same time, to ascertain the speed and working of the engines. On this occasion the speed was found to exceed any of the former trials, being 13·308 nautical miles, or nearly one fourth of a knot more than she had previously attained. The vessel proceeded to sea, and is reported to have stood remarkably stiff in the water when off Whitstable, although there was a strong sea running, and the wind blowing a breeze. The trial gave great satisfaction, and afforded good earnest of the capabilities of this handsome vessel for the use of Her Majesty, reflecting great credit on all engaged in her construction. The Fairy has been taken into the East India Dock, at Blackwall, to be fitted for Her Majesty's use, and will be ready in a few weeks.

New Iron Steamer.—The *Faugh-a-Ballagh*, a new iron steam-vessel, built for the Drogheda Steam Packet Company, by Messrs. Caird & Co., the eminent engineers of Greenock, arrived in our river last week, after a voyage of eleven hours, from Drogheda. The 'Faugh-a-Ballagh' is of 600 tons burthen; her length over all is 195 feet, length of keel 170 feet, breadth of beam 26 feet, and depth of hold 15½ feet. She is furnished with a pair of engine, each of 150 h. p., fitted up with malleable iron framings, on a new and greatly improved construction. The ornamental appendages of the vessel are of an exceedingly chaste description.—'Liverpool Mercury.'

The "Princeton's" New Gun.—An immense cannon, intended for the American navy, is just being finished at the foundry of Messrs. Fawcett and Co., in this town. It is of malleable iron, of a superior quality, manufactured for the purpose at the Mersey Ironworks. The weight of metal previously to being bored was upwards of 11 tons, and the gun will be about 8 tons when finished. The length is 13 feet, and bore 12 inches; outside diameter of the widest part, 27½ inches, the iron varying in thickness from 3½ inches at the mouth to 7¾ inches at the opposite extremity. The exterior is beautifully finished, bearing a polish similar to engine work, which has cost considerable time and labour. This ponderous piece of ordnance will, on its completion, be placed on board the American frigate Princeton, which is expected here shortly to receive it, and mounted on the same carriage which supported the huge cannon that burst some time back when several persons lost their lives. It is the largest ever made in this country, and will rank as one amongst many other efforts of mechanical skill and ingenuity in iron work which have emanated from Messrs. Fawcett and Co.'s establishment. Before its delivery, the gun will be tested with a double charge of gunpowder (45 lb.) and two balls made for the purpose.—"Liverpool Mercury."

Changes in Electric Conductor Wires.—M. Peltier in a letter to M. Arago, given in the 'Comptes Rendus,' states that about twelve years ago, being desirous of tracing the arrangement of the molecules of lead in the reduction of the acetate, he employed a slip of zinc, placed in the centre of a broad spiral of thick pure copper wire; the two upper emerging extremities were soldered, to form a voltaic couple. At the end of six months or a year, the immersed portion of the copper wire, originally very ductile, became so brittle that it broke with the least effort; the external portion nearly preserved its ductility, at least it retained it longer. The brittle wire presented a dull granular fracture, which indicated not only a different molecular arrangement, but also that it had formed an alloy by cementation with one of the elements of the solution. This same fact of the fragility of the wires subsequently occurred again on the occasion of his establishing a fixed electrical apparatus above his house. The apparatus is formed of long copper wires, stretched horizontally, for the purpose of conducting the electricity of the atmosphere to the common centre, after having traversed a rheometer. These wires, thus exposed to the changes of the seasons, of atmospherical agents, and electric currents, became brittle, which obliged him to renew them at the end of two years. Wires silvered did not last longer; brass wires broke at the end of six months. Sheltered conductors retain their ductility longer, but at last become brittle under the influence of a permanent current.

Volatilization of Zinc.—A note was received by the *Academie des Sciences* from Dr. Becquerel on the effects of the volatilization of zinc in copper foundries. The facts stated by the author are a full confirmation of what had been stated by M. Blandet relative to the injurious action of the white zinc vapour which escapes from the foundries. Amongst other facts, Dr. Becquerel states, that in the shop of a shoemaker, near one of these foundries, every person feels more or less ill on the melting days. The shoemaker's wife has violent tremblings and a severe head-ache, which are carried off during the night by copious perspiration. The young women employed as binders have also suffered severely.

Electricity of Steam.—Prof. Zantedeschi having formed a jet of steam, by an opening in a tubular boiler, applied the electrometer to it, and ascertained that at the origin of the jet, the electricity was negative; at a certain distance it was positive, and between the two points was a zone, in which the steam gave no indication of electricity.

Arsenical Green.—At the *Academie des Sciences*, Paris, in a letter from Dr. Blandet, on the injurious effects resulting to workmen from the arsenical green employed in the manufacture of paper-hangings. He recommends the use of peroxide of iron as a remedy for the colic and other affections experienced by workmen exposed to the action of the dust of arsenical preparations.

Colourless Ink.—At the Royal Society of Edinburgh Sir George Mackenzie explained the nature of a colourless fluid he had invented as a substitute for black ink, it is requisite to have a paper properly prepared for the purpose, when the paper is written upon with the fluid it will turn either black or blue according to the sort used.

Cutlery.—We are always happy to see our manufacturers progress with the age, and therefore we have been pleased to observe among some specimens of cutlery made by Messrs. Gilbert & Sons, of Sheffield, a decided application of decorative art to the more important quality of good and valuable instruments.

St. George's Chapel, Windsor.—This sacred edifice has just been embellished with two additional splendid stained glass windows, executed by Mr. Willement, of London. These windows are in the north aisle of the chapel, immediately under the Royal closet, and facing the back of the tomb of King Edward the Fourth, and his Queen, Elizabeth Wydville. In the two centre compartments of one of the windows, are full-length figures of Edward and his queen, attired in their robes of state, in devotional attitude, over the sacred volume. The two outer compartments contain the armorial bearings of that monarch, and also of his queen. The other new window adjoining, is to be called the "Rutland Window," and contains the arms of Ann, daughter of Richard Duke of York, Thomas Earl of Rutland, Richard Duke of York, Richard Earl of Cambridge, and Ann, daughter of Thomas St. Ledger. Mr. Willement has also filled up the three compartments left in one of the new windows fronting the Royal closet with the arms of the King of the French, the Duke Saxe Coburg and Gotha, and Philip Earl de Grey, the three newly installed knights of the most honourable and noble Order of the Garter.

Roman Tunnel at Marseilles.—A short time since a paragraph appeared in most journals, taken from the French papers, stating that a tunnel of Roman construction had been discovered at Marseilles under the mouth of the harbour. We are assured by Mr. Simms, who was lately at Marseilles, that nothing of the sort was known there.

Atmospheric Power.—At the *Academie des Sciences* M. Stourenel expressed an opinion that the locomotive principle of atmaspheric air might be rendered useful to manufacturers, by transmitting to them at 'any distance' a supply of motive power, and thus rendering steam engines unnecessary! We suppose that M. Stourenel was unaware that his countryman Papin had tried a century ago what he recommends and failed.

Mr. Lough's Statue of the Queen.—The heroic statue of Her Majesty Queen Victoria, for which Mr. Lough received a commission from the Gresham Committee, for the Royal Exchange, is completed. The statue represents Her Majesty in the robes of the Order of the Garter, holding in one hand the ball or globe, and in the other the sceptre. It is rather more than eight feet high, sculptured from a single block of Carrara marble. The difficulty of representing a female figure so much beyond the size of life, and yet preserving the delicacy of feminine grace, has been tolerably well surmounted by the artist, and there is nothing to convey the notion of a giantess, or of disproportion of stature. The likeness is sufficiently accurate to convey the idea of the features and outline of Her Majesty's countenance. Mr. Lough has, however, not flattered the illustrious original in this representation. The draperaies are exceedingly well arranged, and all littlenesses of decoration have judiciously been avoided. The statue is in a pure and simple style of art. It partakes of classical conception without too much servility to antiquity, and will add to the reputation of the sculptor, whose previous labours have already placed him in a conspicuous position amongst the artists of the English school.

San Paulo at Rome.—A writer in the *Quarterly Review* observes, that the restoration of this magnificent church, destroyed by fire in 1822, goes on but slowly.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM MARCH 27, TO APRIL 24, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Charles Pooley, of Chorlton-upon-Medlock, cotton-spinner, for "Improvements in certain machines used in preparing to be spun and in spinning cotton wool and other fibrous substances."—Sealed March 27.

William Bowser, of Parson's-street, St. George's-in-the-East, and William Bowser, jun., of the same place, engineers, for "Improvements in ships' fire-hearths."—March 27.

Richard Weller, of Cassel, near Dorking, brick and tile manufacturer, for "Improvements in the manufacture of drain and other tiles and pipes."—March 27.

John Baptiste Simion Teissier, of Paris, engineer, and Antoine Hyppolyte Triat, of Paris, professor of gymnastics, for "improvements in propelling vessels, carriages, and agricultural machines."—March 27.

Joseph Conrad Marie Baron de Liebhaber, of Paris, for "Improvements in blasting rocks and other mineral substances, for mining and other purposes, and in apparatus to be used in such works." (Being a communication).—March 27.

Wilton George Tinner, of Gateshead, doctor in philosophy, for "Improvements in the manufacture of caustic alkalies, soda and potash, and their carbonates, and also in the manufacture of the ferrocyanates of soda and potash."—March 27.

Dennis Woodin, of Upper Park-place, Regent's Park-road, veterinary surgeon, for "an Improvement in the form of shoes for horses or other animals, and in the process of accomplishing the same." (Being a communication).—March 27.

James Higgins, of Salford, machine maker, and Thomas Schofield Whitworth, of the same place, machine maker, for "certain Improvements in machinery for preparing, spinning, and doubling cotton, wool, flax, silk, and similar fibrous material."—April 2.

William Robinson Mulley, and George Mason, jun., of Ipswich, contractors, for "Improvements in collecting and raising stone or substances found below water."—April 2.

Thomas Lidbetter, of Droitwich, Worcester, manager of salt works, and John Loughton, of the same place, carpenter, for "Improvements in the manufacture of salt."—April 2.

Otis Tufts, of Boston, in the State of Massachusetts, America, engineer, for a "certain new and useful mode of building or constructing either the hulls or decks, or both, as the case may require, of ships, boats, and various other sailing or floating vessels made of iron, or other suitable metal or metals."—April 2.

James Hamer, of Wardour-street, Saint James, machinist, for "Improvements in enema syringes, and in stomach and other pumps."—April 7.

John Rand, of Howland-street, Fitzroy-square, artist, for "improvements in "certain stringed and wind musical instruments, and the application of certain improvements to certain of such instruments." (Being a communication.)—April 7.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "certain Improvements in machinery or apparatus for forging and stamping metals, applicable also to other useful purposes." (Being a communication.)—April 7.

Thomas Robinson Williams, of Love-lane, Aldermanbury, gentleman, for "a new or improved preparation and manufacture of certain fibrous and other materials for the production of a fabric suited among others to the purposes for which horsehair seating and horsehair cloths are usually employed."—April 7.

William Hattersley, of Regent-street, Westminster, pianoforte-maker, for "certain Improvements in the construction of pianofortes."—April 7.

Thomas Tarvis, of Bryanstone-street, gentleman, for "Improvements in preparing extracts from certain vegetable matters, and in the apparatus connected therewith, which apparatus is also applicable to other similar purposes."—April 7.

John Dewrance, of Liverpool, engineer, for "certain Improvements in steam boilers, and in the construction, composition, and manufacture of bearings, steps, and other rubbing surfaces of steam engines and other machinery, and also for a method of lubricating the same."—April 7.

Thomas Metcalfe, of Elizabeth-street, Eaton-square, brush-maker, for "certain Improvements in propelling carriages, which Improvements are also applicable to driving certain machinery."—April 7.

Giacomo Silvestri, of Naples, physician, for "certain Improvements in preserving animal and vegetable substances from decay." (Being partly a communication.)—April 7.

John Hick, of Bolton-le-Moor, engineer, for "certain Improvements in machinery or apparatus for cleaning wheat and other grain or seeds from smut or other injurious matters." (Being a communication.)—April 7.

Dominic Frick Albert, of Manchester, doctor of laws, operative chemist, for "certain Improvements in the manufacture of candles."—April 7.

James Lamb Hancock, Frederick Lamb Hancock, and William Lamb Hancock, of Guildsfield, Montgomery, for "an improved rotary steam engine."—April 7.

John Henry Shearman, of Clement's-lane, merchant, for "a method of separating and extracting the grease and oil and oleaginous matter from water, in which any such matter may be contained, more particularly the water which has been used in the cleansing of wool, spun wool, and woollen cloth."—April 7.

Edward Bury, of Hanslope, Buckinghamshire, civil engineer, for "certain Improvements in locomotive engines, carriages, or wagons running upon railways or common roads, for the prevention of accidents."—April 7.

Esprit Galibert, of Bridge-street, Southwark, for "certain Improvements in hats."—April 7.

William Wylam, of Gateshead, esq., for "certain Improvements in artificial fuel, and in machinery for manufacturing the same."—April 7.

Christopher Binks, of Sunderland, chemist, for "Improvements in the application and use as manure of certain substances or compounds not hitherto so employed, and for improvements in manufacturing such compounds."—April 7.

Charles Powell, of Smith's-buildings, Leadenhall-street, farrier, for "certain Improvements in the construction of horse-shoes."—April 9.

Elijah Galloway, of the Strand, engineer, for "Improvements in propelling railway carriages."—April 10.

William Cormack, of the Commercial-road, chemist, for "Improvements in purifying gas."—April 10.

Samuel Stocker, of Canonbury-place, engineer, for "Improvements in machinery, or apparatus for lifting, forcing, or conveying liquids in vessels, for holding liquids, and improvements in water-closets."—April 10.

John Coope Haddan, of Liverpool-street, King's-cross, Middlesex, engineer, for "Improvements in preparing sleepers, chairs, and spikes, and constructing wheels for railways."—April 14.

Frederick Rosenborg, of Kingston-upon-Hull, gentleman, for "certain Improvements in machinery for cutting and shaping wood and other materials into various forms or figures, and also for cleaning and smoothing the surfaces of the same forms or figures."—April 15.

George Carter, of Willenhall, Stafford, johbing smith, for "certain improvements in locks and latches."—April 15.

William Wylam, of Gateshead, merchant, for "certain Improvements in hydraulic presses, and in machinery connected therewith."—April 15.

John Lord, of Friday-bridge, in Birmingham, merchant, for "Improvements in supplying steam-boilers with water." (Being a communication.)—April 15.

John Taylor, of the Adelphi, gentleman, for "Improvements in separating metals from each other, and from certain combinations with other substances." (Being a communication.)—April 15.

John Pelton, of Bolton-percy, near Tadcaster, station master, for "Improvements in wafers, and in the means of securing letters and notes from being surreptitiously opened."—April 15.

James Muspratt, of Liverpool, gentleman, for "Improvements in the manufacture of manure."—April 15.

Moses Poole, of London, gentleman, for "Improvements in the construction of taps or cocks." (Being a communication.)—April 15.

Henry Phillips, of Clist Honiton, Devonshire, chemist, for "Improvements in purifying gas."—April 15.

James Williamson Brooke, of Bagnigge Wells-road, gentleman, for "Improvements in lamps."—April 15.

Charles Black, of Adam-street, Adelphi, gentleman, for "Improvements in the manufacture of horse-shoes."—April 15.

George Royle, of Church-hill, Wednesbury, Stafford, whitesmith, for "Improvements in locomotive, marine, steam, gas, and other tubes."—April 15.

Hypollite Chauvier, of London, gentleman, for "Improvements in the manufacture of soap."—April 17.

James Startin, of Finsbury-place, gentleman, for "Improvements in boiling liquids applicable to many purposes of domestic use, and particularly to tea or table urns."—April 17.

Samuel Wilkinson, of Balloon-street, Leeds, mechanic, for "A certain machine to be called a patent washing, wringing, and mangling machine."—April 17.

William Peter Piggott, of Wardrobe-place, Doctors' Commons, mathematical instrument-maker, for "certain Improvements in mathematical, nautical, optical, and astronomical instruments, and also in the mode of manufacturing dials and other graduated plates."—April 17.

William Shepherd, of Manchester, calico-printer, for "certain Improvements in the art of printing calicoes and other surfaces."—April 17.

James Ivers, of Preston, machine-maker, for "certain Improvements in machinery or apparatus for preparing, roving, and slubbing cotton, wool, and other fibrous substances."—April 22.

John Thomas Perkins, of Monmouth-street, pattern card-maker, for "certain Improvements in machinery or apparatus for cutting paper and other fabrics."—April 22.

William Mackie, of Baggot-street, Dublin, builder, for "Improvements in window-sashes, and in fastenings for window-sashes and shutters."—April 22.

Charles Robert Roper, of Hackney, chemist, for "Improvements in the manufacture of gelatina."—April 22.

Charles Matthew Barker, of Manor place, Walworth, gentleman, for "Improvements in the manufacture of matches for obtaining instantaneous light, part of which improvements are applicable to sawing wood for other purposes."—April 22.

Alphonse Le Mire de Normandy, of Dalston, gentleman, for "Improvements in dissolving tar and shellac, and in rendering fabrics waterproof."—April 22.

Thomas Moss, of Gainford-street, Barnsbury-road, engraver, for "Improvements in printing and preparing bankers' notes, cheques, and other papers, for the better prevention of fraud."—April 22.

Freeman Roe, of the Strand, engineer, for "Improvements in the manufacture of pipes for conveying water and other fluids."—April 22.

Charles Louis Mathurin Fouquet, of Jermyn-street, Haymarket, for "Improvements in the preparation of an artificial vegetable gum, to be used as a substitute for gum Senegal."—April 22.

Joseph Maudslay and Joshua Field, of Lambeth, engineers, for "certain Improvements in propelling, and in propelling machinery."—April 24.

Robert Beart, of Godmanchester, gentleman, for "Improvements in the manufacture of bricks and tiles."—April 24.

[illegible]

HUNGERFORD & LAMBETH SUSPENSION BRIDGE

FIG I

SIDE VIEW

NASMYTH & MAYS' ATMOSPHERIC APPARATUS

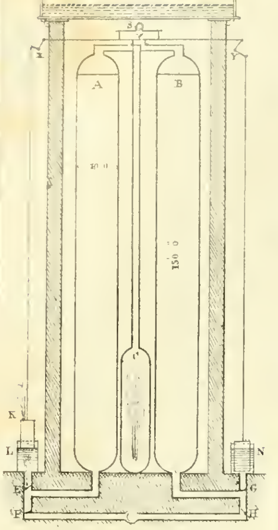


FIG 1.

PLAN

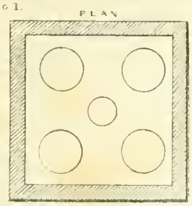


FIG 4, FIG 3, FIG 2.

PROSSERS RAILWAY

FIG 1

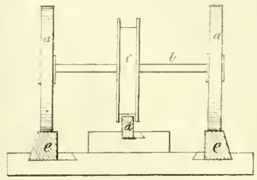
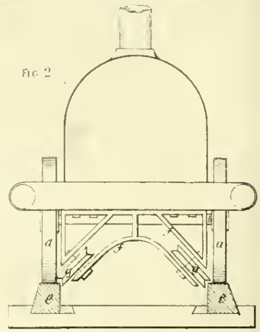
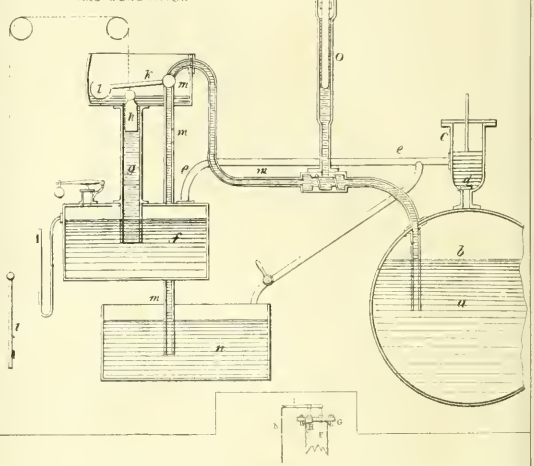


FIG 2

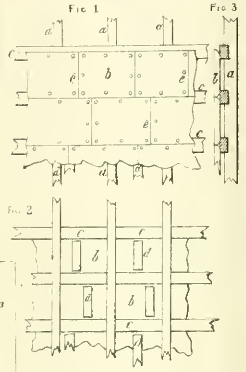


AULD'S STEAM - REGULATOR AND GENERATOR



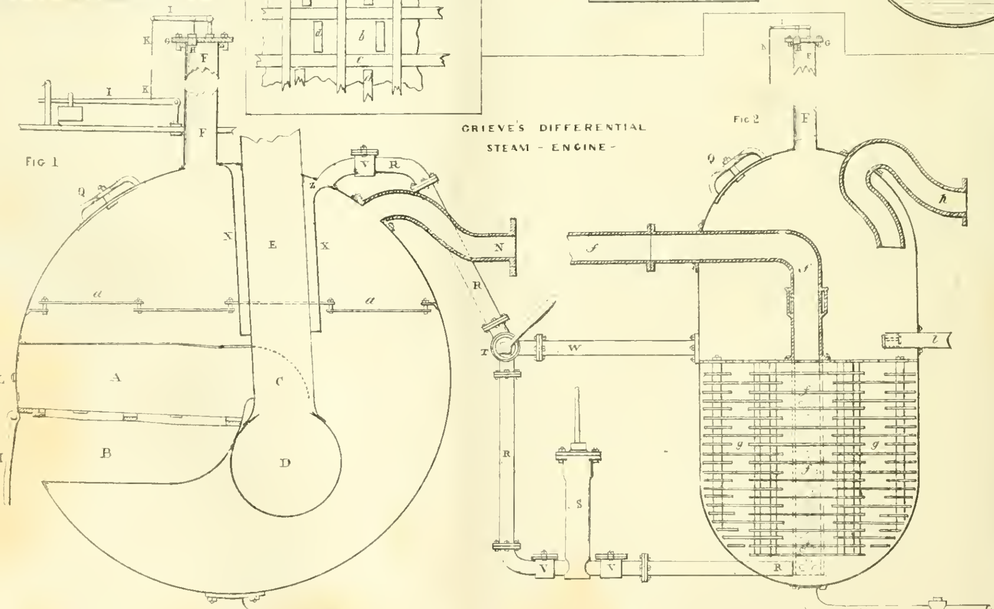
NORTHS SLATE ROOF

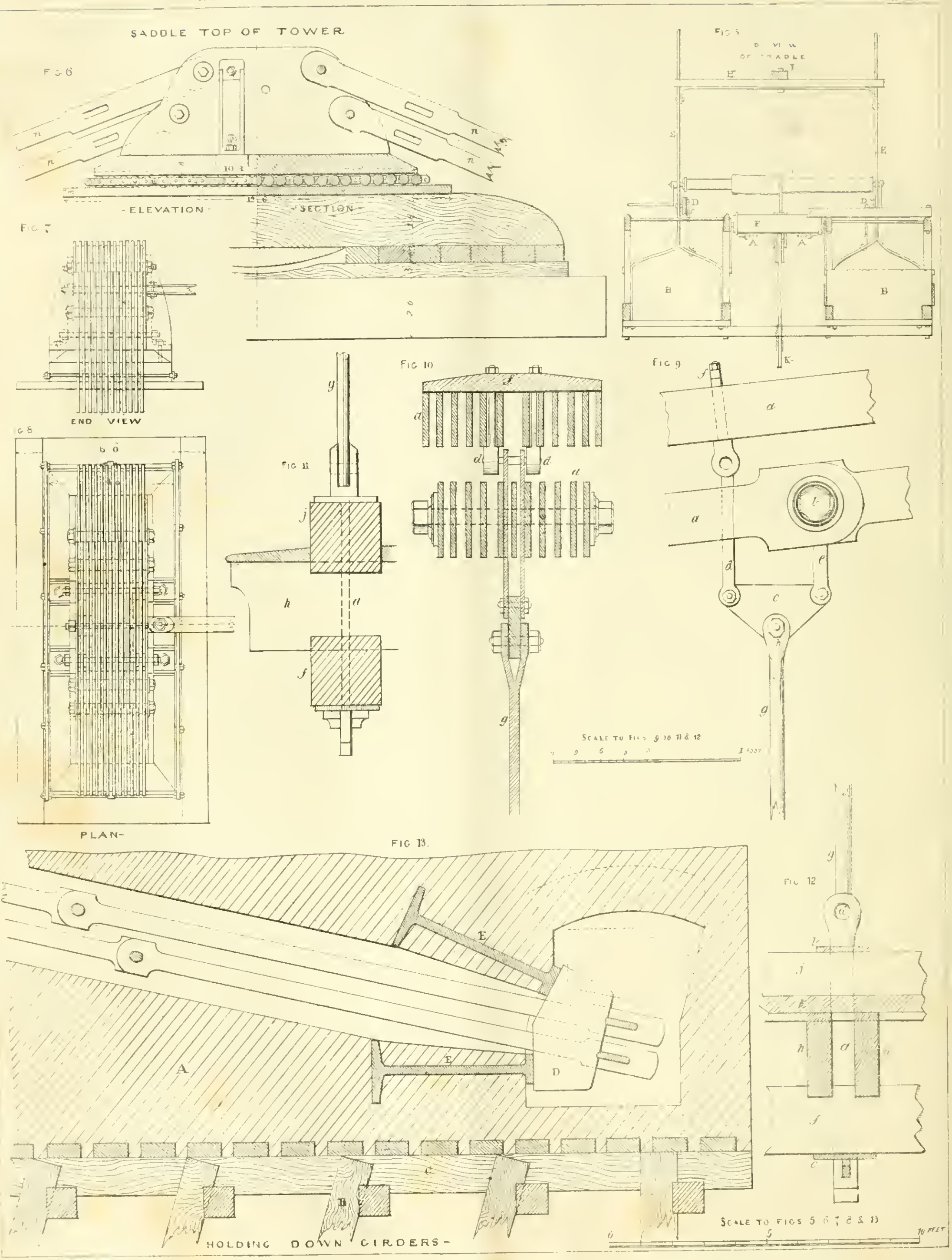
FIG 1, FIG 2, FIG 3



GRIEVE'S DIFFERENTIAL STEAM - ENGINE

FIG 1, FIG 2




SADDLE TOP OF TOWER
FIG 6
ELEVATION
SECTION
FIG 7
END VIEW
FIG 8
PLAN
FIG 5
FIG 10
FIG 11
FIG 9
SCALE TO FIGS 9 10 11 & 12
1 FOOT
FIG 13
FIG 12
HOLDING DOWN GIRDERS
SCALE TO FIGS 5 6 7 8 & 13
10 FEET

HUNGEREORD SUSPENSION BRIDGE.

(With Three Engravings, Plates XIII, XIV, and XV.)

We present our readers in the accompanying engravings with ample illustrations of the details of the Suspension Bridge recently erected over the Thames, and connecting Hungerford Market with Lambeth on the opposite bank of the river. The engravings are carefully reduced geometrically from the original working drawings, and by the scale attached represent accurately the dimensions of the parts illustrated. The details are highly interesting and exhibit a more than ordinary scientific judgment in obviating difficulties which are usually attendant upon suspension bridges,—to these details we have confined our illustrations, as a drawing of a bridge of such large magnitude as the one before us must necessarily have been on such a very small scale, that it would have been perfectly useless to our professional readers.

The Hungerford Bridge is now the ninth structure connecting the two parts of the metropolis on either bank of the Thames—the Vauxhall Bridge being the extreme western, and the Thames Tunnel extreme eastern of this noble range of public works, unparallelled for their magnificence throughout the world. The following account is extracted from a paper read by Mr. Cowper before the Royal Institution.

"This bridge is for foot passengers only: it consists of four broad chains, viz. two chains, one above the other, on each side of the platform; each chain consists of ten and eleven links alternately, and near the piers of eleven and twelve. This increased strength is to meet the increased strain which takes place near the piers. The chain of the Menai bridge is only five links wide, and the chain of the Hammersmith only six links wide; but the great breadth of the Hungerford chain (viz. eleven links, or about two feet,) gives them great power to resist the effects of the wind, and thus prevent vibration. Two brick towers, or campaniles, in the Italian style, are built in the river, over which the chains are carried, forming thus a central and two side spans.

The two piers are in height	80	feet.
The central span between the piers (being 110 feet wider than the Menai Bridge)	676½	feet.
The length between the abutments	1352½	feet.
Deflection of the chain	50	feet.
Length of each link (7 in. wide, 1 in. thick)	24	feet.
Weight of each link	5¼	cwt.
(The connecting pins are 4⅝ inches diameter.)		
The whole number of links	2600	
Their weight	715	tons.
The number of links in the centre span	1280	
Their weight	352	tons.
Width of the platform	14	feet.
Height above high water at the centre of centre span	32½	feet.
——— near the piers	28½	feet.
(Giving a rise of four feet in the centre. This gives additional height for the river traffic, and produces a graceful curve, and prevents any appearance of swagging.)		
The section of the chains at the centre of centre span is	296	sq. in.
——— near the piers	312	sq in.

A square inch of iron *breaks* with 27 or 29 tons, but 17½ tons is taken as the *impairing* weight, *i. e.* the weight at which it begins to stretch; we have, therefore, for the weight the bridge will actually bear,—

$$296 \times 17\tfrac{1}{2} \text{ tons} = 5180 \text{ tons, while } 296 \times 5 \text{ tons} = 1480 \text{ tons,}$$

is the greatest load that can be put upon it. This is taking a crowd standing close together to be 100 lb. per square foot. The entire weight of the chain, the platform, and a full load upon it, would make a load of about 1,000 tons on each pier, being about 8½ tons on each square foot of brick-work, or not quite 1¼ cwt. on each square inch.

The chains are attached to large wrought-iron vertical plates at the summits of the piers: these plates are firmly bolted together, and also to a strong horizontal plate,—the whole forming what is called a saddle. The saddle is not fixed to the pier, but rests on fifty friction rollers, these resting on a thick iron plate, which is supported by a solid mass of iron and timber girders. The pier itself, being pierced with arches, may be considered to consist of four columns of brickwork; the girders, therefore, are so arranged, that no weight is thrown on the *arches*, the whole weight resting on the columns. The saddle is capable of moving eighteen inches each way, equal to three feet entire motion; so that if either span were crowded the chains would adjust themselves, and the strain be still perpendicular upon the piers, and have no tendency to pull the pier over. The method of putting up the chains was thus:—Two sets of *wire* ropes, each consisting of three ropes, were hung from abutment to abutment over the piers, in the exact situation the chains were to occupy,—these *scaffold* ropes, as they may be called, being distant from each other equal to the length of the connecting pin. A few feet above the scaffold ropes, two other ropes were hung in like manner; on these traversed two light boxes, very much resembling a carpenter's bench turned topsy-turvy. These *cradles*, as they are called, were connected together, and contained two windlasses, like those over a common well; these cradles held the workmen. A barge containing the links was moored under the cradles: four men in the cradles hauled up a link; and when they had raised it above the scaffold ropes, the connecting pin was put through, and the pin being allowed to rest on the scaffold ropes, of course supported the link. The cradles were then moved forward, and two links joined to the single link, then one joined to the two; the chain consisting, thus, in the first instance, of alternately two and one links. When this two-and-one-link chain was completed, the scaffold ropes were not required, the two-and-one-link chain forming, as it were, a scaffold for the rest of the links; and thus was this bridge erected *without any scaffolding* but these few ropes, and without the slightest impediment to the navigation, and without a single accident. The cost was—

Mr Chadwick's contract for brickwork, stone work, and coffer dams	£63,000
Sandys, Carne and Vivian for iron work	17,000
	£80,000

The money was raised by—

3200 Shares of 25*l*.	£80,000
By Loan	26,000
	£106,000

The engineer in chief was Mr. Brunel. The resident engineer Mr. P. Pritchard Baly."

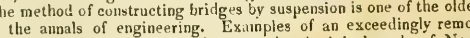
The first large suspension bridge erected in this country was that constructed at Berwick, across the River Tweed: the length was 450 feet, and the engineer of the bridge was Capt. Sir Samuel Brown. The method of constructing bridges by suspension is one of the oldest in the annals of engineering. Examples of an exceedingly remote date are found in China, and among the aboriginal works of North America, but it was not until 1816 that Sir Samuel Brown took out a patent for the construction of chain suspension bridges in this country.

The comparative span, weight, and cost, of the three largest suspension bridges in Europe are:—

Freiburg (wire-rope)	820 feet span	902,572 lb. weight	£107,000 cost.
Hungerford (chain)	676 „	1,601,600 „	£80,000 „
Menai (chain)	580 „	3,987,664 „	£120,000 „

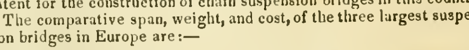
It will be seen that the weight of the wire bridge of Freiburg is only one-fourth that of the Menai bridge, though 294 feet longer; the difference of cost is also £13,000 in favour of the former structure. It may, however, be doubted whether a wire bridge is as secure as one formed of flat iron bars bolted together, as in the former case the metal is liable to much greater injury by oxidation. The Menai bridge was constructed in 1826 by Mr. Telford, and at a time when engineering efforts were comparatively unaspiring, this work was considered a wonderful monument of Mr. Telford's talents; but it is now perhaps, notwithstanding the difficulties overcome in its construction, considered by engineers rather as a proof of courageous, than of perfectly successful, enterprise: it has been subject to a great many serious accidents, which would probably have been avoided had it been erected at a more mature period of art.

The arrangement of the bars forming the compound chain on either side of the roadway of the Hungerford Bridge may be repesented thus—



—It will be seen that by this arrangement each chain consists alternately of 10 and 11 parallel flat bars. The head of each of these bars is perforated to receive a long straight bolt which connects each two series of bars together.

In the Hammersmith bridge the arrangement is thus—



—Here the bars are arranged by threes and sixes: the consequence of the bars in each series being of an even number is that their heads cannot overlap and be connected by a single bolt, as in the Hungerford bridge; but the connection is necessarily formed by a double coupling bolt. In the Hammersmith bridge the wide interval between the chain is the roadway, and the two narrow intervals are footways.

In the case of the Menai the arrangement is thus, by series of five bars—

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| | | | |      | | | | |    | | | | |      | | | | |
| | | | |      | | | | |    | | | | |      | | | | |
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—Here, again, the connection of each two series of bars is by a double bolt: there are in this bridge two roadways. It will be observed that in it, as well as that at Hammersmith, two of the chains are so close together as to be liable to dash against each other in a high wind, a disadvantage avoided in the Hungerford bridge.

We wish to call particular attention to the manner in which, in the new bridge, the chains are supported by the towers. To a casual observer it might appear that these towers are of insufficient strength, but when it is explained that by the manner in which the chains are supported, they exert no lateral strain on the towers, but that their pressure is *wholly* vertical, it will be seen that the only way in which they could injure the towers is by actually crushing the brickwork of which they are composed. This effect is obtained by connecting the ends of the chains with a saddle which runs by rollers on a plate in the top of each of the towers, and consequently the only effect of any inequality in the expansion or contraction of the chains is to move the saddle a few inches forwards or backwards. A somewhat similar method has been employed in the construction of the Menai bridge, except that in that case the rollers supporting the saddle run on an arched plate instead of a horizontal one.

Reference to Engravings, Plates XIII., XIV. and XV.

Fig. 1, Plate 13, is a side view of the Suspension Campanile, showing a portion of the main suspension chains A B, suspension bar C, and platform D, with the perforated parapet E, the perforation is of cast iron, the cap, base and pedestals of timber.

Fig. 2, Plate 14, is a transverse view of the roadway D, and Basement; there are to be steps (which are not shown) to lead down to the floating pier for steam boat passengers to embark and disembark.

Figs. 3, 4 and 5 are a plan, a side view, and a transverse view of the cradle used for fixing the main chains. A A are the two *scaffolds* of Smith's wire ropes eash consisting of 3 ropes, inch diameter; A and B two cradles, principally formed of timber; C C windlasses with barrel 5 in. diameter; c c′ iron ropes, upon which the cradles were suspended by the pulleys D D; the pulleys were fixed in the iron framework E E, to which were suspended by straps the two cradles, the latter were 3 feet wide in the clear and 28 feet long and 3 feet high, they consisted of truss framed work of timber, the top and bottom plates are 3 by 5 and bearers 4 by $2\frac{1}{2}$, the two cradles were connected across by plates 4 by 4, and were also supported by a roller F, 8in. diameter and 3 feet long, which rested upon the two sets of iron wire ropes A A, first described; the windlass barrels C C could be raised and fixed in any part of the iron side standards G G, these were again stayed by the cross pieces of timber and iron tyes H H, and also longitudinally by the piece of timber J. The cradle is shown as lifting one end of the links K of the main chain, the other end having been previously fixed to the bolt L and the two links M last fixed.

Figs. 6, 7 and 8, Plate 15, show one of the saddles. In fig. 6 one half one saddle is shown in section and the others as a side view; the saddles consisted of 13 vertical wrought iron plates *a*, $1\frac{1}{2}$ inch thick, 3 ft. 6 in. high, and 8 ft. 6 in. long, with two ribs *b* to each of the outside cheeks, through which pass 4 bolts *c*, $1\frac{1}{2}$ inch diameter, with screws and nuts to each end and a collar between the vertical plates, these bolts tie the whole of the 13 plates together, the vertical plates rest upon a horizontal iron base plate *d* 4 feet long by 4 feet broad and 8 inches thick, the outer edge chamfered off to 3 inches thick, the horizontal plate rest upon 25 pairs of iron rollers *e*, each 22 inches long and 4 inches diameter, with iron axles, the ends passing through an iron side frame *f*, inch by 3 inches, and secured by screws and nuts, and again by six other bolts *g*. The rollers rest upon an iron base plate *h*, 12 ft. 6 in. by 6 ft. and $3\frac{1}{4}$ in. thick; the two plates over and under the rollers are planed, the lower plate stands upon a solid base of oak timbers 22 inches thick and 20 feet long, with an iron girder between each piece of timber—these timbers lie on the top of transverse oak plates 6 inches thick leaving a vacancy in the centre part, and these plates are laid upon a bed of oak planks 5 inches thick, bedded on the top of the brickwork two feet above the cornice: by this arrangement the whole of the weight is distributed upon the solid part of the brickwork and, entirely removed from over the arches. The two saddles are tied across the pier by an iron girder 10 ft. 6 in. long, the ends work upon centres. The distance between the centres of each pair of saddles is 14 feet. Between the vertical plates *a* of the saddle bars are fixed the 12 upper links *n* of the main chains, with iron bolts $4\frac{1}{2}$ in. diam. and 2 ft. $1\frac{1}{2}$ in. long between the heads.

Figs. 9 and 10 show the coupling bolts and suspension plates, the links *a*, of the main chain, inch by 7 in. and 13 in. at the ends, secured at the junction by a bolt *b*, $4\frac{5}{8}$ in. diameter and 2 ft. to 2 ft. 2 in. long with cast iron nuts 8 in. diam. and $2\frac{3}{4}$ in. thick; *c* the suspension plate $1\frac{1}{8}$ inch thick 15 in. wide and 7 inches deep in the centre, suspended by 2 pair of links, *d e*, of iron 2 by $\frac{1}{2}$ inch; *e* is suspended to the coupling bolt *b*, and *d* to another pair of links attached to the cross bar *f*, 1 ft. 11 in. long $1\frac{3}{4}$ by $1\frac{3}{4}$, resting on the top of the upper main chain; the suspension bar *g*, $1\frac{5}{8}$ diameter has a forked end *h*, secured by bolts $1\frac{1}{2}$ in. diam.

Figs. 11 and 12, side and transverse views of the ends of the girders and suspension bar; *a* suspension strap 3 by inch 2 ft. 2 in. long between the plates *b* and *c*, with a fork at the upper end to attach it by a bolt *d*, $1\frac{1}{2}$ in. diam. to the suspension bar *g*, and the lower end *e* has a wedge formed key and cleet to hold up the plate *c*, which is 8 inches square and $\frac{1}{2}$ inch thick, the upper plate *b* is 5 by 7 and $\frac{1}{2}$ inch thick; *f* side plate or stringer of timber 9 inches square; *h* cross beams or joists, 3 by 11 inches; *j* upper stringer, 9 by 9, which forms the lower part of the parapet; and *k* the platform, under the platform are diagonal bolt ties traversing from side to side the whole length of the bridge.

Fig. 13 shows the holding down pier of brickwork A, resting upon piles B, driven deep into the ground, with a platform of tiober C resting thereon. D is the anchor of iron, through which the links pass, they are secured by keys at the back; the anchor abuts against two cast iron girders E, 5 ft. long, bedded in the solid brickwork with flanges at each end.

The whole of the brickwork of the abutments and towers is built in cement. The two towers were erected in coffer dams, the foundation is gravel, and is surrounded by sheet piling 15 feet deep.

ARCHITECTURAL DRAWINGS, ROYAL ACADEMY.

Much as we complain and have complained—to no sort of purpose whatever—of the treatment which architecture receives at the Royal Academy, and of the very inadequate space allotted to it, we wish that unless it could be extended in the manner it ought to be, the space now afforded were even abridged by the whole of the walls above seven feet from the floor being given up to oil paintings. Most assuredly full one half of the drawings now hung up might be spared without being missed, since put where they are they cannot be looked *at*, even when found out by being looked *for* from the catalogue; therefore if good, their merit is quite lost, and if unworthy of being seen they surely are not worthy of being *exhibited*. We cannot, however, complain of the Academicians for having encroached too largely upon the narrow limits of the architectural room, and there securing all the best places for themselves, since they have very *generously* given up the whole of it this year to non-academical exhibitors. The architectural props of the Academy do not prop up that room: Smirke is of course wholly occupied with the façade and wings of the Museum, into which he is putting the entire store of poetic ideas and fancies he has accumulated during his professional life;—had we seen any drawing of his we should actually have started, as at some portentous and miraculous vision. Professor Cockerell is, we suppose, still dreaming about Colonna, Polifilo and Polia,—is perhaps employed in preparing an English version of the old Dominican's crazy production, with its grotesque illustrations. Either Soane greatly exceeded his duties as Professor of Architecture in the Academy, or the gentleman who now holds that office falls far short of his, for he has no exhibited above once since he was appointed to it, and then what could hardly be called his own, it consisting of no more than a collect tion of Wren's buildings fancifully grouped together. Truly the little man on the top of the column in Trafalgar Square, has been stuck up there to little purpose if he have failed to remind the Professor and the other Academician architects that "England expects every man to do his duty!" Barry has not heeded such monition any more than the Professor himself:—*et tu Brute!*—and are not the public then worthy of being allowed to see—nay have they not even some positive right to demand to see every year during the progress of the works, what advance is making in the various parts of that vast pile which they have to pay for? Is there no draftsman or architectural painter to be found who could make one or two subjects from it every season? or are Mr. Barry's emoluments from that work so trifling that the expense of such drawings—though they would afterwards furnish his own drawing-room—would be an alarming *drawback* on them? Hardwick follows Barry's example, and many follow the example of the four architect academicians. The list of defaulters this season is more copious than usual: among them are both Professor Donaldson, and Professor Hosking; Allom, Basevi, Elmes, Ferrey, Kendall senior, Poynter, Salvin, and Wild. Tite never exhibits—perhaps he is looking forward to becoming an R.A.; neither does Pugin, who is, however, himself exhibited this season *in persona*, in a very clever and striking antiquely *Gothic* portrait of him by Herbert (No. 423), wherein he looks—as *patelin* and *doucereux* as if he had never written his "Contrasts." Blore is another architect whom we find here only in effigy, namely in a bust in the sculpture-room; than which we should have greatly preferred seeing the design of Worsley Hall, the mansion he has just erected for Lord Francis Egerton, near Manchester. Neither do we obtain from the Exhibition any information relative to any other of the various buildings going on in that part of the country, for few if any of the most distant provincial architects exhibit this season.

Still, unpromising as this state of matters is, it must not be hastily concluded that there is a decided and very obvious falling off in the architectural department of the Exhibition, this season. On the contrary if not graced with the most eminent names in the profession, the walls display full the average degree and quantum of talent and several drawings of singular beauty. Though not a few are absent whom we expected and should have been glad to meet with here, there are others whom we can cordially welcome, and among them two who, although not exactly strangers, greatly surpass what we could have looked for from them, judging from what they have before shown us. There is a great deal of what is little better than mere filling-up stuff, —but when was it ever otherwise? We could spare those *Academic* designs, and *tironic* exercises in architecture which treat us with prodigies of pomposity devoid of a single fresh idea; or else with such truly extravagant ideas as that put forth in No. 1168, for a Nobleman's Mansion with a prospect tower 400 feet high, "the ascent being effected by the aid of machinery." Were the extravagance of such a project redeemed in that instance by beauty of design and sublimity of effect, we might have been gratified by contemplating upon paper what would be too daring and gigantic to realize in execution; but the design is no more than an absurd monstrosity. Without reference to that instance in particular, nothing is more common, we may observe, than dwarfishness of imagination getting upon the stilts of commonplace in heroics—like General Tom Thumb throwing himself into the attitude of Ajax. While we are satiated with bombastic grandeurs of that feeble and insipid stamp, we get very few drawings indeed of a class of subjects which unless so shown, the public generally can never know any thing at all of except the existence,—we mean Interiors, of which there are many highly worth seeing, but it is impossible to obtain access to them except by either special favour or rare accident. Such is the case with the apartments in the Royal Exchange, belonging to what is called Lloyd's, and consisting of several rooms two or three of which are striking, not only for their unusual dimensions, but their unusual architectural character also:—a couple of drawings from them would have been an acquisition to the Exhibition. But be the cause what it may, architects are apt to be exceedingly jealous of exposing subjects of the kind to the gaze of exhibition-visitors, choosing rather than to incur such contamination for them, to hide their light under a bushel, and forego the applause that the taste so displayed might obtain for them. Some views of the interior of the Conservative Clubhouse would have been very gratifying to many others besides ourselves,—even more so as far as their mere curiosity would have been interested: however as there is nothing of the kind here, people must form their ideas of the embellishment and effect of the hall and other parts of that building from the *truthful* representations of them in the Illustrated News.

In proportion as we are sparingly favoured with drawings of that class, do we feel grateful for them when they occur, and we accordingly thank Mr. S. Smirke for permitting us to behold Sir Robert Peel's new Portrait Gallery at Drayton Manor (No. 1222). The Premier's name being connected with it, has no doubt attracted to this drawing a great many from whom its intrinsic interest would hardly have secured for it a passing glance, even charming as it is as a drawing, and it is one which completely refutes the absurd notion—now we hope wearing away—that the view of a mere room can never form a picture without the aid of striking accessories in furniture and figures, or other "accidents." As an architectural subject, the chief feature in its design is the part over-head, or ceiling, which consists of a deep cove—of oak or some other dark wood,—and a transparent plafond of plates of ground glass, which is divided into compartments by ornamental transverse beams, terminating against a sort of caryated figures in the cove on each side. The ceiling perhaps predominates too much in the design; for the style, which is that of our English Renaissance, is hardly kept up at all except in the screen of columns—corresponding to which there is, we suppose, another at the opposite and nearer end of the room, not shown in the drawing. The walls are merely hung with green figured silk; yet although that may be suitable enough for a picture gallery under ordinary circumstances, it by no means accords either with the character of the style adopted or the design of the cove and ceiling, both which required some sort of panelling or compartments on the walls; so far from being attended with any inconvenience, such decoration of the walls would have been highly appropriate for a gallery built expressly, it appears, to contain a uniform series of full length portraits, in a single row of them, and so arranged as to correspond with the divisions of the cove; consequently there was nothing to hinder the paintings from being framed into similar compartments on the walls. At any rate the pedestals of the columns ought to have been continued as a dado round the room; for even that would have produced a tolerable degree of correspondence between the upper and lower part of the walls. Instead of which—whether it be owing to an oversight on the part of the draftsman or not—the pictures come down lower than the bases of the columns, the pedestals of which in consequence look disagreeably high, more especially as they are insulated instead of being continued up to the corresponding pilasters against the wall.

(No. 1125) Interior of Farringdon Hall, Finden and Lewis, shows us another apartment, in which the ceiling constitutes the principal part of the design, and is after the fashion of a timber queen-post roof, truncated above by a horizontal plane of the same breadth as the sloping sides, and containing a series of octagon skylight panels. There certainly is some novelty in the design, and taking the ceiling by itself, it is satisfactory enough, but here again, the style expressed by that feature is not at all kept up in any other part; except, indeed, as to colour, in which respect the whole is singularly of a piece—more so than is altogether to be recommended, the walls and ceiling being precisely alike both as to colour (light green) and panelling. On the other hand, the beams, which are either of dark timber or painted in imitation of it, catch the eye too forcibly, there being nothing else of similar hue in the room, and, moreover, cause the room, which is of rather low proportions in itself, to appear lower than it otherwise would. What is the particular destination of this apartment it is difficult to guess, there being nothing to express its purpose, nor does the catalogue give it any name. It is not furnished, nor seems intended to be so, for the floor is carpetted, but for which circumstance it might be supposed to be meant for a sort of entrance hall. There is no indication of its being a saloon, drawing-room, dining-room, library, or sitting or reception-room of any other kind, and yet there are two chimney-pieces on one side of it, and those rather strangely close to each other, there being between them only two of the six compartments into which the side walls are divided; which circumstance, and that of the walls themselves being panelled with mouldings and borders, forbids our supposing that the room is intended to serve as a picture gallery, although no pictures are shown in the drawing. The subject of (No. 1184,) View of Messrs. Williams and Sowerby's New Show-room, D. Mocatta, is already known to our readers: as a drawing it is by no means satisfactory, and is besides hung too low, so that the perspective looks distorted, which is also the case with the preceding subject. We would therefore suggest, that if there be really no help for drawings being hung so low—some even still lower—the inconvenience might be in some degree obviated by their being inclined upwards, the frames being fixed against a plane sloping in that direction for about three feet from the floor, by which means the drawings so placed could be seen by looking upon them, without stooping. We might then be able to see such small drawings hung next to the floor as (No. 1107), The Gallery at Uplands, Hants, by E. Fudge, a new name to us, if it be not an awkward misprint in the catalogue. However, there is something in the subject, and we wish there was more of the kind in the Exhibition. At any rate, what subjects of the kind there are ought to be placed where they can be well seen, there being so exceedingly few of them. This season the above-mentioned four constitute all, for interiors of churches, or such as are not original designs but merely views, and those from buildings which are open to inspection, and which have, perhaps, been besides frequently represented before, hardly belong to the same class. Well could we have spared such a very stale subject as (No. 1192), "Interior of St. Stephen's, Wallbrook;" to say the truth the day for admiring it seems to be gone by, the style itself being now altogether repudiated for church architecture, all the new designs for churches which we here find—and have found for some seasons past—being Gothic, and of many of them the chief recommendation must be that they come under that denomination—consequently are protected from the reproach of Paganism, be it either Greek or Italian. When good in design, the merit of such productions is generally of a somewhat negative kind, inasmuch as they consist of little more than compilation—according to the present improved recipe for concocting them, care being taken to avoid aught approaching to originality of conception or freshness of character. No wonder then that in spite of mechanical correctness in regard to their individual features, a certain feebleness and listlessness stamp so many highly *respectable* things of the sort. We meet with an exception in No. 1291, "Interior of an Anglican Church now in course of Erection," J. M. Derrick, which though so vaguely and cautiously hinted at, we presume to be that of the Holy Cross at Leeds, and if so, that place will possess a very rich and highly enriched specimen of Gothic, not only of the Decorated class, but profusely adorned, if not throughout, at least in the portion here shown, with polychromic painting—applied even to the arches and the shafts of the pillars. These last very much resemble those of the corresponding portion of Patrington Church, Yorkshire,—viz., the entrance to the chancel or division of the plan beneath the tower,—being though exceedingly massive in themselves, composed of a number of very delicate clustered shafts; and the resemblance is increased by those which support the chancel arches being carried up higher than the capitals of the pillars, and the springing of the arches, on the sides.—Though only a part of an interior, No. 1229, "Monument and Obituary Window," E. B. Lamb, as a design has great merit,—of excellent character, yet perfectly simple; it therefore deserved to be placed somewhat lower, so that the design of the painted window could be made out, as well as its character perceived. The propriety of using windows for monumental purposes is however far from being obvious. The same very clever architect—than whom no one better understands the genius and true sentiment of the mediæval style,—gives us in No. 1259, "A Design for a Chapel proposed to be erected at Holloway," something greatly superior to the buildings of that class around the metropolis, as would perhaps have been rendered more strikingly apparent had the design actually chosen been exhibited also: as it is not, we must wait until the building itself shall be erected before we can judge what sort of taste the committee showed in preferring it to the one here at the Academy.—There are again this year some drawings of the designs for the Nunhead Cemetery Chapel, viz., 1178 and 1196, by W. H. Brakspear, and 1289, by T. Little, the successful competitor, who now exhibits "a section of the Antechapel, showing the proposed arrangement of monumental tablets and inscriptions;"—all of them tasteful drawings, but only in sepia, and otherwise of too modest a character to attract notice in an exhibition room, where most of the paintings are studiously coloured up, and some of them almost flagitiously so, making a parade of fierce scarlet and lobster-complexioned bricks,—of skies more intense than heavenly blue,—and of figures and other *ad captandum* fillings-up, to make amends for or conceal their deficiency in architectural interest.—No. 1207 "Restoration of the Church of the Legislation and of the parish of St. Margaret," W. Bardwell (the author of "Ancient and Modern Temples") is, we suppose, merely a volunteer idea for rebuilding—at least in regard to its exterior—that structure; and certainly were it to be so refashioned it would be as handsome as from the mutilations which it has suffered it is now unsightly, yet we question if its entire removal would not be a greater improvement. The "Legislation" would not miss it.

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

IMPROVEMENTS IN THE MANUFACTURE OF SUGAR.

Henry Oliver Robinson, Old Jewry, City, and of Mill Wall Iron Works, Poplar, engineer. for "*certain improvements in steam machinery and apparatus for the manufacture and refining of sugar*."—Granted October 10, 1844; Enrolled April 10, 1845.

The improvements are very important, and consist of four parts. The first relates to the machinery for obtaining the juice of the sugar cane, commonly called a steam engine and sugar mill. Upon the usual mode of constructing these, the steam engine, the driving gear, or connecting wheels, and the mill, are each adapted to be supported upon three separate foundations of timber or masonry, of different heights from the ground, or levels respectively, that is to say, the motor, the machinery communicating motion or power, and the operating machine are connected to each other by their moving parts only. Upon the new mode of constructing the same, the three divisions of the machinery are shaped and adapted in such manner that the lower extremities of the fixed parts are in the same plane with each other, and rest upon and fixed to a base plate or base frame of iron; thus they are connected by their fixed parts, as well as by their moving parts, and form one self-dependent machine, termed by the inventor a "steam cane mill."

The second improvement relates also to the machinery for obtaining the juice of the sugar-cane, commonly called the sugar-mill, considered apart from its connection with the motor, that is to say, to *the operating machine only*. In the common horizontal mill the rolls or pressing cylinders are three in number, and are placed with one above acting upon or against two below. In this new horizontal sugar-cane mill the rolls are four in number, and placed in pairs, two above and two below, each upper roll acting upon or against a lower one, the canes passing continuously between the two pairs of rolls. Each upper roll is placed a little in advance of the lower roll against which it acts, so that the canes when undergoing the pressure of each pair of rolls are in an inclined upward position, and the juice pressed out of them or liberated does not pass through with the canes, but falls down in front of each lower roll into the mill-bed or receiver. Each pair of rolls has its own tie-bolts placed in the exact direction of the strain, so that all the severing force of the action of pressing or crushing the canes is borne by the said tie-bolts and the cast iron side-frames have merely to perform the office of supports. In connection with the above described arrangement of the pressing cylinders of a sugar-cane mill the inventor introduces his *Cane-feeding Apparatus*, patented by him in 1840, in such a manner that the end of the moving platform thereof comes under the upper one of the first pair of rolls of the mill, and delivers the canes properly to the action of the mill: the said upper roll thus taking the place of the small upper roll of the feeding apparatus.

The third part of the improvements relates to the conversion of manufacture of the juice of the cane into sugar, and the refining of sugar. The present process, termed clarification or clarifying, to which cane juice is first subjected is not materially changed or altered. When the cane juice is clarified and collected into a reservoir, it is injected or pumped into a close iron vessel, called a *Close Evaporator;* in this vessel the juice is subjected to the heat of an ordinary fire placed in a fire-grate underneath, and evaporated or boiled till about one-half of the aqueous constituent is driven off. The vapour is not permitted to flow out till a certain pressure above that of the atmosphere is obtained. This vapour or steam is disposed of as hereinafter pointed out. The juice thus boiled is then permitted to flow from the close evaporator through a pipe leading from near the bottom to the top of a metallic vessel called a *Surface Filtrator;* this vessel is also made close or steam-tight, and may be of any strong and convenient shape. The cover is made to remove: within the vessel are placed in alternate layers textile fabric or filtering cloth and wicker or pierced metallic plates; through these the juice is gently urged or forced by means of the pressure of steam in the close evaporator, at such a rate as may be found best, the rate being perfectly controlled by a cock placed in the exit pipe. The juice is now deprived of its feculencies, but is not yet chemically purified. In order to accomplish this latter object the exit-pipe of the surface filtrator is made to communicate with a vessel similar to it in its external form, which is called a *Charcoal Filtrator;* this vessel has a false bottom-plate pierced with holes, and contains animal or bone charcoal, of the usual description of the sugar refineries. Through this medium the juice is in like manner urged, and escapes through a pipe and regulating cock into an open vessel, called a *Filtered Syrup Reservoir.*

Another arrangement of the process is the following:—the liquor or syrup instead of being evaporated to the degree stated in the close evaporator by fire heat, is allowed at an earlier stage to flow into a second close evaporator, similar in its construction to the vacuum evaporator, described hereinafter, and heated by the steam emanating from the juice in the first close evaporator, until the degree of density named is attained, it is then permitted to flow into the filtrating vessels as described. At this point it is no longer deemed proper to submit the syrup to the action of the high temperature of fire heat, and in order to evaporate the remainder of the aqueous constituent and convert the syrup into sugar syrup, it is evaporated in vacuo, by the action of steam heat in a metallic vessel, called a *Vacuum Evaporator;* this vessel is made of a cylindrical form, placed horizontally; at each end is a space or compartment formed by a plate or plates of metal; between these compartments, and communicating with them, are placed straight tubes, the ends of which are let into and fixed to the plates forming the compartments. The liquor or syrup to be evaporated is placed in the body of the vessel through which these tubes pass, and the steam let in to the two end compartments and within the tubes, gives off to the syrup its heat and evaporates it to the required degree of specific gravity. The vacuum or partial vacuum over the surface of the syrup within the vacuum evaporator, is produced by the common mode of a condenser and air pump. When the syrup is thus finished, it is discharged from the vacuum evaporator and crystallized in the usual way.

The steam produced from the juice in the close evaporator above referred to, is employed to supply the vacuum evaporator and the clarifying pans, or a steam engine; thus one fire may suffice for all the processes of the manufacture of the cane juice into sugar; and water can be dispensed with.

In the refining of sugar the same kinds of filtrating vessels, or a series thereof are employed, each being steam-tight or close, and communicating with each other from bottom to top; but in this case as there is no close evaporator from which steam is produced, the flow of the syrup is actuated by a small supply of steam from a steam boiler to keep a pressure on the surface of the syrup, within the vessel or reservoir containing the syrup to be operated upon.

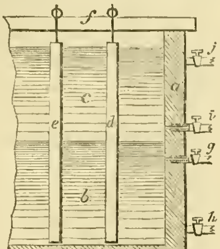
The fourth improvement is the making of the vacuum pan used in the manufacture of sugar, or in the refining of sugar, of cast iron, and in the manner described above.

COPPER ORES.

William Henry Ritchie, of Lincoln's Inn, in the county of Middlesex, gentleman, for "*improvements in obtaining copper from ores.*" (Being a communication.)—Granted October 10, 1844; Enrolled April 10, 1845. *Reported in the London Journal.*

This invention relates to using galvanic currents for precipitating copper from solutions of sulphate of copper, obtained by dissolving copper ores. In previous attempts to effect this object, the exciting liquid and the solution of copper have been kept separate; but, in the present instance, the exciting liquid is in contact with the solution of copper. Another improvement consists in the application of cast-iron for receiving the precipitated copper; though, when using other parts of the Invention, other metal surfaces may be employed, and these surfaces the inventor calls the "generating surfaces." Another part of this invention consists in combining sulphate of iron or zinc with copper ores, when they are being calcined or roasted.

The ores are mixed with as much sulphate of iron or zinc, in the state of crystals, as will be equal to one-fifth of the quantity of sulphate of copper contained in them; they are then calcined in the ordinary manner, and are afterwards dissolved; the solution is then put into any suitable vessel, and on the top of it is placed a solution of sulphate of iron, for the exciting solution, as shown in the annexed engraving, wherein *a* is the vessel, *b* the solution of the ores, and *c* the exciting solution. A cast-iron plate or "generating surface," *d*, and a "conducting surface" or plate of lead, or other suitable metal, *e*, are now introduced, and being suspended from a rod of copper, or other suitable material, *f*, the copper in the solution becomes deposited on the leaden plate: as many pairs of cast-iron and leaden plates may be used as the vessel *a*, will contain.



Owing to the difference in their specific gravity, the solution of sulphate of copper will be at the lower part of the vessel *a*, and the solution of sulphate of iron at the upper part, and they will remain in contact without mixing. In the course of working the solution of sulphate of copper will become lighter at the upper part that lower down, and should be drawn off when it has lost about half its copper; the solution of sulphate of iron, which is made by mixing two parts of water with one part of a saturated solution, becomes heavier at the lower part than at the upper, and should be drawn off when it is as dense as the weak solution of sulphate of copper that is being drawn off. To keep up a constant equilibrium in the liquids, an outlet *g*, is applied to the vessel *a*, so that the solution of sulphate of copper may flow off at the upper part, whilst an equal quantity is entering at the inlet *h*; and there is an outlet *i*, for carrying off the solntion of sulphate of iron, at the lower part of that liquid, whilst a corresponding quantity is admitted into the vessel *a*, at the inlet *j*: the sulphate of iron, thus drawn off, may be crystallized, and used in the process of calcining the ores.

The patentee claims, firstly,—combining with the roasting of ores, sulphate of iron or zinc. Secondly,—the mode, herein described, of manufacturing copper, by using the exciting liquid in contact with the solution of copper. Thirdly,—the use of cast-iron for what he terms the generating surfaces Fourthly,—the use of sulphate of iron as the exciting liquid, when using galvanic currents to precipitate copper.

ARTIFICIAL STONE.

Frederick Ransome, of Ipswich, caster, for "*Improvements in the manufacture of artificial stone for grinding and other purposes.*"—Granted Oct. 22, 1844; Enrolled April 1845.

This invention consists, first of producing artificial stone for grinding and other purposes, by employing a solution of silica as a means of cementing broken stone, sand, or other convenient earthy or metallic matters; and secondly in causing artificial stone, produced by cementing broken stone, sand, or other convenient earthy or metallic matters with a solution of silica, to be subjected to pressure in moulds, by hydraulic or other mechanical pressure. The great object of the invention is to use a solution of silex as a cementing material for combining uncalcined materials into substances resembling stone of different kinds, depending on the material used and according to the pressure to which the substances are to be applied, thus when for grinding purposes, pulverised or broken burr-stone is preferred; and for imitating Bath-stone, pulverised or broken Bath-stone; and for granite, broken granite; such materials are to be used in a broken or pulverised state, sifted so that the granular parts may be as equal as may be; or other broken stone or earthy matters or sand may be used, and mixtures thereof made to produce varied characters of artificial stone.

The solution of silica, called by the patentee "silicious paste or cement," is prepared in the following manner—100 lb. of crystallized carbonate of soda (subcarbonate of soda, or in commerce called soda), is dissolved in about 50 gallons of water; the carbonate of soda is then rendered caustic in the usual manner by means of lime; or, instead of carbonate of soda, about 50 lb. of carbonate of potash, usually called pearlash, may be used. The caustic alkaline solution is reduced to about 20 or 25 gallons by heat, and then put with about 100 lb. of finely broken flints, or other convenient silicious substance, into an iron boiler or digester and heated 10 or 12 hours up to a pressure of about 60 lb. to the square inch, and frequently stirred. When the mixture is incorporated it is removed from the boiler and passed through a sieve to remove any undissolved stone; the cement is then fit for use, or may be tempered to any required consistency by the admixture of sand or finely powdered flint. For the purpose calcined flint is generally used, and if too thick for the purpose the same is reduced by adding water.

For manufacturing mill-stones for grinding the following proportions are taken—the silicious cement one part, of finely powdered flint or powdered pipe clay one part, and of fragments of burr or other suitable stone three or four parts, which is regulated by the size of the fragments which should be as uniform and free from dirt or earthy matter as possible; the above ingredients are to be well mixed and incorporated together, when it may be compressed in iron moulds under mechanical pressure. When the stone thus formed is removed from the mould, it is to be allowed to dry at common temperature for about 24 hours, when it may generally be removed into an oven or drying room where the temperature is to be gradually raised to that of boiling water, or even beyond that point. In like manner when manufacturing artificial stone for other purposes, granite, common sand, or fragments of any convenient silicious or other hard stone or substance are used, and mixed with from one-fourth to one-sixth of the silicious paste or cement, so as to form by trituration an uniform mixture of the cement and silicious particles.

The claim is, *first* for the mode of manufacturing artificial stone for grinding and other purposes by cementing broken or pulverised stone, sand, earthy or metallic matters with a solution of silica; and *secondly* the subjecting artificial stone produced by the aid of a solution of silica with broken or pulverised stone, sand, earthy or metallic matters, to hydraulic or other mechanical pressure in moulds.

STEAM CONDENSER FOR ATMOSPHERIC RAILWAYS.

James Nasmyth, of Patricroft, Lancaster, engineer, and Charles May, of Ipswich, engineer, for "*improvements in working atmospheric railways and in machinery for constructing the apparatus employed therein.*"—Granted October 22, 1844; Enrolled April 22, 1845.

Mr. Nasmyth has favoured us with the following account of his invention. The idea is analogous to that of the condensers of atmospheric steam engines, and here receives a very ingenious application. We have, in effect, in this invention the work of a steam engine performed without the employment of the piston. We do not think there would be much loss from the steam mixing with the air, for in whatever manner the particles of steam might be arranged with respect to those of air while driving it out, still it is clear that whatever steam was admitted to the condenser would *displace* so much air, and therefore do full duty whether it preserve integrity of stratum or not. The only loss occasioned by inequality in the stratum of steam, or—so to speak—by part of the steam *protruding* beyond the rest, would be that that part would escape, instead of remaining in the receiver to be condensed, but this loss would be very trifling.

A graver ground of apprehension is whether much of the steam would not be lost by condensation with the cold air supplied to the condenser for each operation. An experiment might easily be made on a small scale by which the steam *mixed* with air and escaping with it from the receiver could be condensed and measured; also the steam condensed by contact with the cold air in the receiver could be measured separately from the water for injection and the steam condensed by *that*: these two measurements would give the total loss with great accuracy.

"The chief difficulty which stands in the way of the atmospheric railway system is the much greater expenditure of fuel in the production of the motive power as compared with the locomotive engine system; this objection (and a serious one it is) arises from loss of power in the means at present employed for the production of the vacuum in the atmospheric pipe, as also from leakage in the long valve which covers the slit in it. Much ingenuity is being exercised at present to remedy the leakage of the long valve, with what success time alone can show. It is, however, in the economizing the production of the vacuum itself to which we ought to look as the source from whence the most important improvement must come, and it is with an aim to the attainment of this object a system has been invented of forming vacuum by the direct use of steam alone, which from its extreme simplicity and efficiency bids fair to bring about the most important results in economising the production of the motive power for service of the atmospheric railway.

The principle on which this invention is founded consists simply in the employment of steam as an air dislodging agent in place of the piston of an air pump, by which all friction and complex machinery is done away with, and the whole apparatus reduced to a simple boiler and a few tall air tight vessels, which perform all the functions of steam engine and air pumps.

Reference to fig. 1 exhibits the general arrangement of the apparatus in question. It consists of a set of two or more tall upright air-tight chambers or vessels which are supplied with steam from a suitable low pressure boiler: these vessels may be of any suitable capacity, the dimensions figured in will show what is intended in this respect. In order to produce the vacuum by such apparatus, steam is in the first place permitted to flow in at the *upper end* of each vessel, which steam as it enters is forced to occupy the upper part of these vessels and as it continues to flow in (without in the slightest degree mingling with the air), it depresses and forces out at the valves below all the contained air. It is important to remark that by the peculiar mode in which the steam is admitted to these chambers there is not the slightest mingling of the air with the steam—the stratum separating the two is as perfectly defined as if the steam were a piston descending and expelling the air out at the bottom as it gradually occupies the place of the air. This system of *vertical* displacement is the grand feature of the invention. As soon as the air is all gone from A B and C, the valve V is moved into the position as seen in fig. 2. and the injection of cold water admitted to the condenser C, the result of this is the instant formation of a very perfect vacuum in vessel B; this being the case the valve H is opened to the atmospheric railway main pipe M, and such portion of the air withdrawn from it as is due to the relative capacity of the pipe as compared with that of the vessel B.

The moment this is accomplished the valve V is slid along into the position fig 3, the consequence of which is an immediate transfer of nearly all such portion of steam from vessel A as the contents of B was, minus the balance of the atmosphere; in this action B acts on the contents of A as a sort of preliminary condenser, with this important advantage, that we employ a considerable portion of the steam that was in A to refill the vessel B, and so prepare it for the admission of fresh steam from the boiler. The valve V continues to slide on into position fig. 4, when the entire steam remaining in A is condensed by C, and its contents left in the state of nearly perfect vacuum; the valve F is then opened to the atmospheric pipe M, and A then abstracts it contents, or nearly so, from M, so that at each alternate action of A and B we have the same action as if A and B were (as they really in effect are) vast air pumps, the steam acting in them as a piston, but with this important advantage that there is no friction whatever. Some idea of the rapidity with which steam can in such a case flow into and be withdrawn from such vast chambers or vessels, may be formed by referring to the rapidity of action in the case of large steam engines, the action of steam flowing in and out of such vessels under such circumstances as required or presented here is nearly as quick as thought.

So that all that is requisite to cause these two vast vessels (or as many more as may be thought requisite to act as a set) to act as air pumps is simply to cause the valve V to push backwards and forwards, as indicated by the positions in figs. 2, 3, and 4, in all ordinary cases 4 or 5 fills of such vessels as indicated in fig. 1, would extract the air from the atmospheric pipe between station and station and bring all into action.

One very important advantage in this most simple and direct mode of producing vacuum directly is this, that previous to the starting of the train the entire set of four great chambers may be previously brought into the condition of one vast magazine of vacuum, so that on the signal being given all that has to be done is to open the valve leading to the atmospheric main and in an instant such will be the energetic effect of this chamber of vacuum on the long valve as to cause it to close down tightly all at once, and so entirely remove the risk of that leakage which is certain to exist for a long time in the case of *gradual exhaustion* by the comparatively slow action of the air pump; this gradual closing of the valve is one of the most fertile sources of loss of power in the present system, but by the energetic effect of a rapid air exhaustion, as here proposed, not only would the valve be closed tight down all along the length, but also such a vacuum formed in the pipe as to be in all ordinary cases quite equal to do the duty of drawing the train along. In order to render the action of the valve V self acting, there are two small tanks of water at L and N placed directly over the discharge valves E, G, the action of these are as follow—suppose the air being expelled from chamber A, this air would pass out by the valve E, and bubbling up through the water in the tank L some of it would collect under the gasometer K and raise is up, there being a hole in the top of this gasometer or inverted tank K it will be kept in suspension just so long as there is air being given out from the valve E, the instant the last bubble of air is gone out, and the steam begins to meet the water, K is no longer sustained, and sinking down by reason of the escape of the air from the hole at the top as it sinks it draws the valve V across into the desired position, and then the tank N begins to prepare in like manner for the performance of its duty. Thus is given to the machine a power of nice discrimination as to the exact moment when all the air is gone out, and consequently the proper time to reverse the action of the valve.

The entire success of the enterprise, however, depends on the *vertical displacement*; any attempt to dislodge air by steam *directly* by any other means would not answer. Experiments on the subject show that such is the difference in the specific gravity of steam of low pressure, especially as compared with atmospheric air, that if steam be permitted to enter *gently* at the upper end of a tall upright vessel, in that case the plane of separation of the steam from the air will be found to preserve a very remarkable integrity of strata—air is the worst material to convey heat by *communication* DOWNWARD. Consequently as the steam flows in at the top it soon forms (at the stratum of separation) a quiescent bed for itself to rest on, which goes down along with the descending column of steam to all practical intent like a piston with no friction.

It is proposed to line the inside as well as the outside of the chamber with wood to keep it warm, and so prevent the air from robbing us of heat or fuel. In order to secure a gentle flowing in of the steam in an uniform descending column the low pressure steam is at first let in very gently, and as an additional precaution against any mixture with the air a cup or dish-formed plate is placed opposite the entrance-pipe, which assists the lateral or horizontal diffusion of the steam; as a second precaution a perforated plate is used, which further has the effect of preventing any undue local disturbance of the column of air; the result is that the steam descends with a horizontal understratum like the clouds on a fine summer day, resting on the top of the column of air and depressing it, and forcing it out at the front exit valve below, which affords a very free exit for it. It is not intended in practice to apply the leaky gasometer to do the valve moving duty *direct*, but simply as in the case of a pumping engine to draw the bolt which permits the valve-moving agency to come into action, a small portion of our magazine of vacuum will supply ample means of obtaining the valve-moving agency; but if the apparatus were done on a scale large enough one supply of steam to the set and one condensation would form cubic contents of nearly pure vacuum quite equal to the exhaustion of the pipe to the moderate amount they require, viz, 8 lb. or so; the energetic effect produced on the long valve by the opening the main to such a chamber or magazine of nearly pure vacuum would cause the long valve to flap down tight in an instant, and so save a vast amount of loss of power and time as at present, when it has to remain in a leaky condition till the air-pumps have brought the vacuum to the valve-closing point."

DIFFERENTIAL STEAM ENGINES.

John Grieve, of Portobello, Edinburgh, engineer, for "*certain Improvements in the production and use of steam applicable to steam engines.*"—Granted Oct. 17, 1844; Enrolled April 17, 1845. (*With Engravings, see Plate XVI.*)

The first improvement is founded on the principle that small additions of temperature produce a great increase in the expansive force or power of steam, which increases with the temperature, and that high temperatures are easier maintained as the cooling medium is diminished; to effect this the inventor uses two or more steam vessels, a generator and receiver or receivers, both or all closed to or from the atmosphere, and having regulating valves of different loads, the lesser load on the receiver.

The steam after being formed in the generator is passed into the receiver, as hereafter described, where its expansive force is diminished, and the water in the receiver being only what is required for the production of steam, is raised to any degree of heat that may be wanted, less than the temperature in the generator, by means of loading the valve of the receiver to a greater or less extent; the water in the receiver, after being heated, is forced into the generator by a pump. Steam engines formed on this principle the inventor names "Differential Steam Engines," as it is from the difference of temperature between the generator and receiver that the power for propelling the engine is derived.

The inventor makes seven different claims for generating steam in a separate vessel called a generator, and collecting the steam therefrom in another vessel called a receiver, either before or after it has driven the engine for the purpose of heating the water in such receiver, to be raised into steam for driving an engine, or for feeding the generator with hot water. One of the arrangements is shown in the engravings, figs. 1 and 2, Plate XVI.

In the drawings the same letters on each figure of the same vessel refer to the same parts. Fig. 1 is a vertical section of a spherical shaped steam boiler or generator; A the furnace, B ash-pit, C flues leading from each side of the furnace to D, which is a horizontal flue stretching across the lower part of the boiler, E a vertical flue on the top of which is placed a funnel. (In land engines the boiler may be surrounded by a dome of brick or mason work, leaving a space between for the flame and smoke to circulate with a flue taken from the bottom of the casing, or any other part as may be desirable to the chimney.) F a tube made of boiler plate, on the top of which is placed the plate G, for the safety valves H. I lever, K rod for regulating the pressure on safety valves, L furnace door, M damp r plate, N steam pipe, O sludge pipe, P door (lined inside with fire brick) for cleaning out flues, see fig. 2; Q man-hole door, R pipe for supplying the generator with water from receiver delivered at Z, S force pump to supply the generator with water, T two-way cock, V boxes for valves opening towards the generator, W pipe for returning surplus water to receiver, X casing for flue E. *a* open or perforated plate near the surface of the water to keep the water from shifting heavily. Fig. 2 is a vertical section of the receiver (a cylindrical shaped vessel with semi-spherical ends); *f* steam pipe for ingress of steam, *g* plates for more rapidly transmitting the heat from the steam to the water, *i* end of pipe for supplying the receiver with water, and having a valve opening inwards, the water to be supplied with force pump (not shown) or otherwise, where it may be most expedient with one or two engines working; *h* steam pipe to be used only when the steam is supplied from the receiver to a second engine, F steam tube, G valve-plate valve, this steam tube with its regulating valve on the receiver may be used or not when steam is taken from this vessel to a second engine. When a single engine is to be used it may be placed between the generator and receiver (figs. 1 and 2), the steam from fig. 1 entering the cylinder by the steam pipe N, and after propelling the piston it is conducted from the eduction pipe through the steam pipe *f f* into the receiver, where it heats the water in this vessel, becomes of less expansive force in consequence, and is passed into the atmosphere through the regulating valve H, fig. 4. When two steam engines or cylinders are to be used the steam for the second engine is taken from the receiver and passed through its cylinder by means of the steam pipe *h*, which is only used where two engines are in use, and is afterwards wasted through an air pump and condenser attached to the second engine. This system of supplying cylinders with the same steam can be extended to more than two cylinders when it may be required.

The second improvement is for the formation of a boiler having two or more furnaces, with the flues carried by a curved flue into a horizontal flue stretching across the boiler at right angles to the furnaces, and then carried up into a single chimney, as shown in the drawings annexed to the specification.

DOOR AND WINDOW FASTENINGS.

William Bewley, of Dublin, gentleman, for "*improvements in fastenings for doors, windows, and other places, where fastenings are used.*"—Granted November 2, 1844; Enrolled May 2, 1845.

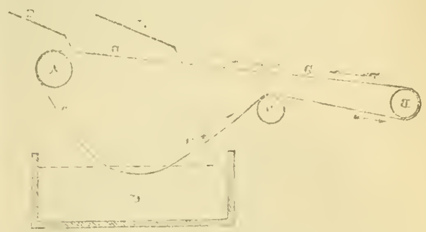
The object of the inventor is intended to arrange the parts of a lock for fastening doors, windows and other places in such a manner that the bolt of such lock may be set free by the act of closing the door, and thereby fasten the same, and that by the moving of the bolt in order to open the door, shall bring the bolt in such a position as to be held by certain mechanical arrangements. The bolt of the lock simply consists of a latch or lever bolt, which is constantly forced outwards by means of a spring, the length of movement being regulated by a pin or stop, there is also a spring which, when the bolt is moved back for the purpose of unfastening the door, which is done by means of a handle, that retains the bolt in such a position until it is moved out of the way, which is effected by means of a projection fixed on the striking plate, against which projection the spring comes when in the act of closing the door, and immediately this spring is acted upon, the bolt is released so as to fasten the door.

DRESSING ORES.

William Brunton, of Pool, near Truro, Cornwall, for "*Improvements in apparatus for dressing ores.*"—Granted Nov. 2, 1844; Enrolled May, 1845.

This invention consists of an improved method of submitting ores or materials containing ores to the action of a stream of water, by depositing them upon an inclined table, moveable either continually or occasionally upward against the stream, whereby the waste is (as in the ordinary methods practised) washed off at the bottom of the incline, whilst the clean or dressed ore by its superior gravity, settles upon the moving table and with it is carried upwards beyond the influence of the washing stream and ultimately deposited into a separate vessel.

The means by which the same is performed is as follows: an inclined moveable table is made with a long sheet of painted cloth with the two ends united, when it becomes an endless band, along each edge and on the outer side is sewed a strip of thick woollen cloth enclosing a soft hempen rope, which forms a ledge or margin to prevent the materials being washed over, and for the transverse support of the cloth are fixed slight pieces of timber extending the whole width of the cloth inside, and at equal and short distances, by copper nails driven through the said margin into the transverse pieces of timber, and for the support and application of the cloth thus prepared a roller is applied, about 1 inch longer than the width of the cloth, having 6 or 8 bars fixed upon its periphery parallel to its axis, and at equal and such distances as will suit and act as detents against the transverse timbers inside the cloth. This roller is supported by its gudgeons between two strong pieces of timber built into and projecting from a wall. There is also a frame of timber about 1 ft. 6 in. longer than the intended length of the inclined table, composed of two sides fixed together by several cross bars of timber, each about 1 inch longer than the width of the cloth, upon these cross bars are fixed four or more longitudinal bearers, upon which the transverse pieces of timber fixed to the inner surface of the cloth bear and slide when the frame is at work, and at the lower end of this frame is fixed another roller without detents, of the same length and parallel to the head roller, its upper surface is in the same plane with the upper sides of the longitudinal bearers. The upper end of this frame is supported by and between the head-stocks, and the lower end suspended by a screwed rod on each side to a fixed cross piece, by which the inclination of the table may be adjusted to suit the nature of the materials to be operated upon; and at about one-third of the length of the frame from the foot roller is fixed another roller to the lower edge of the sides of the frame. Upon the frame and rollers the endless cloth travels, passing from the head roller along the longitudinal bearers to the foot roller, then over the under roller, between which and the head roller the cloth hangs in a curve with its face downward, and low enough to reach about 2 inches within a cistern filled with water wherein the ore is deposited as the cloth revolves. At one quarter part of the length of the table downward is fixed an inclined board with diverging channels to distribute upon the whole width of the table the stuff to be dressed liquified with water, whilst a stream of clear water is made to flow uniformly over the edge of a level board upon the head or upper end of the table and the whole of its width.



When to the apparatus thus described power is applied to turn the head roller in the direction to move the cloth from the foot roller upward, and urey water and clean water in proper quantities are permitted to flow upon the table, it presents a moveable inclined table extending from the foot roller to the head roller, upon which, by the action of the stream, the waste is separated from the ores, which by their greater gravity resist the action or force of the streams and adhering to the cloth are carried over the upper roller and into the cistern, where the water disengages the ore and is there deposited.

The claim is for dressing ores, or materials containing ores, upon an inclined plane continuously or occasionally moving up against the stream and by the same motion depositing the dressed ores into a separate receptacle.

The annexed diagram will show the motion of the cloth or flexible table.—A, head roller, to which the power is applied; B, foot roller; C, under roller; D, cistern or coffer; E, head over which the materials to be acted upon liquefied with water are distributed over the whole width of the table; F, head over which the clean water or washing stream runs; G, cloth or flexible table; dotted line, level of water in cistern or coffer.

IMPROVEMENTS IN RAILWAYS.

William Prosser, Jun., of Shaftesbury-terrace, Gent., for "*Improvements in the construction of roads and in carriages to run thereon*"—Granted Nov. 9, 1844; Enrolled May 9, 1845. *(See Engravings, Plate XVI.)*

The first part of these improvements relates to a mode of constructing railways with wood combined with guide rails for the purpose of guiding carriages thereon. The object of this part of the invention is to construct tram-ways of wood, and by the application of a guide rail to dispense with flanges upon the running and driving wheels of locomotives, which flanges, when wood rails are employed, are considered very objectionable, indeed, almost impracticable, in consequence of the flanges cutting up and thereby destroying the edges of the rail, therefore, in order to obviate these injurious effects the inventor employs a flanged pully fixed upon the middle of each axle of the locomotive, as shown in the accompanying drawing, marked fig. 1, which shows a transverse section of the rails having the improvement applied. Similar letters denote corresponding parts in both figures: *a a* are the wheels, which in this case are made without flanges; *b* is the axle, having a flanged pulley, *c*, keyed upon it; this pulley is made to embrace the guide rail *d*; *e e* are the rails, which the inventor prefers to make with the grain of the wood in a vertical direction, which will render the rails more durable. The second part of these improvements relates to certain modes of applying apparatus to carriages moving on tram-ways of wood, in order to guide carriages thereon. Fig. 2 shows an end view of a locomotive engine having this apparatus applied, which consists of a frame-work *f f* supporting two grooved pullies, *g g*, turning upon axis supported by the frame-work at an angle of about 45°, it will be observed that guide wheels of the above construction placed at each end of the locomotive not only serve to keep the wheels upon the rails, but will also tend to support the engine should one of the axles break or give way.

PRESSURE AND GENERATION OF STEAM.

David Auld, Engineer, of Dalmarnock-road, and Andrew Auld, of West-street, Tadeston of Glasgow, for "*an improved method of regulating the pressure and generation of steam in steam boilers and generators.*"—Granted Nov. 9, 1844; Enrolled May 9, 1845. (*See Engraving, Plate XVI.*)

This invention consists in a mode or modes of regulating the admission of water into steam boilers and generators, and the application of heat to generating steam in such boilers so as to prevent the unnecessary or excessive generation of steam, and thereby to diminish the expense of fuel.

In the annexed drawing we have given one mode by which the patentees propose to effect the above object, the following being a description of the same:—Let *a* represent the boiler of a marine engine, and *b* the average level of the water line, on the top of the boiler there is a valve chest *c* having a weighted valve *d*, from the valve chest *c* there is a pipe *e e* leading to a water tank *f*. Supposing the steam in the boiler *a* to be raised above the average pressure the weighted valve *d* will be lifted, and steam will escape through the pipe *e e* into the tank *f*, and will be partially condensed; but as the water in the tank *f* becomes heated a pressure will be exerted upon the surface thereof which will have the effect of forcing the water up the pipe *g*, and will thereby raise the float *h* and cause the damper *i* to be closed or partially so. Another effect produced will be that as the water rises in the pipe *g* it will flow into the box *k* and cause the float *b* to open the cock *m'* in the pipe *m m*, thereby forming a communication with the boiler *a* and and a water tank *n*, which water in the aforesaid tank will by means of the pump *o* (which is constantly at work) be forced into the boiler so long as the steam remains in excess, or in other words, above the required pressure; but as the steam in the boiler becomes absorbed by the introduction of cold water from the tank *n* the weighted valve *d* will be closed and the pressure of steam shut off from the tank *f*, the water in the pipe *g* will descend, and with it the float *b*, which will close the cock *m*, and shut off the communication between the tank *n* and the boiler, as will be clearly understood. In case of the water in the boiler becoming low, and the pressure of steam insufficient to open the cock *m* as described, the inventors propose to apply a force pump in the ordinary way. They also describe a mode whereby the pump *o* may be applied to such purpose. The specification shows other modifications of the apparatus above described, in one of which it is stated that the cock *m* may be opened by having a projection upon the damper chain in place of the float *i*.

OVENS AND KILNS.

Robert Heath, of Kidsgrove, in the parish of Woolstanton, Stafford. coal agent, for "*improvements in heating ovens and kilns used in the manufacture of china, bricks, tiles, and other articles of earthenware.*"—Granted December 12, 1844; Enrolled May 12, 1845.

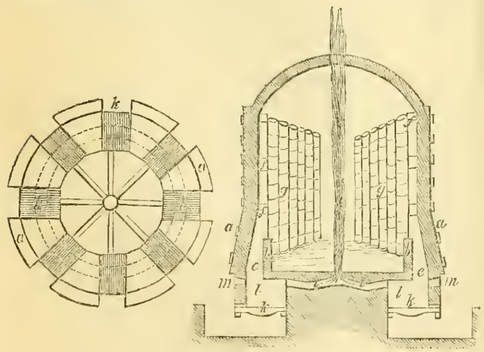


Fig. 2. Fig. 1.

Fig. 1 represents a vertical section, and fig. 2 a horizontal section taken just above the fire bars of this improved oven or kiln, the novelty of which is stated to consist first in making the lower part of the exterior wall to batter or incline outwards as shown in the accompanying figure at *a a*, so as to allow the inner "dwarf" wall *b b* to form an open flue *e e* all round the interior of the kiln, thereby increasing its capacity, at the same time affording means of constructing projections *f f* from the outside wall, which projections support the bungs or tiers of saggers *g g* more steady than in kilns of the ordinary construction, thereby avoiding considerable loss from breakage.

The second part of these improvements is stated to consist in so constructing the fire places that the oven is heated at the bottom, and in placing the fire places inside the exterior walls, and below the bottom of the oven or kiln, by which arrangement a considerable saving of fuel is said to be effected; it will be observed that each of the fire places has a flue *i* leading from the back part thereof, underneath the bottom of the oven to the centre flue, which is common to all, as in ovens of the ordinary construction; *k k* are the fire bars, and *l l* the fire places which are supplied with fuel through an opening *m m*, *g g* are the saggers containing the articles intended to be fired; the kiln is provided with an opening (not shown in the drawing) to admit the workmen, which opening is built up during the process of firing.

SLATED ROOFS.

William North, of Stangate, Surrey, slater. for "*certain improvements in covering roofs and flats with slate.*"—Granted November 14, 1844; Enrolled May 14, 1845. (*With Engravings, Plate XVI.*)

This invention consists in a mode of using battens of wood in combination with slate covers for roofs and flats in such manner that the slates or coverings of buildings are not fixed to the rafters or joists, but to the aforesaid battens as will be hereafter described, by which arrangement the inventor states that the joints of the slates or coverings will not be so liable to become defective by the vibration or warping of such covered roofs. The following is a description, reference being made to the engraving, similar letters referring to corresponding parts. Fig. 1 shows a plan view of a roof constructed according to this invention; fig. 2 is an underside view, and fig. 3 a section taken through the roof or flat in a direction parallel with the joists or rafters, which are marked with the letters *a a*; *b b* are the slates or coverings for the roof; *c c* are battens which fit into recesses cut in the edge of the joists, as will be seen on referring to fig. 3; *d d* are short laths or battens, the position of which with regard to the roof depends entirely upon the size of the coverings employed, as it will be observed that the edges of the slates, and consequently the joints are opposite or above the respective battens *c* and *d*, and are secured thereto by means of screws *e e e*, independent of the joists or rafters. It will also be observed on looking at fig. 3, that the edges of the slates on the underside are chamfered or cut off so as to allow of the joints or edges of the slates to be better imbedded in putty.

PREVENTION OF INCRUSTATION IN BOILERS.

Francis Watteen, of Finsbury-square, in the city of London, merchant, for "*certain Improvements in preventing Incrustation round Steam Boilers and Steam Generators.*"—Granted Nov. 16, 1844; Enrolled May 16, 1845.

The object of this invention is to prevent incrustation in steam boilers and generators by introducing therein certain compounds or chemical mixtures the proportion and ingredients of which vary according to the nature or properties of the water employed in feeding the boiler. The mode by which the inventor proposes to effect this object is as follows:—The several compounds mentioned in the specification being denominated Nos. 1, 2, 3, and 4, and are each intended for 10-horse boilers. No. 1 compound for a 10-horse boiler supplied with water containing sulphate of lime, consists of 4lb. of crystals of soda, 4 lb. of catechu, 2 lb. of dextrine, 1 lb. of American potashes, 1 lb. of beet-root sugar, 1 lb. of alum, and 1 lb. of gum Arabic. No. 2 compound is for water containing sulphate of lime, and consists of 2 lb. of dextrine, 4 lb. of turmeric, 4 lb. of bi-carbonate of soda, 1 lb. of American potash, 1 lb. of molasses, and 1 lb. of alum. No. 3 compound is for ferruginous water, and consists of 4 lb. of gambia, 4 lb. of salt of soda, 2 lb. of dextrine, 1 lb. of Russian potash, 1 lb. of sugar, 1 lb. of alum, and 1 lb. of gum arabic. No. 4 compound is for sea water, and consists of 4 lb. of catechu, 4 lb. of sulphate of soda, 4 lb. of dextrine, and 1 lb. of gum Arabic. These substances must be mixed with about 2 quarts of water, and supplied to the boiler about once every month, or oftener as they may be required, which will depend entirely upon circumstances, and may be found in practice. The quantity of the above ingredients must be increased one-fourth for every additional ten horse power. For steam-boat boilers of 30-horse power, supplied with river water, the following ingredients must be employed, and renewed with every fresh supply of water:—6 lb. of crystals of soda, 6 lb. of dextrine, 2 lb, of alum, 1 lb. of pearlash, and 2 lb. of sugar; and for the same size boiler supplied with sea water—8 lb. of carbonate of soda, 8 lb. of dextrine, 1 lb. of alum, 1 lb. of Russian potash, and 4 lb. of sugar, to be renewed with every fresh supply of water; and for the same power of locomotive boiler the inventor proposes to use 6 lb. of crystals of soda, 1 lb. of dextrine, 1 lb. of alum, and 2 lb. of sugar. In conclusion the patentee states that he does not confine himself to the precise quantities as the same may be varied.

Woolwich, May 12.—Some new experiments were made with three 56-pounder guns on Lieutenant-Colonel Dundas's principle, and three 56-pounder guns on Mr. Monk's principle, at 1,100 yards range. The firing was excellent, the objects aimed at being six targets 12 feet square, each placed in a line making a target 72 feet by 12, and a great number of the shots fired went through it. The whole of the shot went so close that a ship-of-war would have been struck in every instance. The three first rounds from each of the six guns were fired at an elevation of 1 deg. 50 sec., and the two last rounds at an elevation of 1 deg. 45 sec. The following is the average recoil of the carriages on the traversing platforms during the experiments to-day:—Lieutenant-Colonel Dundas's first round 6 feet 7 inches, second round 6 feet 5 inches, third round 6 feet 6 inches, fourth round 6 feet 6 inches, fifth round 6 feet 7 inches. Mr. Monk's first round 7 feet 3 inches, second round 7 feet 3 inches, third round 7 feet 4 inches, fourth round 7 feet 6 inches, fifth round 7 feet 4 inches.

PURIFICATION OF COAL GAS, AND ITS ADAPTATION TO AGRICULTURE.

"*On the Purification of Coal Gas, and the application of the products, thereby obtained, to Agricultural and other purposes.*" By ARCHIBALD ANGUS CROLL, Assoc. Inst. C.E.—*Paper read at the Institute of Civil Engineers.*

The production of coal gas is now become of such importance, from the amount of capital employed in it, and the high degree of public utility resulting from the introduction of gas light, that the author conceives it to be his duty to lay before the Institution, an account of his improvements in the process of purifying and preparing gas for combustion. In London alone, the annual rental paid to the different Gas Companies, for the supply of coal gas, amounts to about £600,000, and 250,000 tons of coal are annually consumed in its manufacture. As nearly every town of two or three thousand inhabitants, is now lighted with gas, vast as is the consumption of London, it forms but a small portion of the quantity of coal gas produced in the United Kingdom. The use of gas seems, however, to be capable of much greater extension than it has yet attained, for though almost universally adopted in the lighting of streets, workshops, warehouses, and places of business, it has been only partially introduced into domestic use. The causes of this limitation in the use of gas, are sufficiently obvious; they consist mainly in the unpleasant odours and unhealthy effluvia, supposed to be exhaled in its combustion; nor have the objections made, on that account, been without foundation; for it is well known to chemists, that notwithstanding all that modern science and invention have hitherto done, to purify gas, a considerable portion of ammonia, and its compounds, the origin of the offensive and injurious vapour complained of, still exist in combination with the gas, and compounds of a deleterious character are given off during combustion.

The author's attention has long been directed towards the manufacture and purifying of gas, and in the progress of numerous experiments, which were continued through several years, he has been fortunate in the discovery of a very simple process, of entirely freeing coal gas from ammonia, and its various combinations. The gas used for illumination, is carburetted hydrogen, and the object of all gas manufacturers, is to obtain that gas, in the greatest possible state of purity, and at the least comparative expense. The method of making coal gas is this: coal being placed in retorts, and subjected to a high degree of heat, the carburetted hydrogen gas is generated, from whence it passes, by well-known contrivances, into the condensing apparatus; but the carburetted hydrogen thus generated, contains several gaseous impurities, the most prominent of which are,—1st, sulphuretted hydrogen; 2d, hydro-sulphuret of ammonia; 3d, cyanuret of ammonia; 4th, carbonic acid, &c.; all these impurities have, to a great extent, been got rid of in all well-conducted gas works. The sulphuretted hydrogen and the carbonic acid, are most effectively removed, by means of dry lime; but to its use (until the application of this process), insuperable objections existed, and it has therefore been usually abstracted from carburetted hydrogen, by wet lime purifiers. A large portion of the hydro-sulphuret of ammonia, the cyanuret of ammonia, and the carbonic acid, have been thus expelled, with much trouble and inconvenience. Still a very great quantity of ammonia remains unaffected by all the processes used for purification and passes, as before observed, into consumption with the gas itself. The carburetted hydrogen, thus generated, passes, with all the impurities mentioned, into the condensers, where the hydro-sulphuret of ammonia is to some extent removed, by a reduction of the temperature of the gas, and in this way the ordinary ammoniacal liquor of the gas works is obtained. That liquor is generally sold to manufacturing chemists, and from it, after saturation with either sulphuric or muriatic acid, the ordinary ammoniacal salts are produced. From each gallon of this liquor about 14 ounces of sulphate of ammonia are produced.

The author's new process of purification is generally employed, immediately after the gas passes out of the condensers; or it may be applied, when the gas has undergone the usual wet or dry lime purification. The gas is conducted into a circular vessel (Figs. 1 and 2), constructed like those in use for the purpose of washing gas, and lined with lead, that metal not being acted upon by sulphuric acid; it is divided at the bottom into a number of sections (fig. 2,) 8 inches or 10 inches in height, which support a lead plate, covering the whole surface of the vessel, except about 5 inches round the edge. The vessel is charged, up to the height of the plate, with water, to which oil of vitrol, at the rate of about 2½ lb., or thereabouts, of acid, to 100 gallons of water, has been added; the gas is then passed under the leaden plate, where the divisions, by which it is supported, completely separate the gas, and bring each portion of it into contact with the acid solution. The ammonia contained in the gas, combines chemically with the sulphuric acid, and forms sulphate of ammonia. But

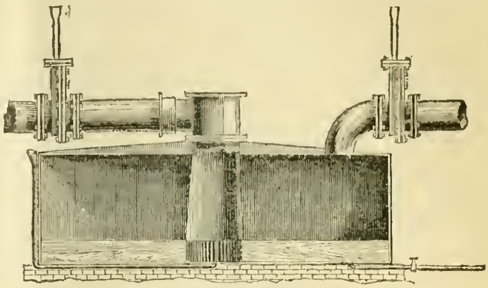


Fig. 1.—Vertical section.

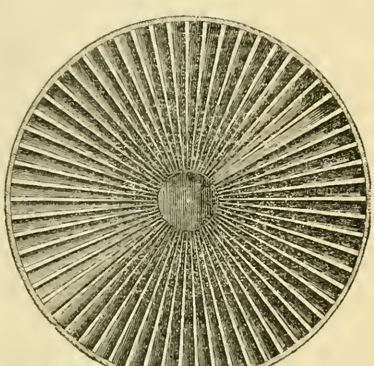


Fig. 2.—Horizontal section.

the acid being thus constantly in process of neutralization, the solution would soon lose its power of separating the ammonia from the gas, but for a small reservoir of sulphuric acid, which being carried into the vessel by means of a pipe furnished with a stop cock, insures a regular supply of acid. The gas thus freed from ammonia, is carried to the dry lime purifiers, which with this process can always be used. In large works, two vessels of this kind are preferable for passing the gas twice over the weak solution of sulphuric acid, which secures a more absolute certainty of the extraction of all the ammonia, should there have been any accidental or temporary deficiency of acid in one of the vessels.

Two vessels of 10 feet diameter and 3 feet deep will purify 500,000 feet of gas every 24 hours, and making that quantity, will require to be charged with the acid solution about every two days. In order to prevent too great a strength of free acid in the vessel, which would precipitate the carbon of the gas, and diminish its illuminating power, the liquor may be tested with the common ammoniacal liquor of the gas-works. When the solution in the vessel has become of the specific gravity of 1170, or thereabouts, as ascertained by the hydrometer, the supply of acid is to be shut off, and the gas is passed through the vessel, until that solution will restore the colour to reddened litmus paper. The liquor thus obtained is evaporated, and produces sulphate of ammonia of remarkable purity, and of such strength, that one gallon produces 80 ounces of sulphate of ammonia, instead of the 14 ounces only, which are produced from the ordinary ammoniacal liquor of the gas-works. And this last-mentioned liquor, must first undergo the process of saturation with sulphuric acid before evporation. The same degree of purification of gas from ammonia, may be obtained, by means of chloride and sulphate of manganese, or chloride and sulphate of zinc, which salts are afterwards reproduced, to be used again and again in the same process.

In the ordinary mode of purification, the gas was conveyed directly from the condensers, to the wet lime purifiers; a considerable pressure on the retorts, was requisite to force the gas through the fluid lime, and thus a loss of gas ensued, with a larger incrustation of carbon in the retorts, and extra labour was necessary for agitating the liquid lime and for conveying the refuse liquor to be evporated. This being effected in pans, placed under the retort furnaces, the sulphur given off tended to destroy very rapidly the iron retorts, which were exposed to the action of the flame. The wet lime purified the gas from the sulphuretted hydrogen, a great portion of the hydro-sulphuret of ammonia, the sulpho-cyanuret of ammonia, and the carbonic acid; but it still allowed a considerable quantity of ammonia and its compounds, to pass into consumption with the gas. The dry lime purifiers used without this process, presented some advantages to the gas companies, over the plan of purifying with wet lime; but it was only in open places in the country that the dry lime could be used, without the works becoming a public nuisance. The objection to dry lime purifiers arose from this cause: the hydro-sulphuret of ammonia, which is generated with carburetted hydrogen gas, is highly volatile, and that portion which is extracted by the lime, having no chemical affinity for lime, but being merely held in mechanical combination, had a strong tendency to fly off. The hydro-sulphuret of lime, is formed in the dry lime purifier, from the sulphuretted hydrogen of the gas; on the opening of the vessel, it rapidly combines with the oxygen of the atmosphere, and becomes converted into sulphate of lime. During that conversion, heat is rapidly evolved, which renders the hydro-sulphuret of ammonia, extracted from the gas by the lime purification, more volatile than ever, and the most offensive stench is the consequence. Besides, so noxious is this gas, that a comparatively small portion of it, in a given volume of atmospheric air, would render it destructive to animal life.

These obstacles would warrant the almost universal abandonment of dry lime purifiers; now, however, in connexion with this process of purifying gas from ammonia, the dry lime purifier will, it is anticipated, become the only system used for the abstraction of the sulphuretted hydrogen. The gas purified from all ammonia, by passing over the solution of sulphuric acid, has only to be freed by the dry lime purifier, from the sulphuretted hydrogen, the sulpho-cyanuret, and the carbonic acid, which form in chemical combination with the lime, the hydro-sulphuret of lime, cyanuret of lime, and carbonate of lime, neither of which are volatile, but are highly valuable for agricultural purposes.

Appliction of the Products to Agriculture.

In those instances, in which the localities have permitted gas companies to continue the use of dry lime purifiers, the value of the products as manure, has been so well understood, that the refuse lime has been bought up as fast as it was produced; and an impression having prevailed, that this refuse lime owed its value to the presence of ammonia, some of the contractors of such gas-works have expressed an apprehension that the adoption of this process, by previously abstracting the ammonia, would destroy the valuable properties of this lime. It is evident, that this is entirely a misapprehension. The chemical causes before detailed will have shown, that the hydro-sulphuret of ammonia, which had been extracted from the gas, in the dry lime purifiers, having been volatilized and lost, long before the refuse lime (then become sulphate of lime), could have been taken from the works; the value of the lime really consisted in the fertilizing power of the sulphate of lime and of the cyanuret of lime. This power will still exist in the same products, concurrently with the use of this process, while the noxious exhalations, which formerly occurred on the opening of dry lime purifiers, will be absent.

In manual labour alone, the Chartered Gas Company have effected a saving, at their Brick-lane station, of between 400*l.* and 500*l.* a-year, by the use of dry lime instead of wet lime purifiers.

In addition to the advantages arising from the use of the dry lime in place of the wet lime purifiers, which this process renders everywhere possible, the saving which will accrue upon the meters and fittings of the Chartered Gas Company, by the abstraction of the ammonia from the gas, will amount to a considerable sum annually.

At the Brick-lane station the number of meters requiring repair, has already been reduced by one-half, and those annually condemned have been two-thirds less, since this process has been adopted, although an increase of meters has taken place. The public lamp fittings requiring repair, since its adoption, have also been two-thirds less in number than previously. A large saving in wear and tear has thus been effected by the plan. In addition to the above, the illuminating power of the gas has been increased upwards of 5 per cent., by its freedom from ammonia, and it may now be consumed in the drawing-room or bed-chamber, with as little inconvenience or effluvium as a wax candle. In addition to the advantages already enumerated, this process comprises another, fully equal if not superior to all the rest. This consists in fixing and neutralizing the ammonia in combination with sulphuric acid, and making it available, in the form of the valuable product of sulphate of ammonia. Already many tons are produced weekly from the works which have adopted this process, and the purity of the product has been sufficiently attested. It is unnecessary to enumerate the various manufactures and arts, in which sulphate of ammonia is useful or necessary; but the author draws attention to its value for agricultural purposes, a subject upon which many men of science, education, and capital, have for several years past bestowed so much attention.

A chemical analysis of the sulphate of ammonia, produced by the evaporation of the saturate-sulphate liquor, before described, as drawn off from the purifying vessels, shows it to be of great purity, as it affords in 100 parts, nearly 30 parts of ammonia, after deducting water and sulphuric acid, equivalent to about 24 parts of nitrogen. This shows a fertilizing power two or threefold greater than any other manure. Actual experiments have corroborated the conclusions of the analytical chemist, and some of the most accurate of these are recorded by Mr. W. M. F. Chatterley, at the Manor Farm, Havering-atte-Bower, in Essex, occupied by Collinson Hall, Esq. These were made in 1842, a season which, like the present, (1844,) was, from its dryness, by no means favourable to top dressings.—It will be remarked, that the weight of the wheat, the grand test of its quality, was increased by the use of sulphate of ammonia, and this alone would add at least 1*d.* or 2*d.* per bushel to the selling price. Other experiments might be detailed, but they have all shown very similar results. 200 lb. of sulphate of ammonia applied in 1843 to poor grass land, by Mr. Bower, of West Dean House, produced an increase of 10 cwt. of hay per acre.—The result of all the experiments, however, seems to show, that 1 cwt. of sulphate of ammonia per acre, whether applied to grain or to grass crops, gives a maximum of profit for the outlay.

The total yearly quantity of coal gas made in London, has been estimated at 2,400,000,000 of cubic feet; whence some idea may be formed of the amount of sulphate of ammonia, which this process may render available for the purposes of agriculture. It should be observed also, that this quantity is over and above that ammonia which was, and still is, obtained from the common ammoniacal liquors of the gas-works, and that the process which enables such agricultural benefits to be secured, effects at the same time, a considerable saving in the manufacture of gas by the companies which have adopted it, while the use of coal-gas for the purpose of illumination, from its being rendered more agreeable and healthy, will be greatly extended in all private families.

Remarks.

After the paper was read, Mr. Lowe confirmed the statements therein, relative to the advantages of the new system. Formerly, when the dry lime purifiers were used at the Brick-lane Gas Station, the health of the men suffered, and the complaints by the neighbourhood, of the nuisance when the lime was changed, were so constant, that the system was abandoned; at present, although ten times the quantity of gas was purified, there was not any nuisance, either in the works, or in the neighbourhood. It had been stated, that the system had been used in other places, and that the credit of the invention was not due to Mr. Croll. Although it was not the province of the Institution to enter into such an inquiry, he might perhaps be allowed to state, that a similar plan had been tried at Bristol, at the suggestion of Mr. Herapath, the chemist; the idea had originated in the same chemical facts, which had induced Mr. Croll's attention to the subject, but the *modus operandi* was essentially different. In Mr. Herapath's plan there was not any continuous supply of acid; no valuable product was obtained; it was troublesome and expensive, hence it was not successful, and the plan was abandoned. Mr. Croll had entered upon the subject, with perhaps more practical skill, which, joined to his chemical knowledge, had enabled him to attain the success which attended the present system. The economy of the process, the diminution of the destructive effects of the purified gas upon the apparatus and the fittings, its increased illuminating power, and its greater fitness for combustion in dwelling houses, with other advantages, had been fully and fairly stated in the paper.—The chemical products obtained from the process, deserved very careful attention, and their adoption for agricultural purposes was important. The effect of sulphate of ammonia, in assisting vegetation, was remarkable, and it was already extensively used in agriculture. It also revived cut flowers, when they were apparently withered and dying. Flowers, whose stems were cut diagonally, so that their capillary tubes were not bruised or torn, on being put into a solution of 8 grains of sulphate of ammonia to 1 pint of water, would be speedily restored to vigour, if somewhat faded, and they might be kept fresh by this means for a long period.

Professor Graham bore testimony to the efficacy of Mr. Croll's process. In the first step of the purification, namely, the proper cooling of the gas, as it escaped from the retorts; he suggested a gradual refrigeration of the gas, or the retaining it for a short time, at an intermediate temperature, such as 212° Fahrenheit, before it was cooled down to the temperature of the air, in the usual refrigerators. The tarry matters in the gas, being the least volatile, would thus condense first, and by themselves, at a temperature which, being inadequate to condense the naphtha, would prevent their carrying down with them, so much of the valuable naphtha vapour, as at present. These tarry matters having an affinity for naphtha, tended powerfully to denaphthalize the gas, when in contact with it at a low temperature, and to deprive it of that valuable adjunct for combustion. Professor Graham had found, that by mixing an equivalent proportion of sulphate of soda with the lime, more than twice the quantity of sulphuretted hydrogen was taken up. The lime was entirely converted into sulphate of lime or gypsum, and the whole soda became bi-hydro-sulphuret of soda, which might be easily washed out of the former. The latter salt might be again converted into sulphate of soda by roasting it; and thus might be used to mix with the lime in the purifiers over and over again. Sulphate of lime, which was the only residue, was valuable for agricultural purposes.—In the distribution of coal gas, every means for counteracting the porosity of the pipes, should be adopted. In experiments upon cast iron gas-pipes, he had found as much as 25 per cent. of atmospheric air, mingled with the coal gas, which had been in the mains for 12 hours. This arose entirely from the porosity of the metal; air entering by the diffusive power of gases, although the coal gas in the main was under a small pressure. This should be guarded against, not only on account of the positive loss of gas which it indicated, but because, as was well known, a moderate proportion of atmospheric air mixed with the gas, greatly diminished its illuminating power.

Porosity of Iron Pipes.

Mr. Simpson stated, that in connexion with the subject of gas-making, the *porosity of the iron pipes*, through which it was circulated in the streets, should be noticed. He believed that formerly, considerable quantities of pipes had been laid without their being previously proved; and even now, experiments he had made convinced him, that few pipes were not in some degree porous. When they were proved with water, under a heavy pressure and a mirror was placed near the surface of the metal, a damp film showed the permeability, and after the pressure had been continued for some time, the exudation of moisture was very visible. Oxydation would, to a certain extent, close the pores of the metal and prevent this effect, and he would suggest, that all pipes should be proved with a solution of sal-ammoniac, which being forced into the body of the metal, would effectually oxydize it, and to a great extent cure the evil. He felt convinced, that 25 per cent. of the gas was lost, from the leakage of the pipes and the joints; and in opening the streets, the difference between the gas and the water pipes, was immediately perceived, by the soil around the former being saturated with gas. He quoted an instance where, in a length of 1000 yards of iron pipes 2 inches in diameter, there had been a loss of 357 cubic feet of gas in 24 hours. By perseverance in repairing the escapes, the porous spots and other defects in the metal of the pipes, the leakage had been reduced in three years to about 13 cubic feet in 24 hours.

Mr. Lowe said, that although in the early stages of gas-lighting, the pipes laid in the streets might not have been proved, such was not now the case; at present all were severely tested, and great attention was paid to the formation of *the joints*, which were made by ramming in layers of gasket, previously soaked in hot pitch and tallow, then running in the lead, and after that was well driven up with a caulking-iron, the joint was smeared over with pitch.—The gas companies were fully aware of the loss they had sustained, from defective pipes and bad jointing, and every attention was now given to the subject. Some time since, Mr. Lowe had been called upon, to examine a provincial gas-work, where, although the consumers paid by meter, and an allowance of 6 cubic feet of gas per hour, was made for each public light, 75 per cent. of the gas which was manufactured, was not accounted for. On examination, it was found, that from the ignorance of the superintendent, a pressure of 2 inches of water was kept constantly by day upon the pipes. The process of exosmose was thus carried on to an enormous extent. As soon as the pressure was diminished, the loss was reduced in proportion, and when, by his advice, the gas was allowed for a time to pass into the pipes, in a less pure state than usual, the leaks were soon discovered and repaired. It was certain, that the process of endosmose and exosmose was constant with gas-pipes, as the cast-iron was of a porous and cellular texture; and he believed, that a great portion of the loss arose from this permeability of the metal. He noticed, on opening the streets, and the soil in contact with the whole length of the gas-pipes, was saturated with gaseous products, and not merely those spots near the joints.

Mr. Farey observed, that the porosity or permeability of cast-iron was a well-ascertained fact. This first came to his knowledge many years ago, in the case of a hydrostatic or Bramah's press, wherein the water, when very forcibly compressed, made its way slowly through the thick cast-iron cylinder by a sort of perspiration at the external surface, so that the press relaxed its pressure and the plunger descended considerably during the night, after a large package of elastic goods had been left in it, under strong compressure in the evening. The external surface of the cast-iron cylinder was found the next morning, covered with very minute drops of water, particularly towards the lower end, where the drops were larger.—As to cast-iron, it was not always a close-grained metal; the carbon, which it contained, and which constituted its difference of substance from pure malleable iron, pervaded the mass, divided into minute particles, which kept the molecules of iron apart, and impaired their cohesion.—Respecting the leakage of gas from cast-iron pipes, a very large proportion proceeded from the joints of the lengths of pipes. At Manchester it had been the custom for several years past, to form the joints of cast iron pipes by boring and turning the ends to fit truly one into the other, and very recently Mr. Hick, of the firm of Forrester and Co. at Liverpool, had shown him a machine which performed the operation of both boring and turning the two ends of a pipe very rapidly. It was a slide lathe bed, having two head stocks with strong mandrils fixed upon it, one near each end; they were placed at such a distance asunder on the bed, as to receive the length of the pipe between them; each mandril had a chuck upon the end of it, with notches into which steel cutters were wedged, like a boring head. One such chuck was adapted for boring out the interior of the socket end of the pipe to a suitable cone; the other chuck had its cutters set for turning the exterior, at the other and of the same pipe, to a corresponding cone. The pipe was fastened down on a sliding carriage, so as to present first one end of it to one chuck, and then the other end of it to the other chuck, by which means the whole operation was very expeditiously and perfectly performed. This mode of preparing pipes was becoming common in Liverpool and Manchester, and was, he thought, deserving of more general adoption.

Mr. Cooper reminded Mr. Lowe of an experiment at which he was present a few years since, where the process of endosmose and exosmose was shown very strikingly. A bag formed of two sheets of paper, pasted together all round the edges, was inflated with coal gas, by introducing a quill at the corner; in 10 seconds it was discovered that the gas had entirely escaped and its place was occupied by common atmospheric air, although no visible defect existed in the bag. He thought that the soft and porous quality of the iron of which the pipes were made, for the convenience of drilling and tapping them, for the service branches, conduced to the process and the consequent loss of gas. Mr. Croll's system would, he thought, be of much benefit, not only to gas companies, but also to manufactures generally by reducing the cost of ammonia. Some years ago the price of sal ammoniac was 3*s.* per lb. for a quality inferior to that which was now sold for 6*d.* per lb. This reduction was entirely owing to the increase of gas lighting, the products being converted into this useful salt.

In a recent communication from Mr. James Muir, New River Water-works, he observes:—"The coal gas may literally be said to saturate the ground, in localities through which the pipes of several gas companies have been laid; and it there frequently effects an entrance into the adjacent water pipes. In seeking a remedy for the evil, the gas companies have been urged to search for their leakages, while the affected service (naturally supposed to be itself defective) has been at the same time stripped,—in some instances driven anew,—and proved, under considerable pressure, to be thoroughly water-tight, but all in vain. This view of the matter induced the proposal of the following simple expedient, as a means of counteracting the evil; it has in several cases been applied, and in all with full success. From the highest part of the service affected by the gas, a wrought iron tube, ¾ inch in diameter, strong enough to resist any tendency to form such a curve as would retain water, is laid evenly, and with an upward inclination, towards the nearest protected situation, such as the side of a house, where it is made to terminate in a vertical piece, extending to any required height above the ground. On the top of this vertical piece is screwed the small float valve fig. 3. The float, A, forms the valve. It consists of a cylindrical piece of cork, in the axis of which a brass wire is fixed, to serve as a spindle for guiding it. The top is covered with leather, by which an air-tight joint is made with the aperture B C, above, when the float valve is raised;

D E F is simply a cover of copper, for the purpose of preventing the entrance of obstructions, and is not an essential part of the instrument.

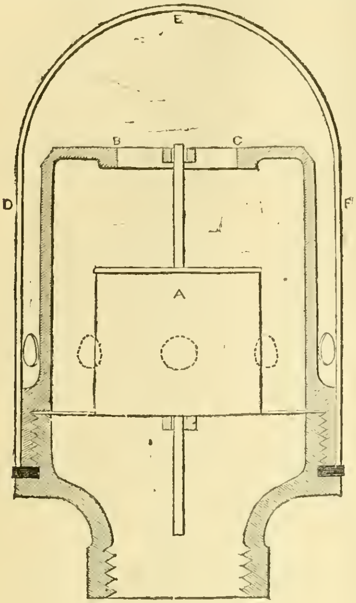


Fig. 3.—Vertical section—full size.

The valve opens a free communication with the external air as soon as the water begins to fall out of the service, and by thus establishing an equilibrium between the fluids around and within, destroys any tendency which the former might have to force an entrance. As soon, however, as the service is again charged with water, the valve closes, and prevents all improper escape."

ON THE SUPPLY OF WATER FOR FIRES.

"*On the means of rendering large supplies of Water available in cases of Fire, and on the application of manual power to the working of Fire Engines.*" By James Braidwood, Assoc. Inst. C.E. (*Paper read at the Institution of Civil Engineers.*)

The plans at present in use, are so few and simple, that it is conceived merely necessary to state the quantity of water required, and to describe the most approved modes of supplying it, in cases of ordinary fires. If water can be obtained at an elevation, pipes with plugs or fire-cocks on them, are preferable to any other mode at present in use. The size of the pipes will depend on the distance and elevation of the head, and also on the size of the buildings to be protected. It may be assumed as a general rule, that the intensity of a fire depends in a great measure on the cubic contents of such buildings; distinction being made as to the nature and contents of such buildings. If no natural elevation of water can be made available, and the premises are of much value, it may be found advisable to erect elevated tanks; where this is done, the quantity of water to be kept ready and the rate at which it is delivered, must depend on the means possessed of making use of the water.

The average size of fire engines may be taken at two cylinders of 7 inches diameter, with a length of stroke of 8 inches, making 40 strokes each per minute. This sized engine will throw 141 tons of water in six hours, and allowing one-fourth for waste, 176 tons would be a fair provision in the tanks for six hours' work; this quantity multiplied by the number of engines within reach, will give an idea of what is likely to be required at a large fire. If however there are steam engines, to keep up the supply through the mains, the quantity of water kept in readiness may be reduced to two hours' consumption. as it is likely that the steam engines would be at work before that quantity was exhausted. This is what may be supposed to be required in case of serious fires in dockyards, in large stacks of warehouses, or in large manufactories. Where water can be had at nearly the level of the premises, such as from rivers, canals, &c., if it is not thought prudent to erect elevated tanks, the water may be conducted under the surface by large cast iron pipes, with openings at such distances as may seem advisable for introducing the suction pipes, fig. 1. This plan should not be adopted, where the level of the water is more than 12 feet below the surface of the ground, as although a fire will, if perfectly tight, draw from a much greater depth than 14 feet (2 feet being allowed for the height of the engine), still a very trifling leakage will render it useless for the time, at such a depth.

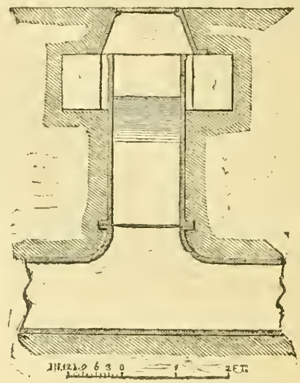


Fig. 1.—Opening for Suction pipe.

The worst mode of supplying engines with water, is by covered sunk tanks; they are generally too small, and unless very numerous, confine the engines to one or two particular spots, obliging the firemen to increase the length of the hose, which materially diminishes the effect of the fire engine. If the tank be supplied by mains, from a reservoir, it would be much better to save the expense of the tank, and to place plugs, or fire-cocks, on the water-pipe. Another evil in sunk tanks, is, that the firemen can seldom guess what quantity of water they may depend upon, and they may thus be induced to attempt to stop a fire, at a point they would not have thought of, if they had known correctly the quantity of water in store. Where sunk tanks are already constructed, they may be rendered more available by a partial use of the method shown in fig. 1.

A great deal has lately been said as to extinguishing fires by jets from water mains, without the use of fire engines. This, no doubt, may be done under particular circumstances, where the pressure is considerable, the pipes large, and if only one or two jets are required; but at large fires, where ten or twelve jets are necessary, the expense would be too considerable, especially as where the largest fires may be expected water is generally least wanted for other purposes; besides, it appears wrong in principle to employ a power which decreases exactly in proportion to the extent to which it is used, independent of the great loss by friction in the leather hose, which reduces the delivery, and of course the height or force of the jet, 2½ per cent. for every 40 lineal feet of leather hose, through which the water passes, as was fully shown by the experiments.

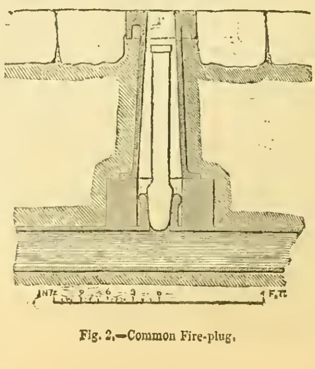


Fig. 2.—Common Fire-plug.

The different modes of obtaining water from the mains or pipes are shown in the accompanying drawings. Fig. 2 is a section of a common plug when not in use. Fig. 3 is a section of the common plug, with a canvas dam or cistern over it, as used in London.* The cistern is made of No. 1 canvas, 15 inches deep, extended at top and bottom

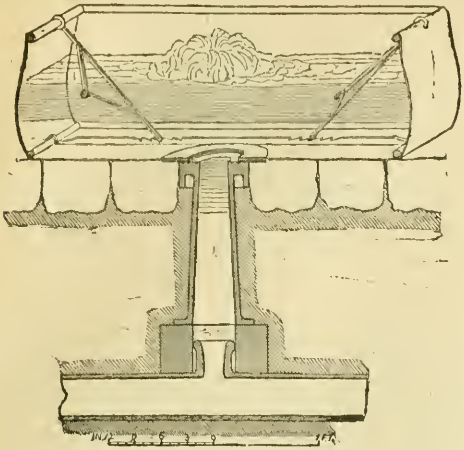


Fig. 3.—Fire-plug with canvas Cistern.

by ⅜ inch round iron frames, a double stay is hinged on the top frame at each end. When the cistern is used, the top frame is lifted up, and the stays put into the notches, in two pieces of hoop iron, fixed to the bottom frame. There is a circular opening 9 inches diameter in the canvas bottom, two circular rings of wash-leather about 2 inches broad are attached to the edges of the opening in the canvas, so as to contract it to 4 inches or 5 inches diameter; the plug being opened, the cistern is placed over it, the wash-leather is pressed down to the surface of the road by the water, and a tolerably water-tight cistern, with about 12 inches or 14 inches of water in it, is immediately obtained. Fig. 4 is a plug with a standcock in it, to which hose may be attached.

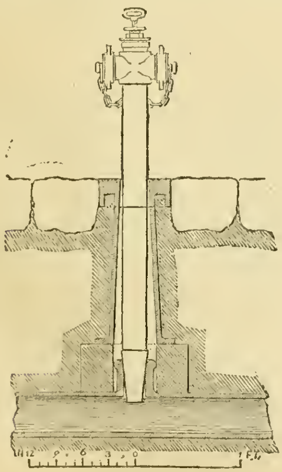


Fig. 4.—Plug, with Standcock.

Fig. 5 is a common single firecock with a round water-way 2½ inches diameter.

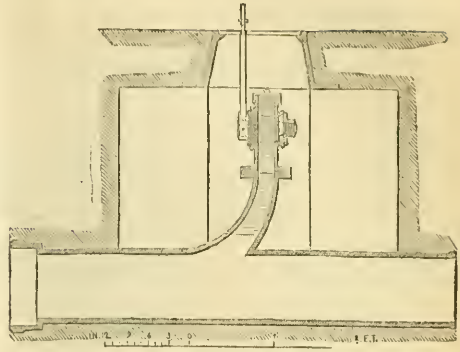


Fig. 5.—Single Fire-cock.

Fig. 6 is a double firecock, as laid down in Her Majesty's Dockyards.

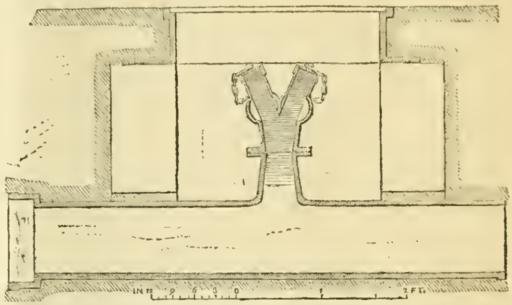


Fig. 6.—Double Fire-cock, used at the Royal Dockyards.

It will be observed, that the short piece of pipe between the main and this firecock is not curved to the current of the water, but merely opened a little; this is done with a view of increasing the supply by steam power, and as the steam engines are, in most cases, situated in a different direction from the tanks or reservoirs, therefore, the curve that would have assisted the current in one direction, would have retarded it in the other. It has been objected to these firecocks, that the opening does not run through the centre of the key, therefore only one side of the key covers the opening in the barrel, while in the common firecock both sides are covered.

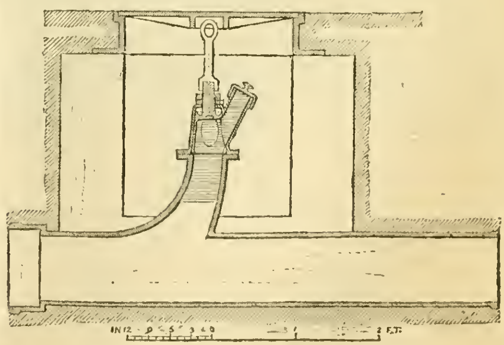


Fig. 7.—Double Fire-cock, used at the British Museum.

Fig. 7 is a double firecock, as laid down at the British Museum. This has a very good delivery, and is certain to be always tight, if well made, as the pressure of the water forces the key into the barrel;

* The canvas dam is the invention of Mr. Bradley, for which he was awarded by the Society of Arts with a silver medal.—Ed. C. E. & A. Journal.

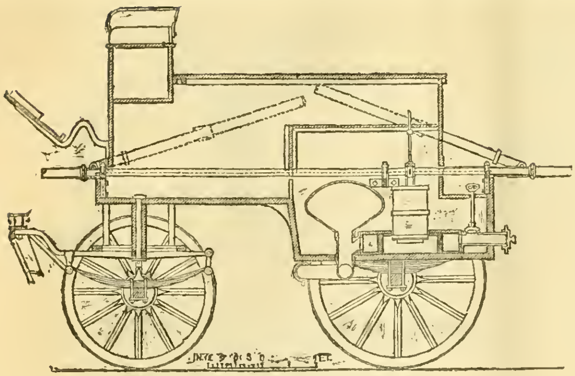


Fig. 8.—Fire Engine, used by the London Fire Brigade. Longitudinal section,—with the Levers turned up for travelling.

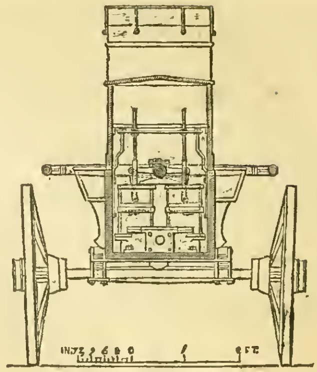


Fig. 9.—Transverse section.

this also renders the cock somewhat difficult to be opened and shut, if the pressure be great; but as a lever of any length may be used, and the key, from its perpendiculur position, may be loosened by a blow, this objection is, in a great measure, obviated.

In figs. 5 and 6, the openings in the street are large enough to admit of the levers for opening the cock to be fixed, that no mistake may occur from the lever being mislaid; but with those at the British Museum, it was not thought necessary to have fixed levers, as a crowbar, or anything that could be introduced into the eye of the spanner, would open them.

On the application of manual power to the working of Fire Engines.

In the application of manual power to the working of fire-engines, the principal object is, to apply the greatest aggregate power to the lightest and smallest machine; that is, suppose two engines of the same size and weight, the one with space for 20 men to work, throws 60 gallons per minute; the other with space for 30 men, throws 80 gallons in the same time; the latter will be the most useful engine, although each man is not able to do so much work as at the former. The reciprocating motion is generally preferred to the rotary for fire engines. Independent of its being the most advantageous movement, a greater number of men can be employed at an engine of the same size and weight; there is less liability to accident with people unacquainted with the work, and such as are quite ignorant of either mode of working, work more freely at the reciprocating than the rotary motion. To these reasons may be added, the greater simplicity of the machinery. Various sizes of engines, of different degrees of strength and weight, have been tried, and it is found that a fire engine with two cylinders of 7 inches diameter, and a stroke of 8 inches, can be made sufficiently strong at 17½ cwt. If 4 cwt. be added for the hose and tools, it will be found quite as heavy as two fast horses can manage, for a distance under 6 miles, with five firemen and a driver (figs. 8 and 9).

This size of engine has been adopted by the Board of Admiralty and the Board of Ordnance, and its use is becoming very general. When engines are made larger, it is seldom that the proper proportions are preserved, and they are generally worked with difficulty, and soon fatigue the men at the levers. When a large engine is required in London, two with 7 inch cylinders are worked together by means of a connecting screw, fig. 10, thus making a jet very nearly equal (as 98 to 100) to that of an engine with cylinders 10 inches diameter; any larger size than this cannot be used, as the friction in the hose of 2½ inches diameter, is so much increased that the jet is comparatively weak; the hose may of course be enlarged in diameter, but the weight is augmented, and the whole of the machinery is rendered more unwieldy and less useful.

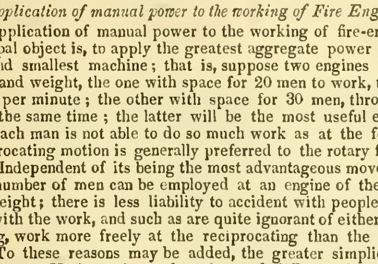


Fig. 10.

Jets.—A great many different shapes of jet have been tried, and that shown in fig. 11 was found to answer best when tried with other forms. The old jet was a continuation in a straight line of the taper of the branch, from the size of the hose screw, to the end of the jet

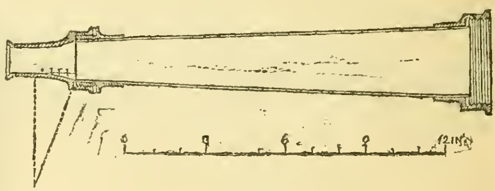


Fig. 11.

pipe; this had many inconveniences; the size of the jet could not be increased without making the jet pipe nearly parallel. As the branches were sometimes 7 feet or 8 feet long, in some instances the orifice at the end of the jet pipe was larger than that at the end of the branch. The present form of the jet completely obviates this difficulty, as the end of the branch is always 1½ inches diameter. The curve of the nozzle of the present jet is determined by its own size; one-tenth of the difference between the jet to be made and the end of the branch is set up on each side of the diameter of the upper end of the branch, a straight line is then drawn across, and an arc of a circle described on this line, from the extremity of each end of the diameter of the jet, until it meets the top of the branch; the jet is then continued parallel, the length of its own diameter; the metal is continued one-eigth of an inch above this, to allow of a hollow being turned out to protect the edge. The rule for determining the size of the jet for inside work is, to "make the diameter of the jet one-eighth of an inch for every inch in the diameter of the cylinder, for each 8 inches of stroke." The branch used in this case is the same size as shown in fig. 11. When it is necessary to throw the water to a greater height, or distance, a jet one-seventh less in area is used, with a branch from 4 feet to 5 feet long.

The usual rate of working an engine, of the size described, is forty strokes of each cylinder per minute, this gives 88 gallons. The number of men required to keep steadily at work for 3 or 4 hours is 26; upwards of 30 men are sometimes put on when a great length of hose is necessary. The lever is in the proportion of 4½ to 1. With 40 feet of leather hose and a ⅞ inch jet, the pressure is 30 lb. on the square inch; this gives 10·4 lb. to each man to move a distance of 226 feet in one minute. The friction increases the labour $2\frac{1}{2}$ per cent. for every additional 40 feet of hose, which shows the necessity of having the engine, and of course the supply of water, as close to the fire as is consistent with the safety of the men at the levers.

REVIEWS.

The Geometric Tracery of Brancepeth Church. Illustrated by ROBERT BILLINGS. London: Boone. 21 Engravings. Quarto.

This work is by the author of numerous publications illustrating ecclesiastical architecture. The works of Mr. Billings are Illustrations of Durham Cathedral; of Carlisle Cathedral; the Temple Church in London; Kettering Church in Northamptonshire; and several other books of a similar nature. The present work is confined to the illustration of a screen, or portion of a screen, in Brancepeth Church, which is divided into numerous panels, all of them carved in different designs. The patterns of each of these panels, between twenty and thirty in number, are exhibited at large in separate engravings, which contain also outline diagrams corresponding to each pattern, and showing the circles and straight lines by which it may be supposed to have been produced. The following extract will give a clear idea of the nature of the screen itself.

The title plate furnishes a complete miniature resemblance of the whole subject set forth in the following illustrations. It would perhaps be difficult to find in any similar production of art so many designs represented in so small a compass, and at the same time exhibiting memorials of Gothic skill so full of interest, although produced at comparatively a late period, viz., about the year 1500. Various conjectures might easily be formed as to the original use to which the mass of ornament here delineated was applied, but according to tradition the prototype belonged to the ancient Rood Screen of Brancepeth Church, and was removed to the place it now occupies over the chancel arch at the time of the erection of the present Screen by Bishop Cosin, who was previously Rector of Brancepeth.

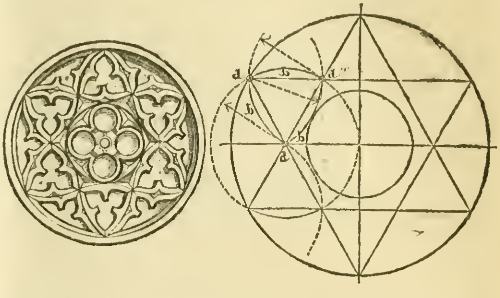
It has undoubtedly been a portion of the crowning member of a screen or a monument, because the three divisions are slightly canted (canopy like) and surmounted by a foliated border.

At each end of the paneling, corresponding fragments are clearly discernible, giving undeniable evidence that the magnitude of the original work exceeded its present dimensions. It may, however, be considered fortunate that so much practical knowledge relating to tracery has been bequeathed to us in the construction of these remarkable specimens, and although some are marred by singularity rather than distinguished by beauty, they form in the aggregate a most interesting collection, as they bear in a remarkable manner upon the system of construction employed in the geometric paneling in Carlisle Cathedral, which has been completely illustrated by the author of the present volume.

Possibly we are indebted to the genius of the same individual for the analogous designs of which the Church of Brancepeth and the Cathedral just named are the depositories, or, if they are not the results of one master mind, they must undoubtedly be ascribed to individuals guided by the same rules of art. Upon comparison of the histories of Carlisle and Durham, arguments are adducible that the former conjecture is a true one, because two distinguished persons respectively connected with each place must have been brought into intimate association by their ecclesiastical position,—we mean the reputed author of the Carlisle tracery, Thomas Gondibour, Prior of Carlisle (1484-1507), and Richard Bell, Prior of Durham, who was Bishop of Carlisle from 1478 to 1496; and our conjecture is greatly strengthened by the fact, that most of the works, if not all, in the churches of the diocese of Durham emanated from the dignitaries of the cathedral establishment in that city. Hexham Abbey, in Northumberland, equidistant between Carlisle and Brancepeth, contains in its organ screen some tracery which forms a remarkable connecting link between the same class of ornament in both places, and was almost to a certainty designed by the same hand.

It is Mr. Billings' object in the present work to show that the beautiful forms which Christian Architecture exhibits were all produced by systems of circles and straight lines. We give a copy of one of his illustrations in order to show clearly how he sets about his task.

In the view of those whose architectural notions coincide with those of our author, the Art of Architectural Design was, among the mediæval architects, not so much the result of vivid imagination and an exquisite perception of beauty as in the kindred arts of painting and sculpture; but it was rather a "mystery" or "craft" which must be learned by fixed rules, which rules were kept secret from the public with all the jealous care of freemasonry. To be an architect of those times—Mr. Billings and those of his school will have it—a man must not only have exquisite taste and a genius tempered by the study of existing models and masterpieces;—he must have something more even than this—he must be *initiated*, he must be admitted the incorporate member of a *guild*, and learn its geometric secrets, or his taste and genius and study all go for nothing. With this view of the case it is clear that the architect could not be strictly said to design freely—his curves could not be drawn *liberâ manu:* the rules by which he



was to design were laid down for him with a precision and minuteness quite different from those general axioms which, in painting and sculpture merely warned and suggested, but did not attempt to guide. The architect must never have approached his working drawing with pencil in hand, unless at the same time armed with the rule and compass.

It is certainly very interesting to know whether there be any or how much truth in this theory. It assuredly receives powerful corroboration from certain marks and traces which have been discovered in stones of ancient buildings which have been dislodged by violence or decay, or have been necessarily disturbed during works of restoration. The modern architect has frequently observed with interest the pencil marks remaining on these stones of intersecting circles, triangles, and straight lines drawn at right angles to each other: these marks usually exist in those parts of stones which were covered with mortar, or by the adjacent stones; and the antiquary who spends his long holiday hours in loitering about ancient ruins and the half falling walls of decaying edifices, soon learns by experience where to search for these interesting *vestigia* of the skill of old bygone times. It has been said, also, that some of the stones of mouldings have been, not chiselled, but turned in the lathe, and that the centre holes by which these stones were fixed to the "chuck" may still be distinctly seen.

Such seems to Mr. Billing to have been the method by which the "geometric" tracery of Brancepeth Church was produced.

Each series commences with a simple elementary panel composed of a number of quatrefoils within an equal number of squares. Proceeding from that primitive form, the centres of the curves being upon the same foundation lines, the designs become so complicated that it is by no means easy to decipher their construction, and some indeed, without close investigation, might, by the complexity of their apparently fanciful intersections, be said to have refused subjection to the regularity of linear projection, and consequently might be placed among those produced in modern times by "rule of thumb."

It will be immediately conceived that if the whole science of mediæval architecture be resolved into a geometric system, such as our author would suggest, the limits within which the architect might exercise the fertility of his genius would be much narrowed. He might, indeed, combine his circles and straight lines in differing orders of succession; but his efforts, like arithmetical combinations, though very numerous are not quite infinite. We can no longer look upon him as a poet wrapt in visions of beauty which are called up spontaneously, without effort, before his "mind's eye," passing in rapid succession in and out of sight, or else preserved *con furore*—with enthusiasm,—with the fervour of inspiration as it were—by a hasty sketch, which rather reminded of the original than delineated it. It is thus that we believe that the great masters of painting originated their noblest works; and those who gaze on the wondrous, almost miraculous, beauty which our cathedrals exhibit, and in gazing feel that elevated enthusiasm and admiration of the master mind of the architect, (without which none can be deemed inspired with the true spirit of architecture,) will be loath to admit that while Rubens' "Descent from the Cross" was the work of genius and inspiration, the glorious cathedral which that work adorns was itself no more than the result of squares and circles combined according to the secret rules and system of a "craft" of artificers.

The doctrine then, which we here enunciate, has been, as might be anticipated, the subject of much learned discussion, and elaborate erudition of books more or less unreadable. Without attempting to drag the reader into the controversy, we may perhaps suggest to those who wish to search elsewhere for an account of it, that they will probably solve many of their doubts by that tritest of maxims "the truth lies between the two extremes." While every mathematician will tell you that *any* curve whatever may be produced by portions of sufficiently numerous intersecting circles, it is scarcely credible that many of the curves of pointed architecture could have been so produced. Mr. Billings, indeed, allows in his present work that in one of the panels which he delineates the design was not totally geometric.

The trefoil heads are all formed by hand, which circumstance considerably mars the effect which this design would have had, if they had been geometrically drawn.

Indeed, we do not see in any of his outline diagrams a method of drawing trefoils, quatrefoils, &c., geometrically, or otherwise than "by hand;" and perhaps if he examine the subject he will find that the drawing of a quatrefoil by compass and rule would involve a geometrical construction more difficult than he might at first suppose. He observes, indeed—

We have refrained from entering into very minute details of the various lines which form a key to each pattern, because the plate itself, in all the minor points, furnishes at once to the eye a complete linear solution, and our intended limits would have been far exceeded had we entered into lengthy descriptions of those parts which the graphic exposition itself renders obvious.

But perhaps, had he attempted to supply the deficiency, the very difficulty of the task would have modified his opinions.

Another great proof to ourselves that his theory is but partially true, is a certain stiffness and formality which prevail in all the illustrations which he has given. This, of course, he would stoutly deny; but we rest our judgment not only on our own opinion, but on that of several others to whom we have submitted his drawings. The instance which he takes is of a late era, when Art was on the point of declining into "the sere and yellow leaf." At such a period a geometric system would perhaps partially prevail, which would not be looked for in the Golden Age of Architecture. Paucity of invention is ever marked by efforts to substitute the tricks of system for the efforts of genius.

In justice, however, to Mr. Billings' work, which is in every respect meritorious, our readers shall have some of the reasons on which his theory is based.

The comparatively recent date of the specimens now before us, and perhaps certain questionable peculiarities or anomalies discoverable in their style, may be liable to objection. Their real value, however, consists in the beautiful illustration of principle which they develope, and on this account they are certainly deserving of the most attentive consideration.

It is satisfactory to find that the more we examine Gothic architecture, the more we are convinced that chance was in no possible way connected with the linear designs of construction. The most exuberant richness of contour can, by a careful analysis, be reduced to simple geometric rules; and in the investigation of the laws of description which we have here endeavoured to exhibit, it has been curious to observe how extraordinary an alteration in the general features of such panels as have fallen under our notice is effected by a very slight deviation in that most simple of all curves—the arc of a circle.

There are several distinct geometric species in the panels under notice; these are—

1. Those composed of circles or their arcs, having all their centres upon the sides of a given number of squares or their diagonals.

2. Where the principal frame work is a series of circles of equal radius touching each other, three of whose centres are consequently at the angular points of an equilateral triangle. The continuous curve produced by the arcs between the points of tangency of these circles in mutual contact is known by the term "ogee." Or this curvilinear figure may be more easily explained by placing two equilateral triangles on each side of a common base, and describing a circle from each of the four vertices, with radius equal to half the side of the triangle. But this form of the ogee is not invariable, because it may be, and is frequently much elongated, by substituting isosceles triangles in the place of equilateral triangles, according to the following construction. Bisect the equal sides of an isosceles triangle, produce the base both ways, draw through the vertex a line parallel to the base, then bisect each half side by perpendiculars cutting the produced base or the line parallel to the base. From the points of intersection describe arcs of circles through the angular or middle points of the sides.

The interminable variations of which this curve is capable, are doubtless that form known to artists as the "line of beauty," and which is represented as such by our great painter Hogarth. Its manifold combinations form the staple of all flowing tracery, because it is not at all necessary that the upper and lower limbs of the curve should be segments of circles having equal radius. From this elementary principle have resulted all the beautiful compositions of the decorated and flamboyant styles of Gothic architecture.

3. The division of the panel into rectangular parallelograms.

4. Panels having their origin in the subdivision of a given circle into a number of sectors. Some of the specimens in this subdivision are extremely curious, and perhaps are without their parallel in any other examples, but the architect and antiquary attach the principal value to those formed upon the square and the triangle, because they not only form the most elegant examples, but verify a principle, since they are based upon the same analytical elements as examples in various other places. P. 5.

A Manual of Gothic Mouldings, illustrated by nearly 500 *examples.* By F. A. Paley, M.A., Hon. Sec. to the Cambridge Camden Society. London: Von Voorst. 1845, 8vo., pp. 72; 16 plates.

Having recently had occasion to speak in somewhat unfavourable terms of a work by Mr. Paley, entitled the Church Restorers, it affords us great gratification to be able in the present instance to speak of the book before us in terms of all but unmingled approbation. The design of this book is a classification of the different mouldings prevailing at different periods of Christian Architecture, and the plates which accompany the letter-press show the gradual changes which took place in architectural taste in the transition from one period to another, the abandonment of some forms of mouldings, the modification of others, and the permanence of a third class unchanged from the earliest Norman to the latest Perpendicular styles.

Now it is very clear that a work having this object, will, if executed with fitting diligence and perspicuity, be well-nigh invaluable both as contributing to a more accurate knowledge of architecture amongst amateurs, and as affording to the professional architect a book of reference which he will soon learn to consult as frequently as a navigator the Nautical Almanac. The branch of architectural knowledge which Mr. Paley has undertaken to illustrate, is one too minute and detailed to excite general interest perhaps, but one hitherto so little studied, that we feel convinced that any one with Mr. Paley's book in his hand, would discover in the best modern buildings the greatest blunders in the construction of mouldings.

It must be confessed, though the assertion be an invidious one, that but little acquaintance with mouldings is evinced in the works of most modern architects. Surprising as it may appear, it is a fact that, till very lately at least, scarcely one capital or base in twenty has been correctly worked: and even in the present revival, it is but too common to find the most wretched and meagre imitations of ancient examples, the spirit and character of which are completely lost or perverted by some culpable violation of leading principles. This certainly ought not to be. It is impossible that professional men should *now* acquire respect and celebrity, when they neglect such essential elements of their art. How is it that buildings of the greatest cost and pretension sometimes exhibit serious anachronisms and confusion of styles in the use of their mouldings? The reason is, that the science is a deep and a difficult one, which cannot be attained without particular and extensive study. Each artist has only his own exertions and observations to depend upon in acquiring any knowledge of it, and it is evident that adverse circumstances may occur to prevent this in a great many cases. P. 4.

The peculiar notions which usually characterise Mr. Paley's writings and those of the Cambridge Camden Society—about symbolism, esoteric architecture, &c.—we are happily relieved from in the present volume. There are no attempts to persuade us that the middle aisle of a church represents "the pathway of meek devotion," that mediœval architecture is tacitly or expressly commended to us by our Faith as an integral part of religion: Classic Architecture is not called Pagan Architecture, nor are we told that it is to be abhorred by all good Christians because of its Pagan origin: mouldings are not alluded to as the representatives of doctrines; religious tenets are not as heretofore found in bricks and mortar, nor are we directed to look for "sermons in stones;" and the walls, buttresses, windows, and steeple of a church are no longer looked upon as forming an architectural horn-book, a gigantic primer, by which religion is to be familiarised to simple minds, in much the same way that children are taught by geographical puzzles, models of cubes and pyramids, scientific teetotums, philosophical wooden horses, or the Royal Game of Goose slightly modified for the purpose of moral instruction.

While perhaps it must be allowed that such foolish nonsense could scarcely find its way into a work so unspeculative as Mr. Paley's, we observe with pleasure that even where opportunity offered for introducing these childish absurdities he has not embraced it. He does indeed observe in one place, when speaking of changes of the Christian Styles—

Whence these forms arose, whether from a natural process of gradual development, or from some esoteric principle of symbolical design; whether they originated in some real or pretended secret of freemasonry, or, lastly, in mere accident or caprice, are curious questions, which, so far as the author is aware, have never yet been made the subjects of much investigation. P. 1.

But this is nearly the only allusion to these notions. If it were not too much vanity, we might almost hope that our own arguments had contributed somewhat towards the desired change, especially as Mr. Paley seems acquainted with this Journal, and quotes it in one place; or at least that the ridicule which his eccentric views have met with in other reviews has persuaded him, if not to alter his sentiments, at least to render them less conspicuous.

Before entering into the detailed portion of his work, the author gives some general views on the formation and application of mouldings. The following is an exposition of the generic distinctions between Mediæval and Classic mouldings.

The early English base is allowed by all to have been borrowed from the Attic, and we shall hereafter clearly demonstrate that such was the case. And it may be that some forms, such, for instance, as the scroll-moulding and the roll-and-fillet, came from some external source. But if every form can be shown to be an improvement or modification of a preceding one, we may fairly conclude that the whole series is the offspring of one and the same progressive art.

In their use also Gothic mouldings differ as widely as possible from Classic. The former are repeated to almost any extent, so as entirely to occupy the large recessed spaces in jambs and arches. They are repeated too in groups, each group being composed of the same members, or nearly so, especially in the earlier styles. The latter are few in number, and very limited in their application. The combinations of the one are in a great measure arbitrary, though the forms themselves are fixed; in the latter both are absolutely defined. The former run principally in vertical lines, the latter in horizontal. In Gothic architecture, horizontal mouldings occur in water-tables and string-courses, and in capitals and bases, in which positions they invariably form subordinate lines, so as to contrast and display the predominant principle of a vertical ascending sweep, and may so far perhaps be regarded as lingering vestiges of the Classic usage—evidences of the victory of Christian over Pagan art. For it is needless to remind the reader that Gothic owes its origin, though not its development, to Basilican, that is, to Roman architecture. P. 11.

The following remark will, or ought to, administer a severe rebuke to many a modern architect who looks on a moulding as a mere factitious appendage—something to be added when the rest of the work is done.

The student will already have perceived, from the manner we have adopted of drawing the sections, first, that all these mouldings are *formed out of the solid block solely by removing edges and sinking hollows*, and must never be regarded as excrescences on a plane surface; secondly, and in consequence, that *the groups lie in the planes of the uncut blocks*, the outermost edge of each member touching the original or chamfered surface, that is, not being cut away so as to fall below, or short of it. The original planes, or uncut square surfaces, are represented in our engravings by dotted lines. These two facts must be regarded as fundamental canons in the arrangement of mouldings.

There are three planes in which mouldings will be found to lie: one parallel with the outer wall, which we shall designate the *wall-plane;* one at right angles to it, or parallel with the soffit, which may be called the *soffit-plane;* and the third, the plane formed by chamfering an edge, which was generally (not invariably) done at *an angle of forty-five degrees*, or the *chamfer-plane.* It is clear that by sinking hollows in any one of these surfaces, a group of mouldings would be developed.

In considering any series of mouldings previously to copying them, the first point is to lay down on paper the various planes, that is, to ascertain the plan of the arch, or other feature, before the mouldings were cut. When this is done by accurate measurement, the rest of the process becomes comparatively easy, and the most complex and extensive combination, which it appears at first sight impossible to copy with anything like accuracy, may be readily disentangled, analysed, and sketched with precision. Without attending to these facts, all attempts to do so will be futile.

It may be alleged as a general rule, that Early English mouldings lie on the planes rectangular; that Decorated, according to their kind, fall either on these, or on the chamfer-plane alone; and that Perpendicular mouldings almost always lie on the last. P. 19.

The next chapter to that from which the above extracts are made, contains useful remarks on the various methods of copying mouldings. The method of the "lead tape," though simple, is objected to on account of the risk of inaccuracy from the bending of the lead. The method of applying wet clay or soft wax to obtain a matrix-mould from which a cast exactly resembling the original may be obtained in plaster of Paris, has the defect of being inapplicable where there is much undercutting.

A beautiful and ingenious instrument has been invented by Professor Willis, and called by him the Cymagraph, by which mouldings may be copied with the most perfect accuracy, and of the full size. It is described and illustrated in the *Civil Engineer and Architects' Journal*, No. 58. It can hardly be successfully used without a little practice; but the most extensive and complex mouldings can be taken by its aid. The only disadvantages are, that the instrument, though by no means large, is an inconvenient appendage to the equipment of a pedestrian, and that only a few inches of a moulding can be taken at once; so that a number of separate pieces of paper must be pinned together on the spot, and that with great accuracy, or the planes and bearings will be incorrect.

Geometric methods, both of copying and reducing mouldings, are fallible; for the members and curves were very often drawn *libera manu*, especially in earlier work; so that very considerable deviations from geometric precision must be expected in observing ancient examples. P. 23.

The last remark will be interesting to those who read our review of Mr. Billings' work in this month's number. The method which Mr. Paley has found experimentally the best is to copy by the eye alone, giving some of the principle measurements. He says that it will be found that by practice exceeding accuracy may be attained in this kind of drawing, which to many other advantages joins this important one, that by it mouldings may be copied which are inaccessible, and yet distinctly visible to the eye.

We must endeavour to extract a few passages from the main body of the work, but it is difficult to select them, on account of the style being necessarily that of a work of reference to examples, and for the most too unconnected to present interesting extracts—here and there, however, we have very pleasing exceptions.

The exquisite skill, taste, and patient labour invariably evinced in the working of Early English mouldings, are truly admirable. The ingenuity that was never at a loss in any difficulty of finish or constructive irregularity, and the minuteness with which even the most concealed and darkened parts were executed, are circumstances of much interest, if we contrast the hasty and economical practice of the present day. The deepest hollows are all as cleanly and perfectly cut as the most prominent and conspicuous details; and in the village church as much so as in the most glorious cathedral. An Early English doorway is often a wonderful piece of art, however little it may attract the attention of ordinary observers. It is most pleasing to notice the long trails of dog-teeth lurking in the dark furrow of a label or chancelled recess; to see the end of some inconvenient member got rid of by throwing a flower across the point where it suddenly stops or dies into the wall; to admire the efflorescent boss and the foliaged capital intruding their luxuriance upon the mouldings and hollows, as if they had overgrown their original and proper limits. How beautifully, too, the knots of pierced and hanging leaves extend like some petrified garland or bower of filigree work round the arch, dividing the plainer mouldings into groups, and almost imparting life to the very stones! There are abundance of doorways of this style which exhibit the most delightful varieties in their forms and groupings; always, yet never the same. Some examples occur at Bolton and Furness Abbeys, whose arch-mouldings extend five or six feet in width. The west fronts of several of our cathedrals have Early English doorways of amazing magnificence. Alas, that we should now try to borrow an unreal splendour by "*running*" archways by the yard in vile terra-cotta or viler patent cement! And strange, that with such noble examples of rich perspective effect and artistic display before them, our architects will generally persist in inventing mouldings for themselves, rather than copy any of the perfect works of ancient art which are everywhere to be met with, and of all degrees of costliness. The wretchedness of modern mouldings can only be appreciated by those who take the pains to compare them with the ancient.* P. 34.

The following is taken from the chapter on mouldings of the Decorated period.

We sometimes meet with mouldings of much earlier or later date than we should have expected from other characteristic marks in the building; and there are not a few instances in which, without the aid of such marks, it would be impossible to say whether a moulding is of the fourteenth or the fifteenth century. In fact, this science does not appear capable of more than general treatment; though there is quite enough of uniform system to enable us to apprehend the broad distinctive principles which obtained in the different periods.

Generally, then, we observe much greater geometrical precision in drawing both the hollows and the projecting members than prevailed in the preceding style. Segments of circles, both concave and convex, were much used; and there was a softness of blending, a delicacy and gentleness of grouping, an avoidance of strong and violent contrasts of light and shade, which imparted a more pleasing, though much less striking, effect. There can be no doubt that the perfection of moulding, as of all architectural detail, was attained in this style.

And yet rich Decorated mouldings are of rather rare occurrence. A great many of the finest buildings in this style scarcely afford as good examples of mouldings as the smallest and humblest church of the Early English age. Very often plain chamfers are used in all the windows, doorways, and pier-arches; while minor parts, such as bases, capitals, sedilia, sepulchral recesses, and the like, have fine and elaborate details. It is in this kind of work that we must look for the best mouldings in the Decorated style. P. 36.

* Mr. Rickman's mouldings to the central gateway in the cloisters of St. John's College, Cambridge, is partly Early English and partly debased Perpendicular. It has besides its poverty of effect other serious faults.

The next chapter naturally brings to the subject of Perpendicular mouldings. Their general characteristics are well expressed in the following extracts: there is an implied moral in the remark respecting the tendencies exhibited in the decline of Art to avoid labour, which might be profitably listened to in our time.

In mouldings of this style we shall at once perceive a debasing influence in the comparatively meagre, *save-trouble* method of working them. Large and coarse members, with little of minute and delicate detail, wide and shallow hollows, occupying spaces which, in early work, would have been filled with groups of separate mouldings; hard wiry edges in place of rounded and softened forms, and general shallowness of cutting, are all conspicuous characteristics. Add to these, that their general arrangement on the chamfer-plane, which is a marked feature of the Perpendicular period, gives a flatness which is unpleasing to the eye in comparison with the rectangularly recessed grouping of the two preceding styles. P. 45.

In the chapter on Columns, we find the following:—

The most certain evidence of date is furnished by the mouldings of the abacus. In Early English capitals it is almost invariably undercut, or hollowed out, so that it seems to overhang the bell just as the bell does the shaft, and with the same profile, consisting of the half of a roll-and-fillet. The Decorated abacus consists of the scroll-moulding, with a cylindrical roll of rather less size below it. P. 57.

Perpendicular capitals present very marked features, which are seldom liable to be mistaken. The mouldings are large, angular, meagre, and few. Neither abacus nor bell is clearly defined,—a fact similar to that already stated with regard to arch-mouldings, that the distinction of *orders* is generally lost. The abacus, in short, no longer appears as a separable member, and the bell either wholly vanishes, or is very imperfectly developed. The upper part of the abacus is usually sloped off to a sharp edge, like the chamfer of an angle; the section of the moulding below resembles the letter S inverted, and, above all, the capital is *octagonal*, while that of the preceding styles is round. The shaft, however, is circular in Perpendicular work; while octagonal capitals only occur in the other styles in the case of large single columns of the same shape, if we except a very few cases of Early English detached shafts with octagonal capitals, as in the transepts at Histon, near Cambridge, and the west front of Peterborough Cathedral. P. 59.

The extracts we have given, will we trust serve to give our readers a general impression respecting the book. As a first step in classifying mouldings, it is invaluable: imperfect as though it be (and as a first effort it must necessarily be imperfect), it exhibits a fund of knowledge which ought to render it at once indispensable to the architect. May we not be forgiven if in closing our review we lament that, while an amateur like Mr. Paley, who pursues the study only from ardent admiration of it, exerts his utmost industry, patience, and thought, and above all a teachable spirit in his labours to advance the knowledge of art, the professional architect sometimes spurn the information of books, looks upon efforts at making progress superciliously as reflecting on the state of *his* knowledge, and rather than copy models, even the most beautiful, contents himself with his own vicious principles of design, or in his very horror of servile imitation, most servilely confines himself to the forms which he was set to copy when learning the elements of his profession. To this remark there are indeed many illustrious exceptions, but there are still too many who require books such as Mr. Paley has written to undeceive them as to their own supposed infallibility.

On some Remarkable Properties of Water and other Fluids, with reference especially to the Causes and Prevention of Steam Boiler Explosions. By JOHN EDDOWES BOWMAN, Member of the Chemical Society of London. London: Parker, West Strand. 1845. 8vo., p.p. 19.

This is a small pamphlet containing the substance of a lecture recently read before the Royal Institution of Manchester, and, notwithstanding its unassuming form, contains some most interesting, and in many respects astonishing, facts respecting the properties of water when in contact with heated metallic surfaces. The reader who takes an interest in the philosophy of the steam engine, will find his account in following us in an analysis of the results of Mr. Bowman's very valuable investigations. We ought to premise that Mr. Bowman takes very little credit to himself for the researches which he here details, and wishes to attribute the merit of them to M. Boutigny, with whom he conducted a series of experiments respecting the properties of fluids; but the reader will feel inclined to suspect that our author's modesty leads him to underrate his own just claims to approbation.

It is a well known fact that if water be dropped on hot iron it will frequently assume a globose form, and remain rolling about on the metal for a long time without evaporating. The most probable explanation of this phenomenon is that the globe of water has its exterior surface so highly polished that it reflects almost all the heat of the iron. A familiar instance, adduced by Mr. Bowman, is the test which laundresses use to ascertain whether their smoothing irons be sufficiently heated.

I allude to the property which liquids possess, of assuming the form of a globe or spheroid, when thrown upon any substance which is at a high temperature. Of this property, a familiar instance is afforded by an experiment performed every day in our laundries. When it is required to know whether a smoothing iron is sufficiently hot for her purpose, the laundress, on taking it from the stove, applies extemporaneously a drop of moisture from her lips, and if this at once rolls off in the form of a globule, she knows by experience that the iron has reached a proper temperature; while if the drop of water bubbles and boils, however violently, it is condemned as not hot enough, and returned to the stove.

Once, then, in the flight of ages past, it was discovered that water, though it so readily boils when thrown upon a moderately hot iron, does not boil at all when in contact with metal considerably more heated.

The illustration is certainly a rather homely one, but it is no worse for that, as a distinct exposition of the phenomena which in fact form the subject of the pamphlet. M. Boutigny succeeded in ascertaining by experiment that many other liquids besides water could be made to exhibit these phenomena: it was also found that water which under ordinary circumstances would boil away in one minute, would in the "spheroidal state" require *an hour* for its dispersion.

The next point was to ascertain the temperature of water when thus spheroidal, and the conclusions arrived at are very extraordinary.

Let a large spheroid of water be formed in a tolerably thick crucible of platinum or silver, and the bulb of a small and delicate thermometer be carefully plunged into the middle of it, taking care not to allow it to come in contact with the heated metal. The temperature of the water thus ascertained is invariably 205°.

Perhaps one of the most curious facts which have been established in connexion with this subject is, that any variation in the temperature of the vessel containing a spheroid, does not affect the temperature of the spheroid itself. Thus it is found that a spheroid of water, when contained in a crucible heated considerably below redness, is just *as hot* as one contained in a crucible intensely heated to whiteness in the most powerful blast furnace!

From numerous experiments, indeed, with water, alcohol, ether, and many other liquids, the following law may be deduced:—"*That bodies in the spheroidal state remain constant at a temperature below that of boiling, however high the temperature of the containing vessel may be.*"

Another most extraordinary fact which these experiments ascertained was, that if boiling water instead of cold water were thrown on the hot metal, still in the "spheroidal" state it maintained the same temperature of 205°.

The same remarkable results are obtained if, instead of pouring the liquids while cold into the red-hot vessels, they be absolutely *boiling* at the moment: strange, and almost incredible as it may appear, the instant they reach their fiery resting-place, they absolutely *become cooler*, and as it were shaking off the trammels of all known laws of nature, *cease to boil!*

Liquids then, when in that peculiar physical condition which I have called *spheroidal*, always remain at one definite temperature; and this temperature is invariably, in the case of every liquid, lower than that, at which, under ordinary circumstances, that liquid boils. Let us enquire a little more narrowly into the consequences of this law.

Similar experiments were made with other liquids; among others, with those produced by the compression of gases. Sulphurous acid gas which liquefies under a pressure of 30 lb. to the square inch, and which maintains its liquid form below a temperature of 14° Fah., or 18° below freezing point of water, was found, on being thrown on heated surfaces, to preserve a temperature actually lower than 14° its evaporating point!

The experiment which was selected for the purpose of furnishing an answer to this question, is perhaps one of the most striking and apparently paradoxical in the whole range of physical science. Liquid sulphurous acid is subject to the same remarkable law as water and other liquids, it being invariably, when in the spheroidal state, at a temperature lower than its boiling point which 14° of Fahrenheit's thermometer; so that if a spheroid of sulphurous acid be formed, it remains constant at a temperature of about 12°, even though the crucible containing it be at a red or a white heat. If a little water contained in a small glass bulb, $\frac{1}{8}$th or $\frac{1}{10}$th of an inch in diameter, be immersed in the spheroid of acid, it is almost instantly frozen, thus affording incontestible evidence of the remarkably low temperature of the spheroid.

Most persons have seen the well-known lecture-table experiment of causing water and other liquids to boil in vacuo at temperature considerably below their ordinary boiling points; a result depending upon the diminished pressure on their surface. When liquids in the spheroidal state, however, are placed under the receiver of the air-pump, and the air removed, no sign of boiling is ever perceived. We may therefore suppose that the temperature of the spheroid in vacuo, is lower than when exposed to the atmospheric pressure, as otherwise ebullition would inevitably take place: but I am not aware that the temperature has ever been examined with a thermometer under these circumstances, and it would be by no means easily done.

I shall probably scarcely be believed when I say that even liquid sulphurous acid does not, when contained in a red-hot vessel, and in the spheroidal state, boil in vacuo.

It is also stated that if a piece of ice be thrown into a red-hot crucible part of the ice becomes water in the spheroidal state, and the rest remains unmelted within the globule. Another very important fact, which seems to have been ascertained, was that spheroidal liquids did not actually touch the liquid metal.

If silver be touched with nitric acid it is rapidly corroded, and in a short time dissolved. But if a quantity of nitric acid be poured into a crucible or dish of silver, sufficiently hot to induce the spheroidal state, no corrosion whatever will take place; clearly proving that the acid is at no time in absolute *contact* with the metal. That this is not owing to any deficiency in the strength of the acid may be seen by placing in the spheroid a piece of cold silver, when violent action of course takes place, nitrous fumes being given off, and nitrate of silver formed.

A remarkable effect may be produced, owing to this repulsion between liquids and heated solids, if a large spheroid of water be formed on a surface nearly flat, and a small bar of white or red-hot iron be then thrust into the middle of it. *Contact* being impossible between the bar and the water, the latter forms a ring at some little distance from the heated bar, presenting very much the appearance of Saturn and his ring. Whether any real analogy exists between the two effects, or whether the causes be in any way connected, further researches into the nature of that anomalous appendage of the planet may perhaps decide.

Mr. Bowman concludes his valuable history of his experiments by shewing their application to the explanation of explosions of boilers.

If heat be applied to water contained in an open boiler, the temperature of the water will of course continue to rise until it reaches 212°, when the elastic force of the steam is sufficiently great to overcome the pressure of the atmosphere, and the water boils. If the heat be still continued, the whole of the water will, as is well known, boil away, leaving the vessel empty: but as long as any liquid remains, the temperature of the vessel never rises above 212°, owing to the absorption of heat by the steam.

As soon as the boiler is empty, however, its temperature of course rapidly rises, and may reach a red, or even white heat, provided the furnace be sufficiently powerful.

If water be now gradually thrown into the overheated boiler, we know from what has already been said, that it will pass at once into the spheroidal state, and will continue at 205°, until, from some cause or other, it is permitted to *come in contact* with the heated surface, when violent ebullition immediately takes place, an enormous quantity of steam is instantaneously produced, and, if the vessel be a closed one, as is the case with steam boilers, *an explosion* is the almost inevitable result.

An experiment exceedingly easy of performance is sufficient to illustrate this. Let a large spheroid be formed in a vessel of platinum, or copper; so long as the heat is applied to the latter, the water never shows the least sign of boiling; but if the lamp be extinguished, and the vessel allowed to cool a little, the water suddenly comes in contact with the metal, and an enormous quantity of steam is instantly formed.

He then shows that it is a positive fact that steam boilers may become red-hot even while containing water, owing to the water assuming the spheroidal state, and that if by cooling the water come in contact with the metal steam is generated with such rapidity that the boiler instantly bursts. Our last extract shall be from the practical rules which the experiments suggest for the prevention of explosions, and in concluding our notice of the pamphlet we unhesitatingly recommend it as well worthy of a most attentive perusal.

Be careful that the boiler is kept as free a possible from earthy incrustations, which, if allowed to accumulate, form, in fact, a boiler of stone inside the iron one, and thus retard the passage of heat from the fire to the water, until the iron has become more or less overheated.

Never let there be a deficiency of water in the boiler, since when that happens, the latter may become heated almost indefinitely, and is consequently sure to render water spheroidal when thrown in; when an explosion will be (without great care) almost certain.

And lastly, If it be known that, owing to any cause, the water in a boiler has already become spheroidal, instantly stop the supply of water, and take care that the fire is well kept up until the whole of the water has evaporated; when that is the case, the boiler should be allowed to cool to its natural temperature, when water may be added and the fire rekindled.

A Nomenclature of Colours. By D. R. Hay. Edinburgh and London: Blackwood and Sons. 8vo. pp. 72.

The author of this work is known to the public by several preceding books of an analogous description. The subject is one which possesses a great interest on account of its importance with reference to the manufacturer. It is obvious that a systematic classification of colours, from its superior accuracy and convenience, would be a great improvement on the loose indefinite terms now in use. The object of publishing the present volume is stated by the author in the following terms:—

My purpose is to attempt to classify, arrange, and define colours, in order to enable those who are following such branches of study, as well as the artist, more easily to comprehend the nature of each particular hue, tint, and shade, and the relation that it bears to the primary elements of light, darkness, and colour. By this knowledge a description may be given where no proper name can be applied, and every compound become as well understood as the primary elements, yellow, red, and blue.

The work is illustrated by specimens of a great many colours and tints, some of them very brilliant. The classification adopted is a very good one; the "primary" colours are red, blue, and yellow, the "secondary" are those arising from the combination of every two of the preceding, the "tertiary" are those arising from combinations of the secondary. This arrangement is very convenient for practical purposes, but Mr. Hay's speculations on the physical theory of light are of a very sorry character indeed. The following will suffice for a specimen.—

According to the language generally employed by writers upon colour, yellow, red, and blue are said each to absorb a certain portion of the rays of light, and reflect or transmit the remainder. But I cannot consider this doctrine to be correct, while I believe colour to be produced by the joint influence of light and shade, as already mentioned. We know that fire is produced by combustion, and that the active agent is oxygen, and the passive agent the body consumed, by which joint operation fire is produced. In like manner, light is the active and darkness the passive agent in the production of colour; and each of the primaries is thus the effect of the principles of light and darkness acting together upon the visual organ, and producing by their joint operation a colour.

We are sorry Mr. Hay "cannot consider" the doctrine respecting the absorption of rays "to be correct," because we *almost* fear that philosophers generally will be inclined to defer more to the names of Huygens, Fresnel, Sir William Hamilton, &c., than to that of Hay; and *may* perhaps prefer the splendid analytical investigations of the former to the unsupported *dicta* of the latter. Of the meaning of the phrase "light is the *active* and darkness the *passive* agent" we have not even a glimmering conception, nor do we see what analogy "combustion" has to colour. This philosophy, on the whole, appears of that mysterious kind which based the science of pneumatics on Dame Nature's "abhorrence of a vacuum"—the fastidious jade!

Mr. Hay has some crotchet about colour being a mixture of light and darkness, (as if darkness were a positive existing principle and anything more than the absence of light). Well,—when he opens his shutters of a morning, does he find that, as more and more light is admitted to the room, the colour of objects within it changes? He also offers another theory at the end of the book, which, as we do not more than half understand it on account of its excessive profundity, shall be given in the original words.

The fact has also been ascertained that the atmosphere, when pure, is composed of two gases, with the admixture of a small proportion of aqueous vapour and carbonic acid. * * * Now, as the atmosphere is admitted to be a body, may we not suppose that it is constituted like other elastic bodies, though it cannot, like those that are solid, be brought within the sphere of microscopical investigation, and that this aqueous vapour is distributed throughout the atomic interstices in the form of an infinitely minute and symmetrically reticulated fibrous tissue, susceptible of tension and attenuation, like that known to exist in animal and vegetable substances?

By such a supposed distribution of the aqueous vapour, an independent vehicle of sound is at once supplied, and the gaseous elements of the atmosphere left to perform their wonderful and important duties in the economy of the creation undisturbed. * * * The supposition which I have hazarded, will also satisfactorily account for the greater facility with which sound is transmitted in the lower regions of the atmosphere, where the relative proportion of the aqueous vapour to that of the gaseous elements is greater than in its higher regions.

From all which we may safely conclude that sounds depend on the hygrometer and barometer; that in dry weather the human voice sinks to a whisper, and on a very rainy day oral communication may be maintained between London and York.

The work abounds in numerical tables of the "powers" of colours, but as these tables seemed in some way connected with Mr. Hay's own theory of light, we have not thought it worth while to examine them.

The Practical Miner's Guide, comprising a complete set of Trigonometrical Tables. By J. Budge. London: Longman. 8vo. pp. 218.

This is the second edition of a work which forms a compendium of various geometrical and trigonometrical theorems without the accompanying demonstrations. This we believe to be the difference between systematic works on geometry and "practical guides,"—in the one no construction is given without proof of its accuracy; in the other the rules are given without explanation,—just like medical prescriptions and recipes in a cookery book. We confess we prefer the former method, not only because of its superior accuracy, but because advancing every step by logical deduction it is, we are convinced, actually more expeditious and easier to be learned. Mr. Budge's work contains methods of assaying metals, and also formula for the power of steam engines. As a frontispiece to the work we have—not a trigonometrical diagram, not a view of some important mine, not the representation of some steam engine, but—a portrait of Mr. Budge! *This*, if nothing else, is a novelty in a work on practical science; and as of course the insertion of the portrait could not possibly have arisen from a feeling of conceitedness and personal vanity, the only other motive we can suggest is, that the author, on the principles of Lavater, wished to give his readers in the lineaments of his physiognomy a correct index of the mighty intellectual powers of —Budge!

We cannot, however, conclude our notice without remarking on some passages which occur towards the end of the book. Mr. Budge, after arriving at the discovery that despite "the labours of our large body of geologists . . . no good has emanated from their labours to the value of a swabbing stick" makes the following deductions.

This is the grand cause why the efforts of our geological societies have utterly failed—they have set themselves against the *truth*—they have rejected the inspired history of the creation of the world; hence their writings and sayings are replete with error, inconsistency, and contradiction.

Let them begin again; cancel what they have written, and lay their foundation on the sublime account so minutely given us in the Scriptures. Then let them follow nature in all her grand and stupendous subterranean operations, and they will discover a world of harmonious wonders, and will bring to light, to the admiration and benefit of mankind, the cause and effect of the magnificent order of every part of creation that is allowed to fall under the inspection of man.

I shall be borne out in stating my firm conviction that no sceptic ever made a good geologist; and whatever those men may think of themselves, who dare to write in contradiction to the Word which the Creator has graciously condescended to bestow on his creatures, they are no better than practical atheists, in the judgment of all men "who believe and know the truth," and their writings are calculated to inflict a serious injury on society. See how these talented infidels try all they can to sap the foundation of the Christian's faith!—their first, second, and third *formations*. One thing *produced* by another. Coal *formed* of vegetable matter, and lately they have discovered that slate is a *marine production!*

We desire to give Mr. Budge full credit for the integrity of his motives; indeed, if warmth of expression prove his sincerity, there can be no doubt respecting it. At the same time we cannot help wishing that he had exercised similar charity towards those whom he honours with his notice. It seems somewhat hard that gentlemen, many of them clergymen and men of hitherto unquestioned orthodoxy, should be declared to be "practical atheists" and "talented infidels" who "try all they can to sap the foundation of the Christian faith," because they have the misfortune to differ from Mr. Budge on certain philosophical points. We should almost have imagined that these vituperations proceeded from a vulgar uneducated bigot, had not the gentlemanly candour, the pious humility, and, above all, the exceedingly classical language of Mr. Budge's book convinced us of our error.

We cannot help concluding that if Mr. Budge would read a little more, and think a little more, and write a little more slowly, he would be rather less vituperative.

THE INTRODUCTION OF RAILWAYS INTO BRITISH INDIA.

We again recur to the subject of Railways in India. A pamphlet has been put into our hands containing the report of Mr. R. M. Stephenson on a general system of Railway communication, and other reports from the local authorities of the districts examined for the purpose of laying down lines. The pamphlet is accompanied by a map of the Railways projected in India. The indefatigable exertions which Mr. Stephenson has made to obtain accurate information, give a great additional value to this pamphlet. The number of sources from which local statistics have been collected are extraordinary; and not a single effort seems to have been neglected to present before the reader a perfectly complete synopsis of the whole undertaking.

The nature of the whole project may be stated in general terms thus—considering Bombay, Calcutta, and Madras as three points at the angles of a vast triangle, lines are to be drawn connecting each of those points with the others. The advantage of Railways in India must be estimated in two points of view. First, the benefits to Europeans and others from facilities of communication; secondly, the probable profit of the lines as speculations, estimated according to the populousness of the districts traversed. The first-mentioned consideration would of course suggest the connection of the capitals of the three great presidencies, as affording by far the greatest benefit to Europeans travelling. But then regarding the undertakings as speculations, it is quite clear that the distance between the termini is so vast that without intermediate and local traffic such Railways could not be remunerative.

It must be remembered, however, that in dealing with India we are dealing with a country which, notwithstanding its enormous extent, is densely populated. Taking the population of the modern states of Hindoostan at 130,000,000, and the area at 1,300,000, we have a population of one hundred to the square mile.

The first project proposed by Mr. Stephenson is a communication between Calcutta and Mirzapore to the North West, which would ultimately be continued to Bombay. One advantage of this railway is that it would be directly inland: we think lines approaching the coast ought in such a country as India to be avoided. Even in Englanfl the policy of coast lines is at best doubtful. The greater part of the railway projected to Hydrabad is a coast line, and parallel to the route of the steamers from Madras to Calcutta. Now as the whole of this coast is accessible by steam navigation, we think that it is by no means favourable for the establishment of railways. Indeed we think that in the first instance at least all railway schemes should be confined to directly inland communication.

Extracts from the Report of Mr. R. Macdonald Stephenson, and other Documents referring more especially to the proposition of a Railway from Calcutta to Mirzapore.

Having completed the collection of the documents which appertain to the line of country between Calcutta and the great central entrepôt for merchandize and produce of all descriptions at Mirzapore, I have been induced to submit the whole of the valuable information already collected by myself and by others who have for some years past been so engaged, and who have kindly placed their papers at my disposal, and to recommend that a commencement should be made upon this line without delay, pending the construction of which, the statistical returns, surveys, &c., of other districts will be obtained for future consideration, in the events of the inducements held out being such as to justify their being undertaken, on the completion of the first line.

There are strong grounds for believing that the proposed Railway will hereafter connect Calcutta with Bombay, by a line passing along the valley of the Nerbudda, as there are several objections to the more direct route which has been suggested; among which may be mentioned the comparative trade upon the two lines—the one already existing, the other having yet to be made—and the construction of the one line being attended with less loss of life than the other, from the unhealthiness of the districts traversed; whereas the advantage in time of the direct over the longer line will not exceed a few hours.

The statistical returns of the traffic in goods and passengers, as well as the cost of conveyance between Calcutta and Mirzapore, have been obtained, and the extent of the trade is sufficient to justify measures being taken to improve the means of transport by laying down a railway between these two places, which should pass through the rich and productive district of Burdwan. The uniform and gradual inclination of the road from Howrah (opposite to Calcutta) to Raneegunge, where the principal collieries are opened, presents advantages which are rarely to be obtained upon a line of equal length, and as this portion of the great line would, upon its completion, yield an independent and considerable income, it would be most advisable that to this extent the line, which has been carefully surveyed upon a former occasion, should be first completed, and the interval be occupied in completing the surveys and levels of the remainder; the more especially as it is a question in the minds of many, whether after passing through Burdwan, the direct trunk road to Mirzapore, or the more circuitous route along the Valley of the Ganges, would present the greatest advantages, and as, in either case, the line to the Burdwan collieries would form a part of the plan, it would in this respect signify little, in the first instance, which direction shall be adopted. It is the opinion of most qualified men, to whom application has been made upon the subject, that £6,000 per mile will suffice to complete the entire distance, taking the level parts of the country as well as the hilly districts and rivers into consideration; but it may be more satisfactory to increase the amount to £8,000 per mile, a sum more than sufficient to cover every contingency.

Upon this basis I most strongly recommend the undertaking being commenced, provision being made to complete the entire line, but the smaller portion being proceeded with and opened at the earliest possible period.

The establishment of schools upon the European principle, in the several sanataria in India, and the ready access afforded to them by means of Railways, will do much to alleviate one of the most severe privations and hardships to which every resident in India is to a greater or less extent subjected —the continual separation from one or more members of his family, who, in lieu of proceeding to England, the Cape, or other distant parts, for the purposes of health, education, or change, will be enabled within a few hours, to accomplish their object as effectually as at present can only be obtained at a very considerable cost of time and money, and at a sacrifice of personal feeling and anxiety to which there are few who cannot bear ready testimony from their own sad experience.

I would further suggest, to prevent as much as possible the speculation in shares, which a less amount is calculated to facilitate, and to render this stock one for permanent rather than for temporary and speculative investment, that the shares should be fixed at no less than £250 each; the more especially as the payment of the several instalments will of necessity extend over a period of several years.

From a pamphlet recently published, under the title of "Railway Reform," it appears that of a capital of £63,000,000 invested in 55 railroads, of the aggregate length of 1,732 miles, in the United Kingdom, the 24 principal lines, of 1,014 miles, which have cost £28,000,000, are now worth £48,000,000, and that they are paying an average dividend of 6¼ per cent. upon the original outlay, of which the London and Birmingham Railway, to which the proposed Calcutta and Mirzapore line bears a close analogy and resemblance, as regards the relative traffic between the two termini, is paying 11 per cent. on the original capital expended; and that these 24 railways have cost on an average £36,910 per mile; whereas, from the level character of a considerable portion of the country throughout India, from the absence of any heavy Parliamentary expenses, from the cheapness of labour and materials, and from the moderate cost of the land, if purchased by the Government of Bengal for the Company as being applied to a public work, the cost of a railway in that country will not, on the average, exceed one-fourth of that amount, while the extent of traffic, if it do not exceed, is very little below that from which, even at the above heavy original expenditure, a dividend of 11 per cent. has been derived.

A Calcutta merchant who desires to visit Mirzapore must incur an expenditure of £70, and a loss of six weeks, if he avails himself of the steam vessels, and if he proceeds by Dâk the amount will be nearly the same, and the period required to perform the distance there and back will be about ten days of unremitting and most fatiguing travelling.

The Railway will enable him to perform the entire distance to Mirzapore and back to Calcutta in thirty hours, and at an expense, if the English rates were adopted, of £11 4*s*., £7 18*s*., or £5 1*s*. 1*d*., according to the train which might be selected. These rates would, however, be unnecessarily low, and an intermediate would be readily paid, and unquestionably induce very many to avail themselves of the facilities offered, who are at present of necessity prevented by the delay and loss of time, more than on account of the expense which is entailed.

From the accompanying documents it appears, that the imports and exports of Calcutta, amount to £16,570,000 in one year, of which the chief portion has been received from or is conveyed into the interior.

That the transport of merchandize between Calcutta and Mirzapore averages by water 47*s*. 6*d*. per ton, and by land 10*l*. 16*s*. to 13*l*. 10*s*. per ton, the former occupying an average of six weeks, the latter seven weeks, in the transit;

And that the estimated traffic, at a moderate calculation made by an experienced officer in the service, who has furnished the most recent and carefully collated details of the trade between Calcutta and Burdwan, will amount to upwards of 107,310 tons a year upon the existing traffic, exclusive of passengers.

The levels of those portions of the line which have been already ascertained, show a gradual inclination of twenty-four inches in the mile, from Howrah, on the banks of the Hoogly, opposite to Calcutta, at which the railway would commence, to the Burdwan Collieries, to which it is proposed to extend the first line at once. Upon this portion of the entire line the expense will not exceed 6,000*l*. per mile, or 840,000*l*. for its completion, upon which the gross returns of the ascertained existing traffic in goods alone, exclusive of passengers, troops, the mails, or Government stores, will be 125,160 a year, without calculating upon that increase which invariably follows the providing of improved and additional facilities for communication.

The whole of the documents, plans, levels, &c., have been placed in the hands of one of the most eminent English engineers (Charles Vignoles, Esq.), whose attention has been, for some years past, directed to this important subject, and whose opinion will be found annexed, in regard to the sufficiency for every useful purpose of the information which has been submitted, to enable him to express his decided as well as unqualified and favourable opinion of the undertaking.

In conclusion, I may mention that, having travelled over and examined a considerable number of the European, as well as American lines of railway, I have no hesitation in stating that the amount of existing, as well as of the certain prospective traffic in goods and passengers, through several of the principal districts, with the facilities which the country affords for the economical construction of railways, are calculated to render such an undertaking one of the most remunerative, and extensively beneficial of any similar work, with which I am acquainted.

Extracts from a Letter from Captain A. S. Waugh, Surveyor General of India, Aug. 10, 1844.

Although I am of opinion that a preliminary survey is indispensable to an accurate discussion of the question, still the general knowledge which we have of the tract of country between the commercial capital of Bengal and the upper terminus will be useful in taking a cursory view of the subject. Referring to the map it will be found that the direct distance from Calcutta to Benares is about 388 miles, to Mirzapore about 408, to Allahabad about 456 miles. Of this distance 218 miles are situated in a highland country, rising in one direction to the height of near two thousand feet above the sea. The rocks composing it, are primitive transition and secondary, and with the exception of a small portion of sandstone grit belonging to the coal measure, they are of the hardest class of rocks, such as granites, basalt, and greenstone. These are impenetrable, except at vast expense, by means of tunnels, or excavations, and the acclivities are so steep that they cannot be surmounted by railroads. But even if the direct line was not beset by insurmountable obstacles, it would be inexpedient on account of the poverty of the country, which for nearly the whole distance above cited, is a wilderness, diversified at long intervals by a little cultivation, and scarcely animated by human beings. This line would moreover follow the valley of the Damooda for some distance, and would have to cross that river at least twice. Abandoning this line, and moving a little to the eastward, we come to the tract between the Damooda and Adji Rivers, and following the lines of the new road, we pass through Burdwan, and the district of the coal mines. This line undoubtedly offers fewer obstacles than the other; it outflanks the Damooda River, and also the highest levels of the hilly tract. If it be practicable in other respects, it is preferable to any other line that could be proposed. It is very nearly a direct line, and the immediate connection of the coal districts is in itself a great object. I have never travelled upon this route, and cannot therefore offer an opinion, but valuable information could be obtained from the superintendent of the road. The first part of the line through the Hoogly and Burdwan districts is covered with water during the rains, and the road would need to be embanked the whole way to the height of a few feet, but this would not be a costly work, provided the embankment be not made unnecessarily high, which is generally the case in all such undertakings. The first 120 miles therefore presents no obstacles of any consequence. The line then enters the coal districts, which are intersected by numerous dykes, hills, and ranges of primitive formation. Passing along the foot of the Parisnath Mountains (4,483 feet high), the line follows a tract which I imagine is not impracticable, although more or less hilly and rocky, until it reaches the Llanwa Pass, which impediment I suppose might be surmounted by judicious measures. The gradient at this spot would, however, be very steep, and I imagine fixed engines would be indispensable. From Llanwa Pass to Sassram is 87 miles including the passage of the Son River, a formidable but not insurmountable obstacle. I have never traversed this part of the line, although I have surveyed the country a few miles south of it, and am disposed to consider that there is nothing impracticable. The rest of the line will be comparatively easy work.

Arrived near Rajmahal, it is a question whether the line can continue along the right or south bank of the Ganges. The river frequently runs close to the Rajmahal Hills, which are composed of obdurate igneous rocks, and what with these obstructions, and swamps, creeks, and shifting nature of the river, I apprehend great difficulty as far as Monghyr, after which, with the exception of the passage of many tributary streams, the work will proceed with comparative facility.

If on examination it should be found impossible to creep along the foot of the Rajmahal and Bhagulpur hills, there is no alternative but to cross the Ganges below Rajmahal, and carry the line through the rich and fertile country on the north bank of the Ganges. This part of the line will present no formidable difficulties, except at the passage of the Ganges. and its principal tributaries, viz., the Gundak, Gogra, and Goomtee, besides many smaller rivers.

Statistics of Trade, and Cost of Materials upon the Line of Railway.

Timber.—There are several descriptions of timber available for railway purposes in Bengal; but saul and sisso, from their abundance, will probably be found most suitable for works of the kind. The former is a hard though coarse grained wood, and bears exposure tolerably well. I have seen posts which have been five years in the ground, and yet seemed sound. The white ants do not attack it until it begins to decay, and at no time are they very fond of it. It is at present brought down the Ganges to Calcutta from forests at the base of the Himalaya; but it abounds in other directions especially in the hilly tract lying along the Benares road, where it may be obtained for little more than the expense of cutting. The price in Calcutta is generally about half a rupee (one shilling) the cubic foot for squared timber. Round sticks fitted for railway sleepers—that is, seven or eight feet long and seven inches in width, would cost 8*d*. or 10*d*. sterling each. Sisso is a dark, coarse grained, but very tenacious wood, and has at times been much used for ship-building. It bears exposure to the weather nearly as well as saul, and resists the white ants; but it is more expensive in Calcutta. The country in all directions is covered with the Babool—a species of mimosa—which lasts a long time when in contact with the ground. It never grows to a great size; but sticks large enough for railway sleepers might be procured in Bengal in almost any quantity. The price of babool wood in Calcutta for sticks fifteen feet long and about eight inches in diameter in one rupee. In the interior it may be obtained for little more than the expense of cutting. Another species of timber of which there is a great quantity in the hilly districts west of Calcutta, is the Soondree tree. It is very highly spoken of for its highly durability when exposed; though at present it is not much used, as the means of conveyance to Calcutta are scanty. From the quantity of acid it contains, it is never touched by insects. It might be procured in any quantities at a cheap rate in the districts about Hazareebaugh. At the Fort Gloster mills, saul posts were pointed out to me which had been in the ground sixteen years. They were covered with coal tar, and were perfectly sound.

Machinery.—There seems to be no reason to apprehend any difficulty, from the want of mechanics, in the introduction even of the finest steam machinery, in India, without dwelling upon the success attending the employment of the finest machinery in the mints both at Bombay and Calcutta, I would bring forward the experience in the cotton mills at Gloster as conclusive upon the above point. All those acquainted with the nature of the machinery used for spinning cotton must be aware of its extreme complication and nicety; of the constant attention—the accurate adjustment and great delicacy required for its management. If such machinery, therefore, can be used at Port Gloster, by natives, under two European superintendents only—and if it can be altered, repaired and removed, by Native agency, and a cotton mill containing nearly 30,000 spindles can thus be kept in daily use and high order, there can, I think, be no doubt that all the machinery connected with a railway, including locomotives, could be kept in equal order by the same means in any part of India. I must also observe that no difficulty is experienced in the employment of the steam-engine in the neighbourhood of Calcutta, by Natives without European assistance of any kind. I have seen a small steam-boat in which none but Natives were employed, and have been informed by a practical mechanic, long in the habit of working with them, that they acquired a knowledge of machinery as readily, and used it as expertly, as any operatives he had ever met with.

Fire Wood.—As the Burdwan coal contains large quantities of sulphur it will not be available for locomotive engines; but wood will form a good substitute. The fire-wood of India is remarkably powerful and good. In Calcutta it cost from twelve to twenty rupees the 100 maunds, or 3½ tons weight, and on the route to Benares it is procurable at a much cheaper rate. At the above rate, however, it is not more expensive than upon many of the railroads in America, where it is used in preference to coal.

Price of Land.—The value of land, even in the most fertile portions of Bengal, is comparatively low. In the estimates for some of the canals projected for the neighbourhood of Calcutta, 20 rupees (£2) per bega is allowed as compensation; a bega being equal to one-third of an acre. The rent of ordinary land in Bengal varies from half a rupee to two rupees per bega, and 40 rupees (£4) per bega would be ample compensation for almost any land required for railway purposes. Among the hilly tracts between Calcutta and Benares the greater part of the land is worth little or nothing. By the perpetual settlement, Government have reserved the right of taking whatever land may be required for roads free of all payment.

Expense of Excavation in India.—By careful and necessarily very laborious examination of the system of levels, transverse and longitudinal, furnished by Lieutenant Cunningham, and on consideration of the rate of labour ascertained, it appears that in the line of least cutting, and that otherwise best adapted for the navigation, the quantity of earth to be excavated on the Rajmal canal would amount to 41,100,000 cubic yards, which at the rate of twenty cubic yards to a rupee, will cost in digging 2,055,000 rupees (or 205,500*l.*). The rate of digging here taken may, however, be considered a high one, as in the table of the rates given by Lieutenant Cunningham, he states the cost of excavating tanks near Jummoo Kandee to the depth of 21 feet, or that ascertained by the Rajmahl Canal survey to stand per rupees as follows:—458 cubic feet, 578 cubic feet, 686 cubic feet, the average of which is 574 cubic feet, or twenty-one one-third cubic yards for a rupee, and it is to be observed that this is for excavating tank work (in which the earth raised has to be carried a great distance), to the depth of twenty-one feet, whilst the average depth of digging in the canal will only amount to nineteen three-quarters feet.

Expense of Travelling in India.—Travellers between Calcutta and Benares proceed in a variety of ways, viz.:—1st. On horseback, or rather on tatoos. 2nd. In carriages, of which there are three kinds—namely, the chuckra, the eka, the rutha. 3rd. On foot. 4th. In boats. 5th. In palkees or dhooleys. 6th. By dawk. 7th. By steam-boats.

The expense attending the journey is as follows:—	£	s.
On Horseback.—Value of a pony which is purchased, and sold at the end of the journey	1	10
Feeding the animal		16
Allowance to Syce		14
	£3	0
Deduct value of pony resold		14
Total	£2	6

May therefore be taken as the expense of a journey by land between Benares and Calcutta, exclusive of food and lodging.

By Wheel Carriage.—The hire for a chuckru, which will carry three persons, is 25 rupees; for an eka, for two persons, 30 rupees; for a rutha, carrying four persons, 60 rupees. The charge for crossing rivers and other expenses, amounts to 8 rupees in addition.

On Foot.—It is difficult to arrive at the expenses exactly of a journey on foot; a small sum for protection and accommodation is paid every night at the serais for foot passengers, but the allowance for the journey among natives, when a messenger is sent on foot is 10 rupees, which includes wages, food, and all charges.

By Boats.—A boat of six oars, capable of taking from six to ten persons, costs for the passage 60 rupees. The toll is three rupees, and the sums paid Chokeydars to prevent detention, and for other contingencies, are estimated at 12 rupees. The expense, therefore, exclusive of food, by boats, may be estimated at 75 rupees for from six to ten persons.

By Palkee.—In this mode, by taking eight bearers, about fifteen miles are accomplished daily; it is attended, however, with considerable danger from robbery; and natives who adopt it generally take a couple of followers as a guard.

By Dawk the charge is half a rupee per mile, or about 22 rupees.

To the above charges must be added the expense of food and other contingencies, which vary from two annas to five rupees per diem.

The time occupied between Calcutta and Benares is

On horseback, from	15 to 18 Days
By wheel carriages	15 to 22 „
On foot	18 to 20 „
By boats	30 to 45 „
By palkee	15 to 18 „
By dawk	4½ to 5 „
By steam	15 to 25 „

The natives of Bengal generally prefer the route by water, as it is attended with less exertion. But the people of Hindostan and the Upper Provinces, generally go by land on horseback, or in carriages. The poorer class are forced to proceed on foot.

Note by the Editor of the C. E. &. A. Journal.—Since the above was written a dispatch of the East India Company to the Governor General of India, on the subject of Railways has been published. This dispatch is for the purpose of obtaining further local information, and is accompanied by an intimation that if that information prove favourable, the Company will feel disposed to further Railway projects in India.

PROCESS OF COINING AT THE ROYAL MINT, LONDON.

By Professor Brande.*

The chief importation of gold into this country is through the Hamburgh and Paris market, and the original supply of that valuable metal is principally from three sources, namely from the American mines, the sands of the African rivers, and no inconsiderable quantity from the Russian mines of the Ural mountains. From the year 1832 to 1841, there was imported into this country about 334,000*l.* worth of gold from Africa. The ingots of gold, as they come into the market, are sent from the Bank of England (who are the usual importers as far as we are concerned) to the Mint, having been previously melted by their own melter and assayed by their own assayer, so that when they come to the Mint they are so far of known quality and purity as far as the Bank is concerned. The bullion in ingots is delivered into the Mint and weighed in by the officer of the Mint, who is called the "weigher and teller," and whose business is exclusively to weigh in and weigh out the precious metals in that establishment. The bullion is there weighed in, in the presence usually of two Bank officers, or officers attending from the importers. The other Mint officers, who are always present on this occasion, are the Comptroller of the Mint and the Queen's Clerk. So that the bullion received from the Bank, under the precautions stated, is consigned to the care of the Mint officers just named, associated with the Deputy Master of the Mint. The Mint are now to become responsible for determining what is the real value of the treasure intrusted to them by the Bank, at first resting merely on the statements of the Bank. Then these ingots are handed over to be examined by the Master of the Mint's Assay Master, and the fine and the coarse ingots are so mixed, and so apportioned, that the whole, if possible, may be brought to the state of standard. If, however, all the ingots should remain impure, or below the standard, in that case it becomes necessary to direct the addition of pure gold. If, on the other hand, they run above standard, it is then necessary that copper should be added in order to make the standard, or some other metal described under the name of alloy.

Let it be here clearly understood as to what is meant by the term "standard." Standard gold is that which contains eleven parts out of twelve of

* A Lecture delivered at the Royal Institution, January 24, 1845, and reported in the 'Repertory of Patent Inventions.'

pure gold, the remaining twelfth in it being what goes under the name of "alloy;" it may, of course, consist of any metal, necessarily of an inferior value to gold, which does not materially affect either the colour, malleability, or durability, of the noble metal. In fact, there are only two metals practically employed for the purpose, namely, copper and silver. Thus the twelfth part, which is called alloy, may be silver, or a mixture of silver and copper. This was generally the case, till of late, means of extracting silver with profit have been devised; so that now, when the ingot of gold comes to the Mint or Bank containing silver, as well as copper, that silver is reported on, and as far as the ingot goes it constitutes increase of value, because it may be sent to the refiners, and the refiners may extract that silver and replace it by copper, and then return it to the Mint, and still pass as standard; because everything is considered except pure gold as alloy. Whether the twelfth part consists of silver or copper is of no consequence to us, but matters considerably to the owner of the bullion. These points are very curious and would interest if the lecturer could, upon one evening, have brought the whole subject in detail, showing how small a quantity of silver will pay for the operation of extraction. All this depends entirely on the great improvement which has taken place of late years in the chemical arts, especially in the manufactory of great engine of chemistry, sulphuric acid, or oil of vitriol. It may be added, also, that we owe much to Dr. Wollaston's mode of working platina so as to enable us to employ platina; and it is cheapness of oil of vitriol on the one hand, and the possibility of using platina on the other, that has enabled the refiners to bring this process to such perfection, so as, in fact, to take the silver out of the gold with a profit.

There is an important circumstance cennected with the alloy, namely, the endurance of friction in circulation. It appears from the experiments of Messrs. Hatchett and Cavendish, that an alloy of equal parts of silver and copper was most effective in that respect; and, accordingly, when we have alloy in an ingot of metal containing eleven parts of pure gold, the remaining twelfth being half copper and half silver, that is the article, perhaps on the whole, best adapted for coinage. There is one point, however, of great importance in all these steps, which is this, that the copper which is used for alloy should be absolutely pure; for if it contain a minute quantity of certain other metal it does infinite mischief to the gold, and, above all, renders the ingots brittle and intractable, so that they cannot be rolled or worked in the succeeding operations. There are two colours of sovereigns at present in circulation; one kind, the pale sovereigns, are fast disappearing—those are the sovereigns which contain silver; the dark looking being such as are alloyed exclusively with copper. Standard gold, that is, gold to which one-twelfth alloy has been added, coins better, and sustains wear and tear better, and it is more fusible than pure gold; pure gold being so soft as to bend, and so tough as to clog the dies, besides the great difficulty, and, indeed, impossibility, that we had of procuring and preparing it for the purposes of coinage.

It is curious to observe the extreme difficulty in getting a perfectly uniform bar. Even shadows of difference that would not be noticed are important. There is a very curious document in existence, published on the operations of a part of the Mint, showing the great difficulty of making what are called trial plates. That is, in making the standard plates, which are to be uniform throughout, and which are to be deposited in the exchequer and elsewhere, for reference upon emergency and particular occasion, to determine the purity of the coinage.

In the case of the importation of silver the same general rules are adopted as in regard to gold; but, with us, the standard silver differs from that of the gold, the former being an alloy of which there are 11$\frac{2}{20}$ silver and $\frac{18}{20}$ copper. It will be observed that our standard is high, and above that of France; both in regard to gold and silver, the standard is nine of noble metal to one of alloy or $\frac{1}{10}$. Now, it is found generally, in regard to alloy of silver and copper, that the specific gravity of the standard alloy is 10$\frac{3}{10}$, and this is a tittle below the Mint; so that silver and copper, when made into an alloy, undergo a slight dilatation, or diminution of specific gravity. The present account will be limited to gold coinage, which involves in its general outline the course adopted equally in silver and copper coinage; but gold coinage requires the extremest accuracy and nicety in all its details. It is our standard value, and no charge for labour or expense of coinage, and *à fortiori*, no profit, shall then be taken on it, so that an individual bringing gold to the Mint receives in return the full value in coin, which, of course, is more valuable than the bullion, in so far as it bears a stamp which is a security for its circulation over the whole civilized world.

The fineness, value, or composition of the ingots having been determined, and the whole having been adjusted to standard, the ingots are handed over to the melter, with proper directions for melting and casting them into standard bars. The melter receives a quantity of ingots with a paper telling him how he shall pot those ingots, that he shall take such and such numbers, and such and such. The gold is melted in what are called black-lead pots, each of which is placed in a separate furnace, and holds about one cwt. of gold. They cast in iron pots the bars of the shape shown, if intended for sovereigns, but if for half-sovereigns, the bars are smaller. The silver is melted in a much larger pot, in fact in a pot which holds from 400 to 500 lb. The gold melting pots are known under the name of black-lead pots; they are extremely refractory and bear a high degree of heat without a chance of cracking, if carefully used, and will admit of being lifted out of the fire without risk, which is important, because, it is obvious, that if by any accident a pot of metal gets broken and falls, a great deal would be destroyed and lost at the cost of the melter. In order to enable these crucibles to hold a number of ingots, before they are run down in this way, they put them into another crucible, technically called a muffin; then the whole is covered up and heated in a common wind furnace, until the whole is melted; they are then carefully stirred and lifted out of the furnace by a particular but very convenient kind of leverage, and then are poured carefully into the moulds; there is a great deal of care requisite in that operation in order to prevent the gold fining or refining, as it is called; that is, if not carefully done, part of the alloy (the copper) will separate from it, and consequently, it will turn out too fine; the Melter, therefore, has, in the first place, to take care that the mixture is uniform in the pot; in the next place, to take care that part of the alloy is not destroyed, because the pure gold is not altered by heat, but the copper is oxydized and goes away in dross. The silver melting-pots are made from cast-iron, and contain from four to five cwt. of metal. Formerly the silver was melted in small pots like the gold. This great improvement in melting we owe to the present Deputy Master of the Mint, Mr. Morrison, who, when he came into the office, completely reformed the process of melting and pouring the silver. Now, these are placed in proper wind furnaces, of course; they are then poured by machinery into moulds; and then again, great care is required to stir the metal before it is poured, and again, to prevent its fining or burning out the copper. In the present arrangement of the Mint, about 10,000 lb. weight of silver is very easily melted every day; in fact, at the present moment, a larger quantity is melted daily. Of course, in carrying a large quantity of these heavy metal bars about there is a good deal of difficulty in the mere carriage, this is effected at the Mint usually in little trucks which run on iron wheels on railroads for the purpose, there being a communication between the whole of the offices by means of the railroad. In that way they travel from one to the other.

The Company of Moneyers receive and are responsible for the bars; under their superintendence and direction the money is manufactured, and it is ultimately delivered by them weight for weight through the money-office to the importers. The moneyers are an extremely ancient company; a company that may be traced back to a very remote period. When the bars are passed to the moneyers they are first received into the rolling room. The first operation they undergo is usually called breaking them down; the bar is squeezed between rollers, which extend and elongate it into a thick fillet about 8 feet long 1$\frac{1}{16}$ inch broad and $\frac{1}{4}$ of an inch thick; this is cut in pieces of almost 19 inches in length, and passed between rollers till each is 3 inches wide and $\frac{1}{20}$ of an inch thick. In this process of rolling the metal becomes hard, and it is necessary from time to time to anneal it. Now this is a very nice process, and consists in making a quantity of metal red hot and allowing it to cool slowly. But then there is the difficulty, that if it be done in the air part of the copper becomes oxydized or lost; therefore the pieces are carefully put into a copper cylinder and heated out of contact with the air. They are heated to a red heat, and then the metal becomes softened. The last rolling operation brings the ribbon to nearly its required thickness. A piece is now cut out and if found to be of proper weight—that is, a little above what the sovereign is ultimately to be.—the ribbon or fillet is then handed over to a further process of manufacture. It is rolled down in the first instance by the simple operation of rolling to a considerable degree of nicety. The rolling of the mint is perfectly distinct from the rolling of iron, copper, or other metals is commonly carried on. The utmost nicety is required to proportion the edges and parts of the ribbon to the particular thickness, which is determined by very nice guages; above all to take care that there shall be no inequality in the pressure, so that one side of the bar should become thinner than the other. It is necessary, further, to take care that the ribbon is perfectly true, not curved or curled in any way, and that the edges especially are correctly squeezed out. All these are matters of extreme difficulty in practice, but most highly essential, in order to avoid a great deal of trouble which must result if points of this kind be not attended to in the earlier process of manufacture. The final adjustment of the thickness is done by a machine invented by the late Sir John Barton, and consists of a peculiar process of drawing. In this machine a most exquisite and surprising uniformity is given to the thickness of the metal.

When the sovereign is punched out on one side of the bars and out of the other it is weighed in a very delicate balance, and ought to be perfectly correct; if it be not perfectly correct then a little more finish is given to the bar, or it passes, if necessary, through a pair of very fine rollers again. That the whole set of sovereigns cut out of the bar shall all be perfect as to weight is a matter of great nicety, but of great importance, and involving a number of practical difficulties, which, however, have been wonderfully got over by perseverance and the help of this machine. The ribbon being now completed it is placed in the blank cutting-machine, This is a machine with twelve cutters arranged in a circle, each cutter being lifted by a lever toug attached to a vertical fly-wheel. Upon the lower tool the ribbon is placed, and a succession of pieces is punched out of it constituting the blanks. In general a row of blanks is cut out, and the blanks as they are cut fall through the lower tool into a drawer placed underneath in order to receive them. Imagine here again the extreme nicety of these cutters; they must be so adjusted as to cut out exactly the proper weigh. Supposing that the bar or fillet which is to be cut into sovereigns is exactly standard, it goes through a particular cutter which will cut it standard; but, suppose that in testing this way it should be found a shade too light, it then goes to a cutter which will cut them a shade too heavy or rather compensate for that lightness. There are, in fact, a number of cutters of this kind, each varying a mere idea, or mere thought, but still producing a very important result.

The blanks are next carried to the sizing-room, where persons are employed to weigh each individual piece: these are weighed a second time in order that they may all be exactly standard. Not only are they weighed twice, but each piece is sounded or chinked, in order that no split, cracked, or "dumb pieces," as they are called, may be put into circulation. The standard weight of a sovereign is 5 dwts. 3¼ grains; the current, or that at which it circulates, 5 dwts. 2½ grains. So that the extreme difference between the two—the standard and current sovereign—may be in value about three halfpence, a grain of standard gold being worth about twopence. Upon eight light sovereigns, therefore, the loss will amount to one shilling; upon 800, 5*l.*; and on 10,000,000 sovereigns the loss would be about 62,000*l.* sterling, in this slight shade of difference. The discs, or blanks, as they are called, having been thus adjusted as to size, are marked, as it is called; that is, they go through a pair of steel cheeks, and the edges are a little raised up. There are here some blanks which have been marked, and others which came from the cutter direct. Those from the cutter are rather rough at the edge, those, which have been marked have been a smooth edge; an edge a little raised. The marking-machine is one of extreme rapidity; it will operate upon about 240 pieces in a minute. The blanks in this mark have now become so hard that it is necessary, before they are struck or coined, to anneal them. The annealing is done by packing them in iron cases, and in which there are about 2,800 blanks packed in each case, carefully sealed up, put into a furnace, where they are heated. They are then allowed to cool slowly, are opened, and are thrown into a very weak solution of sulphuric acid, by which they are "blanched," as it is called; that is, the little film or oxidization of copper is taken from the surface and they become clean, and the blanes are then fit for the operation of stamping. There are at the Mint eight coining-presses, working by a most ingenious and beautifully-formed machine, contrived by the late Mr. Bolton, in which the blow is performed by a piston falling *in vacuo*. The fall of the piston is *in vacuo*, then it pulls the press and strikes the blow. There are eight presses, each coining from 30,000 to 40,000 pieces a day; that is, each coining from 60 to 70 pieces a minute. The lower die, on which the reverse of the coin is engraved, is placed in the press in a particular position, and the collar, exactly fitting it, works up and down upon this blank die. Now, that collar has a milling engraved in it, and at the moment the blow is struck the collar is elevated, and the piece, which otherwise would spread, meeting with the collar, takes the impression of the rim from it, and so becomes milled. Then, after that operation, the collar is pushed down, and the pieces forced off. This is done by a part of the press technically called "the layer-on." Each time the press comes down, this, which is the upper die, falls on the piece and keeps it. While the press is in the act of rising this layer-on puts another blank, in order to receive the blow immediately afterwards. Here is a tube containing blanks, and by means of this instrument, called the layer-on, a sort of forceps, or finger and thumb, is so contrived as to take a blank, put it on the die, and return for another blank. Formerly all this was done by hand, and the finger and thumb were liable to a great many accidents. The operation of the press then is this: there is a blank brought forward and put on the die by the layer-on, it goes back, the piece which is to be coined is struck, the press is elevated, and another is brought on. The average consumption of dies in the Mint amounts on an average to a pair of dies to each 50,000 or 60,000 pieces. It must be remembered that in these coining-presses at the Mint one blow must complete the coin, so that the skill of the engraver is called into requisition, and shown by the art with which he makes a low relief susceptible of being perfectly brought up by one blow of the coining-press. He makes the tool produce a good effect, and by which he avoids those prominences and asperities in the coin which would tend to its wear and debasement. Nothing can be worse than a high relief in a coin; it accelerates its degradation by wear, and never can be perfectly brought up from the very nature of the coining machinery. In these respects, therefore, the engraver is tied down by the power of the machinery or press. He is very often blamed for what, in fact, is his great merit. There is no difficulty whatever, by a succussion of blows in rapidity, in bringing up a very high relief, like that of medals, for instance, in proof pieces; but when one blow of a certain power, repeated from sixty to seventy times a minute, is required, and each time to produce a certain coin, then it is that the talent and skill of the engraver are more severely taxed.

The monies being finished they are now weighed up in what are called "journey weights," being 15 lb. of gold or 60 lb. of silver. These are weighed up in bags and returned by the Company of Moneyers to the Mint-office. But before the money is delivered finally to the importers, and through them to the public, it is subject to a series of examinations, called "a check," to ascertain its weight and fineness, or, as it is said, it is "pixed."

In concluding this subject one observation must be made. In regard to the work of the Mint, one often hears it said, "Your money is very well, but it ought to be in higher relief; more perfect workmanship, more time bestowed upon it. It is very well to talk about coining 40,000 pieces at each press every day, but it is a bad thing to do for the arts." This, however, is certainly not the case. It is of the utmost importance that the coin should be as quickly produced as is compatible with good workmanship; and the workmanship of our Mint will stand comparison with that of any in the world as far as it is compatible with perfect accuracy of weight and fineness; because you may imagine that all the checks I have stated take up, of necessity a great deal of time. Then, again, you will remember that as regards the loss of interest of any bullion during its passage through the Mint, that is a very serious consideration. And, lastly, in the event of any panic, as in 1825.—At that time bullion came in from the Bank on the Saturday, and 140,000 sovereigns were returned on the Tuesday succeeding, to the Bank, and the same number every day till the following Saturday, when confidence was restored, the draught on the Bank began to be diminished, and the threatened crisis was averted. The gold ingots came in from the Bank at nine in the morning, and at ten at night 147,000 were coined and finished. Here you see the extent and perfection, the good management and machinery of the Mint, which achieves this; achieves it with some difficulty, but very accurately.

As to the capability of the Mint, it has been stated what number of pieces the presses will produce. In seven days' work in gold, in the year 1842: the weight of gold bars in work during that week amounted to 10 tons. The coin worked weighed 12,085 lb.; they were 985,435. From the 1st of July, 1842, to 1st of July, 1844, there were coined in the Mint, of sovereigns and half-sovereigns, 15,920,411 pieces; silver coins, 20,976,000; copper coins, 19,621,956; making in the whole 56,528,367 pieces. Since that period, that is, from the 1st of July, 1844, to the 31st of December last, there have been coined besides 10,000,000 sovereigns; so that, in that period of two years and a half, there was turned out of the Mint 66,528,367 pieces, which, as far as gold and silver are concerned, had undergone all those ordeals.

The grand trial of the pix is performed by a jury of goldsmiths. To those persons are handed over the pix-bags from time to time, which are taken with great ceremony to Westminster, where the Lord Chancellor empannels a jury, or, at least, instructs one, as to their examination; they then adjourn to Goldsmiths' Hall, and examine the whole mass of coin or sample to be fairly taken, and, if it pass, they ultimately report upon it, and from that report the Master of the Mint is exonerated from all further charge and responsibility respecting the coin.

A DESCRIPTION OF A CATHEDRAL OF THE ORIENTAL CHURCH

(Abridged from the Ecclesiologist.)

We propose in the present paper to prove, that, differing very widely in many less important arrangements from the Western Church, the Eastern Church has retained, and even amplified, their essential features. And to this end we shall endeavour to give a brief and familiar account of a Greek cathedral. The monastic churches differ from those of the seculars in many respects: not therefore to perplex the reader, we shall confine ourselves almost entirely to the latter.

The church in question then, would consist, strictly speaking, of four parts; the altar-space (*hagion bema, hiepateion*, or *heikel*, as it is termed in the Coptick Church); the choir; the nave; and the porch or narthex, at the west end. The aisles of the nave extend both to the east and west ends; and in the former terminate (as does the altar-space itself) aspidally.

Commencing with the east end, we should find that the altar stood in the centre of the chord of the middle apse: in the same position therefore which in churches of this description was allotted to it in the Western Church. It was overhung by a dome or canopy, supported on four pillars, and surmounted by a cross. This canopy, often called the Trullus, is also known by the name of *ciborium*, and also *concha*, from its similarity to a shell. At the tops of the pillars, also called towers, lilies were worked, and the names of the Evangelists sometimes were engraved on the columns, as we learn from Simeon of Thessalonica, the Durandus of the Eastern Church. Veils were suspended between these columns, sometimes richly adorned with gold and purple (Paul. Diac. *Mich.* 1. xxiv.). but this arrangement is now much disused. The Blessed Sacrament is not reserved in a silver dove or tower, but laid by in a place appropriated for that use, and situated behind the altar: it is called the *Artophorium*, and a lamp perpetually burns before it, as in the Western Church.

A plurality of altars is unknown among the Greeks; except indeed that in Russia, where the intercourse with Rome has been considerable, it has in a few cases been introduced. In some instances however a chapel with its separate altar *(Parecclesia)* has been erected contiguous to the church itself: and in these the ferial offices are said. On Monday, that of the "Bodiless," *i. e.*, the Angels: on Tuesday, of the Mother of God: on Wednesday, of the Forerunner: on Thursday, of the Apostles: on Friday, of the Cross: on Saturday, of the Departed Faithful.

The piscina is situated immediately under the altar: it is called *choneion*, or more frequently *thalassidion*, 'the place of the sea.' Its position and name are not improbably derived from the account (3 Kings, xviii. 32) of the altar and trench made by Elijah; where the Septuagint explains "trench" by θαλασσα. In the same way, the great laver which stood in the court of the Temple, upon oxen of brass, is in our own translation called the "Sea" (3 [1] Kings, vii, 23). In the great church at Constantinople, it was richly ornamented with precious stones. This practice never seems to have obtained in the Western Church.

The primitive position of the Bishop at the eastern end of the apse, surrounded by his presbyters, is retained by the Greeks during the time of "Liturgy."

The north apse is appropriated to the *Prothesis*, in the shape of a separate altar. A part of the Liturgy is here performed; and the ceremony of the "Great Entrance,"—the offertory of the elements,—is one of considerable pomp.

In the southern apse is the sacristy. This was sometimes called the Scenophylacium: at others the Metatorium: at others, and it is the commonest title, the Diaconicum. We find that the Emperor Leo, son of Basil the Macedonian, when under sentence of excommunication, was allowed to attend the Divine Office in the Diaconicum, and it would appear that there was a kind of Priests' (or rather Deacons') door just without it, and of course on the south of the church.

The αγιον βημα was separated from the chancel by the screen. It is called by Simeon of Thessalonica *Cincliade*, or *Diastolae*: but it is also termed, and more especially in the Græco-Russian Church, the *Iconostasis*, because the pictures of Saints are hung or fixed upon it. In early times it was apparently of much the same nature as our own rood-screens; but afterwards it assumed its present shape of a solid erection.

The rood-doors were called the *Holy Gates*. On the right ride, on entering, was invariably figured our LORD: on the left, the Mother of GOD: other Saints were replenished in any position that the piety or taste of the architect might suggest. But some principal Saint was so placed as to be very conspicuous from the seat occupied (if a monastick church) by the Hegumen; (if a cathedral) by the Bishop: the easternmost, namely, on the south side of the choir. Before the holy door hung a curtain, embroidered with the image of S. Michael, brandishing his sword, as if to "keep the way of" this second "Tree of Life" from irreverent access.

A little to the west of the *Iconostasis* is (or rather was, for the arrangement has fallen into disuse) the *Soleas*, or chancel steps. As the Bema images the Tribunal of CHRIST, so the *Soleas* (a word corrupted from *solium*) represents His Throne. The portion between the Soleas and the Iconostasis was in earlier times appropriated to monks; as partaking in part of the character both of laics and clergy. So we learn from Dionysius. But Simeon of Thessalonica tells us that afterwards it was appropriated to the inferior orders of the clergy, and was even called the Bema of the Readers. The whole charge of the Soleas, *i, e.*, the space eastward of these steps, including the Bema, was entrusted to the *Candelaptes*: he was of the order of the Readers, but on account of this office privileged to enter into the Holy of Holies.

Opposite the holy doors stood the *Ambon* or pulpit, answering in its uses to the rood-loft of the Western Church. That in the church of the Eternal Wisdom is described by Codinus as adorned with jewels and lights. For lights were fastened to crosses even as early as the time of S. Chrysostom, if we may trust Nicephorus. To the ambo were two entrances, one east and the other west: for Codinus, speaking of the Emperor's going up into it, says that he ascended, not on the side which fronted the Beautiful Gates, but on that which was opposite to the Soleas. Symbolically, according to the Mystagogue and Simeon, the ambo, and its situation near the holy gates, signified the stone that was rolled away from the Sepulchre; and the deacon mounted on the ambo, the angel seated on the stone. Such as ambo is, or was, possessed at Rome, by the churches of S. Mary ad Martyres, S. Laurence, S. Pancras, and S. Clement.

In monastic churches, almost the whole of the building is choir, though the stalls do not extend over more than a third of its length, and are *returned* as in our cathedrals; and here are situated ωραιαι πυλαι, the Beautiful Gates. But in "Catholick," *i. e. secular* churches, there is no division at the western end of the stalls: and the Beautiful Gates separate the narthex, or porch, from the church. This triple division into holy of holies, choir, and nave, is extremely perplexing, because in small churches that which seems the nave is sometimes merely the Gynaeceum, or place appropriated to women: and the different position of the Beautiful Gates in monastick and Catholic buildings seems (though in effect it does not) to destroy any analogy between them. The external western doors are known by the name of the *Great* or Silver Gates: and in the porch, on the southern side of the door, is the usual position of the font. In such a cathedral as we have been endeavoring to describe, the women would probably occupy the north aisle. The bells, whether of metal or wood, hang on each side of the porch.

It will be seen then that the spirit of this arrangement is precisely the same as that of the Western Church: all that we have ever called essentials,—the distinct and spacious chancel, the rood-screen, and the porch,—are retained by the Oriental, as well as by the Latin communion, thus vindicating for them the application of the rule of S. Vincent of Lerins.

ORIGIN AND PROGRESS OF THE RAILWAY SYSTEM.

The details of the invention of steam vessels are pretty well known, but the communication by railroad has never yet in this country been traced to its origin. Now, it happened that a few weeks since, a very satisfactory account of this new medium of communication has been given in two German periodicals—the *Gazette of Cologne* and the *Sonntagsblatt* or *Sunday's Journal*. The latter is a weekly paper for general information and entertainment, forming a supplement to the *Weser Zeitung* or Weser Gazette, which is published daily at Bremen, the Hanse town on the Weser river. The reporter of the facts relating to the invention of railroads is a barrister living at Osterode, a Hanoverian town on the Hercynian mountain; his only object was to establish a fact, but he is otherwise in no way interested in the matter, and he claims no reward, for the original inventor who, indeed, died several years ago. The subject being one of considerable interest to this country, I drew up the present paper embodying the substance of the barrister's German report; the letter is dated Osterode, the 20th March, 1845, and is inserted in No. 60 of the *Sountagsblatt*, of April 6th, 1845.

It appears that the original inventor of the railroad system was the late principal engineer Mr. Friederichs (Frederics), son of a miner in that part of the Hercynian district which belongs to Hanover. His talent for mechanics was soon perceived by an influential gentleman, the director of mines, who solicited the Hanoverian Government to furnish him with the means for increasing his practical knowledge in mechanics and generally cultivating his mind by a tour through Europe. The request was granted, and young Frederics set out on a tour of several years. Two of them he spent in the salt mines of Galicia, and it was there that the thought occurred to him of constructing a new machine for the easier conveyance of heavy loads; no experiments, however, were then made, and it was not until after his return home, that he matured his plan, when necessity compelled him further to consider it. At that time, before the French invasion of Hanover, the leading silver mine of the Hercynian mountain was the "Dorothy;" but the road from it to the "Pucherich," where the ore is refined, and from that place to the silver melting house (*Silberhuette*), was very inconvenient and caused considerable expenses. The "Dorothy" being situated on a moderate declivity, and the "Pucherich" at a distance of three quarters of an hour, being placed in a valley, the road from the first place to the latter goes downwards; as to the minerals, they were carried in carts drawn by horses, but on account of their heaviness and the nearly impassable road, only small quantities could be at a time transported. These circumstances compelled Frederics further to consider and to perfect his plan of a new conveyance, and he finally invented iron rails, exactly as they still are in use, a locomotive engine, and a cart to run from the pit to the "Pucherich," and thence to the silver melting house. The cart is a four wheeled one, and on its frame is placed a wooden chest, which may be filled up with minerals to the weight of from sixty to eighty cwt. The guide sits before the chest, just as the coachman sits on the driving box; by pressure he is enabled to direct the cart, and also to arrest it at any time, however fast it may run. The arrangement is so certain and safe, that to the present day no accident has happened. The locomotive engine is all of iron, but instead of a detailed description of it, which would not suit the taste of promiscuous readers of a German journal for general information and entertainment, the reporting barrister cites a fact from which its efficiency appears; and refers, in support of his statement, to witnesses still living. When, in the summer of 1811, the King and the Queen of Westphalia visited the Hercynian district, the director of the mines, M. von Meding, caused a carriage of the invention of M. Frederics to be fitted up for an excursion from the pit to the "Pucherich." The barrister alluded to was present, saw the King, attended by ten gentlemen of his court, mounting the first vehicle; and the Queen, attended by the ladies of her suite stepping into the second carriage, which closely followed the first. They started at the same time, and the walking distance of 45 minutes was accomplished in five minutes. Witnesses still living are:—M. von Meding, minister of state and of the cabinet; M. Albert, principal counsellor of mines *(Oberbergath)*; M. Muehlenfeldt, principal engineer *(Maschinen director)*; and Dr. Jordan, assayer of the mint *(Muengwardem)*, at Elansthal, a Hanoverian town of the Hercynian district. Several years afterwards, when M. Frederics, then in an advanced age, was taken ill, he sent to the barrister to frame his last will. The latter did so, and next waited on him, whom he found engaged in executing a drawing. "This is," said M. Frederics, "intended for an English gentleman, who wishes to run my new cart in his own country as I do here. He admires it; and I take great care in executing my work, in order to prove that we here are not a set of blockheads."

Thus this invention was transferred to England, where Mr. Thomas Gray, of Exeter, advocated it zealously. He led the way in introducing and establishing it in this country; he pointed out to the most influential public men of the day the advantage of direct lines over circuitous ones, the economy which by the construction of railroads upon the direct principle would be effected in horses, carriages, and time; he explained his system in memorials illustrated by maps, which with the petitions of meetings he forwarded to Government; and finally he brought his plan in a printed form before the public, all which could not be done without personal sacrifices. Others came to his assistance, supported and recommended the new invention, but his exertions were more prominent and longer continued. The efficiency of steam in propelling vessels having been ascertained, this new invention was (it is not precisely known by whom first) combined with that of Mr. Frederics, and the new medium of communication rendered more valuable.

The account of the origin of the railroad system, given by the German barrister, certainly contains details not known before; but the simple fact of M. Frederics having invented the railroad system, and communicated his invention to an English gentleman, was all along known among the inhabitants of the Hercynian district and the adjacent country. The late poet Thomas Campbell, in speaking of Germany in one of his much admired poems, says, the world was indebted to her for three most important inventions, viz., those of powder, printing, and clockmaking. M. Frederics added to them the fourth, which is now very generally acted upon throughout Europe.

John von Horn, D.D.

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FRICTION IN THE BEAM AND DIRECT ACTION STEAM ENGINES.

Sir—I have had my attention directed to a paper in your April number, entitled "Comparative Loss of Friction in Beam and Direct Action Engines," and as I am much occupied in considering dynamical questions, I naturally take great interest in such a subject, and must congratulate you on such a complete exposure of error as is there made. Your correspondent is evidently well versed in scientific principles, and his criticisms illustrate a point which you have laid down in an article in your May number, that it is quite necessary that scientific men should go hand in hand with practical men, and not let petty jealousies keep them apart. If this desirable end were attained, of bringing science and experiment more directly together, we should never have had such a mass of mistaken labour as Mr. Pole's paper. You are fortunate in having secured the services of so sound a contributor as H. C. I have read his remarks with great pleasure, not only derived from seeing that the *real* points at issue are grappled with, that an ignorance of *dynamical principle* is shown to exist so clearly and so forcibly, but that it is made intelligible even to men who know nothing of mathematics, that Mr. Pole's paper is all wrong.

Just consider what an injury is done to science by any one who presumes to point out an application of our laws; and so signally fails, that it is impossible but that experiment should show a wide discrepancy, (a discrepancy so wide that the mere empiric will at once throw overboard the science). The long desired union of theory and practice is being put off by such writings instead of being advanced.

I have often thought that if the French had had our opportunities and our workmen, they would long since have beaten us in the field of engineering, and I am persuaded that this result so much to be deprecated, will be brought about by patronizing and putting forward such waste of energy, labour and time, as Mr. Pole's paper. If our science is wrong, our neighbours who are getting our workmen and our experience, will in time march a head of us.

Now how are we to amend? for it is not enough to censure. I think the jealousy of science which some show, only proves that they are conscious of their own deficiency, and are afraid that theory should prove it to the world. The true way is to give us a kind of free trade in mechanical and engineering progress. Let every one do all he can, but let him also endeavour to understand clearly and thoroughly what his neighbour is doing, that so we may not impede but assist each other. The scientific man should know the results of experiment, and the experimentalist endeavour to enlighten the theory, where data are wanting. By following such a course as this, the magnificent science of engineering (the adaptation of the powers of nature to man's wants) will really advance, and those who are now at the top of the tree, the English engineers, will keep the position they have gained, by intrenching themselves within impregnable ramparts, viz., the eternal truths of science.

I remain, your obedient servant,

M. Cowie.

College, Putney, May 7, 1845.

*** This is not the only letter which we have received to the same effect. But the name of Mr. Cowie, who was senior wrangler of his year at Cambridge, and since moderator and examiner in the University mathematical examinations, will be quite conclusive as to the value of the investigations which he has examined.—Ed. C. E. and A. Journal.

THE FOUNTAINS OF TRAFALGAR-SQUARE.

[We insert the following letter, though at the cost of some self-denial, on the approved principle that "virtue is its own reward." We must however preface the letter by begging the reader, if he should be able to get through it, to read the remarks which we have taken the liberty of appending.]

Sir—A gentleman who in his zeal to instruct the public occupies with his correspondence so conspicuous a portion of your journal as that appropriated to "The Fountains of London and Paris" in your last number, might have taken a little more pains to be correct in his facts, however uncandid it may please him to be in his observations. *Suum cuique* is a wholesome rule, and you may perhaps spare a corner to inform your correspondent (it is difficult to imagine any one else can require it) that the Nelson Column is not only *not* the design of Mr. Barry, but that it was placed in the situation it occupies in direct opposition to his judgment, as being totally out of character with his plans for the general arrangement of the site. This fact your correspondent might have learned from what took place before a Committee of the House of Commons, not so long ago but that it must be supposed within the knowledge of any one thinking himself qualified to have an opinion upon the subject. Thus much for the assumption which supplies your correspondent with a good half of the diatribe aimed at Mr. Barry, but which in reality hits Mr. Railton. With regard to the fountains little need be said in reply to a critic reduced to borrow the capital joke of the dumb waiter To attempt to disparage the Trafalgar-square fountains by a comparison with such as are most remarkable for their large scale and elaborate design, is merely to say that they are what they are, and not something else which they do not pretend to be, and it would be more candid before such comparisons are instituted, to inquire what means were placed at Mr. Barry's disposal for their erection. It would, perhaps, be found that he was limited by Her Majesty's Commissioners to a cost which would not have produced one of the ocean deities the absence of which is made such a reproach.

It might be thought that while your correspondent was making comparisons, he might have extended them a little further; to Rome, for example, where he might have found some fountains of the "dumb waiter" form, the "intense ugliness" of which has not hitherto been remarked. If it is the composition to which he objects (and this must be his meaning, if he means anything) it is rather strange that he should have selected by way of contrast, two fountains of which the composition, apart from the detail, is essentially the same, with this variety in one of them, that the upper basin is placed topsy-turvey. It would be easy to criticise the "nearly sixty other" fountains of Paris in the tone assumed by your correspondent by affirming that any one in possession of a cistern with a tap in it can command a better show of water than is exhibited by a great majority of them, and that they are for the most part absolutely insignificant. It is, however, dealing with them and with their authors rather more justly and honourably to observe that for the most part they display much taste and skill in taking advantage of very scanty resources; but that they are "almost all large and elaborately ornamented," or that they are to be compared in any respect with the fountains in Trafalgar-square, is as true as your correspondent's assertions about the column.

I am, Sir, your obedient servant,

ANTI-ZOILUS.

*** Our correspondent writes angrily, and an angry man is not likely to be accurate in his statements nor just in his conclusions. Had "Anti-Zoilus" read correctly the criticism which has given him so much umbrage, he would have found that there was not one word in it to the effect that the Nelson Column was the design of Mr. Barry. In fact, so far from such an absurd assertion being made, it was distinctly stated that Mr. Barry designed only a part of the erections in Trafalgar-square. The words were these—"We think that the *share* Mr. Barry has had in the design is one of the least happy of his efforts;" and if it were not stated in so many words that Mr. Barry did *not* design the column, the reason why that information was not given, is precisely that of "Anti-Zoilus" himself, namely, that "it is difficult to imagine any one else can require it" except those who are totally ignorant of the progress of architecture in London. It was said—and truly, we still think—that in Mr. Barry's works columns may be found applied to wrong purposes. Will our correspondent be hardy enough to deny that this is the fact? Surely he must be very dull or very captious to apply general remarks on an error of a great—a very great—architect, to an instance with which, every one knows, he had no concern.

Mr. Barry has not been fortunate enough to secure a generous champion, for "Anti-Zoilus," though he stoutly defends his own *protegé*, takes care enough to shift the effects of the "diatribe!" (who ever dreamed of a diatribe except himself?) to Mr. Railton—who no doubt will feel highly indebted and grateful. The rest of the letter is soon disposed of. The excuse of insufficiency of funds is the never-failing and now threadbare apology for all bad designs. Our own opinion is that, *cæteris paribus*, a beautiful design is cheaper than an ugly one. Some of the most beautiful works of art which this world has seen have been conspicuous for their simplicity of detail, and owe their effect to nothing but the dignified and chaste beauty of their outlines. Such designs, we confess, are the most difficult to produce, and can *only* proceed from a man of genius. But then, if it really were indisputable that works of art to be *beautiful* must be *elaborate*, why was not the money thrown away in working so refractory a material as red granite devoted to the production of minuter ornaments. Are we solitary in this objection? "Anti-Zoilus" knows that the general public feeling is against him.

The assertion of the identity of the "composition" of the "two fountains" contrasted, is contrary to fact. We should be sorry to accuse our correspondent of misrepresentation, but in the present case our only alternative is to pity him for remarkable obtuseness. The only point of resemblance between the two fountains is that each contains two tazzas: except this we defy our correspondent to produce one point in which they agree. In the Paris fountain the upper tazza is reversed, or in the elegant language of "Anti-Zoilus," "topsy-turvey:" the water is thrown inwards from the edge of the basin, and consequently the jets have an entirely different arrangement from those in Trafalgar-square; the shapes of the basins themselves differ; the proportions of the whole differ; the outline is different; everything is different. The composition "essentially the same"! as well might you say two tea boards were of the same pattern because each had two saucers on it.

The growl at the Parisian fountains may pass. Paris is a long way off, and "Anti-Zoilus" will have, therefore, few to contradict him. For ourselves we are quite content to take our stand on his own dictum respecting those fountains, "that for the most part they display much taste and skill in taking advantage of very scanty resources;" but how ungracefully does this come after pleading for the Trafalgar-square fountains *in formâ pauperis!*

It will be observed that the merits or demerits of the criticism contained in our notice are left unexamined. No attempt is made to defend the division and subdivision of the noble area of Trafalgar-square into minute insignificant parcels,—nothing about the ugly appearance of a large flat surface of cement and asphalte, unvaried except here and there by pieces of orange-peel, or vestiges of the interesting game of hop-scotch,—nothing about the posts, or stumps rather, of granite (if they would only get rid of *them*, it would be something),—nothing, lastly, about the propriety of hoisting a statue out of sight. Verily the day for such "sights unholy" is fast passing away. We have comfort in thinking how rapidly public taste advances, and that soon that severest of all critics—THE PEOPLE, will terribly recompense architectural sinners for such enormities.

We have gone seriatim through the letter, and of course we come last to the signature—"*Anti-Zoilus!*" Zoilus, be it known (to those who do not yet know it) was a grammarian of Amphipolis and a critic on Plato and Homer (*Vide* Lexicon). They say he was not at all a favourite in general society, lived rather scantily, and died rather suddenly, being, in fact, stoned to death. Happy Zoilus! the stones wherewith they pelted thee were unhewn and simple as nature formed them—hadst thou been stoned in our day, and had the missiles been red granite, the hideous shapes—the worse than Indian distortions had frighted thee by their deformity even in thy dying pangs.

Since writing the above we have heard it whispered that the fountains are to be altered by the introduction in each of a third tazza below those existing, which are to be elevated, and that our own suggestion of adding jets to throw water from the circumference of the ground basin inwards has been very favourably received in an influential quarter, and will probably be before long adopted. This does not look much like a condemnation of the notice which has so much offended our correspondent.

JUNCTION OF THE ATLANTIC AND PACIFIC OCEANS BY A SHIP CANAL AND RAILROAD ACROSS THE ISTHMUS OF TEHNANTEPEC IN MEXICO.

As the *Civil Engineer and Architect's Journal* was the first scientific work to bring before the public Mr. GALLOWAY's plan for constructing a railroad in the Desert, and uniting Suez, Grand Cairo and Alexandria by a few hours journey, instead of many days, so it has now the means of calling attention to a much greater and more magnificent project for uniting the Atlantic and the Pacific, saving to the vessels of Europe 8,000 miles, and to those of America 12,000 miles in voyaging to China and the East, opening a new world to the enterprize of the old one, connecting the mother country with her distant colonies—obviating the present difficult and dangerous passage by Cape Horn, twice under the burning sun of the Tropics, and contributing more than any discovery since that of the mariner's compass and those made by Columbus, to the vast objects of commerce and civilization, the enrichment of many and the enlightenment of more. To Don José de Garay, assisted by the Mexican Government, is the honour of planning, surveying and demonstrating this magnificent project due, to Mr. Alderman Vickers the credit of appreciating its consequences and capabilities, and adopting it and bringing it before the British public. The distance across the Isthmus is 120 miles, the length of the river with its winding, which is navigable, is 40 miles, and 80 more can be dredged; the length of canal to be cut is 49 miles.

The following extracts from a circular just issued by Alderman Vickers, will exhibit the progress of the undertaking.

Don José de Garay, who is now in London, conceived the execution of this grand project; and the Government of Mexico appreciating its vast importance granted to him the most ample concessions, in case he should succeed in carrying it out. Fortified with this concession, and the countenance of the government, the projector formed, under the direction of Don G. Moro (an Italian engineer), a scientific commission, the members of which, after an examination of the Isthmus for upwards of a year, made a report, in the most favourable terms, as to the practicability of the undertaking. The Mexican officers Don Manuel Robles and Don José Gonzales (whose services the government had placed at the projector's disposal), took part in this commission. The most important concessions made to Don José Garay by the Mexican government are: First—Power is granted that he is to fix such dues or tolls as he deems eligible, and to receive for fifty years (commencing from the day that communication shall have been effected between the two oceans), all tolls and dues accruing from transit, both by means of a canal and railroads, or either, with the condition that one-fourth of the dues (after expenses are paid), is to be advanced to the government during the said fifty years; for this advance the proprietors will be compensated by the payment of one-fourth of all dues received for fifty years after the project shall have passed into the hands of the government. Second—A guarantee is given that for sixty years no person or company shall have power to employ any steam vessel or steam carriage of any kind within the Isthmus of Tehnantepec, without leave or license from the said Don José de Garay or his assigns. Third—The government cedes to Don José de Garay in fee simple the breadth of ten leagues (thirty miles) of land on each side of the communication. These lands are of the first quality, embracing numerous points favourable for the construction of harbours, towns, villages, &c., and amounts to nearly five millions of acres. Fourth—The valuable privilege to purchase lands, &c., of establishing colonies to the extent of fifty leagues (one hundred and fifty miles), on each side of the line in addition; with all rights and privileges in perfect equality with Mexican citizens, which is not granted to other settlers. The present government of Mexico has recognized the grants which form the basis of this project. The celebrated Arago has submitted it with his own commendation to the *Academie des Sciences* at Paris, and it has been mentioned most favourably in various learned associations of this country. By the adoption of this project all vessels that now double Cape Horn from the United States would save upwards of twelve thousand miles of the distance, and those from Europe eight thousand in reaching the west coast of Mexico,, proceeding from thence to China, &c., and all vessels bound to the Pacific would not only save time but also avoid the dangers of the present navigation. By this undertaking the Oregon territory, the Californias, Mexico, Peru and Chili, an extent of eight thousand miles from Nootka Bay to Cape Horn, will receive what may be termed a new existence. These countries can produce hides, fish, oil, whalebone, fine woods, cotton, indigo, coffee, sugar, cocoa, cloves and other spices, cochineal, ivory, furs, coral, ore of the precious metals, &c., and offer for colonization many advantages to capitalists.

(Signed) WILLIAM VICKERS.

12, *Somers Street, Gloucester Square, Hyde Park.*

We hope to be able next month to give more ample details of this undertaking, together with a map showing the adjacent country.

THE ANTI-CORN-LAW BAZAAR.

Viewed quite apart from the particular political tenets of the promoters of the undertaking, the exhibition of British manufactures in the Covent Garden Theatre, during the month of May, possesses many features which deserve the general attention of the country. A synoptical display of the rarest artificial productions of the greatest manufacturing country in the world, must necessarily be a wonderful and dazzling exhibition, but it possesses a value beyond that of merely amusing, or exciting interest in the spectators. Compared with analogous exhibitions in other countries, it furnishes an index not only of our actual progress in the arts, but of our relative progress also; informs us not only whether we advanced or not, but also whether we are advancing faster or slower than other nations.

And this comparison has better objects than the puerilities of national vanity. The manufacturer in viewing the efforts of his own countrymen, receives a wholesome stimulus to his exertions, and gains at every step instruction and suggestion; observes how difficulties, which the experienced eye could alone discover, have been obviated by others, and notes down the effects of their errors; in fine, gets more practical information in a few days than his own cogitations would have taught him in a twelvemonth. Such are the great advantages which may be fairly anticipated from a national exhibition of arts and manufactures. Such are the effects really produced by the *Expositions des Beaux Arts* all over the continent, and the Covent Garden Bazaar had it been even less meritorious than it was, would have possessed the exceedingly great merit of suggesting the establishment of *Expositions* in our own country.

It has occurred to the conductors of this journal to witness in various parts of the continent these national exhibitions, and nothing contributes more to the self-satisfaction of an Englishman than the comparisons, or rather contrasts, thus afforded between foreign manufactures and our own. Without refusing a great share of merit to our neighbours for their progress in the arts, we cannot avoid an impression that the products which they exhibit, as samples and specimens, are seldom equal and never superior to those met with in the ordinary course of trade in England. We are accustomed to a certain inflated style in the descriptions of continental *Expositions* and museums of manufactures; we hear much, for instance, of the wondrous magnificence of the Sevres porcelain,—but, heterodox as the sentiment may appear to those who are content with the information of itineraries and guide-books, it may be doubted whether our admiration in walking through the Sevres gallery would not be much abated by a previous inspection of our own Potteries. And we here institute the comparison most favourable to the continental manufacturer, namely, the comparison of works of which the greater part of the value is derived from their ornamental details, but in productions of pure utility we apprehend that the foreigner would not even venture on a competition.

Imagine the costly grandeur, the magnificent diversity and vastness, of an adequate NATIONAL EXHIBITION OF BRITISH MANUFACTURES, an exhibition not confined within the limits of a theatre, but filling the galleries of a vast public edifice,—not promoted by one particular part of the people, but undertaken by the co-operation of the imperial magistrate, the legislature, and the whole nation! Conceive the amount of genius, industry, wealth, and skill displayed in the magnificent spectacle. Such an exhibition were to a rightly thinking mind the noblest ever projected by the genius of man or executed by his skill,—a gigantic monument of the combination of physical and intellectual power, a vast *realization* of thought, the fitting representation of the greatest of nations, and, above all, a substantial exponent of its moral influence.

It were difficult to overrate the advantages of such an undertaking, or even to foresee them. Even the exhibition already accomplished, imperfect as it necessarily is, is a beautiful indication of the variety and resources of the national industry, and every way gratifying, as proving the practicability of one more complete. The appearance of manufactures displayed with all the accessory effect that could be obtained from dazzling light and the scenic decorations of the theatre, produces an impression almost illusive. Notwithstanding the extent of space really filled, there has not been room for a great part of the contributions, and even those actually exhibited are too much crowded together. It must not, however, be supposed that the character of the Bazaar approaches that of a National Exhibition of Manufactures; we are not even prepared to allow that it in this respect fulfils the expectations which might naturally be formed from the professions of the exhibitors. The gorgeous displays of carpets for instance, of gold and silver plate, of Sheffield ware, and of the costly porcelain of the Potteries, which our manufacturers might well produce, are here wanting. Those only who really know the magnificence of the manufactures of England can properly estimate the defects of the Bazaar as an Exposition of them. Indeed we find serious fault that the exhibition has been too much of a Bazaar, and too little an Exposition of Arts. This, however, was perhaps unavoidable, but notwithstanding the large space appropriated to the valuable manufactures, we felt that they did not deserve to be jostled by displays of kettle-holders, fortune-telling dolls, autograph doggrel, abortive efforts at wit, and multitudinous productions of patchwork and pasteboard which do not atone for their uselessness by any beauty of design.

Our report is carefully abridged from a series of papers called the *Bazaar Gazette*. These papers are written admirably, and contain here and there ideas so valuable that we regret to see them conveyed in a temporary publication. The most beautiful part of the collection is, perhaps, the contributions from Colebrook Dale. The notice in the *Times* stated that the design of the roof of the Gothic Hall was that of a cathedral. We beg, however, to assure our readers that they have never seen a cathedral roof resembling this, and in all probability never will. The style, if anything, is civil—or rather *theatrical*—Gothic.

The first view of the general arrangement of the *Gothic Hall*, at the entrance is very imposing; the illuminated roof, with its Gothic mouldings and richly decorated arches, the two vistas of pillars extending along each side, and the gorgeous painted window at the remote extreme, seem to realize the imaginary halls in the palace of Aladdin. The elevation of the dress circle above the level of the pit enables the visitor to take in the whole at the first glance, and hence the effect of the *coup d'œil* is most striking and imposing. There is a descent of a few easy steps into the body of the hall, where the stalls are situated, and we shall first describe those connected with the range of boxes on the right hand side of the visitor at entrance.

"Some beautiful specimens of table cutlery, in handsome cases, were exhibited, from the manufactory of Messrs. Hargraves: the exquisite style in which they are finished, and the taste displayed in the handle, ferules, and other fittings have attracted universal admiration. Several splendid pairs of scissors, of universal richness, in an elaborate style of ornament, have been contributed; also superb specimens from the extensive manufacturing establishment of William Greaves and Sons, Sheaf Works, Sheffield. These consist of a selection of carpenters', curriers', and ship builders' tools, and file, and steel articles not ordinarily (as it would be thought) possessing the capability of much display. This intractability is overcome by a splendour of finish only inferior, as we are credibly informed, to their solid and intrinsic qualities.

"William Greaves and Sons furnished an admirable specimen. It is a solid bar of steel, showing at one extremity about six inches of the steel in its *first crystallized state after fusing*. The next six inches exhibit the same bar of steel, drawn out under hammers, into a round suitable for dies for coining. The next six inches into a square for edge tools, &c. The next octagon, for chisels and turning tools. The next triangular, for machinery purposes. The next flat, for razors, table knives, &c.; and, finally, the bar is elongated into a spear blade about 11 inches long; the whole highly polished, and ornamented in exquisite etching, save only the first six inches of the *raw unhardened steel*, which is left in its originally rough state, as an interesting contrast to the finished blade at the other extremity.

"The Sheffield stall exhibits a gold-backed knife, valued at 20 guineas, and several cases of table knives and forks; an exquisite model of a steam engine, executed with equal taste and accuracy, so as to be at once a handsome ornament in a drawing-room, and a valuable teacher of mechanical science. This model was contributed by Messrs. Chesterman & Co. There were also several telescopes, and an assortment of powder flasks. Of the plated ware there is a very rich and varied assortment, including trays, stands for bottles, and liqueur cases. The China and Porcelain stall at the upper end of the saloon exhibits some noble specimens of Wedgewood's unrivalled jasper vases, from New Etruria, in the Staffordshire Potteries. Among them is a fine copy of the Portland or Barberini vase, so recently broken in the British Museum.

(*To be continued.*)

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE ROYAL SCOTTISH SOCIETY OF ARTS.

The Society met in the Saloon, 91, Prince's Street, on Monday, April 14, 1845.—The PRESIDENT in the Chair.

The following communications were made:—

"*A New Self-Acting Method of taking the Buckets from the mouth of Coal Pits, and shutting off the Steam from the Winding Engine.* By Mr. DANIEL ERSKINE.—A beautifully executed working model, in which the cylinder of the engine is only a quarter of an inch in diameter, and of half an inch stroke, was exhibited in action. The winding engine draws the buckets up the pit, which, having arrived at the top, are then drawn towards the engine, and landed on a level platform; at the same time, on reaching a certain point, the steam is shut off from the engine by a self-acting process. The pitman then takes the bucket off the rope, and attaching it to another rope, sends it down an inclined plane to be emptied, and the weight of the full bucket descending the incline, draws up an empty bucket to the pitman's hand, who hooks it on to the pit-rope, reverses the engine, and the bucket is immediately carried back to the pit-mouth and descends the pit, while a full bucket is at the same time drawn up to go through the same process.

"*A new method of enabling Locomotive Engines and Railway Carriages to ascend Inclined Planes with greater ease.*" By the Same.—A well constructed working model in German silver was exhibited in action. The principle on which it acts is, that when the locomotive engine arrives at the foot of the inclined plane, the common wheels on which it travels cease to touch the rails, there being another set of wheels keyed on the same axles, but of only one-fifth of the diameter. A raised rail is used on the incline to suit the smaller diameter of the wheels which now come into play, and the large wheels being lifted off the rail, act as fly-wheels to the smaller ones. The engine is thus enabled to ascend an incline which it could not do with wheels of the usual diameter; and this was shown to be the case by Mr. Erskine's model, which easily ascended an incline of 1 in 16, with the small wheels, whereas, with the common wheels it stood still.—[Not new, Ed. C. E. and A. Journal.]

"*On a simple mode of Constructing Models, illustrating the Systems of Crystallography.*" By George Wilson, M.D., F.R.S.E., Lecturer on Chemistry, Edinburgh.—Dr. Wilson stated that he had been led to devise these skeleton models with a view to render the apprehension of crystallography more easy, in the hope that he might thereby assist the mineralogist, optician, chemist, and natural philosopher, in acquiring familiarity with crystalline forms. Each model corresponded, not to a single crystal, but to a system of crystals, and consisted of thin bars of wood intended to represent the axes of the crystals, differing in number, and crossing each other at different angles, according to the crystallographic system they were designed to indicate. Six skeleton models are all that are necessary for illustrating the principles of crystallography; as by passing threads or wires over the ends of the wooden rods, all the more important forms of each system can be represented on a single model.

"*Report on the Earl of Dundonald's Rotatory Steam Engine*, erected in H. M. Dockyard, Portsmouth." By R. Taplin, Esq., Engineer and Mechanist of that Dockyard; dated April 2, 1845.—In this report it was stated that the rotatory engine, after hard working for two years in the Dockyard, had required little or no repair, excepting what six men could have done in one day. The vacuum produced by the engine was stated to be = 28 inches of mercury.

In the absence of Mr. Alexander Bain, the patentee, Mr. Bryson, V.P., "*exhibited and described* Mr. Bain's *Electro-Magnetic Clock.*"—The clock was exhibited in action, by means of a current obtained from the earth. Mr. Bain obtains the electricity by which his clocks are moved from the earth. He buries a quantity of coke in the ground, and at the distance of a few feet, he buries one or more plates of zinc. These two elements, with the intervening soil, form a galvanic battery, from which an uniform current of electricity of very low tension is obtained. It is the constancy of this current which renders it available as a motive power for time-keepers. The current is led from the coke and the zinc by means of copper wires, the two ends of which terminate in the upper part of the clock.

To obtain motion from this current Mr. Bain forms a pendulum of fir rod, and instead of the ordinary bob, he employs a coil of bobbin or copper wire the wire being covered with cotton thread. In the centre of this bobbin is a hole upwards of an inch in diameter, through which is passed a case containing two sets of bar magnets, having their similar poles placed opposite each other with a small interval between them. The coil has freedom of motion along the case containing the magnets, and when the pendulum is at rest, the coil stands over the adjacent similar poles of the magnets. From the coil proceed two wires up the back of the pendulum rod; one of these is attached to the steel spring by which the pendulum is suspended, and that again is in metallic connection with the copper wire proceeding from one of the elements of the battery (say the zinc); the other wire from the coil terminates in a metallic disc near the point of supension of the pendulum, while the wire proceeding from the other element of the battery (say the coke) terminates in a screw on one side of the disc above mentioned. This disc is like a small inverted pendulum, capable of falling to the right and left alternately, when its centre of gravity becomes changed by the alternate motion of the pendulum. When the disc falls to the one side, the current flows through the wires; but when it falls to the other side upon a detent, the current is broken. On the return of the pendulum, the disc again falls on the screw attached to the wire, and renews the connection betwixt the positive sides of the battery. By this contact a stream of electricity passes through the wires and coil; and as this takes place when the pendulum is at its extreme point of deviation, at each alternate beat, the coil has at that moment one of the sets of bar magnets nearly in its centre.

Previous discovery had shown that, when a coil of copper wire is thus situated with respect to a bar magnet, it will, immediately, on a stream of electricity being passed through it, and provided it has freedom of motion, be impelled towards one or other of the poles of the magnet, according to the direction of the current of electricity.

It is this fact of which Mr. Bain has availed himself to give motion to the pendulum of his clock, and accordingly whenever the pendulum is at its extreme point deviation from the perpendicular on one side, as already described, it receives an impulse, in aid of its gravitation, from the action of attraction and repulsion of their different poles exerted by the bar magnets on the electrified coil of wire forming the bob of the pendulum. When the pendulum moves to the other side, the disc falls to the opposite side, and the current of electricity being thus broken, the pendulum returns by the action of gravity alone. In this manner Mr. Bain maintains the oscillations of the pendulum, which thus become the prime mover of the clock, and by simple mechanical adaptations is made to drive the three index wheels.

Mr. Bain's invention, however, does not end here, for by a very ingenious contrivance, he can make the principal pendulum clock keep in motion as many as 20 or 30 other clocks which will keep exact time with itself.

Mr. Bain has contrived several methods of connecting the pendulum with the wheels of the clock, and one in particular where the connection is maintained without contact, and consequently without friction. These were explained to the meeting, as was also the plan which Mr. Bain has in view for making the electric clocks strike the hours.

The great advantage which these clocks present over those of ordinary construction is, that they never require to be wound up. Their accuracy as time-keepers will depend on two points—the uniformity of the electric current obtained from the ground, and the perfect compensation of the pendulum for temperature and moisture—an element of importance in the construction of all clocks. So far as experience goes, report speaks favourably of the permanence and uniformity of the electric current, and if this point be established, Mr. Bain's invention must be regarded as completely successful, and his clocks will be introduced into general use.

It was mentioned that Sir Thomas Brisbane, whose eminence as an Astronomical observer is well known, has ordered one of these clocks from Mr. Bain, in order to institute a series of observations upon its qualities as a time-keeper. This, however, has chiefly in view its fitness for nice or Astronomical purposes, as from the trials already made for six or eight months past, it would appear that the Electric Clock keeps as accurate time as our house on the common construction, and is stated to be not more expensive.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

April 28.—H. E. Kendall, Esq., V.P. in the Chair.

A paper was read by Mr. J. Thomson, descriptive of the Parish Church of Alderton, Wilts, the most remarkable feature of which consists in two hagioscopes, or squints, opened in the angles formed by the nave and transept, the apertures being pierced through masses of masonry carried, for the purpose, on corbels, across the exterior entering angles of the building. These excrescences appear to be of later date than the church, since on the south side the windows are partially blocked up by their introduction.

Mr. F. J. Francis read some observations "*On Encaustic Tiles.*" Those which are so well known, consisting of brown clay inlaid with devices in yellow, and glazed, appear to hold a middle date between two other sorts of paving tiles less common,—one more ancient, in which the devices are in *creux*, and another not older than the 16th century, in which they are in relief. Mr. Francis observed, with regard to the mode of employing these tiles, that a due proportion of ornament and repose is essential to their good effect; and that the manner of spreading the decoration over the whole surface of the floor common in modern imitations, reduced it to the appearance of floor-cloth; and with reference to the subjects of the decorations impressed upon them during the Middle Ages, he took occasion to expose the absurdities of the symbolical system, as set forth by Durandus, and adopted by the writers of the Cambridge Camden Society, who have denounced in the *Ecclesiologist*, ludicrously enough, the use of symbols, which they have actually introduced in the paving of the Round Church.

May 5.—At the Annual Meeting the following officers were elected for the ensuing year:—*President:* Earl De Grey.—*Vice Presidents:* H. E. Kendal, J. B. Papworth, W. Tite.—*Honorary Secretaries:* Ambrose Poynter, G. Bailey. —*Honorary Secretary for Foreign Correspondence:* T. L. Donaldson.—*Treasurer:* Sir W. R. Farquhar, Bart.—*Honorary Solicitor:* W. L. Donaldson.—*Auditors:* G. Mair, R. W. Billings.—*Ordinary Members of Council.* T. Bellamy, W. Burn, E. M. Foxhall, G. Godwin, J. Noble, C. Parker, W. F. Pocock, S. Smirke, J. Shaw, J. Thomson.

May 12.—H. E. Kendall, V.P. Esq., in the Chair.

The Rev. Richard Burgess, B.D., Hon. Member, read a paper "*On the Walls of Ancient and Modern Rome.*" Mr. Burgess commenced with some observations, showing the connexion between the present subject and that of the aqueducts, which he had described on a former occasion, and gave a short historical sketch of the progressive increase of the city of Rome from the time of Romulus to the period when Servius Tullius and his successor completed the enclosure of the Seven Hills, by fortifying the eastern side of the city exposed to the Sabine territory by the agger, or mound crowned with a stone wall of which some vestiges can be traced in the vineyard beneath the Villa Barberini. He then proceeded to describe the several alterations and additions made under the Emperor Aurelian, about which time it was discovered that something more than rough stone walls was necessary for the defence of the city: at this time the circuit was much extended, and many towers added; and subsequent extensions and reparations where effected under the Emperors Honorius and Justinian, and under Belisarius and Narses. A description was then given of the various modes of construction adopted during the long intervening period which elapsed to the time of Pope Leo IV. when the city became papal, and on that of Pope Nicholas V., by whom the ancient walls, which had been greatly injured during the repeated convulsions of the empire, and by the devastations of succeeding ages, were to a great degree restored. Mr. Burgess then explained the various additions made to the papal walls, by Pope Pius IV. and Urban VIII., and exhibited some fragments of the constructions, showing that the materials employed were different in the several portions.

SIR JOHN RENNIE'S FIRST CONVERSAZIONE.

The first *conversazione* given by Sir John Rennie, the President of the Institution of Civil Engineers, took place on Saturday evening, 24th ult., and although we were well assured that there would not be any diminution in the hospitable reception, and the interesting collection of works of art, to which we have been accustomed in former years, we were not prepared for the tasteful preparations and brilliant display on this occasion.

In addition to the ordinary suite of rooms, a large apartment had been constructed specially for the occasion at the rear of the house, adjoining the second saloon. The walls and ceiling were tastefully decorated in encaustic painting, by Sang. The effect of the light upon the vivid colours of the encaustic decorations was particularly striking. In the centre of this room was suspended a magnificent chandelier, made by Mr. Apsley Pellatt, from the prize drawing at the School of Design. It was entirely composed of glass, combining the effect of the prismatic colours, of cut white drops, with the Bohemian stained glass.

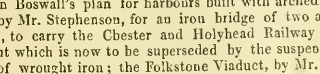
We can scarcely attempt to particularize all the numerous works of art, and interesting models, which were profusely spread throughout the rooms; but we must notice the bronzes from Mr. Deville's collection, an exquisite carving in Caen stone of St. George and the Dragon, by Mr. Thomas; Mr. Goadby's highly interesting anatomical preparations; the paintings and portfolios of sketches; beautiful specimens of Claudet's new process of Talbotype, by which the accuracy of Daguerreotype, and the artistic effect of oil painting appear combined. There were some excellent wood carvings by Rogers, almost equalling a case of ivory carvings by Fiamingo, from the collection of Mr. Vulliamy; these appeared to excite much attention.

The models were, perhaps, somewhat less numerous than usual, but they were select and well displayed. We must mention from among them, Mitchell's screw-pile battery; the Air Point Lighthouse, by Messrs. Walker and Burgess; Captain Boswall's plan for harbours built with arched piers; the original design, by Mr. Stephenson, for an iron bridge of two arches, each of 360 feet span, to carry the Chester and Holyhead Railway across the menai Straits, but which is now to be superseded by the suspended tunnel-bridge, formed of wrought iron; the Folkstone Viaduct, by Mr. W. Cubitt; an ingenious cast iron trussed girder bridge, by Mr. Borthwick; and a good model of a stone bridge, with flat elliptical arches, designed some years since by Mr. Rennie, to replace Westminster Bridge. There was a fine model of the "Great Britain;" a steam-frigate, with direct-acting engines and screw-propeller, by Mr. Rennie; a beautiful pair of marine engines, by the late Mr. Henry Maudslay; Mr. Bodmer's patent horizontal engines and screw-propeller; Mr. Hicks's improved locomotive engine; Messrs. Grissell and James's combinations of a weighing-machine and crane, to ascertain the weight of an object while raising it. Our limits will not permit a more extended notice, but next month we hope to be able to give a full account of the *conversazione* on Saturday the 31st ult.

FALL OF THE SUSPENSION BRIDGE AT YARMOUTH.

On the 2nd of May a frightful loss of life was occasioned at Yarmouth by the fall of the suspension bridge over the river Bure. The government having sent Mr. Walker, the eminent engineer, to examine into the causes of the catastrophe, he gave at the coroner's inquest the following evidence, which we have extracted from the 'Times.' Accidents similar to this at Yarmouth are, unhappily, by no means singular. The Menai and the Montrose suspension bridges, one of those in the Regent's Park, London, and two of those over the Seine at Paris, have given way to a greater or less extent. The inevitable effect on the public mind will be a distrust of suspension bridges generally, and a suspicion that they are not usually constructed of sufficient strength. The case of the Yarmouth bridge, however, has features peculiarly its own. By the addition of footways, 'outside' the chains and the collection of a large crowd on one footway only, one of the chains became useless and contributed nothing to the support of the weight.

If the line below represents a section of the platform, and A, B be the two points of



suspension, any weight at W, between A and B, will press on those two points in the inverse ratio of its distance from either of them, that is—

Pressure at A : Pressure at B :: B W : A W.

But if the weight were not between A and B, but placed at w, for instance, not only would none of the downward pressure of w be borne at B, but w would actually produce an 'upward' force at that point—so that the 'tension' at B would be changed into a 'thrust.' In this case, then, the force which A would have to bear will actually be 'greater than' w, for it will equal w + the thrust at B, or to express the same thing otherwise

$$\text{Pressure on A} = w\,\frac{Bw}{AB}.$$

We hope that this brief consideration will assist the reader in examining Mr. Walker's admirable evidence.

Mr. JAMES WALKER.—I am a civil engineer, residing in London, and have for 10 years past, until the present session, filled the situation of President of the Civil Engineers' Institution. I came to Yarmouth, at the request of Sir James Graham, for the purpose of examining into the cause of the falling of the suspension bridge over the river Bure, situate at the north end of Yarmouth. I will, at the risk of respecting some things which may have already been given in evidence before, proceed to give a very short historyof the bridge. It belonged to the late Mr. Cory, father of the present owners, and was constructed from a design of Mr. Scoles, an architect in London. At first it was only a substitute for a ferry over the river Bure to the marshes, and to certain pleasure grounds called Vauxhall-gardens, belonging to Mr. Cory. Mr. Scoles, who has attended from London on this occasion, and who has assisted me very liberally with his drawings and calculations, states, that he made designs for a bridge of sufficient width for a carriage and two footways. The design was made from memory of the particulars given to him by Mr. Cory, but I understand that he never was at Yarmouth until the day before the bridge was opened; that these drawings were given to Mr. Green, a surveyor, at Yarmouth, who was at that time employed here. and who was well known in this district. Mr. Scoles thinks Mr. Cory had at that time in view the making of a new turnpike-road from Yarmouth to Aclewhich-road, which was to pass over the bridge, although Mr. Cory at that time did not so inform him. It appears that the work was offered for competition, and that Mr. Goddard was the contractor (who is since dead) for the bridge work, according to specifications prepared by Mr. Green, the surveyor I before referred to. These specifications were embodied in the contract, which contract I have seen, but which does not give the size of the principal parts, although it refers to drawings which it states are attached to the contract, but which are not, nor have I been able to see them. It appears that they are either mislaid or lost. The specifications describe that the iron shall be of the best quality. The specification describes it as the best charcoal iron. Now, this is a description of which very little is made in this country; the meaning of the term is, that it was to be British iron of the very best quality. The specifications make no mention as to the quality of the iron being tested, as far as I have observed. From a drawing which is now in Mr. Scoles's possession there appears no reason to doubt that the main or suspending chains and other parts of the bridge are of the size which were intended. The drawing which I have in my hand is executed in a very excellent and workmanlike manner. There are altogther four suspending bars, two on each side, to form a chain. The bars are connected together by bolts passing through openings or eyes at each end of them. These bars are 2½ inches wide by seven-eights thick; from them rods of 1 inch square were suspended to carry the roadway, which was 14 feet 6 inches in width and divided by an iron kerb or carriage-way from a footpath on each side 4 feet in width. The length between the centre of the towers is 92 feet; the deflection of the chains is 7 feet 4 inches. An act of Parliament, constituting the bridge a turnpike road, was passed in May, 1830, and the road was opened in 1832; in 1842 the Yarmouth and Norwich Railway Act was passed, which contains a clause, obtained, as I understand, after much litigation and opposition, by which this bridge was constituted the only communication between the railway station and the terminus, Mr. Cory agreeing to receive the tolls, stipulating to widen it, and afterwards to suspend it. It appears that Mr. Scoles was again consulted respecting the enlargement of the carriage-way to a width sufficient for two carriages to pass abreast—the footway being formed on each side by planks separated by iron straps attached to the framing of the bridge. This footway was therefore outside the suspending chains. That was in 1844. Mr. Cory says, that after the above alterations were made, he consulted an eminent engineer as to the sufficiency of the bridge, who said that it was fit for any traffic. I cannot help observing on this that any opinion taken from an engineer, however eminent, in an off-hand manner, is what the engineer would not consider himself bound by, and which I should think it very unfair to implicate him in, because sometimes a gentleman is asked a question in an off-hand manner, and either from a feeling of politeness, or a desire to get rid of it altogether, he answers in a favourable manner; much more so than he would if he had an opportunity of examining it. The foundations appear to have been piled well, and to have stood well. Mr. Scoles showed me a drawing of the piling, and, if the work were executed according to that, I have very little doubt of the soundness of the foundation. You are probably aware that I am very well acquainted with the foundations of this pert of the country, having been consulting engineer to the Haven and Pier Commissioners for many years. I have also made drawings for a fixed bridge over the Yare, and I erected the temporary bridge which is now there. It is stated that the crowd collected on the 2nd of May was confined to the south side; that the crowd was composed chiefly of children in the front rank, with adults behind, to see some exhibition which was then to be seen on the water. They were supposed to be four or five deep, and it appears that they had collected on the bridge to the number of from 300 to 500. The coroner has stated to me that he has seen double the number on the bridge (or even more than that), but that on those occasions they were spread over on both sides of the bridge, so that all four bars or two chains were equally loaded. It has been stated, I believe, by one of the witnesses who has been examined before, that some sort of cracking noise was heard, which induced him to look up, when he saw that one of the bars or rods of the suspending-chain was broken—that two points where the fracture had taken place were entirely separated, and that in about five minutes afterwards came the fatal catastrophe. This cracking was no doubt occasioned by the snapping in pieces of the bar which first gave way. There was now only one bar left to support the whole weight, and this bar consequently gave way in five minutes after the one on the opposite side; the platform, being then entirely unsupported, fell into the river. I have seen and examined the two bars which gave way—they form the link next but one to the saddle or top of the chain on the east side of the bridge. The fracture in the bar which first gave way is about eight inches from the other end, and there is the same distance from the lower end of the bar. It appears that in forming these bars the two circular ends and about six inches of the straight bar were first made. Between these a straight bar of the proper length was afterwards introduced, each of the pieces having been what is termed scarfed—that is, terminating diagonally, and not in a straight line across. These three pieces being heated and welded together made one bar or link. Then each bar had in it two joints, six inches from one and six inches from the other. In work of this kind there is great difficulty in getting iron so constructed as to make a perfect union or junction with the two ends. It was at these points that both bars in the present case broke. On minutely examining the fracture of the bar, it is evident that for some length of time, or from perhaps its original manufacture, the "weld" was imperfect—not more than one-third of the melting surface being united, and the other two-thirds presented a rusty surface. This would have been doubtless seen, as it is evident on a very slight inspection. The joint or weld of the other link is good—the corresponding one forming the bar. But I find that this bar (the second one) is one inch longer than the one which broke first; in the bar which broke second, putting the bolts through the eye at the lower end, I find that it does not fit, but passes obliquely, and is one inch longer than the other. This extension or difference of length is caused without doubt by the stretching of the unsupported rod before it broke, during the five minutes that it had the whole weight to carry. I have no doubt but that this caused it to stretch quite an inch in length. Having had the quality of the iron tested in a variety of ways, by a very intelligent blacksmith (Mr. Gooda), I find the straight pieces, or middle of the bar, to be much better than the other end; the straight piece is better than the end pieces, which contain the eyes, which are very coarse and inferior in quality. This, (holding a bar up to the jury) is one of the middle pieces; not the one which broke, but one taken indiscriminately. I desired Mr. Gooda to lengthen it, and to apply a power to twist it. As far as I can judge this iron is good. I also desired a screw to be formed in another bar, and I am of opinion that that bar is also good. There is another straight piece between the two ends. I think generally that the quality of the ends is not according to the specifications, nor are they in my opinion proper for the purpose. Had any sufficient means been used to prove and test them, the inferiority of this iron must have been at once discovered. This is a piece of one of the ends, which is a very open, course-grained, and inferior piece of iron, and which broke when the blacksmith referred to was applying a hammer to the middle of the bar; the part which he did not strike broke like a piece of cast iron. The blow was applied, remember, at some distance from where it broke. If care had been taken to test this iron properly, it is impossible but what this defect must have been discovered. No one could have expected that it was going to break, but it did. Another bar was taken by my direction for the purpose of testing it as to fibre, and it broke in pieces just in the way a carrot would do, and did not bend like a piece of stout fir timber, which it would have done had it been sound. I shall now make a few remarks upon the strength of the bridge, as compared with the load. Taking the load at the time to be all on the south chain, I find by calculation that the two rods of $2\frac{1}{4}$ inches by $\frac{7}{8}$ are capable of supporting a temporary load of 56 tons without injury. Of course, I am assuming in that that the bridge should be properly constructed. I need not say, that in order to arrive at anything like accuracy, a great deal of calculation is required, because the deflection of the iron and the span of the bridge ought to be taken into account. I find that the strain, taking 400 individuals at an average of seven stones each, and allowing for the weight of the bridge, was, at the time of the accident, about 44 tons. Therefore, but for the defect in the quality of the iron and in the workmanship, the strength of the bridge exceeded the load upon it; but even then the excess was not sufficient where the effects of failure are so important. I say so because experiments are generally made with good iron, and at all times large allowances ought to be made for imperfections. If we suppose any of the pieces to be bad, as was the case here, then we have the strength less than the strain. The bridge appears to me to have been by no means too strong as originally formed, and the additions made to its width have been in the present case exceedingly injurious, by the weight being placed outside the suspending chain. The weight had therefore to be carried entirely by that chain in place of being equally borne by all, which is the case when the weight is within the chain. In reference to the sufficiency of the bridge to carry the greatest load which could be placed upon it, I find that its strength is somewhere a little above the weight which it would carry, but so small as not to be practically sufficient, even without any allowance for imperfections. It is proper, however, to say that the question is not how many people can be packed 'en masse' upon the bridge, although even that contingency ought to be provided for. After the bridge was widened the strength exceeded the strain, of course, less than it did before; but, even before, it does not appear to me to have been sufficiently strong to ensure perfect security, supposing a mass of people to have been packed upon it in the way in which I have described. It appears that on other occasions a very great number of persons had been upon the bridge, and that it had borne them without falling; the coroner has informed me that he has known twice or thrice the number upon it that was collected on the occasion alluded to, and therefore we have it evident that for the load at that time the strength of the bridge was adequate. It is also evident that when a bridge has been frequently loaded to the utmost which it will bear, it becomes weaker and weaker each time, and the bridge may ultimately give way, although at first it was sufficiently strong to resist the weight put upon it. I have now only a few remarks to add in the shape of general conclusions from what I have stated, and they are these:—

1. I consider the immediate cause of the accident to have been a defect in the joining or welding of the bar which first gave way.

2. That the quality of the iron and the workmanship, as far as I have been able to examine them, are defective; and I believe that the accident would not have happened had the work been properly examined at the time of construction.

3. That the widening appears to have been made without sufficient reference to the original strength of the bridge, and the weight which it had to support, and therefore that it acted as an aggravation of the evil.

4. That in the original construction of the bridge, the casualty of a great load all on one side does not appear to have been contemplated; if it had been, I think that the links on that side would have consisted of more than the two bars, any one of which was unequal to the load which the bridge was likely to carry.

I am bound to add, that in this investigation I have received every possible assistance from Mr. Cory with reference to all documents which were in his possession; this has enabled me to come to the conclusions I have done in less time, and I hope with a greater approximation to accuracy, than otherwise I could have done. I believe I have said all I have to say, as far as the case has gone. I can only add, that under the direction of Sir James Graham any question which any gentleman might put to me I shall be very glad to answer. Perhaps I may also add, that the whole weight of the bridge has been taken with great accuracy by Mr. Scoles, and that the addition to the width, as far as its own weight goes, is comparatively unimportant. The weight of the bridge, including the suspending chains, before the additional width was added, was 17 tons 14 cwt. 3 qrs. 25 lb.; with the additional width, and the railing added, its weight was 20 tons 8 cwt. 9 lb., making an addition of 2 tons 13 cwt. The evil of it is, the footway being outside the chains, and therefore throwing the whole load upon the two suspending chains, without any part being thrown upon the chain on the north side.

In answer to questions put by Mr. Evans (a barrister at Norwich, who attended to watch the proceedings on behalf of the owners of the late bridge), Mr. Walker said—I saw in the original specifications that all the wrought iron should be proved by heating it red-hot; and, if this had been adopted, we should not have had the weldings which we have seen to-day. I observe, in the specifications, that all the materials to be used in the before-mentioned works should be of the best quality, and that it should be in the power of Mr. Cory, or his surveyor, to reject any materials which he or they might deem insufficient for the works. It was most undoubtedly the duty of the person undertaking to be the surveyor of these works to have ascertained by some such means as I have described the quality of the iron, and the manner in which it had been welded. If the surveyor, who is since dead, and whose duty it was to watch and see the contract carried out according to the specifications, had done so, this accident would not have happened, in all probability. I mean that the defect must of necessity have been discovered. If a person had watched, as he should have done, the welding of every link, this defect would not have arisen; the defect in the quality of the iron must have been very apparent to any one at all acquainted with the subject. I have made my calculations as to the weight of people upon the bridge, upon six to the square yard. I should think that, practically, such crowding seldom, if ever, occurs. It is with reference to such packing that I have spoken, and I think the bridge would hardly have borne it. I think even if, as I believe to have been the case, the crowd consisted chiefly of women and children under 14, that 7 stone is about a fair average weight. It is too much of course for children, but not enough for a good fat woman. It is perhaps rather a large average. I took it partly because it has been frequently adopted before. Looking at the contract generally, I do not think the gentleman who built the bridge originally had taken the necessary precautions to have the work properly done, more particularly as regards the mode of doing it. I think the contractor should have given the engineer or inspector of the work the power of having it tested in such a way as he should think fit. I do not find that in the contract. The clause which empowers the engineer to reject any materials which he might deem unfit gave this power indirectly, and in a manner; but I think the surveyor ought to have the power to do so without such a clause as that.

By the Jury—In my opinion, and speaking from the general result of experience in these matters, the defective iron bars were probably made in the country; they were sent here, and the good iron (the middle pieces) was supplied at Yarmouth and used here. The welding, or joining, was most likely done here. The difference between good and bad iron was shown mainly by the breaking; good iron broke like a piece of good fir timber, bad, as I have before said, like a carrot—it snaps in two. He had estimated the number on the bridge at 400, because the statements he had heard were 300 and 500. If 300 were the proper number, you have only to deduct one-fourth from the estimated weight on the bridge.

The following is the unanimous special verdict of the Jury.—

"That the deceased came by her death by the falling of the suspension bridge across the River Bure in this borough, on the 2nd of May, 1845. That the falling of the bridge was attributable immediately to the defect in the joint or welding of the bar which first gave way, and to the quality of part of the iron and workmanship being inferior to the requirements of the original contract, which provided that such should be of the first quality. Although the jury do not wish to add more to their verdict, they wish to express the fullest concurrence in what had fallen from the coroner as to the facilities which had been afforded by the Messrs. Cory in the prosecution of this inquiry, which had been so scientifically conducted by Mr. Walker, who had been deputed by Sir J. Graham to come down and examine into the cause of the accident. They are of opinion that every possible precaution has been taken by the original proprietor of the bridge, and that had the clerk of the works performed his duty in the proper examination of the work, the calamity which they now deplore would have been prevented. They beg also to express their sympathy with the present proprietors of the bridge, whose entire conduct has reflected the greatest credit upon them, in the kindness they had shown to the survivors of those who had been lost by the sad event."

MISCELLANEA.

Steam Navigation.—In the House of Commons in the debate on the Navy Estimates, Sir G. Cockburn stated that he was in hopes before long to have all the vessels of the navy fitted with screws instead of paddle wheels, and as an instance of the efficiency of the screw, he mentioned that in a trial of speed the Rattler beat the Vesuvius, went round the Bass Rock and turned back 20 miles before it met again the latter vessel.

Launch of Two Splendid Iron Steam Frigates at Liverpool.—Two fine ships of war constructed of iron were launched on Wednesday, April 23, at the building yard of Messrs. Thomas Vernon and Co., North Shore. Both ships have been constructed on the most approved modern principles, with patent rib-iron; both vessels are from the same moulds; of equal tonnage, and to be provided with equal steam power—being what may be termed sister ships; and (still more curious) that they have been constructed for two of the most exalted potentates of the European continent,—the Emperor of Russia and the King of Prussia, and these standing somewhat in relations of rivalry. Each was built to the same measurement, as follows:—

Length over all	185 feet
Breadth, or beam	29 „
Depth of hold	17 „ 6 in.

Burthen 750 tons, old measurement.

—In model they are almost precisely alike, with very fine extremities, but with that peculiar fulness of bilge and slight rise of flooring amidships, which is found, though somewhat contrary to the usual conception of the 'beau ideal' in naval architecture, to impart stability and speed, especially to steamers, besides additional buoyancy, suiting them for peculiar navigations. The whole of the side frames or ribs, and the deck-beams, are of Kennedy and Vernon's patent iron, (a decided improvement on the angle-iron hitherto in use.) This new form of ribs has already been partially employed in other vessels with satisfactory effect; but in these it is used in every part where it is applicable, and combines the greatest strength and non-liability to fracture, with the utmost attainable buoyancy. The plates of the garboard streak are $\frac{3}{4}$ inch in thickness, and decreasing a little as they rise, are at the gunwale, or covering board, $\frac{1}{2}$ inch. They are so rivetted and secured to the ribs, which are strung together in every possible manner for efficiency, that the whole is, as it were, one solid mass of metal. The bottoms, to light water mark, are clencher-built or lap-jointed, and the sides flush or carvel, and present a smooth and finished appearance. They have each gilt eagle heads, and are made good from the bulwarks to the extreme point forward,—a comparatively modern improvement, which gives a vessel greater buoyancy when meeting with a seaway a-head. The vessels are both schooner-rigged, and will be fitted with fine engines of equal power from the works of Messrs. Bury, Curtis and Kennedy.

The Pyramids Eclipsed.—The *National Intelligencer* (an American paper) contains a long letter from Mr. Pickett at Lima, commenting upon discoveries of very extraordinary ruins said to have been found by Judge Neito, in the province of Chaohapoyos, while on an exploring expedition. In making a survey of the country he found at Ceulap, a building of most extraordinary character, which he describes as a wall of hewn stone 560 feet in width, 3,600 feet in length, and 150 feet high. The edifice being solid in the interior for the whole space contained within 5,366,000 feet of circumference, which it has to the beforementioned height of 150 feet; is solid and levelled, and upon it there is another wall of 300,000 feet in circumference in this form, 600 feet in length and 50 in breadth, with the same elevation (150 feet) in the lower wall, and, like it, solid and levelled to the summit. In this elevation, and also that of the lower wall, are a great many habitations or rooms of the same hewn stone, 18 feet long and 15 wide, and in these rooms as well as between the dividing walls of the great wall, are found neatly constructed ditches, a yard or two-thirds in length, and half a yard broad and deep, in which are found bones of the ancient dead, some naked, and some in cotton shrouds or blankets, of very firm texture, though coarse, and all worked with borders of different colours. If this description be authentic—and we have no reason to doubt it—this building must be the greatest in the world in point of size. We know of nothing in Egypt or Persia to equal it. From the description it must have been a vast tomb, but whether erected by the Indians, before the Spanish discovery, or by remote generations, cannot be decided; yet the Judge says that the ingenious and highly wrought specimens of workmanship, the elegance of the cutting of some of the handsomest stone, the ingenuity and solidity of the gigantic work, all in stone, the elegant articles of gold and silver, and the curious wrought stones found in the mounds, all satisfy him that the territory was occupied by an enlightened nation, which declined in the same manner as others more modern; as Babylon, Baalbec, and the cities of Syria; and this, he says, is evidently the work of people from the old world, as the Indians had no instruments of iron to work with.

Bridge across the Alleghany.—The *Pittsburgh Chronicle* gives an account of the manufacture of a suspension bridge across the Alleghany. The bridge is the work of a mechanic of that city. The whole will be finished by the 1st of April. The suspension ropes, which extend from pier to pier in the form of an inverted arch, are to consist of seven strands of wire, each strand being about three inches in diameter. Four of these strands are already finished across the entire length of the structure, and the fifth will be completed to-day. The ropes will then be wrapped in annealed wire, (No. 14) which will render it one solid mass, and as each individual wire is varnished before it is put across, and as the whole will be painted when finished and wrapped, it will be impervious to water, and consequently not liable to be weakened or impaired by the weather. On these two immense wire ropes the structure is to be suspended. But this is not the only reliance for strength. The trunk is to be constructed from pier to pier—the sides being of solid lattice-work—that is, strong beams placed in this form—XXX. The beams are to be placed contiguous to each other for greater strength, so that when finished the trunk alone, without the wire-ropes, will be a firm and strong structure, capable not only of sustaining its own weight, but also of bearing up as much additional work as a lattice-work would do. In effect, the trunk is a lattice-work bridge without arches. The ropes, being suspended across strong stone towers placed upon the piers, are in fact inverted arches, capable of sustaining more than double the additional weight which the letting in of the water would place upon the trunk; the trunk itself is an independent, strong, and immovable structure, so that when finished the aqueduct will not be liable to be moved either from the swell of water or the effect of storms. The wires are carried across the river, from one pier to another, by a wheel which traverses the whole distance upon ropes, unbending the wire from the reels as it goes. The ropes are moved by horse-power. The splices of the wire are made by placing the two ends together and winding them with fine annealed wire, and it is done so strongly that a sufficient force to break the wire will not affect the splice.

THE ROYAL PALACE OF BERLIN.—The *Vossische Zeitung* gives a rather long, but more dazzling than luminous, account of some alterations which have just been made within this edifice under the direction of the present court architect Stüler. What ought to be description is so strangely confused that it is impossible to form any intelligible idea of the plan and design of the new apartments,—for undeniably, mere epithets are not only useless for shaping out form, but they are generally so indiscriminately applied that we receive them with considerable distrust. All that we can make out is that there is a new "parade-treppe," or state staircase, leading to a spacious hall—apparently in continuation of it—adorned with Corinthian columns, whose bases and capitals are of metal plated with silver; but whether the shafts are white or coloured marble is not said, yet we must suppose the last, as the pilasters are described as being panelled with coloured marbles. The walls are encrusted with slabs of marble, veined, on a white ground, whose joints form gilded lines. The window draperies, which are of red velvet, are suspended from silver cornices, and the doors correspond, they being also covered with red velvet, which serves as a ground to a rich arabesque pattern of open work in metal. Besides these novelties in decoration, there is a profusion of sculpture, statues, caryatid figures, and other embellishments, silver lamps included.

FORTIFYING HAVRE.—The *Courrier du Havre* states that a commission, composed of military and naval officers, has been appointed to prepare a bill for adding to the fortifications of that town, to be presented to the Chamber in the course of the next session. These works, the estimates of which are to amount to 25,000,000f., will consist of a fort on the Heve, two forts on the heights above the greater roadstead, a fort on the Amfar-bank, another fort towards Nieges, a fort at St. Adresse, and a military work in front of the Mare aux Hoguenots, to command the south-western passage.

THE CAMBRIDGE CAMDEN SOCIETY.—The affairs of this society seem far from being satisfactorily arranged by the result of the meeting on the 8th ult. Those who wished for its dissolution altogether are the most dissatisfied with its reconstruction, it being, in their opinion, but a partial one after all. It is asserted that the new committee is composed of men whose extreme theological opinions are the same as those of the old, which gave such scandal throughout the church and caused the schism in the society. A document disapproving of the society on the ground that its executive being virtually unchanged, its position is disrespectful to the church and university, has been going round the colleges for signatures within the last week. Amongst the seceders from the society who have signed this document are the following of high rank and influence in the university:—the Provost of King's College, the Vice Provost of King's College, the Masters of Clare Hall and Downing, Professors Corrie, Sedgwick, and Lee; the Revs. J. W. Blakesley, W. H. Thompson, M.A., Atkinson, and W. C. Mathison, fellows and tutors of Trinity College; the Rev. J. J. Smith, fellow and tutor of Caius College; the Rev. H. Philpott, fellow and tutor of Catherine Hall; the Rev. J. Cartmell, fellow and tutor of Christ's College; the Rev. H. W. Cookson, fellow and tutor of St. Peter's College; the Rev. A. Tate, fellow and tutor of Emmanuel College; the Rev. W. J. Kingsley, fellow and tutor of Sidney College; Philip Frere, Esq., fellow and tutor of Downing College; the Rev. J. Woolley, Rev. A. M. Hopper, C. T. Simpson, M.A., fellows of St. John's College; C. C. Babington, M.A., St. John's College; the Rev. Edmund Mortlock, and the Rev. C. A. Swainson, fellows of Christ's College; the Rev. E. Bennett and Rev. B. J. Bunch, fellows of Emmanuel College; the Rev. B. Smith and Rev. J. E. Birrell, fellows of St. Peter's College; W. Hopkins, Esq., Bedell, M.A., St. Peter's College; the Rev. J. Power, fellow of Pembroke College; the Rev. C. U. Barry, Trinity Hall. The following have also resigned subsequently to the 8th instant:—The Rev. G. Currey, fellow and tutor of St. John's College; the Rev. W. Keeling, fellow and senior Dean of St. John's College. The Rev. J. H. Hewitt, the Rev. S. Bucknall, and the Rev. W. S. Wood, fellows of St. John's College.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM APRIL 26, TO MAY 24, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Samuel Wilkes, of Wolverhampton, Stafford, iron founder, for "Improvements in the manufacture of hinges."—Sealed April 26.

John Sylvester, of Great Russell street, Bloomsbury, civil engineer, for "Improvements in stoves and fire-places."—April 29.

William Gilmour Wilson, of Earl-street, engineer, for "Improvements in the construction of wheels for carriages."—April 29.

William Maugham, of Newport-street, Surrey, consulting chemist, and Archibald Dunlop, the younger, of Upper Thames-street, London, gentleman, for "Improvements in the manufacture of ale, porter, and other fermented liquors."—April 29.

Frederic Lennard, of Kepple-street, engineer, "for Improvements in generating steam, and evaporating liquors."—April 29.

James Nasmyth, of Arundel-street, gentleman, for "certain Improvements in engines or machines for obtaining and applying motive power."—April 29.

John Herbert Bickey, of Dundee, flax spinner, "for Improvements in spinning threads."—April 29.

John Read, of Regent's Circus, Piccadilly, merchant, for "certain Improvements in machinery, or apparatus for raising and forcing fluids."—April 29.

James Ambler, senior, of Manningham, York, manufacturer, for "Improvements in preparing and combing wool."—May 1.

James Darrell, of Belmont, Ramsgate, gentleman, for "Improvements in machinery for beating and brushing carpets."—May 1.

James Francis Pinel, of Skinner's Place, Size-lane, chemist, for "certain Improvements in the mode of treating farinaceous substances."—May 1.

Richard Prosser, of Birmingham, civil engineer, for "Improvements in the manufacture of metal tubes, and in the machinery and apparatus for producing the same."—May 1.

Frederick George Underhay, of Wells-street, Gray's-inn-road, brazier, for "Improvements in taps and valves."—May 3.

Charles Attwood, of Bishop Oak, near Wolsingham, Durham, Esq., for "certain Improvements in manufacturing iron."—May 3.

William Radley, of Laburnum-terrace, Kingsland-road, engineering chemist, for "certain Improvements in the production of gases, and for their application to purposes of general illumination, and in the apparatus and machinery to be employed in manufacturing, measuring, and distributing the same."—May 3.

William Brindley, of Liverpool-road, Middlesex, paper manufacturer, for "Improvements in the manufacture of trays and other japanned wares, and various articles of japanners, and other wares made of pulp."—May 5.

James Foreman, of Ranelagh road, Middlesex, for "certain Improvements in the construction and manufacture of pipes and tubes applicable to locomotive purposes, and to the conveyance of water, gas, and other fluids." Communication.—May 5.

Charles Wheatstone, of Conduit-street, Esq., and William Fothergill Cooke, of Kidbrooke, near Blackheath, Esq., for "Improvements in electric telegraphs, and in apparatus relating thereto; part of which improvements are applicable to other purposes."—May 6.

Joseph Hill, of Ipswich, wire worker, for "Improvements in manufacturing wire fabrics for blinds, and other uses."—May 6.

Joseph Burch, of Craig Works, Macclesfield, Cheshire, calico printer, for "Improvements in machinery for printing calico and other fabrics; part of which improvements is applicable to other purposes where resistance to heat is required."—May 6.

Albert Daniel Hindley, of Berners-street, Oxford-street, carpet manufacturer, for "Improvements in the manufacture of carpets, and other piled fabrics."—May 6.

Joseph Amesbury, of Devonshire-street, Portland-place, surgeon, for "Improvements in apparatus for the relief, or correction of stiffness, weakness, or distortion in the human body."—May 6.

George Duckett Barber, in Beaumont, of Sandy Combe Lodge, Twickenham, Middlesex, for "Improvements in propelling carriages."—May 8.

John McIntosh, gentleman, of Glasgow, for "Improvements in preparing materials for colouring and printing calicoes, and other fabrics; and improvements in printing and ornamenting fabrics."—May 8.

William Prosser, jun., of Pimlico, Esq., and Jacob Brett, of Hanover-square, both in the county of Middlesex, gentleman, for "Improvements in railways, and in propelling railway carriages."—May 10.

John Mease Chapman, of Newcastle-upon-Tyne, banker, for "Improvements in the manufacture of rails, and other parts of railways."—May 10.

George Ferguson Wilson, of Belmont, Vauxhall, gentleman, George Gwynne, of Regent street, gentleman, and James Pillans Wilson, of Belmont, aforesaid, gentleman, for "Improvements in treating certain inflammable matters, and in the manufacture of candles and soap."—May 10.

Frederick Ransome, of Ipswich, engineer, for "Improvements in combining small coal and other matters, and in preserving wood."—May 10.

John Parsons, of Stones-row, St. Pancras, machinist, for "certain Improvements in the manufacture of fuel, and in apparatus for the use of the same."—May 14.

Charles James Smith, of Birmingham, gun maker, for "certain Improvements in artillery, guns, pistols, and other fire-arms, and in the apparatus to be used therewith."—May 14.

John Henry Pape, of New Bond-street, piano-forte manufacturer, for "Improvements in musical instruments."—May 17.

Apsley Pellatt, of Falcon Glass Works, Holland-street, Surrey, glass manufacturer, and Frederick Pellatt, of Blackheath, gentleman, for "Improvements in the manufacture of glass, and in casting, rolling, moulding, blowing, and drawing glass."—May 17.

Thomas Wells, of Ware, whitesmith, for "Improvements in the construction of timber and other jacks, and floor cramps."—May 17.

Alexander MacDougall, gentleman, of Daisey Bank, Manchester, for "certain Improvements in the method of working atmospheric railways."—May 17.

Louis Antoine Blancharde, of Gerrard-street, doctor of medicine, for "certain Improvements in the application of heat to boilers for generating steam, which improvements may be also applied to other purposes where heat is required."—May 17.

Christopher Nickels, gentleman, of York-road, Lambeth, for "Improvements in binding and covering books, pamphlets, portfolios, writing cases, and other similar articles."—May 20.

James Fletcher, of Manchester, machine maker, for "certain Improvements in machinery, or apparatus for preparing, roving, and spinning cotton, and other fibrous substances."—May 22.

Charles Joseph Hullmandel, of Great Marlborough-street, lithographer, for "certain Improvements in producing patterns upon earthenware and porcelain."—May 22.

Thomas Bailey, jun., of Manchester, cotton spinner, for "certain Improvements in the flyers used in machinery for roving and spinning cotton and other fibrous substances."—May 22.

James Heath Lewis, of Dover, printer, for "certain Improvements in printing."—May 22.

Edward Wilkins, of Blue Anchor-road, Bermondsey, tanner, for "an Improvement or improvements in the manufacture of leather."—May 22.

Peter Armand le Comte de Fontainemoreau, of Skinner's-place, London, for "certain Improvements in dissolving and separating the oxides from the metals and metallic substances." Communication.—May 22.

Augustus Septimus Braithwaite, of St. Martin's-le-Grand, gentleman, for "certain Improvements in buckles, clasps, and other fastenings." Communication.—May 22.

Robert Kerr, of Thread-street, Scotland, manufacturer, for "certain Improvements in hand-loom weaving, and for producing a double fabric of raised figure-work in the same loom by one process of weaving."—May 22.

James Clark, of Glasgow, power-loom weaver, for "Improvements in the manufacture of fabrics from fibrous materials."—May 22.

Michel Bocke, of Paris, manufacturer, for "Improvements in apparatus for measuring charges of powder and shot."—May 22.

James Napier, of Hoxton, dyer, for "Improvements in treating mineral waters to obtain products therefrom, and for separating metals from other matters."—May 22.

Richard Coleman, of Colchester, Essex, iron founder, for "Improvements in the construction of harrows and sheep-folds."—May 22.

Henry Deacon, of Eccleston, engineer, for "Improvements in apparatus for grinding and smoothing plate glass, crown glass, and sheet glass."—May 22.

Jeremiah Simpson, of Burslem, Stafford, oven builder, and Joshua Seddon, of Burslem aforesaid, earthenware manufacturer, for "an Improved method of constructing the flues and interior arrangements of ovens and kilns used by manufacturers of china and earthenware."—May 24.

Richard Fell, of Crown-street, Finsbury, plumber, for "certain Improvements in the generation and application of steam, and in obtaining and applying motive power."—May 24.

Jules Adolph Delmaid, of the City of London, merchant, for "Improvements in the construction of metallic boats and other vessels having curved surfaces." Communication.—May 24.

John Constable, of the City of London, merchant, for "certain Improvements in the manufacture of gas for lighting and heating." Communication.—May 24.

* William Prosser, jun., of Pimlico, Esq., and Jean Baptiste Carrana, of Milan, gentleman, for "Improvements in working atmospheric railways." Communication.—December 16, 1844.

* Henry Pinkus, of No. 31, Great Marlborough-street, Esq., for "Improvements in obtaining and applying motive power to impelling machinery."—December 17.

* These patents being opposed on caveats at the Great Seal, were not sealed till the 24th of May, but bear date on the 16th and 17th of December last, per order of the Lord Chancellor.

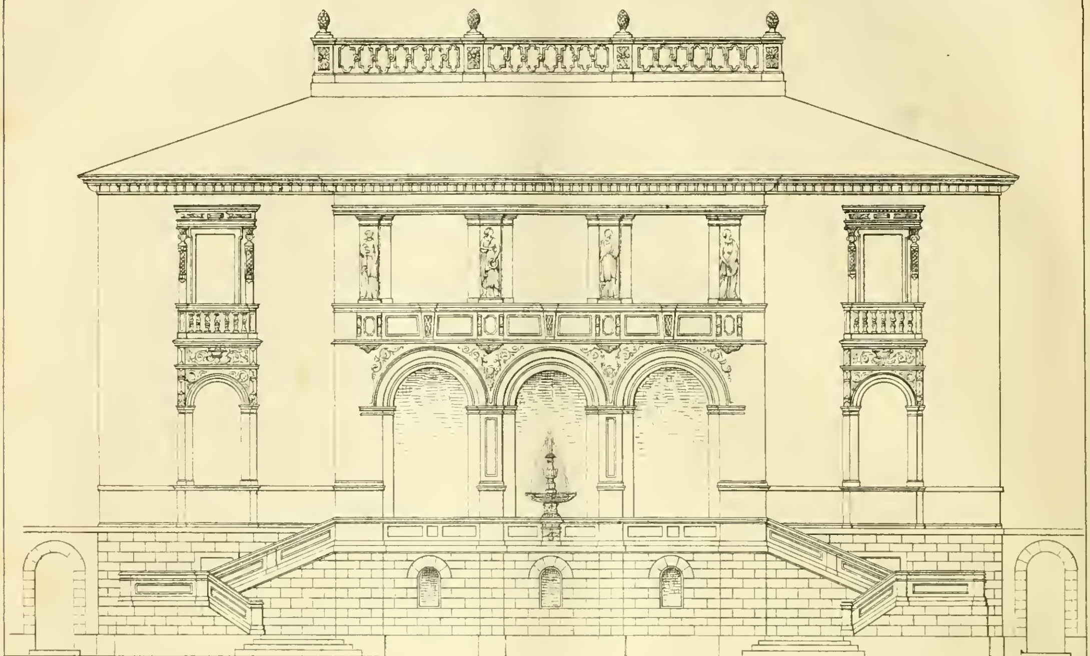
NOTICE TO CORRESPONDENTS.

Mr. Bashforth's communication on Suspension Bridges will appear next month.

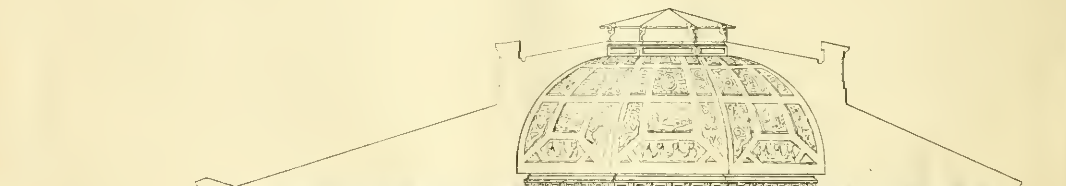
CANTAB.—We purpose to give, if possible, a detailed account of the restorations of the chapel of Jesus College, Cambridge, in a future number.

NAUTILUS.—The hydrostatic law that the weight of a body is equal to the weight of water displaced by it, refers only to "floating" bodies. For instance, if a nautilus having the size of 20 cubic inches were floating on the surface of the sea, and exactly half his body were immersed, we should know that he weighed exactly as much as ten cubic inches of water. If his whole body were immersed, and he displayed no tendency either to rise or sink, his weight would be that of 20 inches of water.

P.—The power of an overshot wheel is greater than that of an undershot wheel "ceteris paribus" in the ratio of 14 : 5.



ELEVATION



SECTION

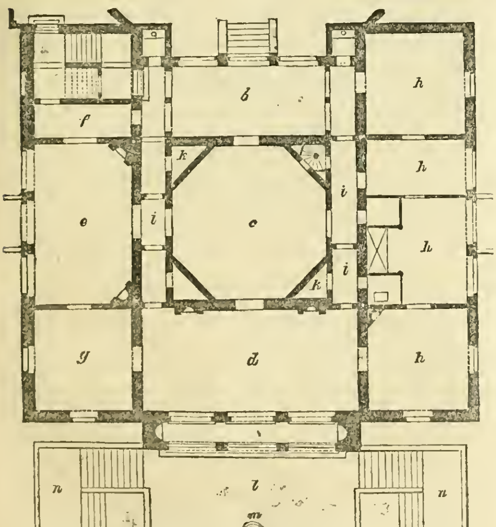
10 5 0 10 20 FEET

"VILLA ROSA," NEAR DRESDEN.

(With an Engraving, Plate XVII.)

It is interesting and profitable to turn our attention occasionally from the progress of architecture in our own country, to examine the results of the labours of continental architects. In domestic architecture especially, which is now becoming elevated into a distinct systematic profession, it is particularly advantageous to gain information by comparing our own efforts with those of our neighbours. By confining ourselves to the specimens of domestic construction which exist in our country, we are apt to form crude and limited view of the art. Our ideas become insipid and lose their freshness by being constantly repeated, as ground which is constantly cultivated for the same kind of crops bears only scanty and dwindled produce. We are in dangerabove all from setting before us a constant recurrence of the same or similar forms, to fall into *conventionality*, than which nothing is fatal to the free and vigorous development of the Fine Arts. We give in the accompanying illustrations a specimen of German Domestic Architecture, presenting arrangements, which, though different in many respects from our own, and perhaps unfit for imitation here, have, at least to an English eye, the advantage of novelty. The "Villa Rosa" lately built near Dresden appears to have excited much attention among the German architects. Indeed, the *Allgemeine Bauzeitung*, a work of considerable authority in architectural matters, pronounces this building the most successful after the Dresden Theatre, which has been there erected. It is the property of Messrs. Oppenheim, of Berlin, bankers, and erected near Dresden. The architect was Professor Semper. The style of the building most nearly approaches that of the *Renaissance*, though differing from it in some respects. The plates represent, first, the front elevation; secondly, a section from front to rear, displaying the principal parts of the interior. The whole will be rendered intelligible by reference to the following plan of the ground floor.

North.



South.

The ground plan is nearly square, being about 72 fect by 76. From the octagonal saloon in tbe centre of the building there are four doors communicating with 1st, the vestibule *b*; 2nd, the dining room *e*; 3rd, tbe garden saloon *d*; and 4th, with the ladies rooms *h h*. Corridors to the right and left of the centre saloon extend from the garden saloon to the vestibule. The passages afford means of communication without the necessity of traversing the grand saloon. Adjoining the garden saloon is a piazza communicating with a handsome broad terrace, and fountain (*m*). On either side of the terrace are steps leading to the garden.

The principal feature of the building is the octagonal saloon, and to this attention is to be directed both on account of its size and ornamental structure. It is lighted by an ornamental sky-light, and is of the height of the two stories. There are balconies on four sides of the upper story of this saloon which look into it. The walls above are painted white, and decorated with sculpture. The cornice is of unusally large dimensions, but harmonizes well with the whole. From the cornice springs the octagonal spherical doom in quarter circle, and terminating in the skylight. This dome is of plaster, pannelled in compartments, of which some are enriched architecturally, and some contain coloured landscapes and figures.

The cost of the principal parts of the building was about £6000.

CANDIDUS'S NOTE-BOOK.

FASCICULUS LXV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Both in his personal and his professional character, Soane was a strange compound of contradictions and inconsistencies. Liberal and illiberal, ostentatiously profuse and sordidly mean by turns, he was no less unequal in his taste as an architect; exceedingly happy in his ideas just by fits and starts—now fanciful and poetital, and then sinking down into the dullest prose; alternately classical and cockney in his fancy, as is most forcibly evidenced by the loggia at the north-west corner of the Bank, and by the front of his own house in Lincoln's-inn Fields,—the one a most charming architectural *tableau*, the other without any architectural physiognomy at all, except a very flimsy and pasteboard one, and in its style looking very much like a house built of cards, in the upper part more especially. Nevertheless, his affection for it was like that of a parent towards a deformed child, for he most solicitously provided that it shall be preserved intact *in perpetuo* for the admiration of posterity, in order to convince the world what exquisite taste he could display when left to follow the bent of his own peculiar talent, untrammelled and uncontrolled. It is somewhat strange that, having come to the resolution of *giving* his house to the public, he did not determine to do so handsomely, and by adding the one on each side (which also belonged to him), to render it better adapted for the purpose of a public museum; had which been done, the part of it that was so appropriated might have been always opeo to the public, without at all interfering with the Curator's residence, and there might then also have been a proper reading-room set apart for those who want to consult any of the books and drawings. Or if that would have been showing too great liberality towards the public, he might have been somewhat less niggardly towards himself, and might have thrown all the three houses together externally into a single façade that should have been worthy of the architect of the Bank. Were it not certain beyond the possibility of question or doubt, it would hardly be believed that the two buildings were designed by the same man, and what is more, that instead of being an earlier production on which he tried his "'prentice hand," the front of his own house was erected subsequently to that angle of the Bank which has ever been considered his *capo d'opera* in external design, and justly so. Even the Bank itself exhibits great inequality of taste,—for the centre of the south front manifests a lamentable falling-off from the *episodical* bit alluded to, as if he had exhausted his ideas and broken down altogether when he reached conclusion of his epic work. So far from being at all happy in conception, or dignified in character, that centre portion is so much the reverse as to be a positive anticlimax in the general composition,—far more mongrel in style than original in idea, and stamped by a littleness of manner, a degree of insignificance little less than surprising. Even the interior of the Bank exhibits, together with many admirable ideas and most valuable hints, many offensive and paltry caprices. In the Rotunda, for instance, the sunk, wavy, zigzag lines by way of border to the arcaded recesses are in most vile and barbarous taste,—quite devoid of any sort of meaning or style,—intended we must suppose for decoration, but producing both a look of poverty and harsh deformity. In fact, throughout the whole interior, there is scarcely any one part that is perfectly satisfactory and consistent, but is either evidently left in an unfinished state, as is the case with the Lothbury court—which now seems destined to remain so—or else looks as if not fully wrought up as it was intended to be, though advanced to a penultimate stage of progress. The Bank has accordingly been composed—and not very incorrectly—to an architectural sketch-book containing many able and clever ideas, excellent hints and useful studies, yet merely in bits and fragments. Even Soane himself seems to have felt that the edifice would not bear thorough and deliberate examination, for otherwise he would probably have made it the subject of a specific work, executed upon an adequate scale, and in the most able and finished style of architectural drawing and engraving, so as to be a worthy record to after times, when the fabric erected by him may, in its turn, have experienced the fate of Sir Robert Taylor's façade. That he did not do so seems to exculpate him from the charge of overweening vanity which has been brought against him, more especially as one so wealthy, and withal so very "liberal" and "munificent," could hardly have been deterred from such an undertaking by the cost attending it. Still the last seems to have been really the case, for his character was marked by a singular mixture of munificence—or what the world was pleased to call such—and downright penuriousness. The passion of thriftiness must certainly have gained complete mastery over the natural *storge* of an artist for his own productions, when he published, towards the end of his professional career, his "Public and Private Buildings," that work being so wretchedly got up and so villianously executed as to be not only discreditable but actually disgraceful, and some of the plates little better than libellous caricatures of the buildings themselves; whereas, it might have been thought that he would certainly take the opportunity of doing ample justice to himself, by causing his buildings to be shown to the utmost possible advantage, and making manifest how very much better some of them would have been had they been executed entirely according to his own intentions and original designs for them, without his being thwarted by "embarrassments thrown in his way." Poor Sir John Soane!—on that occasion he certainly cheated himself, defrauding himself of what was due to his reputation, merely in order to spare his purse. Poor man! he ought afterwards to have prosecuted himself for libel and defamation of character, for the libels he did complain of—the memorable one hight "Bœotian Architecture" included—were innocent pleasantries in comparison with a self-inflicted injury far exceeding all that the most malicious of his enemies could devise. There was, besides, something in the history of that publication which it would not have done to have touched upon in an *éloge* upon Sir John Soane, in proof of his private virtues and amiable generosity. But I may leave the personal character of the *man* alone, merely remarking that since his decease a very significant sort of silence has succeeded to that vehement magnification of his noble qualities which certain parties indulged in during his lifetime.

II. Considering him then merely as an artist, Soane seems to have been for ever making experiments without arriving at any consistent and satisfactory conclusions. Leaving others to censure his "constant hankering after novelty," I think that he erred in not following up more decidedly the course he had ventured upon. He seems to have entangled himself in a labyrinth, where he was fearful of advancing yet equally loth to turn back. With a constant glimmering of the object of his search before him, he kept groping and fumbling about without being able to lay hold of it, or even to conceive any definite shape of it, wherefore, so far from forming—as has nevertheless been said of him—a style of his own, he often departed altogether from every thing deserving the name of style—as witness the aforementioned front in Lincoln's-inn Fields! If such egregious paltriness of manner and design can be called style, any body may any day achieve for himself a style of his own. No wonder then that such a precious sample of architectural taste was treated very cavalierly by Welby Pugin in his "Contrasts;" the wonder is that Pugin did not also show up that still more *Pecksniffian* production the front of the National Debt Redemption Office in the Old Jewry, a thing of such *studied* meanness and deformity, and ugliness, and vulgarity, as to partake of the marvellous. Surely no man was ever more unequal in taste, not only as displayed in different productions but in one and the same. A few ideas of his own he certainly had, and upon the strength of them—though feebleness is a term that would better apply to most of them—he obtained credit for originality, but instead of properly cherishing them to death, without at all advancing them, or making anything more of them than they were when he first took them up. There was generally something wavering and indecisive in his designs, as if he did not exactly know what he would be at, or else was frightened at his own temerity, like the man who was scared at the valorous look of his own countenance whenever he saw it in a glass. Having passed the Rubicon, and left architectural orthodoxy behind him, Soane's courage failed him, and he stood shilly-shallying without progressing any further. Instead of carefully rearing up his own favourite ideas to maturity, he cockered and petted them till they became stunted for want of exercise, so that scarcely any of them ever got beyond the state of dwarfish whims. The tiny prettinesses of his own house seem to have always haunted his imagination, and to have been present to it when they ought to have been dismissed for others of a more elevated stamp, although originating in the same embryon of fancy. One critic has attributed high merit to Soane for perfect consistency of detail, and has further assured us that it is "based on the purest examples of antiquity, and always harmonious," yet it is not easy to reconcile such dictum with his practice of scoring walls with horizontal lines, or of attempting to relieve flat surfaces by a few sunk lines of most *jejune* pattern as a substitute for ornament in relief,—a mode, besides, often utterly at variance with the express character of the order employed by him. So far from being harmonious, many of his compositions—executed ones as well as unexecuted—are made up of the most conflicting and contradictory elements, not artistically blended together, but merely put side by side of each other. They exhibit affected severity and affected playfulness in the same breath. One or two of them are little better than architectural *sandwiches*—slices of the sternest Greek Doric clapped between other slices of "my own house!" The same writer who claims consistency of detail for Soane tells us that "his compositions take the forms dictated by utility and convenience;" but it must surely be intended for irony, since both at the Bank and in the building at the corner of Downing Street, he employed an order so manifestly contrary to all utility that its entablature, which is hollowed out behind, comes directly across some mezzanine windows, that are thereby all but completely blocked up. Indiscreet and unguarded compliments, and to call attention to the very defects they are meant to divert it from. It is much after the same fashion that in the book calling itself the "Georgian Æra," Soane is praised for the quality of all others by which he was least distinguished—amenity of disposition and suavity of manners!

III. The British Museum and some other buildings of our great classical architect being discussed the other day, one of the company observed that "at all events Sir Robert's designs had no *nonsense* about them, but were all exceedingly chaste." To which another replied: "Without engaging to swear for their chastity, I am willing to let them have the credit of it, for I defy any one to convict them of pregnancy—of being pregnant with a single idea.

VI. Its loyalty notwithstanding, *Fraser's Magazine* has ventured to give us sundry very free and tranchant, certainly not complimentary, comments upon royal taste and royal patronage, with reference to the frescoes in the summer-house at Buckingham Palace—the fate of one of them, and the remuneration bestowed on the artists. "What victims," exclaims the writer, "have those poor fellows been of this awful patronage! Great has been the commotion in the pictorial world regarding the fate of those frescoes, which royalty was pleased to order, which it condescended to purchase at a price that no poor amateur would have had the face to offer." This is pretty strong, considering the quarter that it comes from. "Think of august powers and principalities," continues the audacious Titmarsh, "ordering the works of such a man as Etty to be hacked out of the wall,—that was a slap in the face to every artist in England!" Really this makes one feel quite "*all-overish*:" I am not apt to be particularly scrupulous with my pen myself, but to talk at this rate, and then to boast that "Etty goes on rejoicing in his old fashion, quite unabashed by the squeamishness exhibited in the highest quarter," is quite unbearable. I wonder there was not "a slap in the face" given to the august taste which commanded a *Bal Poudré*.

V. Nothing can be a more higgledy-piggledy set out than the walls of our Exhibitions—where subjects the most incongruous are jammed together. A pictorial banquet there may be, but then it is one served up in the most careless and slovenly manner imaginable. In point of worth they may be pretty much alike; for my own part, were I compelled to accept of one of them, I think I should give the preference to the "pot-house piece" as it has been called,—but there surely is a most striking disparity as to subject between Cooper's "Race for the Derby" and Haydon's "Uriel and Satan," both pictures are in the same corner of the west room in the present Exhibition. But then what a specimen of an archangel is that Uriel! fit only, as Titmarsh saucily observes, "to hang up over a caravan at a fair." How works of art ought *not* to be arranged the Academy has gone on showing us year after year; how they might and ought to be arranged may now be learnt from the newly opened Glyptotheca, or Hall of Sculpture, at the Colosseum; and though that is not for pictures, the same principle might be applied to galleries for pictures as to one for statues, namely, that of dividing the walls into separate spaces or compartments less lofty than the walls themselves, which, besides producing some degree of repose—whereas at present we behold one dense and bewildering mass of pictures from floor to ceiling—would leave room for architectural adornment. The Colosseum puts us more out of conceit than ever with the disgracefully miserable sculpture room of the Academy.

INAUGURAL ADDRESS

To the British Association for the Advancement of Science, held at Cambridge, June 1845.

By Sir W. Herschel, *President.*

Gentlemen,—The terms of kindness in which I have been introduced to your notice by my predecessor in the office which you have called on me to fill, have been gratifying to me in no common degree—not as contributing to the excitement of personal vanity (a feeling which the circumstances in which I stand, and the presence of so many individuals every way my superiors, must tend powerfully to chastize), but as the emanation of a friendship begun at this University when we were youths together, preparing for our examinations for degrees, and contemplating each other, perhaps, with some degree of rivalry (if that can be called rivalry from which every spark of jealous feeling is absent). That friendship has since continued, warm and unshadowed for a single instant by the slightest cloud of disunion, and among all the stirring and deep-seated remembrances which the sight of those walls with which we are now assembled arouse, I can summon none more every way delightful and cheering than the contemplation of that mutual regard. It is, therefore, with no common feelings that I find myself now placed in this chair, as the representative of such a body as the British Association, and as the successor of such a friend and of such a man as its late President.

Progress of Science in Cambridge.

Gentlemen,—There are many sources of pride and satisfaction, in which *self* has no place, which crowd upon a Cambridge man in revisiting for a second time this University, as the scene of our annual labours. The development of its material splendour which has taken place in that interval of twelve years, vast and noble as it has been, has been more than kept pace with by the triumphs of its intellect, the progress of its system of instruction, and the influence of that progress on the public mind and the state of science in England. When I look at the scene around me—when I see the way in which our Sections are officered in so many instances by Cambridge men, not out of mere compliment to the body which receives us, but for the intrinsic merit of the men, and the pre-eminence which the general voice of society accords them in their several departments—when I think of the large proportion of the muster-roll of science which is filled by Cambridge names, and when, without going into any details, and confining myself to only one branch of public instruction, I look back to the vast and extraordinary development in the state of mathematical cultivation and power in this University, as evidenced both in its examinations and in the published work of its members, now, as compared with what it was in my own time—I am left at no loss to account for those triumphs and that influence to which I have alluded. It has ever been, and I trust it ever will continue to be, the pride and boast of this University to maintain, at a conspicuously high level, that sound and thoughtful and sobering discipline of mind which mathematical studies imply. Independent of the power which such studies confer as instruments of investigation, there never was a period in the history of science in which their moral influence, if I may so term it, was more needed, as a corrective to that propensity which is beginning to prevail widely, and, I fear, balefully, over large departments of our philosophy, the propensity to crude and overhasty generalization. To all such propensities the steady concentration of thought, and its fixation on the clear and the definite which a long and stern mathematical discipline imparts, is the best, and, indeed, the only proper antagonist. That such habits of thought exist, and characterize, in a pre-eminent degree, the discipline of this University, with a marked influence on the subsequent career of those who have been thoroughly imbued with it, is a matter of too great notoriety to need proof. Yet, in illustration of this disposition, I may be allowed to mention one or two features of its Scientific History, which seem to me especially worthy of notice on this occasion. The first of these is the institution of the Cambridge University Philosophical Society, that body at whose more especial invitation we are now here assembled, which has now subsisted for more than twenty years, and which has been a powerful means of cherishing and continuing those habits among resident members of the University, after the excitement of reading for academical honours is past. From this society have emanated eight or nine volumes of memoirs, full of variety and interest, and such as no similar collection, originating as this has done in the bosom, and, in a great measure, within the walls of an academical institution, can at all compare with; the Memoirs of the Ecole Polytechnique of Paris, perhaps, alone excepted. Without undervaluing any part of this collection, I may be allowed to particularize, as adding largely to our stock of knowledge of their respective subjects, the Hydrodynamical contributions of Prof. Challis—the Optical and Photological papers of Mr. Airy—those of Mr. Murphy, on Definite Integrals—the curious speculations and intricate mathematical investigations of Mr. Hopkins on Geological Dynamics—and, more recently, the papers of Mr. De Morgan on the foundations of Algebra, which, taken in conjunction with the prior researches of the Dean of Ely and Mr. Warren on the geometrical interpretation of imaginary symbols in that science, have effectually dissipated every obscurity which heretofore prevailed on this subject. The elucidation of the metaphysical difficulties in question, by this remarkable train of speculation, has, in fact, been so complete, that henceforward they will never be named as difficulties, but only as illustrations of principle. Nor does its interest end here, since it appears to have given rise to the theory of Quaternions of Sir W. Hamilton, and to the Triple Algebra of Mr. De Morgan himself, as well as to a variety of interesting inquiries of a similar nature on the part of Mr. Graves, Mr. Cayley, and others. Conceptions of a novel and refined kind have thus been introduced into analysis—new forms of imaginary expression rendered familiar—and a vein opened which I cannot but believe will terminate in some first-rate discovery in abstract science.

Neither are inquiries into the logic of symbolic analysis, conducted as these have been, devoid of a bearing on the progress even of physical science. Every inquiry, indeed, has such a bearing which teaches us that terms which we use in a narrow sphere of experience, as if we fully understood them, may, as our knowledge of nature increases, come to have superadded to them a new set of meaning and a wider range of interpretation. It is thus that modes of action and communication, which we hardly yet feel prepared to regard as strictly of a material character, may, ere many years have passed, come to be familiarly included in our notions of Light, Heat, Electricity and other agents of this class; and that the transference of physical causation from point to point in space—nay, even the generation or development of attractive, repulsive or directive forces at their points of arrival may come to be enumerated among their properties. The late marvellous discoveries in actino-chemistry and the phenomena of muscular contraction as dependent on the will, are, perhaps, even now preparing us for the reception of ideas of this kind.

Cambridge Mathematical Journal.

Another instance of the efficacy of the course of study in this university, in producing not merely expert algebraists, but sound and original methematical *thinkers*—(and, perhaps, a more striking one, from the generality of its contributors being men of comparatively junior standing,) is to be found in the publication of *The Cambridge Mathematical Journal*, of which already four volumes, full of very original communications, are before the public. It was set on foot in 1837, by the late Mr. Gregory, Fellow of Trinity College, whose premature death has bereft Science of one who, beyond a doubt, had he lived, would have proved one of its chief ornaments, and the worthy representative of a family already so distinguished in the annals of mathematical and optical science. His papers on the 'Calculus of Operations,' which appeared in that collection, fully justifies this impression, while they afford an excellent illustration of my general position. Nor ought I to omit mentioning the Chemical Society, of whom he was among the founders, as indicative of the spirit of the place, untrammelled by abstract forms, and eager to spread itself over the whole field of human inquiry.

Cambridge Observatory.

Another great and distinguishing feature in the scientific history of this place, is the establishment of its Astronomical Observatory, and the regular publication of the observations made in it. The science of Astronomy is so vast, and its objects so noble, that its practical study for its own sake is quite sufficient to insure its pursuit wherever civilization exists. But such institutions have a much wider influence than that which they exercise in forwarding their immediate object. Every astronomical observatory which publishes its observations, becomes a nucleus for the formation around it of a school of exact practice—a standing and accessible example of the manner in which theories are brought to their extreme test—a centre, from which emanate a continual demand for and suggestion of refinements and delicacies, and precautions in matters of observation and apparatus which re-act upon the whole body of Science, and stimulate, while they tend to render possible an equal refinement and precision in all its processes. It is impossible to speak too highly of the mode in which the business of this institution is carried on under its present eminent director—nor can it be forgotten in our appreciation of what it has done for science, than in it our present Astronomer-Royal first proved and familiarised himself with that admirable system of astronomical observation, registry, and computation, which he has since brought to perfection in our great national observatory, and which have rendered it, under his direction, the pride and ornament of British Science, and the admiration of Europe.

Magnetic and Metereological Observatories.

Gentlemen, I should never have done if I were to enlarge on, or even attempt to enumerate the many proofs which this university has afforded of its determination to render its institutions and endowments efficient for the purposes of public instruction, and available to science. But such encomiums, however merited, must not be allowed to encroach too largely on other objects which I propose to bring before your notice, and which relate to the more immediate business of the present meeting, and to the general interests of science. The first and every way the most important, is the subject of the Magnetic and Meteorological Observatories. Every member of this Association is, of course, aware of the great exertions which have been made during the last five years, on the part of the British, Russian, and several other foreign governments, and of our own East India Company, to furnish data on the most extensive and systematic scale, for elucidating the great problems of Terrestrial Magnetism and Meteorology, by the establishment of a system of observatories all over the world, in which the phenomena are registered at instants strictly simultaneous, and at intervals of two hours throughout both night and day. With the particulars of these national institutions, and of the multitude of local and private ones of a similar nature, both in Europe, Asia, and America, working on the same concerted plan, so far as the means at their disposal enable them, I need not detain you: neither need I enter into any detailed explanation of the system of Magnetic Surveys, both by sea and land, which have been executed or are in progress, in connexion with, and based upon the observations carried on at the fixed stations. These things form the subject of Special Annual Reports, which the Com mittee appointed for the purpose have laid before us at our several meetings, ever since the commencement of the undertaking; and the most recent of which will be read in the Physical Section of the present meeting, in its regular course. It is sufficient for me to observe, that the result has been the accumulation of an *enormous* mass of most valuable observations, which are now and have been for some time in the course of publication; and when thoroughly digested and discussed, as they are sure to be, by the talent and industry of magnetists and meteorologists, both in this country and abroad, cannot fail to place those sciences very far indeed in advance of their actual state. For such discussion, however, time must be allowed. Even were all the returns from the several observatories before the public, (which they are not, and are very far from being,) such is the mass of matter to be grappled with, and such the multitude of ways in which the observations will necessarily have to be grouped and combined to elicit mean results and quantitative laws, that several years must elapse before the full scientific value of the work done can possibly be realized.

Expiration of the grant for these Observatories.

Meanwhile, a question of the utmost moment arises, and which *must* be resolved, so far as the British Association is concerned, before the breaking up of this meeting. The second term of three years, for which the British Government and East India Company have granted their establishments—nine in number—will terminate with the expiration of the current year, at which period, if no provision be made for their continuance, the observations at those establishments will of course cease, and with them, beyond a doubt, those at a great many—probably the great majority—of the foreign establishments, both national and local, which have been called into existence by the example of England, and depend on that example for their continuance or abandonment. Now under these circumstances, it become a very grave subject for the consideration of our Committee of Recommendations, whether to suffer this term to expire without an effort on the part of this Association to influence the Government for its continuance, or whether, on the other hand, we ought to make such an effort, and endeavour to secure either the continuance of these establishments for a further limited term, or the perpetuity of this or some equivalent system of observation in the same or different localities, according to the present and future exigencies of Science. I term this a grave subject of deliberation, and one which will call for the exercise of their soundest judgment; *because*, in the first place, this system, of combined observation is by far the greatest and most prolonged effort of scientific co-operation which the world has ever witnessed; *because*, moreover, the spirit in which the demands of Science have been met on this occasion by our own Government, by the Company, and by the other governments who have taken part in the matter, has been, in the largest sense of the words, munificent and unstinting; and *because* the existence of such a spirit throws upon us a solemn a solemn responsibility to recommend nothing but upon the most entire conviction of very great evils consequent on the interruption, and very great benefits to accrue to Science from the continuance of the observations.

Magnetic Conference.

Happily we are not left without the means of forming a sound judgment on this tremendous question. It is a case in which, connected as the Science of Britain is with that of the other co-operating nation, we cannot and ought not to come to any conclusions without taking into our counsels the most eminent magnetists and meteorologists of other countries who have either taken a direct part in the observations, or whose reputation in those sciences is such as to give their opinions in matters respecting them, a commanding weight. Accordingly it was resolved, at the York meeting last year, to invite the attendance of the eminent individuals I have alluded to at this meeting, with the especial objects of conference on the subject. And in the interval since elapsed, knowing the improbability of a complete personal reunion from so many distant quarters, a circular has been forwarded to each of them, proposing certain special questions for reply, and inviting, besides, the fullest and freest communication of their views on the general subject. The replies received to this circular, which are numerous and in the highest degree interesting and instructive, have been printed and forwarded to the parties replying, with a request for their reconsideration and further communication, and have also been largely distributed at home to every member of our own Council, and the Committee of Recommendations, and to each member of the Council and Physical Committee of the Royal Society, which, conjointly with ourselves, memorialized Government for establishment of the observatories.

In addition to the valuable matter thus communicated, I am happy to add, that several of the distinguished foreigners in question have responded to our invitation, and that in consequence this meeting is honoured by the personal presence of M. Kupffer, the Director-General of the Russian System of Magnetic and Meteorological Observation; of M. Ermann, the celebrated circumnavigator and meterologist; of Baron von Senftenberg, the founder of the Astronomical, Magnetic, and Meteorological Observatory of Senftenberg; of M. Kreil, the director of the Imperial Observatory at Prague; and of M. Boguslawski, director of the Royal Prussian Observatory of Breslau, all of whom have come over for the express purpose of affording us the benefit of their advice and experience in this discussion. To all the conferences between these eminent foreigners and our own Magnetic and Meteorological Committee, and of such of our own members present as have taken any direct theoretical or practical interest in the subjects, all the members of our Committee of Recommendations will have free access for the purpose of enabling them fully to acquaint themselves with the whole bearing of the case, and the arguments used respecting all the questions to be discussed, so that when the subject comes to be referred to them, as it must be if the opinion of the conference should be favourable to the continuance of the system, they may be fully prepared to make up their minds on it.

Physical Observatories.

I will not say one word from this chair which can have the appearance of in any way anticipating the conclusion which the conference thus organized may come to, or the course to be adopted in consequence. But I will take this opportunity of stating my ideas generally on the position to be assumed by this Association and by other scientific bodies in making demands on the national purse for scientific purposes. And I will also state, quite irrespective of the immediate question of magnetic co-operation, and therefore of the fate of this particular measure, what I conceive to be the objects which might be accomplished, and ought to be aimed at in the establishment of PHYSICAL OBSERVATORIES, as part of the integrant institutions of each nation calling itself civilized, and as its contribution to Terrestrial Physics.

It is the pride and boast of an Englishman to pay his taxes cheerfully when he feels assured of their application to great and worthy objects. And as civilization advances, we feel constantly more and more strongly, that, after the great objects of national defence, the stability of our institutions, the due administration of justice, and the healthy maintenance of our social state, are provided for, there is no object greater and more noble—none more worthy of national effort than the furtherance of Science. Indeed, there is no surer test of the civilization of an age or nation than the degree in which this conviction is felt. Among Englishmen it has been for a long time steadily increasing, and may now be regarded as universal among educated men of all classes. No government, and least of all a British government, can be insensible to the general prevalence of a sentiment of this kind; and it is our good fortune, and has been so for several years, to have a government, no matter what its denomination as respects society, impressible with such considerations, and really desirous to aid the forward struggle of intellect, by placing at its disposal the material means of its advances.

But to do so with effect, it is necessary to be thoroughly well informed. The mere knowledge that such a disposition exists, is sufficient to surround those in power with every form of extravagant pretension. And even if this were not so, the number of competing claims, which cannot be all satisfied, can only harass and bewilder, unless there be somewhere seated a discriminating and selecting judgment, which, among many important claims, shall fix upon the most important, and urge them with the weight of well-established character. I know not where such a selecting judgment can be so confidently looked for as in the great scientific bodies of the country, each in its own department, and in this Association, constituted, in great measure, out of, and so representing them all, and numbering besides, among its members, abundance of men of excellent science and enlightened minds who belong to none of them. The constitution of such a body is the guarantee both for the general soundness of its recommendations, and for the due weighing of their comparative importance, should ever the claims of different branches of science come into competition with each other.

In performing this most important office of suggesting channels through which the fertilizing streams of national munificence can be most usefully conveyed over the immense and varied fields of scientific culture, it becomes us, in the first place, to be so fully impressed with a sense of duty to the great cause for which we are assembled, as not to hesitate for an instant in making a recommendation of whose propriety we are satisfied, on the mere ground that the aid required is of great and even of unusual magnitude. And on the other hand, keeping within certain reasonable limits of total amount, which each individual must estimate for himself, and which it would be unwise and indeed impossible to express in terms, it will be at once felt that *economy in asking* is quite as high a "distributive virtue" as economy in *granting*, and that every pound recommended unnecessarily is so much character thrown away. I make these observations because the principles they contain cannot be too frequently impressed, and by no means because I consider them them to have been overstepped in any part of our conduct hitherto. In the next place, it should be borne in mind that, in recommending to Government, not a mere grant of money, but a scientific enterprise or a national establishment, whether temporary or permanent, not only is it our duty so to place it before them that its grounds of recommendation shall be thoroughly intelligible, but that its whole proposed extent shall be seen—or at least if they cannot be, that it should be clearly stated to be the possible commencement of something more extensive—and besides, that the printing and publication of results should, in every such case, be made an express part of the recommendation. And, again, we must not forget that our interest in the matter does not cease with such publication. It becomes our duty to forward, by every encouragement in our power, the due consideration and scientific discussion of results so procured—to urge it upon the science of our own country and of Europe, and to aid from our own resources those who may be willing to charge themselves with their analysis, and to direct or execute the numerical computations or graphical projections it may involve. This is actually the predicament in which we stand, in reference to the immense mass of data already accumulated by the magnetic and meteorological observatories. Let the science of England, and especially the rising and vigorous mind which is pressing onward to distinction, gird itself to the work of grappling with this mass. Let it not be said that we are always to look abroad whenever industry and genius are required to act in union for the discussion of great masses of raw observation. Let us take example from what we see going on in Germany, where a Dove, a Kämtz and a Mahlman are battling with the meteorology, a Gauss, a Weber and an Ermann with the magnetism of the world. The mind of Britain is equal to the task—its mathematical strength, developed of late years to an unprecedented extent, is competent to any theoretical analysis or technical combination. Nothing is wanting but the resolute and persevering devotion of undistracted thought to a single object, and that will not be long wanting when once the want is declared and dwelt upon, and the high prize of public estimation held forth to those who fairly and freely adventure themselves in this career. Never was there a time when the mind of the country, as well as its resources of every kind, answered so fully and readily to any call reasonable in itself and properly urged upon it. Do we call for *facts?* they are poured upon us in such profusion as for a time to overwhelm us, like the Roman maid who sank under the load of wealth she called down upon herself. Witness the piles of unreduced meteorological observations which load our shelves and archives; witness the immense and admirably arranged catalogues of stars which have been and still are pouring in from all quarters upon our astronomy so soon as the want of extensive catalogues came to be felt and declared. What we now want is *thought*, steadily directed to single objects, with a determination to eschew the besetting evil of our age—the temptation to squander and dilute it upon a thousand different lines of enquiry. The philosopher must be wedded to his subject if he would see the children and the children's children of his intellect flourishing in honour around him.

The establishment of astronomical observatories has been, in all ages and nations, the first public recognition of science as an integrant part of civilization. Astronomy, however, is only one out of many sciences, which can be advanced by a combined system of observation and calculation carried on uninterruptedly; where, in the way of experiment, man has no control, and whose only handle is the continual observation of Nature as it developes itself under our eyes, and a constant collateral endeavour to concentrate the records of that observation into empirical laws in the first instance, and to ascend from those laws to theories. Speaking in an utilitarian point of view, the globe which we inhabit is quite as important a subject of scientific enquiry as the stars. We depend for our bread of life and every comfort on its climates and seasons, on the movements of its winds and waters. We guide ourselves over the ocean, when astronomical observations fail, by our knowledge of the laws of its magnetism; we learn the sublimest lessons from the records of its geological history; and the great facts which its figure, magnitude, and attraction, offer to mathematical inquiry, form the very basis of Astronomy itself. Terrestrial Physics, therefore, form a subject every way worthy to be associated with astronomy as a matter of universal interest and public support, and one which cannot be adequately studied except in the way in which Astronomy itself has been—by permanent establishments keeping up an unbroken series of observation:—but with this difference, that whereas the chief data of Astronomy might be supplied by the establishment of a very few well worked observatories properly disposed in the two hemispheres—the gigantic problems of meteorology, magnetism, and oceanic movements can only be resolved by a far more extensive geographical distribution of observing stations, and by a steady, persevering, systematic attack, to which every civilized nation, as it has a direct interest in the result, ought to feel bound to contribute its contingent.

I trust that the time is not far distant when such will be the case, and when no nation calling itself civilized will deem its institutions complete without the establishment of a permanent physical observatory, with at least so much provision for astronomical and magnetic observation as shall suffice to make it a local centre of reference for geographical determinations and trigonometrical and magnetic surveys—which latter, if we are ever to attain to a theory of the secular changes of the earth's magnetism, will have to be repeated at intervals of twenty or thirty years for a long while to come. Rapidly progressive as our colonies are, and emulous of the civilization of the mother country, it seems not too much to hope from them, that they should take upon themselves, each according to its means, the establishment and mainteoance of such institutions both for their own advantage and improvement, and as their contributions to the science of the world. A noble example has been set them in this respect, within a very few months, by our colony of British Guiana, in which a society recently constituted, in the best spirit of British co-operation, has established and endowed an observatory of this very description, furnishing it partly from their own resources and partly by the aid of government with astronomical, magnetic and meteorological instruments, and engaging a competent observer at a handsome salary to work the establishment—an example which deserves to be followed wherever British enterprise has struck root and flourished.

The perfectly unbroken and normal registry of all the meteorological and magnetic elements—and of tidal fluctuations where the locality admits—would form the staple business of every such observatory, and, according to its means of observation, periodical phenomena of every description would claim attention, for which the list supplied by M. Quetelet, which extends not merely to the phases of inanimate life, but to their effects on the animal and vegetable creation, will leave us at no loss beyond the difficulty of selection. The division of phenomena which magnetic observation has suggested, into periodical, secular, and occasional, will apply *mutatis mutandis* to every department. Under the head of occasional phenomena, storms, magnetic disturbances, auroras, extraordinary tides, earthquake movements, meteors, &c., would supply an ample field of observation—while among the secular changes, indications of the varying level of land and sea would necessitate the establishment of permanent marks, and the reference to them of the actual mean sea level which would emerge from a series of tidal observations, carried round a complete period of the moon's nodes with a certainty capable of detecting the smallest changes.

The abridgement of the merely mechanical work of such observatories by self-registering apparatus, is a subject which cannot be too strongly insisted on. Neither has the invention of instruments for superseding the necessity of much arithmetical calculation by the direct registry of *total* effects received anything like the attention it deserves. Considering the perfection to which mechanism has arrived in all its departments, these contrivances promise to become of immense utility. The more the merely mechanical part of the observer's duty can be alleviated, the more will he be enabled to apply himself to the theory of his subject, and to perform what I conceive ought to be regarded as the most important of all his duties, and which in time will come to be universally so considered—I mean the systematic deduction from the registered observations of the mean values and local co-efficients of diurnal, menstrual, and annual change. These deductions, in the case of permanent institutions, ought not, if possible, to be thrown upon the public, and their effective execution would be the best and most honourable test of the zeal and ability of their directors.

Necessity of Classification of Observatories.

Nothing damps the ardour of an observer like the absence of an object appreciable and attainable by himself. One of my predecessors in this chair has well remarked, that a man may as well keep a register of his dreams as of the weather, or any other set of daily phenomena, if the spirit of grouping, combining, and eliciting results be absent. It can hardly be expected indeed, that, observers of facts of this nature should themselves reason from them up to the highest theories. For that their position unfits them, as they see but locally and partially. But no other class of persons stands in anything like so favourable a position for working out the first elementary laws of phenomena, and referring them to their immediate points of dependence. Those who witness their daily progress, with that interest which a direct object in view inspires, have in this respect an infinite advantage over those who have to go over the same ground in the form of a mass of dry figures. A thousand suggestions arise, a thousand improvements occur—a spirit of interchange of ideas is generated, the surrounding district is laid under contribution for the elucidation of innumerable points, where a chain of corresponding observation is desirable; and what would otherwise be a scene of irksome routine, becomes a school of physical science.

Nautical and Colonial Observations.

Such a spirit must be excited by the institution of provincial and colonial scientific societies, like that which I have just had occasion to mention. Sea as well as land observations are, however, equally required for the effectual working out of these great physical problems. A ship is an itinerant observatory; and, in spite of its instability, one which enjoys several eminent advantages—in the uniform level and nature of the surface, which eliminate a multitude of causes of disturbance and uncertainty, to which land observations are liable. The exceeding precision with which magnetic observations can be made at sea, has been abundantly proved in the Antarctic Voyage of Sir James Ross, by which an invaluable mass of data has been thus secured to science. That voyage has also conferred another and most important accession to our knowledge in the striking discovery of a permanently low barometric pressure in high south latitudes over the whole Antarctic ocean—a pressure actually inferior by considerably more than an inch of mercury, to what is found between the Tropics. A fact so novel and remarkable will of course give rise to a variety of speculations as to its cause; and I anticipate one of the most interesting discussions which have ever taken place in our Physical Section, should that great circumnavigator favour us, as I hope he will, with a *vivâ voce* account of it. The voyage now happily commenced under the most favourable auspices for the further prosecution of our Arctic discoveries under Sir John Franklin, will bring to the test of direct experiment a mode of accounting for this extraordinary phenomenon thrown out by Colonel Sabine, which, if realized, will necessitate a complete revision of our whole system of barometric observation in high latitudes, and a total reconstruction of all our knowledge of the laws of pressure in regions where excessive cold prevails. This, with the magnetic survey of the Arctic seas, and the not improbable solution of the great geographical problem which forms the chief object of the expedition, will furnish a sufficient answer to those, if any there be, who regard such voyages as useless. Let us hope and pray, that it may please Providence to shield him and his brave companions from the many dangers of their enterprise, and restore them in health and honour to their country.

Death of Prof. Daniell.

I cannot quit this subject without reverting to and deploring the great loss which science has recently sustained in the death of the late Prof. Daniell, one of its most eminent and successful cultivators in this country. His work on Meteorology is, if I mistake not, the first in which the distinction between the aqueous and gaseous atmospheres, and their mutual independence, was clearly and strongly insisted on as a highly influential element in meteorological theory. Every succeeding investigation has placed this in a clearer light. In the hands of M. Dove, and more recently of Colonel Sabine, it has proved the means of accounting for some of the most striking features in the diurnal variations of the barometer. The continual generation of the aqueous atmosphere at the Equator, and its destruction in high latitudes, furnishes a *motive power* in meteorology, whose mode of action, and the mechanism through which it acts, have yet to be inquired into. Mr. Daniell's claims to scientific distinction were, however, not confined to this branch. In his hands, the voltaic pile became an infinitely more powerful and manageable instrument, than had ever before been thought possible; and his improvements in its construction (the effect not of accident, but of patient and persevering experimental inquiry), have in effect changed the face of Electro-Chemistry. Nor did he confine himself to these improvements. He applied them: and among the last and most interesting inquiries of his life, are a series of electro-chemical researches which may rank with the best things yet produced in that line.

The immediate importance of these subjects to one material part of our business at this meeting, has caused me to dwell more at length than perhaps I otherwise should on them. I would gladly use what time may remain without exciting your impatience, in taking a view of some features in the present state and future prospects of that branch of science to which my own attention has been chiefly directed, as well as to some points in the philosophy of science generally, in which it appears to me that a disposition is becoming prevalent towards lines of speculation, calculated rather to bewilder than enlighten, and, at all events, to deprive the pursuit of science of that which, to a rightly constituted mind, must ever be one of its highest and most attractive sources of interest, by reducing it to a mere assemblage of marrowless and meaningless facts and laws.

Lord Rosse's Telescope.

The last year must ever be considered an epoch in Astronomy, from its having witnessed the successful completion of the Earl of Rosse's six-feet reflector—an achievement of such magnitude, both in itself as a means of discovery, and in respect of the difficulties to be surmounted in its construction, (difficulties which perhaps few persons here present are better able from experience to appreciate than myself), that I want words to express my admiration of it. I have not myself been so fortunate as to have witnessed its performance, but from what its noble constructor has himself informed me of its effects on one particular nebula, with whose appearance in powerful telescopes I am familiar, I am prepared for any statement which may be made of its optical capacity. What may be the effect of so enormous a power in adding to our knowledge of our own immediate neighbours in the universe, it is of course impossible to conjecture; but for my own part I cannot help contemplating, as one of the grand fields open for discovery with such an instrument, those marvellous and mysterious bodies or systems of bodies, the Nebulæ. By far the major part, probably, at least, nine-tenths of the nebulous contents of the heavens consist of nebulæ of spherical or elliptical forms presenting every variety of elongation and central condensation. Of these a great number have been resolved into distinct stars, and a vast multitude more have been found to present that mottled appearance which renders it almost a matter of certainty that an increase of optical power would show them to be similarly composed. A not unnatural or unfair induction would therefore seem to be, that those which resist such resolution do so only in consequence of the smallness and closeness of the stars of which they consist; that, in short, they are only optically and not physically nebulous. There is, however, one circumstance which deserves especial remark, and which, now that my own observation has extended to the nebulæ of both hemispheres, I feel able to announce with confidence as a general law, viz. that the character of easy resolvability into separate and distinct stars, is almost entirely confined to nebulæ deviating but little from the spherical form; while, on the other hand, every elliptic nebulæ, even large and bright ones, offer much greater difficulty in this respect. The cause of this difference must, of course, be conjectural, but, I believe, it is not possible for any one to review *seriatim* the nebulous contents of the heavens without being satisfied of its reality as a physical character. Possibly the limits of the conditions of dynamical stability in a spherical cluster may be compatible with less numerous and comparatively larger individual constituents than in an elliptic one. Be that as it may, though there is no doubt a great number of elliptic nebulæ in which stars have *not* yet been noticed, yet there are so many in which they *have*, and the gradation is so insensible, from the most perfectly spherical to the most elongated elliptic form, that the force of the general induction is hardly weakened by this peculiarity; and for my own part I should have little hesitation in admitting all nebulæ of this class to be, in fact, congeries of stars. And this seems to have been my father's opinion of their constitution, with the exception of certain very peculiar looking objects, respecting whose nature all opinion must for the present be suspended. Now, among all the wonders which the heavens present to our contemplation, there is none more astonishing than such close compact families or communities of stars, forming systems either insulated from all others, or in binary connexion, as double clusters whose confines intermix, and consisting of individual stars nearly equal in apparent magnitude, and crowded together in such multitudes as to defy all attempts to count or even to estimate their numbers. What *are* these mysterious families? Under what dynamical conditions do they subsist? Is it conceivable that they can exist at all, and endure under the Newtonian law of gravitation without perpetual collisions? And, if so, what a problem of unimaginable complexity is presented by such a system if we should attempt to dive into its perturbations and its conditions of stability by the feeble aid of our analysis. The existence of a luminous matter, not congregated into massive bodies in the nature of stars, but disseminated through vast regions of space in a vaporous or cloud-like state, undergoing, or awaiting the slow process of aggregation into masses by the power of gravitation, was originally suggested to the late Sir W. Herschel in his reviews of the nebulæ, by those extraordinary objects which his researches disclosed, which exhibit no regularity of outline, no systematic gradation of brightness, but of which the wisps and curls of a cirrhus cloud afford a not inapt description. The wildest imagination can conceive nothing more capricious than their forms, which in many instances seem totally devoid of plan as much so as real clouds,—in others offer traces of a regularity hardly less uncouth and characteristic, and which in some cases seems to indicate a cellular, in others a sheeted structure, complicated in folds as if agitated by internal winds.

Should the powers of an instrument such as Lord Rosse's succeed in resolving these also into stars, and, moreover, in demonstrating the starry nature of the regular elliptic nebulæ, which have hitherto resisted such decomposition, the idea of a *nebulous matter*, in the nature of a shining fluid, or condensible gas, must, of course, cease to rest on any support derived from actual observation in the sidereal heavens, what countenance it may still receive in the minds of cosmogonists from the tails and atmospheres of comets, and the zodiacal light in our own system. But though all idea of its being ever given to mortal eye, to view aught that can be regarded as an outstanding portion of primæval chaos, be dissipated, it will by no means have been even then demonstrated that among those stars, so confusedly scattered, no aggregating powers are in action, tending to draw them into groups and insulate them from neighbouring groups; and, speaking from my own impressions, I should say that, in the structure of the Magellanic Clouds, it is really difficult not to believe we see distinct evidences of the exercise of such a power. The part of my father's general views of the construction of the heavens, therefore, being entirely distinct from what has of late been called "the nebulous hypothesis," will still subsist as a matter of rational and philosophical speculation,—and perhaps all the better for being separated from the other.

The Nebulous Hypothesis.

Much has been said of late of the Nebulous Hypothesis, as a mode of representing the origin of our own planetary system. An idea of Laplace, of which it is impossible to deny the ingenuity, of the successive abandonment of planetary rings, collecting themselves into planets by a revolving mass gradually shrinking in dimension by the loss of heat, and finally concentrating itself into a sun, has been insisted on with some pertinacity, and supposed to receive almost demonstrative support from considerations to which I shall presently refer. I am by no means disposed to quarrel with the nebulous hypothesis even in this form, as a matter of pure speculation, and without any reference to final causes; but if it is to be regarded as a demonstrative truth, or as receiving the smallest support from any observed numerical relations which actually hold good among the elements of the planetary orbits, I beg leave to demur. Assuredly, it receives no support from observation of the effects of sidereal aggregation, as exemplified in the formation of globular and elliptic clusters, supposing *them* to have resulted from such aggregation. For were this the cause, working itself out in thousands of instances, it would have resulted, *not* in the formation of a single large central body, surrounded by a few much smaller attendants, disposed in one plane around it,—but in systems of infinitely greater complexity, consisting of multitudes of nearly equal luminaries, grouped together in a solid elliptic or globular form. So far, then, as any conclusion from our observations of nebulæ can go, the result of agglomerative tendencies *may*, indeed, be the formation of families of stars of a general and very striking character; but we see nothing to lead us to presume its further result to be the surrounding of those stars with planetary attendants. If, therefore, we go on to push its application to that extent, we clearly theorize in advance of all inductive observation.

But if we go still farther, as has been done in a philosophical work of much mathematical pretension, which has lately come into a good deal of notice in this country,* and attempt "to give a mathematical consistency" to such a cosmogony by the "*indispensable criterion*" of "a numerical verification,"—and so exhibit, as "necessary consequences of such a mode of formation," a series of numbers which observation has established independent of any such hypothesis, as primordial elements of our system—if, in pursuit of this idea, we find the author first computing the time of rotation the sun must have had about its axis so that a planet situate on its surface and forming a part of it should not press on that surface, and should therefore be in a state of indifference as to its adhesion or detachment—if we find him, in this computation, throwing overboard as troublesome all those essential considerations of the law of cooling, the change of spheroidical form, the internal distribution of density, the probable non-circulation of the internal and external shells in the same periodic time, on which alone it is possible to execute such a calculation correctly; and avowedly, as a short cut to a result, using as the basis of his calculation "the elementary Huyghenian theorems for the evaluation of centripetal forces in combination with the law of gravitation;"—a combination which, I need not explain to those who have read the first book of Newton, leads direct to Kepler's law;—and if we find him then gravely turning round upon us, and adducing the coincidence of the resulting periods compared with the distances of the planets with this law of Kepler, as *being* the numerical verification in question,—where, I would ask, is there a student to be found who has graduated as a Senior Optime in this University, who will not at once lay his finger on the fallacy of such an

* M. Comte, Phil. Positive, ii. 376.

argument,† and declare it a vicious circle? I really should consider some apology needed for even mentioning an argument of the kind to such a meeting, were it not that this very reasoning, so ostentatiously put forward, and so utterly baseless, has been eagerly received among us‡ as the revelation of a profound analysis. When such is the case, it is surely time to throw in a word of warning, and to reiterate our recommendation of an early initiation into mathematics, and the cherishing a mathematical habit of thought, as the safeguard of all philosophy.

Improvement of Lenses by Repeal of Duty on Glass.

A very great obstacle to the improvement of telescopes in this country has been happily removed within the past year by the repeal of the duty on glass. Hitherto, owing to the enormous expense of experiments to private individuals not manufacturers—and to the heavy excise duties imposed on the manufacture, which has operated to repress all attempts on the part of practical men to produce glass adapted to the construction of large achromatics, our opticians have been compelled to resort abroad for their materials—purchasing them at enormous prices, and never being able to procure the largest sizes. The skill, enterprise and capital of the British manufacturer have now free scope, and it is our own fault if we do not speedily rival, and perhaps outdo the far-famed works of Munich and Paris. Indeed, it is hardly possible to over-estimate the effect of this fiscal change on a variety of other sciences to which the costliness of glass apparatus has been hitherto an exceeding drawback, not only from the actual expense of apparatus already in common use, but as repressing the invention and construction of new applications of this useful material.

Increased attention to the Logic of Philosophy.

A great deal of attention has been lately, and I think very wisely drawn to the philosophy of science and to the principles of logic, as founded, not on arbitrary and pedantic forms, but on a careful inductive inquiry into the grounds of human belief, and the nature and extent of man's intellectual faculties. If we are ever to hope that science will extend its range into the domain of social conduct, and model the course of human actions on that thoughtful and effective adaption of means to their end, which is its fundamental principle in all its applications (the *means* being here the total devotion of our moral and intellectual powers—the *end*, our own happiness and that of all around us)—if such be the far hopes and long protracted aspirations of science, its philosophy and its logic assume a paramount importance, in proportion to the practical danger of erroneous conceptions in the one, and fallacious tests of the validity of reasoning in the other.

On both these subjects works of first-rate importance have of late illustrated the scientific literature of this country. On the philosophy of science, we have witnessed the production, by the pen of a most distinguished member of this University, of a work so comprehensive in its views, so vivid in its illustrations, and so right-minded in its leading directions, that it seems to be impossible for any man of science, be his particular department of inquiry what it may, to rise from its perusal without feeling himself strengthened and invigorated for his own especial pursuit, and placed in a more favourable position for discovery in it than before, as well as more competent to estimate the true philosophical value and import of any new views which may open to him in its prosecution. From the peculiar and *à priori* point of view in which the distinguished author of the work in question has thought proper to place himself before his subject, many may dissent; and I own myself to be of the number;—but from this point of view it is perfectly possible to depart without losing sight of the massive reality of that subject itself: on the contrary, that reality will be all the better seen and understood, and its magnitude felt when viewed from opposite sides, and under the influence of every accident of light and shadow which peculiar habits of thought may throw over it.

Philosophy in Germany.

According, in the other work to which I have made allusion, and which, under the title of a 'System of Logic,' has for its object to give "*a connected view of the principles of evidence and the methods of scientific investigation*"—its acute, and in many respects profound author—taking up an almost diametrically opposite station, and looking to experience as the ultimate foundation of all knowledge—at least, of all scientific knowledge—in its simplest axioms as well as in its most remote results—has presented us with a view of the inductive philosophy, very different indeed in its general aspect—but in which, when carefully examined, most essential features may be recognized as identical, while some are brought out with a salience and effect which could not be attained from the contrary point of sight. It cannot be expected that I should enter into any analysis or comparison of these remarkable works—but it seemed to me impossible to avoid pointedly mentioning them on this occasion, because they certainly, taken together, leave the philosophy of science, and indeed *the principles of all general reasoning*, in a very different state from that in which they found them. Their influence, indeed, and that of some other works of prior date, in which the same general subjects have been more lightly touched upon, has already begun to be felt and responded to from a quarter where, perhaps, any sympathy in this respect might hardly have been looked for. The philosophical mind of Germany has begun, at length, effectually to awaken from the dreamy trance in which it had been held for the last half century, and in which the jargon of the Absolutists and Ontologists had been received as oracular. An "anti-speculative philosophy" has arisen and found supporters—rejected, indeed, by the Ontologists, but yearly gaining ground in the general mind. It is something so new for an English and a German philosopher to agree in their estimate either of the proper objects of speculation or of the proper mode of pursuing them, that we greet, not without some degree of astonishment, the appearance of works like the Logic and the New Psychology of Beneke, in which this false and delusive philosophy is entirely thrown aside, and appeal at once to the nature of things as we find them, and to the laws of our intellectual and moral nature as our own consciousness and the history of mankind reveals them to us.*

Meanwhile, the fact is every year becoming more broadly manifest, by the successful application of scientific principles to subjects which had hitherto been only empiricially treated (of which agriculture may be taken as perhaps the most conspicuous instance), that the great work of Bacon was not the completion, but, as himself foresaw and foretold, only the commencement of his own philosophy; and that we are even yet only at the threshold of that palace of Truth which succeeding generations will range over as their own—a world of scientific inquiry, in which not matter only and its properties, but the far more rich and complex relations of life and thought, of passion and motive, interest and actions, will come to be regarded as its legitimate objects Nor let us fear that in so regarding them we run the smallest danger of collision with any of those great principles which we regard, and rightly regard, as sacred from question. A faithful and undoubting spirit carried into the inquiry, will secure us from such dangers, and guide us, like an instinct, in our paths through that vast and enlarged region which intervenes between those ultimate principles and their extreme practical applications. It is only by working our way *upwards towards* those principles as well as *downwards from them*, that we can ever hope to penetrate such intricacies, and thread their maze; and it would be worse than folly—it would be treason against all our highest feelings—to doubt that to those who spread themselves over these opposite lines, each moving in his own direction, a thousand points of meeting and mutual and joyful recognition will occur.

But if Science be really destined to expand its scope, and embrace objects beyond the range of merely material relation, it must not altogether and obstinately refuse, even within the limits of such relations, to admit conceptions which at first sight may seem to trench upon the immaterial, such as we have been accustomed to regard it. The time seems to be approaching when a merely mechanical view of nature will become impossible—when the notion of accounting for *all* the phenomena of nature, and even of mere physics, by simple attractions and repulsions fixedly and unchangeably inherent in material centres (granting any conceivable system of Boscovichian alternations), will be deemed untenable. Already we have introduced the idea of *heat-atmospheres* about particles to vary their repulsive forces according to definite laws. But surely this can only be regarded as one of those provisional and temporary conceptions which, though it may be useful as helping us to laws, and as suggesting experiments, we must be prepared to resign if ever such ideas, for instance, as radiant stimulus or conducted influence should lose their present vagueness, and come to receive some distinct scientific interpretation. It is one thing, however, to suggest that our present language and conceptions should be held as provisional—another to recommend a general unsettling of all received ideas. Whatever innovation of this kind may arise, they can only be introduced slowly, and on a full sense of their necessity; for the limited faculties of our nature will bear but little of this sort at a time without a kind of intoxication, which precludes all rectilinear progress—or, rather, all progress whatever, except in a direction which terminates in the wildest vagaries of mysticism and clairvoyance.

Necessity of establishing the Metaphysics in Science.

But, without going into any subtleties, I may be allowed to suggest that it

* M. Comte ('Philosophie Positive,' ii. 376, &c.), the author of the reasoning alluded to, assures us that his calculations lead to results agreeing only approximately with the exact periods, a difference to the amount of 1·45, the part more or less existing in all. As he gives neither the steps nor the data of his calculations, it is impossible to trace the origin of this difference,—which, however, 'must' arise from error 'somewhere,' if his fundamental principle be really what he states. For the Huyghenian measure of centrifugal force $\left(F \times \frac{V^2}{R}\right)$ "combined" with "the law of gravitation" $\left(F \times \frac{M+m}{R_2}\right)$, replacing V by its equivalent, $\frac{R}{P}$ can result in no other relation between P and R than what is expressed in the Kelplerian law, and is compatible with the smallest deviation from it.

Whether the sun threw off the planets or not, Kepler's law 'must' be obeyed by them when once fairly detached. How, then, can their actual observance of this law be adduced in proof of their origin, one way or the other? How is it proved that the sun must have thrown off planets 'at those distances, and at no others,' where we find them,—no matter in what times revolving? 'That,' indeed, would be a powerful presumptive argument: but geometer will venture on such a 'tour d'analyse?' And, lastly, how can it be adduced as 'a numerical coincidence of an hypothesis with observed fact' to say that, at an unknown epoch, the sun's rotation ('not observed') 'must have been' so and so, 'if' the hypothesis were a true one?

† Mill. Logic, ii. 28.—Also, 'Vestiges of the Creation,' p. 17.

* Vide Beneke, Neue Psychologie, s. 300 et seq. for an admirable view of the state of metaphysical and logical philosophy in England.

is at least high time that philosophers, both physical and others, should come to some nearer agreement than appears to prevail as to the meaning they intend to convey in speaking of causes and causation. On the one hand we are told that the grand object of physical inquiry is to explain the phenomena of nature, by referring them to their causes: on the other, that the inquiry into causes is altogether vain and futile, and that Science has no concern, but with the discovery of *laws*. Which of these is the truth? Or are both views of the matter true on a different interpretation of the terms? Whichever view we may take, or whichever interpretation adopt, there is one thing certain,—the extreme inconvenience of such a state of language. This can only be reformed by a careful analysis of this widest of all human generalizations, disentangling from one another the innumerable shades of meaning which have got confounded together in its progress, and establishing among them a rational classification and nomenclature. Until this is done we cannot be sure, that by the relation of cause and effect one and the same kind of relation is understood. Indeed, using the words as we do, we are quite sure that the contrary is often the case; and so long as uncertainty in this respect is suffered to prevail, so long will this unseemly contradiction subsist, and not only prejudice the science in the eyes of mankind, but create disunion of feeling, and even give rise to accusations and recriminations on the score of principle among its cultivators.

The evil I complain of becomes yet more grievous when the idea of *law* is brought so prominently forward as not merely to throw into the background that of *cause*, but almost to thrust it out of view altogether; and if not to assume something approaching to the character of direct agency, or at least to place itself in the position of a substitute for what mankind in general understand by *explanation*: as when we are told, for example, that the successive appearance of races of organized beings on earth, and their disappearance to give place to others, which Geology teaches us,—is a result of some certain law of development, in virtue of which an unbroken chain of gradually exalted organization from the crystal to the globule, and thence, through the successive stages of the polypus, the mollusk, the insect, the fish, the reptile, the bird, and the beast, up to the monkey and the man (nay, for aught we know, even to the angel), has been (or remains to be) evolved. Surely, when we hear such a theory, the natural, human craving after *causes*, capable in some conceivable way of giving rise to such changes and transformations of organ and intellect,—*causes why* the development at different parts of its progress should divaricate into different lines,—*causes*, at all events, intermediate between the steps of the development—becomes importunate. And when nothing is offered to satisfy this craving, but loose and vague reference to *favourable circumstances* of climate, food, and general situation, which no experience has ever shown to convert one species into another; who is there who does not at once perceive that such a theory is in no respect more *explanatory*, than that would be which simply asserted a miraculous intervention, at every successive step of that unknown series of events, by which the earth has been alternately peopled and dispeopled of its denizens?

A *law* may be a *rule* of action, but it is not *action*. The Great First Agent may lay down a rule of action for himself, and that rule may become known to man by observation of its uniformity: but constituted as our minds are, and having that conscious knowledge of causation, which is forced upon us by the reality of the distinction between *intending* a thing, and *doing* it, we can never substitute the *Rule* for the *Act*. Either directly, or through delegated agency, whatever takes place is not merely *willed*, but *done*, and what is done we then only declare to be explained, when we can trace a process, an show that it consists of steps analogous to those we observe in occurrences which have passed often enough before our own eyes to have become familiar, and to be termed *natural*. So long as no such process can be traced and analyzed out in this manner, so long the phenomenon is unexplained, and remains equally so whatever be the number of unexplained steps inserted between its beginning and end. The transition from an inanimate crystal to a globule capable of such endless organic and intellectual developement, is *as* great a step—*as* unexplained a one—*as* unintelligible to us—and in any human sense of the word as *miraculous* as the immediate creation and introduction upon earth of every species and every individual would be. Take these amazing facts of geology which way we will, we must resort elsewhere than to a mere speculative law of development for their explanation.

Retrospect.

Visiting as we do once more this scene of one of our earliest and most agreeable receptions—as travellers on the journey of life brought back by the course of events to scenes associated with exciting recollections and the memory of past kindness—we naturally pause and look back on the interval with that interest which always arises on such occasions, "How has it fared with you meanwhile?" we fancy ourselves asked—"How have you prospered?"—"Has this long interval been well or ill spent?"—"How is it with the cause in which you heve embarked?"—"Has it flourished or receded, and to what extent have you been able to advance it?" To all these questions we may, I believe, conscientiously, and with some self-gratulation, answer—Well! The young and then but partially fledged institution has become established and matured. Its principles have been brought to uniformity and consistency, on rules which, on the whole, have been found to work according to the expectations of its founders. Its practice has been brought to uniformity and consistency, on rules which, on the whole, have been found productive of no inconvenience to any of the parties concerned. Our calls for reports on the actual state and deficiencies of important branches of science, and on the most promising lines of research in them, have been answered by most valuable and important essays from men of the first eminence in their respective departments, not only condensing what is known, but adding largely to it, and in a multitude of cases entering very extensively indeed into original inquiries and investigations—of which Mr. Scott Russell's Report on Waves, and Mr. Carpenter's on the Structure of Shells, and several others in the most recently published volume of our Reports, that for the York meeting last summer, may be specified as conspicuous instances.

Independent of these Reports, the original communications read or verbally made to our several Sections, have been in the highest degree interesting and copious; not only as illustrating and extending almost every branch of science, but as having given rise to discussions and interchanges of idea and information between the members present, of which it is perfectly impossible to appreciate sufficiently the influence and value. Ideas thus communicated fructify in a wonderful manner on subsequent reflection, and become, I am persuaded, in innumerable cases, the germs of theories, and the connecting links between distant regions of thought, which might have otherwise continued indefinitely dissociated.

How far this Association has hitherto been instrumental in fulfilling the ends for which it was called into existence, can, however, be only imperfectly estimated from these considerations. Science, as it stands at present, is not merely advanced by speculation and thought; it stands in need of material appliances and means; its pursuit is costly, and to those who pursue it for its own sake, utterly unremunerative, however largely the community may benefit by its applications, and however successfully practical men may turn their own or others' discoveries to account. Hence arises a wide field for scientific utility in the application of pecuniary resources in aid of private research, and one in which assuredly this Association has not held back its hand. I have had the curiosity to cast up the sums which have been actually paid, or are now in immediate course of payment, on account of grants for scientific purposes by this Association since its last meeting at this place, and I find them to amount to not less than 11,167*l*. And when it is recollected that in no case any portion of these grants applied to cover any personal expense, it will easily be seen how very large an amount of scientific activity has been brought into play by its exertions in this respect, to say nothing of the now very numerous occasions in which the attention and aid of Government has been effectually drawn to specific objects at our instance.

As regards the general progress of Science within the interval I have alluded to, it is far too wide a field for me now to enter upon, and it would be needless to do so in this assembly, scarcely a man of which has not been actively employed in urging on the triumphant march of its chariot wheels, and felt in his own person the high excitement of success joined with that noble glow which is the result of companionship in honourable effort. May such ever be the prevalent feeling among us. True Science, like true Religion, is wide embracing in its extent and aim. Let interests divide the worldly and jealousies torment the envious! We breathe, or long to breathe, a purer empyrean. The common pursuit of Truth is of itself a brotherhood. In these our annual meetings, to which every corner of Britain—almost every nation in Europe sends forth as its representative some distinguished cultivator of some separate branch of knowledge; where, I would ask, is so vast a variety of pursuits which seem to have hardly anything in common, are we to look for that acknowledged source of delight which draws us together and inspires us with a sense of unity? That astronomers should congregate to talk of stars and planets—chemists of atoms—geologists of strata—is natural enough; but what is there of *equal* mutual interest, *equally* connected with and *equally* pervading all they are engaged upon, which causes their hearts to burn within them for mutual communication and bosoming? Surely, were each of us to give utterance to all he feels, we should hear the Chemist, the Astronomer, the Physiologist, the Electrician, the Botanist, the Geologist, all with one accord, and each in the language of his own science, declaring not only the wonderful works of God disclosed by it, but the delight which their disclosure affords him, and the privilege he feels it to be to have aided in it. This is indeed a magnificent induction—a consilience there is no refusing. It leads us to look onward, through the long vista of time, with chastened but confident assurance that Science has still other and nobler work to do than any she has yet attempted; work, which before she is prepared to attempt, the minds of men must be prepared to *receive* the attempt,—prepared, I mean, by an entire conviction of the wisdom of her views, the purity of her objects, and the faithfulness of her disciples.

THE PROPERTIES OF AIR AS A MECHANICAL AGENT;

Considered more particularly in reference to Atmospheric Railways.

"Mr. P. Barlow presented, as an appendix to his paper on the atmospheric system, the results of a series of experiments upon the force employed in drawing carriages up an incline plane of 1 in 43 by a stationary engine and rope traction upon the Canterbury and Whitstable Railway. From these experiments it appeared that the stationary engine of 25 h. p., with a rope, would produce an useful mechanical effect, equal to the engine of 100 h. p. on the Dalkey Atmospheric Railway—thus proving by direct facts the deduction of Mr. Stephenson as to the amount of lost power by the latter system. These statements were ordered to be printed with Mr. Barlow's paper."—*From the Proceedings of the Institution of Civil Engineers.*

It seems almost incredible, but it is yet true, that in all the numerous discussions and disquisitions which the introduction of atmospheric railways has produced, notice has not once been taken of the propriety or impropriety of employing an elastic agent for communicating motion. In a former number of this publication it was rigorously proved that the communication of power by the agency of elastic air was attended with an enormous waste *quite independent of the loss by leakage:* that paper was copied into many other periodicals, and has not yet met with contradiction. It has been considered indisputable that in atmospheric railways there was a great waste of power, but unfortunately the waste has been uniformly supposed to be occasioned by friction and leakage. Now it will be our present object to show that the greatest loss of all has been hitherto entirely overlooked, that this loss is irremediable, arising as it does, not from imperfections of machinery, but from the fundamental unalterable properties of matter, that it is therefore beyond our control and ingenuity, and *would exist in an atmospheric railway wholly and perfectly free from leakage and friction.*

We may state, as a general axiom, that elastic substances are unfit agents for communicating the mechanical effect of a prime mover, and in showing how this general truth bears upon the particular case of atmospheric railways, we cannot do better than view that invention historically, and we shall see that in the very first instance in which the air was used for the transference of mechanical power, the cause of failure *arose from no defects in the mechanism employed;* and we must conclude that had the laws of force been as systematically established then as now, this failure, being as it was a clear deduction from those laws, would have been at once conclusive against the hope and possibility of ultimate success.

The original idea, then, of the atmospheric railway belongs to Papin; and we entreat particular and very careful attention to the following exposition of the experiment made by him, because an attentive consideration of that experiment will, we are certain, unravel to the reader all the mysteries of the "atmospheric system," and enable him to grasp accurately and philosophically the whole subject.

Papin's experiment was on this wise. He wanted to pump water out of a mine, and the only motive force for the purpose which he had at his command was a water-wheel turned by a neighbouring stream. He was desirous of making this wheel work the pumps which were to draw off the water of the mine; but he laboured under this disadvantage,—the distance from the mouth of the mine to the nearest point where he could erect his water-wheel was upwards of two miles. His object, then, was to transfer the force of the wheel to a point two miles off; and the agent which he used for this purpose was the AIR. He caused a continuous air-tight tube or pipe to be laid down from the water-wheel to the mouth of the mine. At the extremity of this pipe next the wheel a piston was placed, and worked backwards and forwards in the tube by a crank connected with the wheel: at the other extremity of the tube a similar piston was placed, and this piston was connected with the lever of the pump of the mine. From this arrangement Papin expected to be able to communicate the power effectually through a distance of two miles. He anticipated that as the piston next the wheel was worked backwards and forwards, the piston next the mine would move backwards and forwards through the same distance. What, however, really took place was this—the piston at that mine did in truth move to and fro, but *the extent of that motion was much less than that of the first piston;* in the language of the narrator of the event, the extent of motion which it was necessary to give the first piston in order to work the pumps was "*preposterous.*"

We repeat that a clear apprehension of this experiment will put the reader in possession of the whole case of the atmospheric railways.

Here was, it will be observed, an atmospheric tube without the longitudinal aperture—an ATMOSPHERIC RAILWAY WITHOUT LEAKAGE—and *yet* the waste of power was "preposterous."

Now, we wish to show how the loss of power arose, and we intend also to explain a simple method by which the amount of the loss may be calculated with all the precision of a mathematical investigation. In the first place, then, we will consider what took place in the tube while the piston next the water-wheel—the prime moving piston—was worked backwards and forwards. When it advanced, the air throughout the two miles of pipe was compressed until the second piston could no longer withstand the compression; and when the first piston receded, the air throughout the two miles of tube was dilated till the piston connected with the pumps was moved by the pressure of the external atmosphere. We will, however, confine ourselves to the second case, namely, where motion was produced by the *dilatation* of air, because this is the case of the atmospheric railway.

When the prime moving piston receded, the air in the tube was dilated and consequently pressed with diminished force on the second piston, which therefore was moved by the preponderating force of the external air. Let us suppose, for clearness sake, that the atmosperic pressure is 15 lb. to the square inch, and that the pressure to move the second piston was 10 lb. to the square inch. Well then, in order that the external atmosphere might press on the second piston with an *effective* pressure of 10 lb. we must have the pressure on the tube diminished to 5 lb. to the square inch, because the real atmospheric pressure of 15 lb. being opposed by an internal pressure of 5 lb. the *effective* pressure of 10 lb. would be the result.

Simple as all this may seem it is very necessary for our purpose that it should be clearly laid down. We have then the internal air pressure reduced by dilatation to 5 lb. to the square inch; its pressure undilated being 15 lb. Now, to reduce the pressure in the proportion 5 : 15, or 1 : 3, the extent of dilatation must be in the same proportion, or in order that the air may press with only one-third its original force it must occupy three times its original space. If then it had been requisite for Papin's purpose to have on his second piston a pressure of 10 lb. to the inch, it won,d be necessary that the air in his tube should occupy three times its original space—that is, should occupy a tube 6 miles instead of 2 miles in length!

Let the reader carefully review this argument, for it is one which, as far as the writer is aware, has never been offered except by himself, and then proceed to the application of it to the "atmospheric system." First, however, to fix the idea more clearly, let us suppose one or two variations of the problem. Suppose, for instance, M. Papin wanted only an effective pressure of 7½ lb., then he would have to reduce the internal pressure in the proportion 7½ : 15, or 1 : 2, or the internal air would have to occupy four miles instead of two. If he wanted an effective pressure of 5 lb. only, the internal pressure must be 10 lb. instead of 15, and the reduction must be in the proportion 2 : 3, or the air instead of occupying two miles of tube would occupy three. Or tabulating the results—

For a pressure of	12 lb.	the space occupied by air	= 10 miles,
"	10 lb.	"	= 6 "
"	7½ lb.	"	= 4 "
"	5 lb.	"	= 3 "

In the 1st case the dilatation is five-fold, in the 2nd triple, in the 3rd double, in the 4th one and a half.

To apply these results to the case of the atmospheric railway, it will be seen that to obtain at starting a working power of ten pounds to the square inch on the travelling piston, the *preliminary* dilatation must remove two-thirds of the pressure in the tube, or two-thirds of the air must be pumped out before the train is set in motion. Now, if we exclude the idea of leakage altogether, it will be clearly seen that the whole quantity of air pumped out of the tube from first to last is exactly the quantity occupying the whole tube at the ordinary density of the atmosphere: for as the travelling piston successively occupies every portion of the tube, it must, between the beginning and end of its journey, displace the air in every portion of the tube, and as by our supposition this air passes out through the pumps only, it follows that the amount of air pumped out is exactly the quantity contained in the tube before the pumps began to work. Now we have shown that in order to start with a pressure of 10 pounds to the inch two-thirds of the air in the tube must be pumped out; it therefore follows that of the whole quantity of air pumped out of the tube, two-thirds are exhausted before starting.

Now if we can show that this extraction of two-thirds of the air contributes nothing to the subsequent motion of the travelling piston, we shall have arrived, by a process to all intents as indisputable as a mathematical investigation, at the inevitable conclusion that two-thirds of the motion of the prime mover are expended *without* producing motion in the train of railway carriages.

In the first place, then, we have to consider what takes place in the air-tube after the preliminary exhaustion has been accomplished.

We suppose that the working power of 10 lb. to the inch is maintained throughout the journey, and that consequently the rarefaction of the air is maintained at an uniform degree. Now as the piston advances it would speedily condense the air in the tube unless the pumping were carried on at a rate corresponding to the velocity of the piston's motion. Suppose that in advancing a foot forward it displaced a cubic foot of air, that quantity of air must have passed through the pumps: had a less quantity been pumped out the rarefaction would be diminished, had a greater quantity been pumped out the rarefaction would have increased. In other words, in order to the maintenance of an uniform degree of rarefaction after the piston has been set in motion, the quantity of rarefied air pumped out must be equal to the quantity of that air which *the piston displaced during that period.*

Now it need scarcely be stated that during this state of the mechanic operation of the air there is neither gain nor loss of power. That is, while the piston is in motion and the rarefaction uniform, the work done by the prime mover is exactly measured by the quantity of motion transferred to the train of carriages; for every cubic foot of air pumped out at the station the travelling piston describes a foot of space.

This equivalence then being established, namely the equivalence of the work of the station engines to the effect produced on the train, it follows necessarily that that effect is in no way attributable to the agency of the preliminary exhaustion, and that therefore—and this is the point we had to prove—the preliminary exhaustion before motion contributed nothing to this subsequent motion of the train.

In order to clearly establish this position, we must show that no use is made subsequently of the elasticity or *restitutive* force of the air. For it is by no means necessary that the use of an elastic agent should be always attended with a loss of power; in a steel bow for instance the force exerted in bending the bow is almost exactly measured by the velocity generated in the arrow by the bow while unbending. Here, and indeed in all phenomena of elasticity, there are two distinct operations, first the *external* force exerted to make the elastic body change its form, secondly the *internal* force exerted by the body itself in recovering its form, and this second force is aptly called the *force of restitution*. In the case of atmospheric power, the first external force is that of the station engines in rarifying or *stretching* the air. Now if after this, the air were allowed to recover its original form by its natural elasticity, "the force of restitution" would be exerted. But in the atmospheric railway the force of restitution never is in fact made use of. After the air is stretched to its utmost it is not allowed to recover its original form, but is pumped out and removed altogether, so that its restitutive powers could never be used, even if it were desired to employ them. As a matter of fact the pumping is continued till the carriages have nearly finished their journey, and then their momentum is destroyed by the external application of breaks.

So then, neither at the end of the journey nor during the progress of it is the labour of preliminary exhaustion in any way rendered useful—it is wholly lost and wasted, and we therefore arrive *demonstratively* at this conclusion:—

To procure a working power of ten pounds to the square inch in an atmospheric railway TWO-THIRDS *of the strokes of the station engines are wasted* FROM A CAUSE INDEPENDENT OF LEAKAGE AND FRICTION.

For a working power of 12 *lb. the waste is* $\frac{12}{15}$ *or* FOUR-FIFTHS.

" $7\frac{1}{2}$ " $\frac{7\frac{1}{2}}{15}$ *or* ONE-HALF.

" 5 " $\frac{5}{15}$ *or* ONE-THIRD.

The reader may easily verify these results for himself.

In conclusion, it must be carefully borne in mind that the loss here demonstrated is one wholly different from the losses by friction or leakage: those are losses arising from defects of mechanism, but this is essentially the immediate effect of the fundamental laws of matter; and even could an atmospheric railway be constructed wholly free from leakage or friction, no art could abate, avoid, or even increase, this defect. *It is wholly beyond the power, sagacity, or perseverance of man.* Unless we can make the air cease to be extensible—that is, cease to be air; unless we can subvert THE LAWS OF NATURE, we cannot remove the evil. We may have the most extended notion of the powers of human ingenuity and the future triumphs of science,—but there is *one* clear distinction respecting fitting objects for men's ingenuity, *one* obvious limit to the triumphs of his science. The *distinction* is between efforts suggested by the known laws of matter, and efforts to resist those laws: the *limit* confines man's successful energies to the former of these tasks. And no one has thoroughly comprehended the investigation here made unless he be *certain* that all the mechanical genius which the world has produced could not, if combined, remove from atmospheric railways the defect we have demonstrated; no committee report could remove it, no omnipotent act of parliament could remove it, no "monied interest," however vast, could remove it, no fortunate accident could remove it, and lastly, by no stretch of the imagination, by no freak of the fancy however whimsical and fantastic, can we picture the bare possibility of its removal.

H. C.

ON THE MECHANICAL THEORY OF STEAM.

PROPOSED BY THE "ARTIZAN CLUB."

A Treatise on the Steam Engine has recently been published by a person or persons calling himself or themselves the "Artizan Club;" the work appears in shilling monthly parts, and has now reached its twelfth number. The prospectus, after setting forth the defects of all similar works which have hitherto been written, states the object of the present publication in the following terms:—"Engineers are, up to the present time, unprovided with a key to the difficulties of their calling, such as may be found in almost every other department of industry. It is to extinguish this want, and to enable every man of ordinary intelligence and assiduity, and however humble his means, to become thoroughly acquainted with the Steam Engine, in all its phases, that the present work has been projected; and it may be satisfactory if a summary be here given of its intended contents."

In the eleventh number of the Treatise is a chapter on the "Mechanical Power of Steam," and as the remarks are invested with a certain authority by the presence of a quantity of mathematical symbols, it seems highly important that the *conclusions* arrived at should be correct, for with them only can a large proportion of the readers who have not learned the unknown language of analysis acquaint themselves. The mechanical effect of the condenser of a steam engine is thus detailed—

Suppose that when the steam had raised the piston to 142 feet above the base of the cylinder it were suddenly condensed, it is obvious that the piston would be impelled with a force equal to the pressure of the atmosphere on the piston, and through a height equal to that the piston had been raised by the generation of the steam. In doing this it is obvious that the piston in its descent would raise a weight attached to it equal to the atmospheric pressure, and through a height exactly equal to the maximum height of the piston above the base of the cylinder. If a weight be placed upon the piston in addition to the atmospheric pressure, then, as we said formerly, the piston will not rise to such a height, and consequently upon condensation the weight will not be raised so high either; but to counteract this the weight raised will be greater, and that very nearly in the same proportion. Hence the mechanical power of the steam of a given quantity of water as developed by condensation continues very nearly constant whatever be the force at which it is generated, the difference being in favour of the greatest pressure. We see from this that the mechanical power of the steam of a given quantity of water is the same, whether it be developed by generation or by momentary condensation, and that it remains very nearly constant whatever be the temperature of the steam. Hence we may now state this general fact, which it may be useful to treasure up in the memory.

"A cubic inch of water converted into steam will supply a mechanical force very nearly equal to a ton weight raised a foot high, whether this force be developed by generation or by rapid condensation; and this force will not be subject to considerable variation, whatever be the temperature or pressure at which the water may be evaporated; the small difference being in favour of the greatest pressure."

Now this passage is not a little remarkable, and the conclusion is somewhat startling. We are told that a cubic inch of water will produce exactly the same mechanical effect by generation as by condensation, and this remark is not confined to steam of any particular pressure, but applies as well to a pressure of sixty pounds to the square inch as to a pressure of three or four. The obvious conclusion would be, as the effect is the same for both generation and condensation, that if both those actions were applied to an engine the power produced by the *same quantity of water* would be in all cases doubled,—that in a high pressure engine working at a pressure of 60 lb. the application of a condenser would produce an additional pressure of 60 lb. to the inch, and that in a low pressure engine working at the common pressure of 3 or 4 pounds the gain would be other 3 or 4 pounds. This conclusion, we repeat, is somewhat startling, and we think never before occurred to any one who ever saw a steam engine, or even read about one; for it is generally imagined that the variation of atmospheric pressure is confined to much narrower limits than those here suggested. The pressure of the air in well constructed condensing engines (such as those of the Government steamers for example), is usually taken at about 12 lb. to the square inch, but it appears from the above quotation that the pressure is sometimes as much as 60 lb. to the square inch, and sometimes no more than two or three; so that while the engineers of the Government steamers imagine that by condensing steam of three or four pounds pressure the effective pressure becomes 15 or 16 pounds, they in reality command no greater working pressure than four to six pounds.

It will be observed that in the experiment suggested in the quotation above, the piston is supposed to return through the same space as it advanced,—so that, if a steam pressure of 60 lb. would act on it through two feet as it advanced, an air pressure of 60 lb. would act on it through two feet as it returned! Or, as we said, the *same quantity of water* producing the same effect by either kind of action, the effect is doubled if it act by both at once. By the ordinary method, however, of viewing the subject, there is only one *one* degree of steam pressure for which it could be true, namely, for that which equals the atmospheric pressure.

On the theory laid down above, the writer proceeds to certain analytical investigations of the power of condensing engines. From these we make the following extract.

Hence, neglecting the waste and the friction of the piston rod, we have for the mechanical effect of one cubic foot of water, as developed by condensation,

$$5354\ (459) + \left\{1 - \frac{f_1}{f}\right\} = \frac{5354\ (459+t)\ (f - f_1)}{f}$$

lbs. raised one foot. Before leaving this, we may also estimate the losa resulting from friction of the piston rod. Let f_2 denote the friction of the piston rod, which friction we suppose constant. It is obvious that this friction operates in exactly the same manner as the uncondensed steam. The mechanical loss resulting from it will therefore be represented by

$$\frac{5354\ (459+t) f_2}{f}$$

lbs. raised one foot.

We are not going to discuss the equations which we have quoted, but we call the attention of the reader to the meaning of the symbol t which appears in both of them. This t, on looking back, we find to be the temperature of the steam *before* condensation. So that we conclude from the first equation that the force of a single acting engine *after* condensation is in some way dependent on the heat of the steam *before* condensation, and that, of all things in the world, the *friction of the piston* depends on the same cause! The resistance to the piston at any time is determined by the heat of the steam which *was* in the cylinder some time previously! A nice notion the writer must have of steam engines.

If the reader examine the same subject in M. le Comte de Pambour's admirable work *The Theory of the Steam Engine*, he will find the beautiful simplicity of M. de Pambour's views to be only equalled by the perspicuity with which they are expressed.

In the treatise of the "Artizan Club" we have, immediately after the passages quoted, some peculiar notions on the employment of steam expansively.

In order that the piston rod should remain at rest, it is necessary that the pressure upon the piston should equal the elastic force of the steam. If the load upon the piston be in the smallest degree below this, the piston will be forced up till the increased expansion has so diminished the elastic force of the steam as not to move it higher. * * * * The mechanical effect gained by removing at once the load necessary to allow the piston to take the position, is smaller than what would be gained by taking the load off gradually.

We wish to direct the reader's attention to the last sentence. The statement is this, that if the load on the piston be diminished gradually the effect of the steam will be greater than if part of the load be taken off suddenly. This proposition, even were it true, is by no means clear enough to be stated axiomatically, without a demonstration. But there are many reasons for pronouncing it untrue. In the first place, it would lead to this conclusion—that the amount of a force is regulated by the external resistance opposed to it. The problem is essentially a dynamical one, and by all the laws of dynamics the effect of a given force of any nature whatever is the same whether a great or a small resistance be opposed to it. In the first case a small, and in the second a great velocity would be produced. To take an illustration; the elastic force of a bow would be accurately measured by the motion it produced whether it acted on a large arrow or a small one. Let us suppose the law of elastic force the same for the bow as for steam, proportional to the compression, then we have a case exactly in point. But as the size of the arrow does not alter the elastic force of the bow, we cannot imagine that there would be any gain of force were it possible to diminish the arrow while the bow was acting on it, and in the same way the effect of the steam cannot be altered by altering the mass of the piston.

To examine the question analytically—let x be the height to which the piston has ascended at the time t; M its original mass. As far as may be collected from the quotation, the mass is supposed to vary inversely as the height of the piston: $M \div x$ is therefore the mass at the time t. Let $\frac{f}{x}$ be the steam force, then for the instant succeeding the time t the equation of impressed and effective forces is

$$\frac{M}{x}\frac{d^2x}{dt^2} = \frac{f}{x} - \frac{M}{x}g$$

But this equation is identical with the equation for the motion when the mass is unchanged, viz.,

$$M\frac{d^2x}{dt^2} = \frac{f}{x} - M\,g.$$

That is, the *vis viva* generated is the same in both cases.

It is, however, scarcely necessary to be thus explicit, for the author himself makes a deduction from his theories which is certainly one of the most notable in the whole range of mathematical authorship.

Suppose the volume of steam before expansion to be to the volume after expansion in the proportion of 1 to n; in other words let $x = n\,b$, then remembering that, as we have shown previously,

$$p\,b = 5354\ (459+t)$$

we find for the mechanical effect of the expansion E pounds raised one foot high, where

$$E = 5354\ (459+t)\log_\epsilon n.$$

We learn from this that not only is mechanical effect gained by using expansion, but that there is no limit to this gain other than the inconveniences arising from the too extensive application of this principle in practice. The above formula will be useful for determining the amount of mechanical effect gained by cutting off the steam at different parts of the stroke. To facilitate the application of this formula we shall just state the values of n when the steam is cut off at different parts of the stroke. If the steam be cut off at $\frac{1}{2}$ stroke, then $n=2$; if the steam be cut off at $\frac{1}{3}$ stroke, then $n=3$; and generally, if steam be cut off at $\frac{1}{m}$ stroke; then $n=m$, or more generally still if the steam be cut off at $\frac{p}{q}$ stroke, then $n=\frac{q}{p}$.

From the equation "for the mechanical effect of the expansion" we learn that this effect increases as $\log n$ increases, and consequently is infinitely great when n is infinite: and we are told that there is in theory "no limit to this gain." Putting these two remarks together, we come to the following conclusions.

First, a limited force may be made to produce an unlimited effect.

Secondly, putting $n = \infty$, and cutting off the steam at the $\frac{1}{\infty}$ stroke, if *no* steam be admitted the power of the engine is infinitely great.

What, then, is the use of having a boiler?

From all which we conclude that the mathematical theories of the "Artizan Club," though not irresistibly conclusive, are irresistibly comic.

H. C.

ON THE EXPANSION OF BRICKWORK,

(Considered with Reference to a Chimney Shaft, at Mr. Cubitt's Works, at Pimlico.)

Paper read at the Institution of British Architects, April, 1845.

The chimney to which I propose to direct your attention is an object of interest, from the proof it affords of the power of heat, in expanding materials—in which such expansion is generally overlooked. The shaft is encased in a tower, without being any where in contact with it, or any part of the adjoining buildings: great care having been taken while building, to keep the chimney quite free from all the other work. None of the floors or landings of the tower were allowed to touch the shaft; the intention being to permit it to move up and down freely, as the heat acted upon it—thus preventing that displacement of materials in the tower which would otherwise have happened. This shaft is built of brick, which is perhaps of all materials, the least affected by change of temperature, and yet it is found that the shaft differs in height considerably, even with the change arising from the comparatively slight variation in the height of the smoke and vapours passing through it. This variation is never more than 250° Fahr., and yet the shaft at the height of 90 feet alters, or rises, nearly $\frac{3}{8}$th inch with this change only. This shows that the materials with which an architect, engineer, or builder has to deal, are always varying in their bulk, and that no two sides of a building are at all times of the same height, except when there is an unusally uniform and still atmosphere; and of course the external walls of the tower which support the floor, from which this variation is measured, are also subject to constant changes, by alteration in the heat of the atmosphere. Thus it is seen that a variation in size with every change of temperature, must take place in the external parts of all buildings, even a garden wall cannot be of the same height on both sides, when there is more sun, wind, or rain on the one side than on the other.

The chimney is parallel, and the internal diameter in 5 feet; its height from the surface is 108 feet. The foundations were laid at a depth suitable to the nature of the soil, being on a layer of gravel 11 feet from the level of the ground; and in order to spread the weight of the building over a large surface, a bed of concrete was formed 23 feet square, and 3 feet in thickness; on this a mass of brickwork 21 feet square, 2 feet thick, was laid in cement, forming a solid block, equal to being in one piece of stone, like a large solid landing, to carry the upper work. In the centre of this foundation, and through the whole of the before-mentioned brickwork, a well 18 inches diameter was left, and taken down below the water line deep enough to insure the lower extremity of a lightning conductor being always under water. The walls of the tower are 14 inches thick from the bottom to the top, and inclose a space of 14 ft. 9 in. square in the clear at base, and 1 foot less at the top: the tower being tapering, stairs are built in the walls for the purpose of communicating with the belfry and clock room, and with a supply cistern for steam boilers; also for easy access to the top of the chimney, to ascertain what is occurring there, with respect to the temperature of the vapours emitted, and that in case too much heat were given out or wasted at the top, where it could no longer be of any service, such waste might not happen without means of ascertaining the fact that it was occurring.

The smoke shaft in the centre is for 24 ft. 3 in. upward, from footings 1½ bricks in thickness; but at the base, where the flues enter, it is strengthened round the openings by an additional brick in thickness. So far the work is done with bricks of the usual form and size; but above this, they are segment-shaped, and were made purposely for the shaft. In the second piece, 11 ft. 3 in. in height, the work is 10 inches thick; in the third piece, 40 ft. 3 in. in height, it is 9 inches in thickness; in the fourth piece, 17 ft. 9 in. in height; it is 8 inches in the fifth piece, 17 ft. 3 in. in height, it is 7 inches, and in the remaining height the work is 6 inches in thickness.

The first object aimed at in designing the tower, was to conceal the chimney shaft; the appearance of which was thought to be objectionable to the neighbourhood. As it was intended that no black smoke should be suffered to escape, it seemed that if the chimney were concealed from view, its existence might remain unknown; but it was also considered that other direct advantages might be gained to justify the erection and compensate for the increased outlay. These expected advantages have been realized.

A considerable saving of fuel has been effected owing to the chimney being protected from a cold atmosphere, from rain or snow beating against it, which would rob it of its heat, in proportion as the evaporation from the outer surface was more or less rapid. There seems however as much propriety in protecting a chimney from cooling influences, as there is in clothing any other part of the flue, or steam boiler itself; for in order to insure a sufficient supply of air to support combustion, it is necessary that the ascending smoke and vapours should have been heated, so as to become in the required degree lighter, than the external air. In the degree that the strength or force of the draught is required to be increased, so must the air and vapours given off from the furnace be allowed to pass at a higher temperature; consequently, the amount of the difference of heat lost from a chimney exposed to the weather, and from one clothed, is by so much a clear gain.

The height of the tower affords sufficient pressure to make available, a capacious cistern fixed at its top for supplying the steam boilers with water, thus giving great power to the person who has charge of the engine, should occasion require its being brought into action, either through the failure of the force pump, or through evaporation of water from the boilers, or neglect in filling them at the proper time, thereby diminishing to a very great extent the risk of explosion from such causes, or at least rendering the boiler less liable to be deranged.

It will be observed that the shaft is much thinner than it could have been had it been erected without its casing. The quantity of brickwork saved in the shaft, and the economy of fuel, will go very far towards paying the additional cost of the tower, which may therefore be considered as a matter of very little, if any, additional cost, when the advantages are all taken taken into account.

ON THE ABUSE OF OIL AS NOW USED IN PAINTING, AND THE INVERSION OF PRACTICE NECESSARY TO SECURE PERMAMENCE IN PICTURES.

No. III.

The truth of the proverb "*humanum est errare*," obvious as it is in all the acts and theories of man, never was more perfectly demonstrated than in the present practice of painting. It appears to be an ordination that the moment he makes a discovery and succeeds in applying it *well*, his restless ambition to do *better* becomes the track of his retrogradation. Painting had no sooner left the high-road of encaustic than wax rapidly sank in the painter's estimation; resin, at first the mere modifier, became the agent in chief; oil, doubtless from its brilliant effects on colours and its powers of working, succeeded, and, in Leonardo da Vinci's hands, became the grand panacea: now, could Leonardo rise from the grave, I have little doubt but he would tell us "his pure oil was *le grande ouvre*." Alas, we have a living instance of such blindness in man; and perhaps more unpardonable, for the living man professes to teach in his public prelections that which in his own private practice evaporates in smoke. I have myself asserted, in reply to M. Merimée's foolish crotchet,[1]—so foolish that any tyro can disprove it in five minutes,—that "there never was and never will be a varnish made which gives half the brilliance of pure oil alone;" but this power has palpably its limits—brilliance is not permanence; and Mr. B. R. Haydon, in the conclusion[2] of his scraps of Reynolds's M.S. diary—which could only be valuable to man as a whole—seizes on this reply to Merimée to give his premonitory cautions to the *rising artist* against using *any* but *pure and simple agency alone* (meaning oil), with certain flourishes about Titian, as if any man had ever yet libelled Haydon's colouring by an ironical allegation of semblance. In the first place, Haydon cannot prove that Titian used pure oil alone: nay, common sense inferences are against the bare supposition, for Titian's pictures are notoriously more perfect than those of Da Vinci, who did use it lavishly, as testified in his own handwriting. Haydon's private practice denies, in the next place, his public doctrines.

Oil gives inimitable splendour, but, obviously, no permanent picture ever was or ever will be painted with it alone. Every boy knows oil rises, and skins, and horns, in defiance of every ordinary shift of the painter's art; and though a picture painted in Italy will carry safely double the quantity of oil any English painting will allow, even there it shows the cloven foot,—as evidenced in Leonardo's observance of this rising, in Cennini's use of ultramarine with white lead to cover the yellow, and John Thompson's green skies of ultramarine glazed in McGelp upon *gluten without oil*. But, as it may be alleged this is my assertion only as to Haydon's practice, let us see his printed confession. In his concluding scrap from Sir Joshua's diary in the February number of this Journal, he has registered the fact thus:—"*Præcipe—on raw cloth senza olio, Venice turp. et cera. (Seen by Sir George the year before it was burnt at Belvoir*, and said by him to be perfect.—B. R. H.)" Again, in the same—"1781. Dido, oil. (*In beautiful condition*.—B. R. H.) Manner—colours to be used, Indian red, light ditto, blue and black *finished with varnish without oil*, poi ritoccato con giallo."

Now here, in *two special cases*, we have his own assurance of *beauty* and *preservation*, very rare with Reynolds and *not due to oil*; but more of Sir Joshua anon; and I deny *in toto* that he used "*every gum, every spirit, every oil, which earth produces*:" he used many, it is true, and abused more, for a more wavering, empirical man in practice never breathed; and it is somewhat strange that the greatest practical truth Sir Humphry Davy ever committed to print, viz. that "all oils become varnishes in time," arose out of his profound practical ignorance:[3] he was perfectly innocent of the fact of many of the pictures examined by him having been painted in solutions of resin, in fact almost all resin, and that to such they were indebted for their permanence alone.

There is, however, yet another and most material source of change in all modern pictures, not at all suspected by the artist, and arising out of the total neglect of climate, and the blind abuse of what, in the first instance, was doubtless a great convenience if not a high improve-

1 That copal "brightens colours without increasing their drying power."

2 In the February Number, page 41.

3 This is palpable; and, I repeat, Davy was practical on nothing but salmon fishing; his every attempt at "practical science" was a deal failure—save alone the decomposition (by better agency than Baron Borne possessed) of the alkalies; witness his Galvanic Defenders and the Explosion Lamp. Indeed he knew it and felt it; hence arose his suggestion of a College of "Practical" Chemistry, which, God knows, is much wanted. The theoretic gentry amply exposed themselves in a late trial, as well as in that of Bellany, in which really toxicologists and jurists, without ever having saved a single life, dared to peril that of another, or gave scrap evidence, collected from bad books and out of date authorities

ment,—I mean the use of bladder colours,—and however gross the abuse, however clear the demonstration of its ill effects, I know sufficient of artists to doubt whether practice will accompany conviction.

The painters of Cennini's day—and I imagine the practice was equally antecedent and subsequent thereto—used powder colours ground, as with us, impalpably in turpentine or rectified naphtha, and very carefully preserved them in covered vases or bottles; they frequently kept them also under water. Now any and every pigment thus treated would dry too fast by half in Italy, and consequently oil, as a softener, would be a *sine quâ non*. Indeed, Wilkie assured me, in 1821, he had seen olive oil used, by necessity, to prevent drying. Now what is our practice, in an hyperborean climate obviously demanding less oil and more forcing? Why, from sheer indolence and a foolish impression of saving time, we fly to bladder colours saturated with oil, and often changed by it *(as in lakes)* into a real analogy of soap; the colourman of course using such oil[4] as remains green the longest. Here, then, in opposition to climate and common sense, we use a profusion of the noxious agency, and increase the evil by adding *bleached oil*, and dry the whole by boiled oil and McGelp. Is this rational, or is it the acme of human absurdity? Habit and prejudice go far, and yet surely no intelligent artist can fail to see this. Still demonstration is better than assertion. Let him try, then, the ancient practice and modern one in juxta-position; let him rub a little lake, finely ground in turpentine and quite dry, with a little copal varnish, and it will dry too fast for any man's use,—he may now add oil here, by the drop, and he will see at once its beautiful powers, and, moreover, this *bad dryer* dries at his pleasure: now reverse the experiment, follow the modern practice—take flake white from the bladder, and one of the best of dryers requires from twenty-five to forty-eight hours (if flooded with oil) in defiance of copal, that is, what is called copal.

Practical experience, a thousand times repeated, teaches me that if Correggio, Anselmi, and Rubens could rise from the tomb and give to a modern English artist the identical vehicle each had used, (although he would improve in tone, brightness, depth, and impasta,) he would not make *a* permanent picture, much less *so* permanent an one as they did; nor could *they* do so, in this climate, with our bladder colours and abuse of oil; while, the same experience tells me as clearly, by inversing the practice, returning to the ancient use of powder colours, and using oil, as Merimée would copal, to "*brighten colours*," to give body, richness, and standing out power, this artist would paint, in defiance of climate, as permanently as they did, and, maugre the little trouble of mixing on the palette, in half the time he does now. Tubes[5] it is needless to name; no greater curse was ever invented to swamp an art. I have again and again repeated the assertion that permanence in oil painting is dependent on vehicle alone; bearing this in mind and inversing the order of manipulation, remembering that the resinous principle is the source of preservation—as wax and resin were in Greek pictures,—and that *no chemical agency exists to supply their places*, few artists will make changeable ones.

To show, however, how readily we may be mislead, and how easily even the possessors of a really more valuable secret than that which Leonardo da Vinci bequeathed to posterity for refining oil, might and did fall into error. Carry this principle to excess in a simple experiment, — flake white in the vehicle alone use *no raw oil*, and however rapidly it may dry, however beautiful it may look, however hard, without crack, it may become, it changes *more rapidly* than lead and raw oil before sulphuretted hydrogen,—and why? the resin, dissolved in the oil, has so perfectly overcome the rising that *without fresh oil* you have neither the luscious richness of texture nor skin enough to preserve it from the action of the gas; *ergo*, this small quantity of raw oil is a *sine qua non* of permanence and beauty combined, and it is the excess of oil alone I have endeavoured to combat; that excess which Haydon vaunts at the moment he gives an example of the value of its absence *in toto*. And these experiments refer more specially to lead and those metallic colours which readily oxygenize oil and increase its skinning power: lead being, in flake white, the beacon and the guide. So special, indeed, does all my experience bespeak it, I hope to be the means of destroying the use of lead ground in oil alone, as fervently as I hope to destroy the use of tubes, which are adapted only for plaster of Paris and McGelp men.

Davy blundered on that which Reynolds[6] saw distinctly and practically; but, unfortunately, his hasty temperament and vacillating mind led him into false, blind, and stupid experiment. Neither asphaltum nor McGelp, bad as they are, *could* have cracked in any other hands as in those of Sir Joshua; first, because he was perfectly ignorant of any agent capable of giving them toughness without horny skin; and secondly, because even had he possessed such an agency, his very method of painting ensured crack,—egg, Venice turpentine, varnish, wax, &c., touched upon each other, and therefore drying[7] in various degrees and intensities, as any man may readily conceive himself; indeed, scores of pictures have cracked with simple varnishes, not in themselves *disposed to crack*, from this cause, when, had they pervaded the whole texture of a picture, ever so slightly, they would never have cracked at all.

Much is said and written daily about the march of science and progress of art, but I am afraid we have many Sir Joshuas, without a tithe of his real worth, and more than one Davy, in assumption, with none of his naturally bright mind; as a necessary consequence, therefore, painting, like medicine, dwindles into froth and self-conceit, and the pretended progress of science is but the apple-pip toxicology and rabbit-squeaking physiology which disgraces the arts and paralyzes the efforts of man;[8] but to return.

Abstract principles must bend to climate, to habit, and to prevailing modes of manipulation to a certain degree. My own spirituous and resinous vehicle has its defects; it does not sufficiently bear up, it does not lay precisely where and as the touch is placed, pile on pile does not lay to please many artists; I have, therefore, combined its powers in oil alone, and believe, under the conditions above enumerated, it is as perfect as my experience can make it; and I have combined it also in a substitute for McGelp; but, in taking my leave of the Fine Arts for life, I cannot, among the conflicting wants and wishes of artists, forget the Fable of the "Old Man and his Ass," or, that he who follows the maxim of Horace[9] is perhaps, during life at least, as much *respected* after all as either the philosopher or the philanthropist.

W. Marris Dinsdale.

May 1, 1845.

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4 Hence the colourman values nut oil of which he is necessarily as liberal as possible.

5 To my certain knowledge one colourman varnishes his tubes internally; while another has received orders, 'more than once,' "not to send old tubes," under the supposition that old and dirty ones had really been used, from the deteriorated state of the colours.

6 Reynolds saw correctly the positive use of resin and varnish, in some way or other, by the older painters, but misapplied both.

7 Let any man mix a little lake (previously ground in turpentine and dry) with copal varnish, and touch it on flake white "in oil," when only "half dry," this lake will dry on the "wet surface" in four or five hours, and crack infallibly in three days—such is the theory of Reynolds's miserable use of varnish, venice turpentine, &c. &c.

8 I could fill a volume with proofs as strong as Holy Writ, and heartily wish success to the College of Practical Chemistry, although I have some misgivings as to the practical character of its teachers,—where will you get them?—The twaddle about Leibeg is beneath us.

9 "Get place and wealth—if possible—with grace,
"If not—by any means—get wealth and place."

ON THE INTRODUCTION OF CONSTRUCTIONS TO RETAIN THE SIDES OF DEEP CUTTINGS IN CLAYS, OR OTHER UNCERTAIN SOILS.

By Professor Hosking.

Paper read at the Institution of Civil Engineers.

Deep cuttings are not only expensive, but their sloped sides are in most soils so uncertain, and subject to so many contingencies—involving unforeseen outlay, as well as danger to the works, and incidently to human life also;—that any mode of operation, which would have the effect of rendering them more secure, though the original expense were not reduced, would be deserving of consideration; but if it can be shown, that perfect security can be obtained at reduced cost, the consideration becomes even more interesting. The expense of the first formation of a cutting under given circumstances is easily calculable, and so is the time within which the work may be effected. Experience has proved that there is, for every soil, a limit in depth, beyond which it becomes more expedient to drift the required way, and construct an arched tunnel of sufficient dimensions, than to make an open cutting with the requisite slopes. Even when the first cost would not decide the question, the preference is nevertheless, often given to the tunnel because of the greater security of constructed work, than of the sides of an open cutting. There is, indeed, in practice, a considerable range, within which it has always been uncertain whether—taking all things into consideration in each particular case—tunnelling or open cutting is the fitter expedient and it is in this intermediate range, that something seems to be desirable, which has not hitherto been practised.

A tunnel, it may be remarked, is expensive, not from the nature and extent of its construction, but from the circumstances in which those constructions must be executed. The mere constructions are less than would be consumed by common retaining walls to the sides

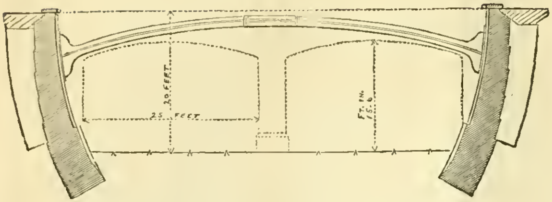


Fig. 1.—Transverse section of the Euston Incline retaining walls, &c. (The dotted lines indicate the outline of one of the galleries.) Scale.—1 inch to 20 feet.

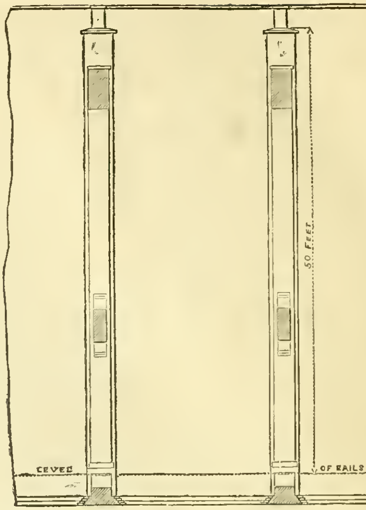


Fig. 5.—Longitudinal section. Scale.—1 inch to 16 feet.

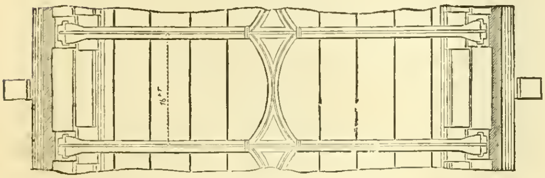


Fig. 2.—Plan.

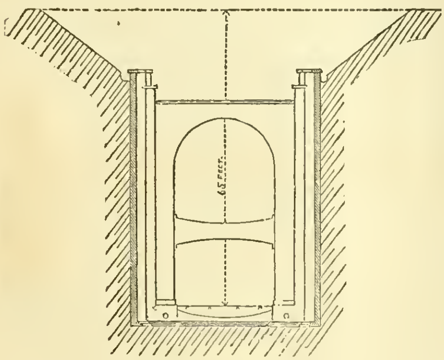


Fig. 3.—Transverse section through the centre of a Bay. Scale.—1 inch to 32 feet.

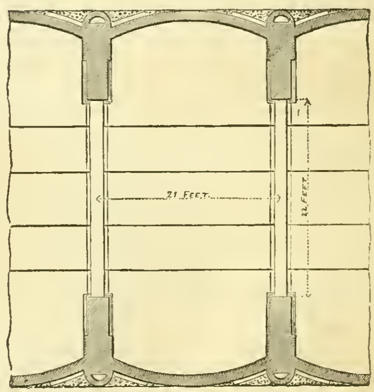


Fig. 6.—Plan.

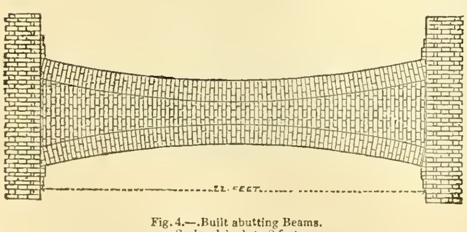


Fig. 4.—Built abutting Beams. Scale—1 inch to 8 feet.

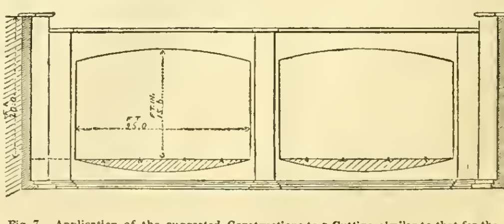


Fig. 7.—Application of the suggested Constructions to a Cutting similar to that for the Euston incline. Scale.—1 inch to 20 feet.

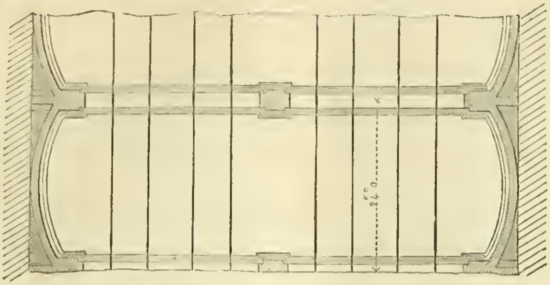


Fig. 8.—Plan.

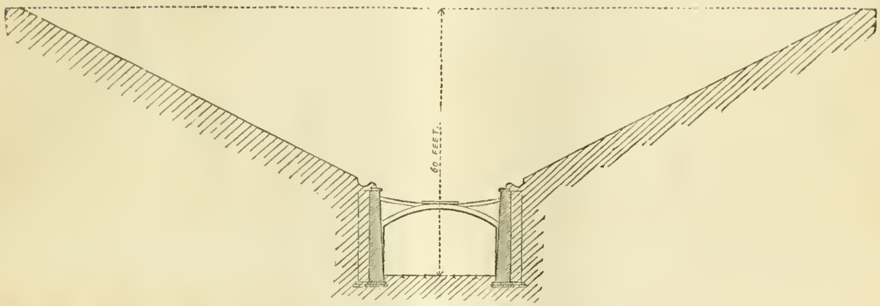


Fig. 9.—Transverse section of the Chorley Cutting, with stone Struts.
Scale.—1 inch to 32 feet.

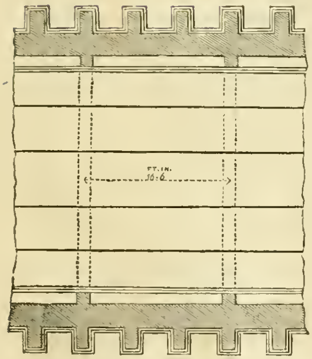


Fig. 10.—Plan of the Constructions in the Chorley Cutting.
Scale.—1 inch to 16 feet.

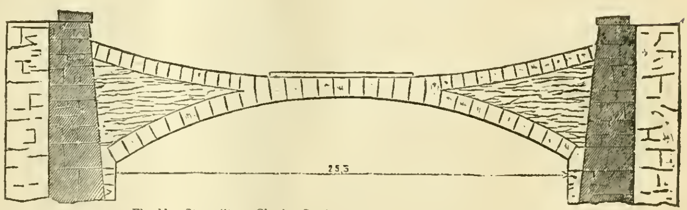


Fig. 11.—Stone Strut, Chorley Cutting. Scale.—1 inch to 8 feet.

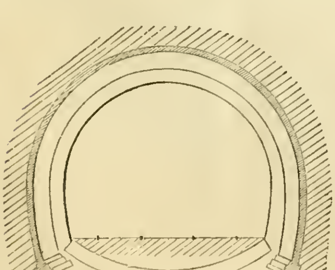


Fig. 12.—Mose Tunnel.—Transverse section.

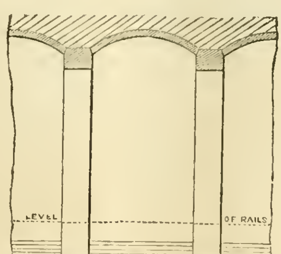


Fig. 13.—Moseley Tunnel.—Longitudinal Section.
Scale.—1 inch to 16 feet.

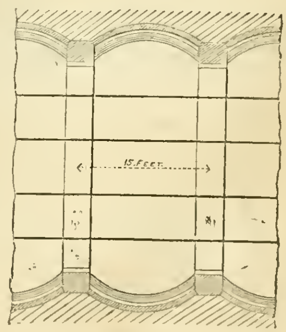


Fig. 14.—Moseley Tunnel.—Plan

of a cutting, not deeper than the eighth of an ordinary railway tunnel. The several parts of a tunnel derive support from each other, which is not the case with ordinary retaining walls, whose efficiency depends wholly upon the resistance which their own mass or weight and extent of base, enable them to offer to the pressure of the body to be retained. If to two opposite retaining walls, be given sufficient means of assisting one another, they may be at once reduced to one-third of the bulk they require without such assistance and would then be as safe as the sides of a constructed tunnel, the strength of which is only limited by the power of the setting material employed in the work, to resist compression.

Before proceeding to the consideration of the means of enabling opposite retaining walls to assist each other, it may be worth while to consider, whether retaining walls are generally constructed in such a manner, as best to adapt their components to the duty to be performed. No one would place a buttress intended to resist the thrust of an arch, within the springing walls, or under the arch whose thrust is to be resisted; yet in the construction of retaining walls the counterfort is placed on that side which receives the pressure, where its utility is very questionable, except to keep the retaining wall from falling back against its load, which, from the transverse section too generally given to such walls, they would be apt to do, if they were not so propped up by their counterforts. Wharf and quay walls, and the revetment walls of military works, may require a fair face, unbroken by projections in front, but this is not the case with retaining walls for roads and railways, where a long line of projecting buttresses would be unobjectionable, the counterforts becoming buttresses and merely changing places with the wall. On account of the common practice of battering the faces of retaining walls in curved lines and of radiating the beds of the brickwork composing them from the centre of curvature in every part, the back of the wall must contain more setting material than the face, with the same quantity of solid brick; that is, if the work be bonded through. Hence the back of the wall will be more liable to compression and settlement than the face. Counterforts must be built in the same courses, and consequently must have still thicker beds of compressible mortar than the wall, or the bond between the wall and its counterfort must be dropped and the counterfort thus become utterly inefficient. Perceiving the fallacy of the back counterforts, as an aid to the retaining wall to resist pressure from behind, the author designed a retaining wall a few years ago, with greater substance in itself than the usual practice would require, but without back counterforts. The wall was substantially of brickwork, with concrete coffered in the heart, to give mass and weight without the expense of solid brickwork; the concrete being in layers of 30 inches thick, separated from one another by two thorough courses of brickwork in every twelve courses in height. The wall was battered in face upon a curved line and had radiating courses of brickwork; but the arrangement spoken of, gave the means of making the longer line of the back of the wall with bricks instead of mortar, by inserting within the height of each coffer at the back, an additional course of brickwork; and the whole construction was well tied together, both longitudinally and transversely, with hoop-iron laid between the thorough courses of brickwork.

The retaining walls, in the cutting upon the line of the extension of the London and Birmingham Railway, from Camden Town to Euston Square, are designed according to the common practice; they are built wholly of brickwork in radiating courses and with counterforts following their own contour. In this case the centre of gravity of the wall falls wholly behind its base; and the counterforts, not commencing until the wall has reached one-third its height, render it still more dependent for support upon the ground it is intended to retain. It is well known that these extensive walls, though furnished with all the collateral works necessary to protect them from exposure to undue influences and although set nearly one-fourth of their height in the ground, have failed to a considerable extent. A system of strutting with cast-iron beams, across from the opposite walls, to make each aid the other, has been applied to meet the exigency (figs. 1 and 2); but this is limited to the upper parts of the walls and the author thinks it may yet be found, that the toes of the walls will require to be strutted apart, or otherwise fortified.

Abutting struts from opposite walls, occurring at intervals only, leave the intermediate portions of the walls exposed to pressure from behind without support, unless these intermediate portions are so disposed, as to communicate the pressure upon them to the struts. Hence a common retaining wall, abutted at intervals, would require these intervals to be more or less distant, in proportion to the strength of the wall between them. Instead, therefore, of a continuous wall on each side of the cutting, the author suggests (figs. 3, 4, 5, and 6), that buttress walls should be placed at intervals, opposite to one another, and strutted apart at their toes by an inverted arch, and above, at a height sufficient for whatever traffic the cutting is to accommodate, by a built beam of brickwork, in vertical courses, supported on an arch, and prevented from rising under the pressure by an invert upon it. This built beam will then be, as it were, a piece of walling turned down on its vertical transverse section, and will resist any pressure brought upon it through the buttress walls, to the full extent of the power of such a wall built vertically, to bear any weight laid upon its summit; the pressure would be applied, in the line of the greatest power of resistance, and there would be no tendency to yield, except to a crushing force. Let such transverse buttress walls, so strutted apart, with the road between them, be the springing walls of longitudinal counter-arched retaining walls, which, being built vertically and in horizontal courses, but arched in plan, against the ground to be retained, will carry all the force exerted against them to their springing walls and the springing walls or buttresses will communicate, through the struts, the power of resistance of each side to the other and thus insure the security of both. This arrangement may be carried to any extent in height, by repeating the abutting beam or strut at such intervals as the thrust to be resisted and the strength of the buttress-springing-walls may require.

It will be admitted, that whatever insecurity there may be in the sloped sides of a cutting, becomes greater, as the depth is increased, the inclination being the same; so that a slope of 40 feet in vertical height is not deemed so trustworthy as a similar slope in the same place of 20 feet in height and, indeed, to give the same degree of security, as the height increases, the inclination of the slope must be increased. Consequently, the expense of a cutting with slopes, increases even in a greater degree than the mere additional depth would require, and if it can be shown, that a cutting 65 deep, in the London clay, or other similar soil, may be made and its sides retained by efficient permanent constructions, at less cost per yard forward than the same cutting would require, with the slopes at which such soils can be trusted to stand,—it will be admitted, that greater advantage would be obtained by the use of such constructions, where the depth is greater; especially where such treacherous soils occur, as those through which the cuttings at New Cross and Forest Hill have been made.

It will not be exaggerating the case against sloped sides in clay cuttings, to assume, that they cannot be trusted at less than 1½ to 1, even up to 20 feet in vertical height, nor beyond 40 feet at 2 to 1; nor will it be extravagant to state the slopes for a cutting 65 feet deep, at 2½ to 1. Many instances, besides those of the Croydon Railway cuttings, give conclusive evidence that the London clay and the superposed strata which occur in connexion with it, will not stand at less than 3 to 1 when the vertical height much exceeds 65 feet; whilst the uncertainty connected with 'silty clays' and 'soapy earths,' exposed to the alternate action of air and water and of heat and cold, renders even slopes of that degree of inclination, a subject of constant anxiety and expense. If then, safe and (so to speak) imperishable constructions, can be applied to retain the sides of a cutting in any soil that cannot be trusted at a less inclination than 2½ to 1, at less cost and in no greater time, than the excavation with such slopes could be made,—taking no account of subsequent cost for slips, or for the dry shafts and bushed drains, in some cases, or the gravel revetments and buttresses in others,—there can be no question, but that such constructions would be better than slopes.

It would be for every engineer to decide upon the substance required under the circumstances of any particular case; that assumed in the accompanying diagrams (figs. 3, 4, 5, and 6) is submitted as, in the judgment of the author, sufficient in ordinary cases of clay cuttings, if executed with materials and workmanship of fair average quality, and such constructions may be applied in any such case, where the depth exceeds 40 feet, and the slopes would require an inclination of more than 2 to 1, at less expense than that of forming slopes to the full depth. Of course, shoring to retain the ground, while the constructions are in progress, would form an important item in any such arrangement; but as the amount of earthwork in forming slopes, and the cost of contingencies connected with them when made, must increase, at least as much as the difficulty of temporarily retaining the ground increases, the proposed arrangement would not be deprived of its presumed advantage, as it regards economy, on this account.

The diagams (figs. 3 and 5) represent a cutting 65 feet deep to the level of the rails. It is assumed, that the ground at the top may stand for the first 15 feet at less than 2 to 1, and that it may, therefore, be cheaper to run out to that depth with slopes, leaving 50 feet from the rails, or about 52 feet in all, to be retained. As the bricklayer may follow up the excavator with bay after bay, his work lying mostly on the side and out of the way of the excavator, the latter would run out the spoil without interruption, his work being benched onwards and shored as he proceeded. As every compartment, with its buttresses, invert, abutting beams and counter-arches is complete in itself, the ground being backed against the counter-arches as the work rises, the shoring would come out, and be sent on for use in the forward benches.

To relieve the work from water, a drain being run along over the middle of the inverts, or side-drains being passed by ring culverts through the buttresses, drain-shafts are carried up at the backs of the buttresses against the springings of the counter-arches, to within a few feet of the surface. These shafts being steined with open joints at intervals to admit drainage water and communicating with the drains below, would prevent the possibility of water lodging or accumulating about the backs of the counter-arches, or even in the ground itself.

The following estimates give the cost of forming 7 yards forward of an open clay cutting, 65 feet deep to the level of the rails, with slopes at 2½ to 1 and from a base 33 feet wide, at 2 feet below the surface of the rails—and of the cost of constructions as above described and shown in the diagrams. Fair average prices are taken on each side; the earthwork in the heading, where the sides are to be retained, is taken at a higher price than that in the open cutting with slopes, with a further charge for the setting, striking and use of shoring. Contingencies are not charged upon either mode of operation, because they may not be pre-supposed greater in the one than in the other.

WITH SLOPES.

	£	s.	d.
29·3 perches of land, at £160 per acre ..	29	6	0
10,448½ cubic yards of earthwork, at 1s. 2d. per yard ..	609	9	6
	£638	15	6

WITH CONSTRUCTIONS.

	£	s.	d.
7·64 perches of land, at 160*l.* per acre..	7	13	0
753 cubic yards of earthwork in open cutting above the top of constructions, at 1s. 2d. per yard	43	18	6
1720 ditto ditto in heading, at 1s. 6d. per yard	129	0	0
10 ditto clay punned at back of side walls, at 1s. 3d. per yard ..	0	12	6
86 ditto strong gravel ditto, at 3s. 6d. per yard	15	1	0
18 rods 184 feet superficial reduced stock brickwork, at 12*l.* per rod ..	224	2	0
224½ feet extra to brickwork in cement, at 5*l.* per rod	4	10	0
139½ feet ditto for picked bricks and in cement, at 7*l.* per rod	3	12	0
311 feet ditto labour to skew-backs, at 1d. per foot	1	6	0
16 yards ditto rendering in cement back of drain shafts, at 2s. 6d. per yard..	2	0	0
77 ft. 7 in. cube stone in coping, including labour and setting, at 6s. per foot	23	5	6
7 yards forward setting, striking, and use of shoring, at 3*l.* per yard ..	21	0	0
Setting, striking, and use of moulds and centres	5	0	0
	481	0	6
Difference, 32½ per cent., or nearly one-third, in favour of constructions ..	157	15	0
	£638	15	6

If the suggested constructions can thus be applied to cuttings with advantage, they may be held also to render embankments safer by diminishing their height; for the 32½ per cent. saved in the cutting may be applied to make it deeper, and so to diminish the adjacent embankment. Where an embankment would be made 50 feet high out of a cutting of similar depth, the latter may be made 65 feet deep and the former reduced thereby to 35 feet high and for the same money at most.

In the comparatively shallow cutting between Camden Town and Euston Square, before referred to, a length of 24 feet forward of the retaining walls on both sides, as originally built, and where the height is 20 feet, contains very nearly 17 rods of brickwork; whereas permanently effective constructions of the kind above described (figs. 7 and 8), with central piers in continuation of those which already exist for the bridges and galleries, would require, in the same length, less than 10½ rods, or about ⅝ths of the former quantity.

Observations.

General Pasley stated, that the principle advocated by Professor Hosking, had already been put into practice by Mr. A. J. Adie, in the Chorley cutting, on the Bolton and Preston Railway. It is about 60 feet deep (figs. 9, 10, and 11); cut through sand, which though dry at the summit, became wet and silty near the level of the forming. In the sand there existed large masses of clay which, after exposure to the weather, split from the top to the bottom. Fearing lest an ordinary wall might be forced forwards by this expansive action, and wishing to avoid the expense of a very thick wall, Mr. Adie introduced a series of arches or struts, traversing the railway at intervals of 15 feet from centre to centre. These struts consisted of two arches of rubble and rough ashlar masonry, placed back to back (figs. 9 and 11). The lower arch springing from the side walls, at a height of 11 ft. 4 in., and rising to 15 feet in the centre. The thickness of the arches at the centre, where they combined and were formed for some distance on either side, by the same stones, was 12 inches, with a course of rough flag stones laid upon the strut to keep the joints dry. The retaining walls were 3 ft. 9 in. thick at the bottom, vertical behind, but battering on the face to 2 feet in thickness at the top. The back buttresses were parallel and projected 2 ft. 6 in. The walls were built upon a layer of engine cinders, which Mr. Adie preferred to concrete, and which he had found of great assistance in constructions in wet situations.

Captain Vetch said he was sure, that Professor Hosking would be gratified to learn, that his view had been already tested by a successful experiment in a cutting near the village of Moseley, on the line of the Birmingham and Gloucester Railway. The average depth of the cutting was about 30 feet, with firm gravel and dry sand at the top, which became wet below, and terminated in a quicksand at the level of the line of the railway.—The cutting was accordingly made and the sides left rough, and at as great an inclination as the nature of the ground would admit of; when the period approached for opening the railway, no definite arrangement about a tunnel having been made, it was deemed provident to be prepared for such a work; Captain Vetch consequently proposed to Captain Moorsom, the engineer, and which met with his concurrence, that at every 15 feet, a rib, or inverted arch of brickwork (figs. 12, 13, and 14), should be thrown across under the railway, and then to carry up, on the ends of these inverts, projecting buttresses with a curved batter; each pair of buttresses, on the same side of the way, to be connected by a concave retaining wall, abutting against them and each opposite pair of buttresses connected by mutual support by a flying buttress, thrown across and over the railway. This construction afforded complete security to the slopes, and was executed at a moderate expense; it was, however, deemed prudent to conduct the concave side walls completely over the top and to make them abut on the flying buttresses, and so to form a complete tunnel at a very small expense; the buttresses, arches, and counter-arches, were all about 2¼ feet square and the concave wall and roofing were only 9 inches thick, but were backed with a little concrete.

ARCHITECTURAL DRAWINGS, ROYAL ACADEMY.

Second Notice.

Though such intention was not expressed, our readers probably look for our continuing our remarks on the architectural subjects, since we have not yet made any mention at all of one or two which are foremost in merit. Still it does not exactly follow that we should do so now, for we might imitate the example of some other critics, who have dispatched their notices of this department of the exhibition very hurriedly indeed, not only omitting several of the most important subjects of all, but merely copying from the catalogue the titles of the few which they have so distinguished. The *Art Union* has this year flung architecture all but completely overboard, after having for two preceding seasons devoted far more attention to it than it had ever done before. In fact, a decided change has of late come over that journal, as far as architecture is concerned. The brief half column allotted to "Architecture" at the Exhibition appears to have been furnished by the same writer as criticized the pictures. That he observes little of what is going on in the architectural world, is evident enough from his complete silence in regard to every one of the designs for the "Choristers' School at Oxford," the competition for which made some noise at the time, and drew down many severe and indignant reflections, both upon the committee and the author of the design selected by them. How truly they deserved the strong censure they incurred we know not; we only know that they have not even attempted to exculpate themselves, but have maintained a dignified and certainly most convenient silence. Perhaps their best and and fairest exculpation is furnished by Mr. Derick's design (No 1220), which certainly is an admirable one—and a charming drawing to boot, prepared, we presume, expressly for the exhibition, and not one of those sent in to the committee. Yet excellent as it is of its kind, this design is hardly of the kind any one would venture to offer in public competition, unless he had good reason to think that such treatment of the subject would be approved of, so dissimilar is it from a modern composition, where, though irregularity and the picturesque variety arising from it may be affected, it is usual to observe as much continuity of mass and of frontage as possible. Here, on the contrary, the School and the Master's Residence, &c., constitute two separate buildings quite distinct in character, attached together by being placed at right angles to each other, so as to form a re-entering angle between them, where they are connected by a somewhat receding and rather lower intervening portion. The whole is faithful not only to the style adopted, but to the architectural physiognomy and constitution which, apart from mere style, mark buildings of the period here imitated. The combination is pictorial rather than architectural,—studied only in being apparently quite unstudied and accidental, perhaps somewhat too much so considering where the building is to be erected—in a city distinguished by stately piles of collegiate architecture. There is, moreover, somewhat of affected homeliness in the range of gabled lucarnes over the school building, introduced perhaps with the intention of preventing that mere chapel-like appearance which it would else have. The drawing is, as we have observed, an admirable one,—so much so that we cannot help ascribing to the charm of its execution much of the satisfaction we feel on looking at the subject. Unusually rich and full in tone, it is also perfectly sober and free from the vice of being "coloured-up." Still it flatters, because the building itself will not wear such ripened complexion until it shall have become completely tanned by sun and stained by weather.

There are other designs for the same building, and that one of them which we next come to in the order of the Catalogue is 1253. Although designated only "A design for a Choristers' School," we have no doubt of its being intended for the one at Oxford, the title being otherwise an unintelligible one, there being no such express class of buildings; and to its title alone is it indebted for notice, the style being that of the smug "lath and plaster Gothic." In the days of Strawberry Hill *virtuosity*, of Walpolian and Wyatt Gothicizings, it might have done very well, but now it will not pass muster. Unluckily for it, it is placed almost midway between two very bad, overbearing neighbours, viz., the one we have just been speaking of, and (No. 1256) E. B. Lamb; the only circumstance in its favour is its being hung quite down by the floor, therefore so as to escape detection except from those who are determined to look at it and can condescend to stoop, most back-breaking work though it be.[1] After all we do not say that there was absolutely no chance whatever for this design, supposing it to have been sent in to the committee, for committees have before now taken a fancy to things of the same calibre, and have had them perpetrated in stone or brick, for their own pleasure and to the utter disgust of every one else,—that is, every one who has any feeling for architecture. It is quite a relief to turn from this idea for *a* Choristers' School to Lamb's, whose design would have furnished a suitable and worthy appendage to the buildings of Magdalen College. It is not, indeed, set off to advantage like Derick's by the captivating charm of pictorial treatment, the drawing being only a sepia one, showing merely a perspective elevation of the front, with scarcely any thing at all in the way of accompaniment and filling up, consequently it is hardly possible to institute a fair comparison between the two designs, without imagining for the one the scenic effect and accompaniments given to the other, or the latter to be stripped of those allurements and left to be judged of solely by its intrinsic merits. Were this done, the disparity between them would be greatly lessened; nay, it is most likely that Lamb's would obtain the preference, as having more the character of a piece of collegiate architecture intended to be towards a street. Without its being exactly symmetrical, a general correspondence and balance of parts are kept up in the composition, which is well marked, the School forming one main division or wing of the building, the Master's Residence the other, connected in front by a screen or open cloister of five arches, through which is seen a small court, and in the background that portion of the building which forms the fourth side of the court, and unites the advanced parts of the plan. The combination is a very effective, and by no means a hackneyed one. A *small* court closed in, yet partly exposed to view—and therefore more piquantly so—through a cloistered screen would be attended with great play of perspective, and the whole front would have unusual force and relief as to light and shade —matters which, if architecture deserves to be esteemed something higher than a mere mechanical art, are to be attended to as well as style, not, indeed, at all to the neglect of the latter, but in addition to it. One advantage which this design possesses over Derick's is that it would tell admirably from the street, in whatever direction it might be viewed, whereas the other will look rather flat and poor, not to say insignificant, when, not viewed as it is shown in the drawing, only the *side* of the School building, or that parallel to the street, is seen. That portion—and it is the principal one or front in point of situation—derives its effect almost entirely from contrast and grouping with parts that come into *accidental* view. We are very far from intending to say that no advantage ought to be taken of such accidents and the perspective combinations that may be derived from them; on the contrary, we would urge the utmost attention to that point, it being one that is scarcely ever studied or taken into consideration at all. Still, front or parallel view effect and character are not to be neglected. We do not much suppose that Barry entered the Oxford competition, but, had he done so, it is not very likely that he would have hit the taste which preferred Derick's design to Lamb's, for he would, almost of a certainty, have produced quite a regular façade, of the same stamp as his Birmingham School,—of which building, by the bye, there is a view in the present Exhibition, viz., (No. 1194), and as it is neither an original subject nor a fresh one, nor shown otherwise than has been done again and again before, we do not see what claim that and other things of the kind have to be hung up in the architectural room. If not originality, freshness of subject ought to be made a *sine quâ non*; and we get both novelty and interest of subject in

(No. 1197), House of M. Guvin, banker, in the Rue de Commerce at Tours, an edifice of the 16th century, H. Mogford,—a capital drawing of its kind, and a most piquant specimen of the French domestic style of that period. It is a mere façade shown directly in front, without anything to make it up according to usual and approved recipe into a picture—a process not at all requisite, it being so eminently picturesque in itself—extravagantly uncouth, yet deliciously picturesque. If Mr. Mogford has brought home more plunder of the kind from France, we hope he will allow the public to share in it. Perhaps the colouring is, to make use of a dandy phrase, a *soupçon* exaggerated, it being so rich, glowing and sunny as to quite kill some of its neighbours; and the hangers seem to delight in contrasts quite as much as Pugin, taking care to put the most vigorous and feeblest coloured drawings, the showiest and most pretending, alongside of each other. But we must return to collegiate architecture, if only to express our wonder that such a thing as (No. 1293), purporting to be a "Design for a College (in the first edition of the catalogue styled a cottage,) should be hung upon the walls of a Royal Academy, especially hung where it displays itself very conspicuously. Surely that piece of dulness and imbecility can have been put there merely because nothing else of the same size could be found to fit into the space it occupies; and the Academy is by far too thrifty to allow any space to be lost, it does not deal in blanks, though they would frequently be preferable to some of the prizes it gives us.[2]

As we have affected very little method—certainly not to follow the order of the catalogue, which is an exceedingly elastic one, rudely jumping us from one pole of art to the other—from Athens to Oxford Street, from the venerable Parthenon to the "spick-and-span" new Show-room of Messrs. Williams and Sowerby, the respective Nos. being 1184 and 5, and as we prefer jumping after our own fashion,—we turn to (No. 1244), Design for the Carlton Club, S. Beazley. This drawing is by no means a striking one upon the wall, it being only in sepia, and besides placed so high that it is quite a fatigue to attempt to examine it. Little more can be made out than the general composition and leading forms: like that of the Conservative Club-house, the façade is divided into three compartments in width, with five windows in the centre and a triple one at each end. On a rusticated ground floor with a Doric entablature rises a Corinthian order of ten columns disposed in pairs, so as to form in the centre an open arcade or loggia of five arches which spring from the entablatures of the columns, and corresponding with which is a second row of semicircular mezzanine windows over those of the principal floor. Some novelty there certainly is in the idea, but it is hardly of the happiest kind; at any rate considerable revision and further study are required to harmonize the *ensemble*, and among the *corrigenda* is the large square lantern on the roof, which as it here shows itself is a sufficiently conspicuous, yet somewhat too ordinary and homely feature. We ought, perhaps, to say that the drawing seems to represent a south-east view, consequently the open loggia would not be in the street front, but in that towards Carlton Gardens, where it would be more appropriate. However, we hardly need inform our readers that this design will not be realized, that of Messrs. Basevi and S. Smirke being the one chosen by the Club; and if we do not see that at the Exhibition next year, we probably shall find there some of the others,—we hope Barry's, for we are curious to learn whether he adhered to the astylar character of his other club-houses, and if so, whether he produced on this occasion a decided variety of it. We may, too, expect to be favoured

[1] If the Academy should take 'Punch's' hint, they will provide visitors with ladders—and why not scaffolds too?—next year, that they may mount and look at the supreme tiers of 'exalted' pictures. A few hassocks or footstools are also very much needed, in order that we might set down upon them and get a comfortable peep at some of the things which are put next to the floor, and which we need not say are some of the smallest of all.

[2] In one of the rooms a great space upon the line is occupied by a vulgar subject called "The Oxford Race Course," one fitted only to the taste of stable-boys and jockeys, and of their equally coarse and low-minded though perhaps aristocratic patrons, and the silly imitators who affect to copy the spirit—that is, the profligacy—of the latter. When will the march of intellect give the death-blow to horse racing and all the scoundrelism connected with it?

with a sight of Mr. Salvin's design for the "Carlton," which is said to have been in the Elizabethan style—so vague a designation that it helps us to no idea whatever of its actual character—and to have been of singular richness and beauty; therefore, we suspect, greatly refined upon actual Elizabethan models and precedents. Without undergoing considerable modification and recombination of elements, that style certainly does not recommend itself particularly well either for modern street architecture generally, or for such a structure as a club-house,[3] requiring an expression of elegance as well as of dignity; and elegance is certainly not the prevailing characteristic of Elizabethan. We do not, however, say that the style is incapable of other expression than the quaint and picturesque, because if we did we must either pass by without notice, or else confess ourselves contradicted by (No. 1260), Mansion erecting for W. Herrick, Esq., Beau Manor Park, Leicestershire, W. Railton, a most attractive drawing and a charming design, one which gives us some of the very best qualities of the style, and its true sentiment without the slightest affectation. Though each of the two fronts shown in the view is regular in its elevation, the whole is eminently picturesque, at the same time quite sober. Yet this mansion is rather upon a moderate scale than at all the contrary—a proof that quantity and quality are very different things. On comparing this with (No. 1243), Design for an Elizabethan Mansion, C. W. C. Edmonds,—and the comparison seems to be solicited, the two drawings being alike in size, similar in subject, and placed as companion pieces on the wall,—the latter makes nearly as favourable an impression as the other, at first sight, but we soon perceive that there is a vast though undefinable difference between the two: there is an exquisite flavour in one which the other lacks. Nor is our admiration of Mr. Railton's design unmingled with astonishment, for we could not imagine the author of so excessively dull and trivial an idea as the Nelson Column to be capable of producing so fascinating a design.

(No. 1120) Design for an Italian Mansion, garden front, W. Deane, affords matter for remark, on account of the great architectural parade it makes in some respects, and the utter disregard of architectural etiquette in others. We behold terraces whose angles are flanked by colossal pedestals—huge masses of stone work as big as those in Trafalgar Square—surmounted by groups of bronze figures, embellishment so pompous—letting alone its cost—as to be fitter for such a palatial pile as Blenheim than for a private country residence. Yet notwithstanding this studied architectural display in regard to accessories, and the symmetrical arrangement of the terraces, &c., and the buildings, one wing of the façade does not answer to the other, it being only a single window in breadth while the other has three, which is surely a gross and perverse violation of the most ordinary rules of taste, and here evidently committed for the nonce, the subject being merely a fancy composition. If irregularity be preferred to regularity of design—architectural *blank verse* to architectural *rhyme*, be it so; but to decide upon rhyme and afterwards hitch in here and there a blank verse,—to plan and arrange everything with scrupulous regard to perfect symmetry and then all at once to break away from uniformity and destroy all balance between what show themselves intended to be corresponding features, is a provoking barbarism,—and if we could, we would attribute it in the present instance to a blunder on the part of the person who made the drawing. We have another rather pompous affair in (No. 1150), Garden front of the Mansion now erecting by J. M. Blashfield, Esq., in Kensington Palace Gardens, from the designs of J. Finden and J. H. Lewis. On first reading its title we fancied there must be some strange mistake in the catalogue—not that mistakes are altogether strangers there—for considering what it purports to be, there is an air of improbability about it that quite staggered us, it being a large and lofty unbroken mass in a heavy Italian style, and much fitter for street architecture than for the situation mentioned. Yet although mistake there is none, the information contained in the catalogue is not quite correct, inasmuch as so far from being "now erecting" this mansion is not even begun at all, nor, as we have reason to believe, will it now ever be so. The practice of describing buildings as being in progress before they actually are so is a reprehensible one, because it renders us mistrustful even when the truth is stated, and doubtful whether we ought to credit it or not. Doubt, however, there is none as to (No. 1235), Garden front of Villa, No. 3, erected on the estate of J. M. Blashfield, Esq., at the Queen's Road, Kensington Palace Gardens, O. Jones. Were it not that attention is called to it by the catalogue, this subject would hardly obtain notice, for though a large one, the drawing is placed so high that its details are lost, and its mere mass and outline are by no means prepossessing. We recognize Owen Jones more advantageously in (No. 1273), Ornamental Cottage and Dairy, described as "designed," and we hope to be also executed, for J. J. Morrison, M.P.

[3] The article "Club-house" in the Supplement to the 'Penny Cyclopædia,' treats for the very first time of buildings of the kind as a distinct class.

Of (Nos. 1204 and 5) Fantasia and Capriccio, or Architectural Innovation, the bare titles are sufficient to scarce all the sticklers for architectural orthodoxy, legitimacy, and precedent, be they either ultra-Greek or ultra-Goths. Nor are those two small drawings misnamed, since innovation is introduced into them neither very sparingly nor very timidly. They are, indeed, furiously heterodox and heteroclite, —certainly nondescript, for it would puzzle us to give any intelligible description of them, and of the exceedingly wayward yet not ungraceful fancies with which they are fraught. We leave others to reprove their author for setting all ordinary rules at defiance, it being quite evident that he has done so wilfully and premeditatedly, consequently he would laugh at us for plodding dullards were we to take him formally to task for the very enormities which he glories in, and to disseminate his principles by publishing his transgressions. One comfort is, these specimens of "innovation" are not likely to corrupt many, they being hung where they are much more likely to be overlooked altogether. There are many other things which we ourselves may have overlooked, and still more in regard to which *overlooking* is quite out of the question, unless we were to take a bird's-eye look at the room through the skylight. Should Mr. (*quære* President) Eastlake's letter to Sir R. Peel have any effect, and we get a new National Gallery, the Academy will then, we trust, be able to afford adequate accommodation in the present building to architectural drawings and models. Of these last there is this year but a very sorry show indeed, and even were they worth looking at they are so huddled up one behind the other, that it is impossible to see them properly. Some of them are so small as to look more like "very pretty toys," than architectural models, and others show only what would be quite as well or even better understood upon paper; for instance, (No. 1322), South west corner of Freeman's Place, Royal Exchange, E. J'Anson, and Son, which is only a compartment of a *plane* elevation, in relief, and deprived of the advantage of colour. It certainly does not convey the most favourable idea of the effect and character of the building itself, which is really a very imposing piece of street architecture. There was something equally indiscreet and superfluous in exhibiting (No. 1316), A model of a Design for the Hardy Testimonial proposed to be erected by subscription in the Square fronting Greenwich Hospital; indiscreet, at the same time fortunate, because it is likely to scare those who might else be disposed to subscribe; superfluous, because the *design* consists of no more than a common-place Greek Doric column. Such "testimonials" might as well be kept ready made. Most assuredly they do not testify the ability of those who design them. We would recommend that the portico of Covent Garden Theatre should be taken down and sold for the benefit of the shareholders in that concern, and there would then be four unexceptionable Doric columns provided for as many different Testimonials.

CHRISTIAN ICONOGRAPHY.

The following valuable translation of extracts from M. Didron's great work *Iconographie Chretienne* have been kindly contributed by Professor Donaldson, together with some original notes. A paper read by him on the subject before the Royal Institute of British Architects is prefaced by the following remarks.

"I have ever considered it my privilege and duty as your Foreign Secretary to bring before you from time to time, and make you acquainted with what has been going on in Foreign Countries with regard to any matters having reference to our pursuits. I have been happy to seize every opportunity, which presents itself from my official correspondence with our Honorary and Corresponding Members, or from my connexion with various Foreign Academies and other learned bodies, of bringing before you the labours of those whose object, like ours, is to contribute to spread a knowlege of Art and inspire a love for those splendid and interesting monuments of the skill of past ages which excite our wonder and admiration, and which should inspire with the zealous ambition to emulate their example.

I have already had to notice to you that about 10 years ago the lovers of the fine arts in France were anxious to release themselves from the trammels of a conventional style, which, however great its claims upon our respect from its purity and correctness in the abstract, had little hold upon the feelings and affections. It possessed not the eloquence and sentiment that pervades those national productions of former periods, which, originating from peculiar institutions and to satisfy peculiar exigencies, bore the emphatic impress of characteristic individuality. Hence the desire to revive a national style of art, taking as its basis the works of the Middle Ages. Such a revolution had been effected in the Schools of Germany spreading from Munich to Berlin.

You possess in your library the first livraisons of a series of instructions issued by the Historical Committe of Arts and Monuments in Paris: an institution formed under the immediate auspices of the enlightened Minister of Public Instruction. As a foreign member of Committee, I have recently received a volume entitled "L'histoire de Dieu"—a startling and almost profane heading. Its meaning, however, is to give a view of the various aspects under which Christian Art had regarded the persons and attributes of the *Divine Three in One.* To illustrate and explain the figured and symbolic art of sacred edifices, and to give a key to the symbols profusely scattered throught the architecture, sculpture, glazing, painting, and printing of past times. This volume is by M. Didron, of the Royal Library of Paris and Secretary of the Committee of Arts and Monuments. I shall translate his words almost without note and comment, and only pray you to remember that in repeating the lively expressions of an impassioned believer in the traditions of early periods, I can by no means adopt the unreserved credulity of the animated Frenchman in his acceptation of the iconolatry of his and our forefathers.

On the Application of the Form of Cross during the Middle Ages.

(From the Histoire de Dieu par M. Didron.*)*

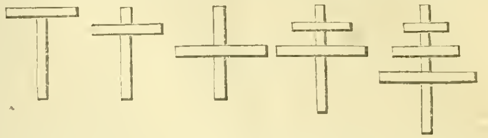
The Cross is more than a type of Christ: it is in iconography, Christ himself or his symbol. Hence a legend has arisen concerning it, as if it were a living being; hence it has been made the hero of an epic poem, which originating in the apocryphal writings, was developed in the golden legend, detailed and completed in the works of sculpture and painting, from the 14th to the 16th century. It would not be unprofitable in this place to give an abridgement of this history, for we should thus ascertain the meaning attached to the representation of the Cross, and the explanation to be given to all those figures and numerous paintings and sculptures with which our cathedrals are adorned; but this would lead to a too lengthened research. We return then to the work of Jacques de Vorage, we there find the first part of that poem on the Crucifixion of Jesus Christ at the Feast of the Invention (discovery) of the Cross, and the second part that of its exaltation. The Invention (discovery) is celebrated on the 3rd of May, The exaltation on the 14th of September. On the death of Adam, Seth planted on the tomb of his father a branch from the tree of life which grew in Paradise. From this branch proceed three shoots which unite in a single trunk; whence Moses plucks the rod with which he works wonders in the land of Egypt and in the Desert. Solomon would make of this now gigantic tree, a pillar for his palace, being either too long or too short, it is rejected and serves as a bridge over a torrent. The Queen of Sheba refuses to cross this bridge, foreseeing that it will cause the ruin of the Jews. Solomon casts into the pool, the beam destined to communicate its virtues to the waters. When Jesus is condemned to death, it is of this wood that his cross is formed; the cross is buried at Golgotha, afterwards discovered by St. Helen. It is carried away captive by Chosroés, king of Persia, rescued and brought back again in triumph to Jerusalem by the emperor Heraelius, broken into many fragments and scattered over Christendom, it performs innumerable miracles: it restores the dead to life and the blind to sight; it cures paralytics and cleanses lepers; it casts out devils and banishes mary ills which oppressed whole countries; it extinguishes fires, and calms the fury of the waves. The wood of the Cross was seen in Paradise at the beginning, at the end of the world it will again appear in the heavens, in the arms of Christ or of his angels, when the Lord shall come to judge mankind.

In the 9th century the praises of the Cross were sounded as the praises of a god or a hero, and Rhaban Maur, archbishop of Mayence in 847, composed a poem in its honour. Long before Rhaban, the fathers had shown that the form of the Cross was engraven on the productions of nature, in the works of man, in the attitude of things inanimate, in the gestures of human beings. The world takes the form of a Cross; the East shines as the summit, the North extends to the right, the South to the left, and the West lengthens under our feet. The very birds, in ascending to heaven, stretch forth their wings in the form of a cross. The position of man in prayer is that of the cross, and as it is, when spreading forth his hands to swim, man differs from the brute creation in that, he stands erect and can extend his arms. The ship, in sailing on the ocean, unfurls its sails in the form of a Cross, and it cuts the waves only as the mast rises cross-like in the air; we cannot even cultivate the earth without making use of this holy emblem, and the "Tau," the cross-like letter, is the letter of salvation. Similar, if not equal worship as that offered to Christ, has then been rendered to the Cross: this sacred wood has received almost equal adoration to that paid to God himself. Numerous churches have been dedicated to it, under the name of the Holy Cross.* Yet further, the greater number of our churches, the largest as well as the smallest, cathedrals as well as chapels, reproduce in their construction the form of the Cross, and thus we are brought back again to iconography, and to the notice of the principal forms of the cross.

* St. Croce in Gerusalemm, and St. Cross, Winchester, for example.

Varieties of the Cross.

There are four kinds of Cross, the Cross without an apex, the Cross with an apex, and one simple piece of timber placed transversely; the Cross with an apex and two pieces placed transversely, and the Cross with an apex and three pieces placed across it. The Cross



without an apex has only three branches, and takes the form of a T, or of the symbolic *tau,* of which we have spoken. Many ancient churches, principally the basilicas of Constantine, St. Pierre, and St. Paul at Rome, are presented very nearly in this form of the tau: the church of Bellaigue, in Auvergne, is thus constructed. We have already spoken of the mystical significations of the tau, we will not therefore advert to them here.

The Cross with the apex and beam placed transversely has four branches, its virtue is greater; in fact the Cross with three branches is the Cross foretold, the Cross prefigured, the Cross of the Old Testament; the Cross with four divisions is the real Cross, the Cross of Jesus, the Cross of the Gospel. The Cross in form of the tau borrowed virtue from the Cross with four branches, it was like a planet having no light in itself, and receiving all its brightness from the Sun of the Gospel. The Cross of Christ was composed of a vertical tree and a transverse beam in the form of a mallet or gibbet.

It is worthy of note, says Guillanme Durand, that the Cross is divided into four parts, either on account of the four depraved principles in us, which Christ has rectified by his passion, or to signify that Christ draws all men unto him from the four quarters of the world, according to this prophecy—"and I, if I be lifted up from the earth, will draw all men unto me." These four divisions may also refer to the human soul—the Cross is high, long, wide and deep. The foot planted in the earth is the depth, the distance from the foot to the arms is the length, the width is from arm to arm, the height is from the arms to the top. The depth signifies Faith resting on its foundation; the height signifies Hope, which reaches heaven; the breadth Charity, which extends towards the left, to our enemies; the length, perseverance unto the end.

The two leading forms of the Cross (with four divisions) are again subdivided and multiplied, they are called the Greek Cross and the Latin Cross, because the first is beloved by the Greek Christians and Oriental Churches, the second by the Latin Christians and Western Churches.

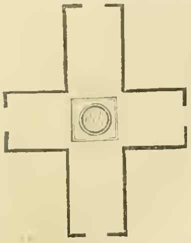
In the figures above, these crosses are formed of two parts—of a staff or shaft, and a transverse beam which cuts it. In the Greek Cross the transverse is equal to the upright beam, and the arms are equal to the shaft. If you divide a circle by two right lines, passing from its centre and cutting each other at right angles; these two lines will give you the Greek Cross. This Cross is formed, then, of four equal parts; of a foot, a summit, and two branches. In the Latin Cross the foot or shaft is longer than the summit or the branches. This cross cannot be inclosed within a circle, but is rectangular. In the Roman Cross the shaft is longer than the transverse beam, and longer also than the apex. This form is that of a man extending his arms. The width from arm to arm is less than the length from the head to the feet; the distance from the head to the shoulders is less than that from the shoulders to the feet. The transverse beam is, as it were, from one arm to the other; the upper part of the shaft is, as it were, from the head to the shoulders, and the lower part of the shaft is from the shoulders to the feet. The Latin Cross resembles the actual Cross of Jesus, and the Greek Cross is an ideal one. The Latins, as materialists, preferred the natural form; the more imaginative Greeks idealized the reality, spiritualized and transformed the Cross of Calvary,—they have made an ornament of the gibbet.

Originally these two forms of Cross were not confined, the one to the Greek and the other to the Latin Church, but were common to both. Thus, in Procupius, it is mentioned that the Church of the Holy Apostles at Constantinople was built in the form of a Cross, the nave of which was made longer than the choir, in order to give the exact form of the Cross. Amongst the ancient monuments of Greece, at Athens, in the Morea, at Macedonia, and at Constantinople, we find instances of the Cross of unequal dimensions. This Cross, then, of unequal dimensions, was known and employed in Greece, but the other was most frequently adopted by the Eastern Church.

In the West, the Cross of equal parts was known and employed as well as the other. The sarcophagi, columns, pillars, the stones for the altar are still marked by this Cross; the other, that of unequal dimensions, belongs more especially to us.

Although these two forms were originally common to both churches, the Cross of equal parts was eventually predominant in the East, and was called the Greek Cross. The Cross of unequal parts prevailed amongst us, and was called the Latin Cross.

In the Eastern Church the Greek Cross was predominant in the principal and subordinate details of religious monuments, in architecture as well as in decoration. The plan of many of the oriental churches exhibited the form of the Greek Cross. The following design gives the plan of a church in Greece. The shaft of this Cross seems to be a little longer than the transverse nave, but this may possibly be an error of the designer; even with this error, it is a Greek rather than a Roman Cross.



The Greek Cross was that most used in the capitals of the Byzantine Churches. In the church of St. Demetrius at Salonica, in those of St. Sophia at Constantinople, St. Marc at Venice, and St. Vital at Ravenna, edifices purely Byzantine, the Cross of equal dimensions, whether in a medallion or not, shines in the midst of the volutes, the knots and leaves of the acanthus. In painting, the robes of St. Chrysostom are adorned with small Greek Crosses in medallions; numerous Greek Crosses also, without medallions, ornament the *chasuble* of St. Gregory Nazianzen. It is a Cross of equal parts which divides the nimbus of God. It was this same Cross which was borne by the Knights of Malta (the descendants of the Knights Hospitallers) as the distinctive decoration of their order.

(To be continued.)

ARCHITECTURE IN IRELAND.

Sir,—It is the most unlikely thing in the world that the Institute of Irish Architects should take up a subject suggested by the inquiries of an individual among the correspondents of a journal—although it be an architectural one. The information I wished to obtain was not of a kind to require a body of men to assemble in conclave in order to draw it up; and I naturally looked to Dr. Fulton,—he having been a frequent contributor to your Journal—as one both capable and ready to satisfy me off hand in regard to a few matter-of-fact particulars. If my asking for some information as to what has been done of late years in the way of building, at Dublin, should lead him to contemplate giving us an historical sketch or *précis* of the modern and recent architecture of Ireland,—so much the better, for it would be quite a new chapter in general architectural history. Gwilt takes no notice whatever of the architecture of our Sister Island. In his table of architects he mentions but one who belongs to Ireland by his works, though not a native of it, viz. Gandon, and then he blunders by attributing to him the Exchange at Dublin, erected before he settled there, and thereby robs Cooley of the fame due to the author of so elegant a structure—one that deserves to have been particularly noticed by Gwilt where he speaks of that class of buildings, as being a most tasteful example of the kind. I wish to ascertain whether a ground plan or section of it has ever been published, and as that is a simple query, easily answered, if it can be answered at all, I hope Dr. Fulton will favour me by doing so, should it be in his power. Perhaps, too, he can inform me when Francis Johnstone, the architect of the Dublin Post-office died, and if there exists any sort of memoir or notice of him. The laborious, painstaking, accurate and universal Nayler, mentions neither him, Cooley, nor Cassels, though his Dictionary is crammed with a host of names of persons who are mere nonenties. Yet perhaps we ought not to reflect upon the negligence of foreigners, when our own biographical dictionaries are exceedingly barren indeed in regard to architectural names—I mean those of our country—the United Kingdom. As to notices of the older Italian architects and such well-known ones as Jones and Wren, they are merely transferred from one work of the kind to another, by the aid of scissors and paste.

I beg to sign myself as before,

Philo-Hibernicus.

ON THE CONSTRUCTION AND PROPER PROPORTIONS OF BOILERS FOR THE GENERATION OF STEAM.

By Andrew Murray, Assoc. Inst. C.E.

(Paper read at the Institution of Civil Engineers.)

This paper commences by investigating the quantity of air chemically required for the perfect combustion of a given quantity of coal, of the quality commonly used for steam purposes. The amount of air to each pound of coal is stated to be 150·35 cubic feet, of which 44.64 cubic feet are required for the various carburetted hydrogen gases given off, and 105·71 for the solid carbon. The practical utility, however, of this knowledge, is much impaired by the circumstance that combustion ceases even in pure oxygen, and much more in air, before the whole of the oxygen present has entered into the new chemical combinations required. It is also known, that carbonic acid gas exerts a positive influence in checking combustion, as a candle will not burn in a mixture composed of four measures of air and one measure of carbonic acid gas. Large quantities of this gas being generated by the combustion of the solid carbon on the grate, and being necessarily mechanically mixed with the inflammable gases as they rise, the quantity of air required for their subsequent combustion must, on this account, be increased to a very large extent. The whole of the air thus supplied in excess, must be heated to a very high temperature, before any combustion can take place, and the loss of the heat thus absorbed must be taken into account in calculating the ultimate economy of igniting these gases.

The form of furnace now in general use, in which the fuel is spread over a large surface of fire-bar, has not been subject, in so far as effects the supply of air through the bars, to much alteration, amongst the many patents and proposals which have been made for the more complete combustion of coal. The point most open to change in the common furnace, is the width between the bars; and as it is desirable to have the supply of air to the furnace as abundant as possible, it should be made as large as can be done without causing waste, by allowing the coal to fall through into the ash-pit. A greater number of these bars is thus to be preferred to a smaller number of broad or thick bars; indeed to such an extent is this carried in France, where coal is more valuable than in this country, and the chemistry of the subject perhaps more generally understood, that the bars are made not more than half an inch thick, the necessary strength being obtained by making them 4 inches deep. With coke or wood, which cannot fall through the bars and be wasted, in the same way as coal, the space is always made much wider, and with great advantage; so much so with coke, as to have led to the opinion that a given quantity of coke would produce as much heat by its combustion as the coal from which it was made. Any grounds for such an opinion could only have arisen from the combustion of the coal having been so imperfect, that not only had the whole of the gases passed off unconsumed, but even a large portion of the solid carbon must have been allowed to escape in the form of carbonic oxide, without having generated its due amount of heat, and been converted into carbonic acid gas.

In the combustion of coke, or of the solid portion of coal, as left in an incandescent state on the fire-bars of a common furnace, after the volatile gases have passed off, the amount of heat generated by the whole of the carbon, uniting at once with its full amount of oxygen, will be the same as what would be generated by its combination, first, with a smaller quantity of oxygen, forming carbonic oxide; and subsequently, by the ignition of this gas, by its combination with the further quantity of oxygen, required to turn it into carbonic acid gas.

As some portion of the carbon is always converted into carbonic acid gas in the furnace, it follows, that the air for the ignition of any carbonic oxide there formed, and allowed to pass into the flues, must be greatly in excess of the quantity chemically required; and the whole of this excess must be raised to the temperature of the other gases, with which it will be mingled. The superior economy, therefore, of at once converting the whole of the carbon into carbonic acid, gas is apparent; and there is no doubt but that this very desirable result may be obtained nearly to the full extent, by due care in the formation, and subsequent management of the furnace.

The best mode of supplying air to the other inflammable gases resulting from the combustion of bituminous coal, which are composed of hydrogen and carbon, and which will be treated of under the common name of carburetted hydrogen, has been a matter of much controversy, and been the subject of many patents. The mode proposed by the greater of the patentees is, to admit the air immediately behind the furnace, at the back of what is termed the bridge. A bridge does not exist in every case; but where it does exist, it is generally in the form of a wall or obstruction right across the back of the furnace; often placed there for no other purpose, than to prevent the fire from being pushed back into the flue. The whole of the products of combustion, as formed in the furnace, necessarily pass over this bridge, before entering the flue. The additional air is sometimes heated, previously to its being admitted to the gases, after they have left the furnace, and the manner in which it is supplied, varies exceedingly; one party advocating its admission in a long thin film, another through a great number of small orifices, and others again attach less importance to the manner of its admission, so that it is only admitted in sufficient quantity. All these plans proceed upon the supposition that large quantities of inflammable gas pass off from the furnace, and as none of them directly affect the operations going on within the furnace itself, the gases which are actually given off, would be the same until they pass over the bridge, whichever plan might be adopted.

These plans must all cease to be necessary or useful, if a furnace can be so constructed, and the combustion of the coal in it so managed, that a very small proportion only of uncombined inflammable gases would pass off, as in this case no economy would result from their combustion, owing to the large excess of air, which must be supplied and heated as before explained.

The admission of a large quantity of air into the flue, at a distance from the furnace, though advocated by some authorities, cannot be advantageous, unless in extreme cases, when the temperatute in the flue is very high, and where the combustion in the furnace has been more than usually imperfect.

As the carburetted hydrogen gases are generated rapidly, on the application of heat to the coal, and are in themselves much lighter, than the carbonic acid gas, or the nitrogen gas, formed at the same time, it is sometimes assumed, that they rise nearly unmixed to the top of the space over the furnace, and thence it is considered more advantageous to supply the air at this place than in the flue. The cooling effect of air, if admitted into the furnace, has been stated to be more injurious than if admitted into the flue; but the correctness of this statement may be doubted, especially if the gases be unmixed, as this would render a much less quantity of air sufficient.

The bars in this case should be placed at least 2½ feet or 3 feet below the boiler, or the crown of the furnace, to allow the principle to be more fully carried out. An increase of space over the bars to this extent has always been found to be advantageous, and ought to be particularly attended to. The system of admitting the air to the gases in a subdivided form, in whatever part of the boiler the admission of it may take place, is very efficacious in procuring a thorough and speedy mixture of the particles. It has been very extensively and successfully introduced by Mr. C. W. Williams in supplying air behind the bridge of the furnace.

An opinion is entertained that a sufficient supply of air for the gases may be obtained, through the fire-bars; and it is obvious that a partial supply, at least, may be obtained in this manner, by a judicious management of the fire. This may be effected by keeping the fires thin and open, feeding by small quantities at a time, or by a system of coking the coal, allowing the combustion of it to be slow at first, by which means the coal is formed into masses of coke, between which the air has a passage. The air which passes through is not vitiated further than in being mechanically mixed with the carbonic acid and nitrogen gases, caused by the combustion of the coal on the bars.

The perfect combustion of the whole ingredients of coal being entirely dependent, chemically considered, on the supply of the due quantity of atmospheric air, it is evident that the velocity with which the air flows into the fire will materially affect the result. According as this velocity is greater or less, so in proportion must the quantity of coal that is to be consumed on a given area of grate be increased or diminished, and there is no limit to the quantity that may be so consumed, beyond the difficulty of supplying the air sufficiently rapid. The various circumstances which affect the velocity of the eatering air, have placed this question, as yet, completely beyond the reach of theory, so that practical experiments must be taken as the only guide, in determining what quantity of air can be made to eater into a given furnace, and consequently, what amount of coal can be properly consumed in it in a given time.

Mr. Parkes has stated, as the result of a long series of experiments made by him, (Vide Trans. Inst. C.E., vol. iii.) that the rate of combustion should not exceed 7 lb. per superficial foot of grate bar per hour, and that this quantity may with advantage be reduced as low as 4 lb. or even 3 lb. General experience would tend to prove that these latter quantities are unnecessarily low, and can only be advantageous when the arrangements for supplying the air, or for carrying off the products of combustion, are defective or inefficient. It is evident that if the area of any part of the passage, for either of these currents, be too limited, the velocity at this contracted spot cannot rise higher, than is due to the weight of the ascending column of heated gases in the chimney. The quantity passing through is therefore diminished in proportion as the area is limited; and a good draught at a particular place, as at the bridge of a boiler, may here be quite compatible with an insufficient supply of air, and imperfect combustion of the coal. The draught in every other part of the flues is, at the same time, rendered slow and languid, and deposition of soot takes place in them. This fault is apparent in a great number of boilers at present in use, and in some cases, especially in tubular boilers, it is attended with very injurious results, by stopping up the tubes and decreasing the amount of heating surface to such an extent, as to render the boilers incapable of generating the required amount of steam.

The furnaces of the boilers in general use in Cornwall, are upon the common principle of construction, and as in them it is not usual to apply any of the peculiar patented arrangements, for the supply of air to the gases, behind the bridge, it follows, either that these gases are not consumed, or that they are consumed by air admitted through the bars. In the Cornish system of raising steam, slow combustion is adopted in its fullest extent; the fires are kept thin and open, the fuel is supplied in small quantities and frequently, and it is well spread over the whole surface. As the result is highly favourable in the economy of fuel, it may be presumed that the combustion of the gases, as well as of the solid carbon, is comparatively perfect. When more air is admitted into the furnace than can be made to eater through the bars, it is generally done by apertures in the furnace doors.

The average rate of combustion throughout the country is far above even the largest quantity named by Mr. Parkes, and may be stated to be about 13 lb. per superficial foot of grate per hour. With due care in the construction of the furnaces and flues, there seems to be no reason why this quantity may not be as perfectly consumed, and the heat as thoroughly extracted fro the products of combustion, before they leave the boiler, as with the smaller quantity. Whether this be so or not, it is necessary in practice to prepare for many cases, as on board of steam-vessels, where it is impossible to allow a larger amount of fire grate, or boiler room, and when it would cease to be ultimately economical to obtain a small saving of fuel, by great additional expense in boilers and their fittings, and in space for them.

To determine the velocity wiht which the products of combustion pass off from the furnace, or from the boiler, is attended with much difficulty, on account of the great number of extraneous circumstances, which do so easily and so constantly affect it. Some experiments on this subject were made by Dr. Ure, and an account of them was read before the Royal Society, (Read June 16, 1836,) when he stated, that he considered the velocity might be taken at about 36 feet per second, and as this result has been corroborated by others, it may be assumed, in the absence of better data, as nearly correct.

The subject, in a theoretical point of view, is surrounded by many difficulties—in discovering the allowance which must be made for friction, and other circumstances, similar to those affecting the flow of water through pipes; and though this latter has engaged much more of the attention of scientific men, no very definite results, to bear accurately upon practice, can yet, even in this case, be obtained by calculation.

The practical question of the proper proportions of the eifferent parts of boilers is then proceeded with in the paper, the leading chemical and physical features connected with the combustion of coal in their furnaces having been considered.

The supply of the requisite quantity of air to the fuel on the bars being of the utmost importance, it is usual to make the ash-pit, and the entrance to it,, as large, and as free, as the situation will allow. In marine boilers, or wherever it is necessary to limit the size of asp-pit, the area for the entrance of the air into it should never be less than one-fourth part of the area of the grate; and in order to facilitate the supply to the back part of the grate, the bars should be made to incline downwards to the extent of about 1 inch in a foot. No advantageous results will be obtained rrom increasing the ash-pit, as is sometimes done in land boilers, to a very great extent, by making it 5 or 6 feet deep; about 2½ feet is sufficiently deep, even supposing that the ashes are not cleared out oftener than once a day.

The extent of "dead plate" in front of the furnace is not material, as respects combustion; in marine boilers it is generally not more than about 6 inches broad, which is the width of the water space, between the fire and the front of the boiler; but in land boilers it is frequently required lo be very broad, to support the brickwork, especially in those cases where the flue is carried across the front.

The amount of the opening between the bars should be about $\frac{7}{16}$ths of an inch, but this must be regulated by the kind of coal to be burnt upon them; but for any kind of coal, it should not be less than ⅜ths of an inch, nor more than ½ an inch. If the space were made larger, the waste from the amount of cinders, or of small pieces of coke, which would fall through in a state of incandescence, would be considerable; otherwise it would be prefeɹable to have a larger space. In order to facilitate the supply of air, each bar should be as thin as is consistent with the strength required. The bars in general use this country are 1 inch or 1⅛ inch in thickness, but it would be much more advantageous to use them thinner, as in France, where they are frequently used not more than ½ inch thick.

The advantage of a considerable amount of space in the furnace, over the fire-bars, has been already mentioned, but no very decisive experiments have been made on this subject. Three cubic feet of space to each superficial foot of grate bar surface, may be stated as a good proportion, where there is nothing to prevent this amount being obtained. When the space is reduced below one foot and a half of grate, it will be found to be attended with a marked disadvantage.

The area of the flue, and subsequently of the chimney, through which the the products of combustion must pass off, must be regulated by their bulk and their velocity. The quantity of air chemically required for the combustion of 1 lb. of coal, has been shown to be 150·35 cubic feet, of which 44·64 enter into combination with the gases, and 105·71 with the solid portion of the coal. From the chemical changes which take place in the combination of the hydrogen with oxygen, the bulk of the products is found to be to the bulk of the atmospheric air required to furnish the oxygen, as 10 is to 11. The amount is therefore 49·104. This is without taking into account the augmentation of the bulk, due to increase of the temperature. In the combination which takes place between the carbon and the oxygen, the resultant gases (carbonic acid gas and nitrogen gas) are of exactly the same bulk as the amount of air, that is, 105·71 cubic feet, exclusive, as before, of the augmentation of bulk from the increase of temperature. The total amount of the products of combustion in a cool state would therefore be $49{\cdot}104 + 105{\cdot}71 = 154{\cdot}814$ cubic feet.

The general temperature of a furnace has not been very satisfactorily ascertained, but it may be stated at about 1000°Fah., and at this temperature, the products of combustion would be increased, according to the laws of the expansion of aëriform bodies, to about three times their original bulk. The bulk, therefore, of the products of combustion which must pass off, must be $154{\cdot}814 \times 3 = 464{\cdot}442$ cubic feet. At a velocity of 36 feet per second, the area, to allow this quantity to pass off in an hour, is ·516 square inch. In a furnace in which 13 lb. of coal are burnt on a square foot of grate per hour, the area to every foot of grate would be $\cdot516 \times 13 = 6{\cdot}709$ square inches; and the proportion to each foot of grate, if the rate of combustion be higher or lower than 13 lb., may be found in the same way. This area having been obtained, on the supposition that no more air is admitted than the quantity chemically required, and that the combustion is complete and perfect in the furnace, it is evident, that this area must be much increased in practice, where we know these conditions are not fulfilled, but that a large surplus quantity of air is always admitted. A limit is thus found for the area over the bridge, or the area of the flue immediately behind the furnace, below which it must not be decreased, or the due quantity could not pass off and consequently the due quantity of air could not enter and the combustion would be proportionally imperfect. It will be found advantageous in practice to make the area 2 square inches instead of ·516 square inch. The imperfection of the combustion in any furnace when it is less than 1·5 square inch will be rendered very apparent, by the quantity of carbon which will rise unconsumed along with the hydrogen gas and show itself in a dense black smoke on issuing from the chimney. This would give 26 square inches of area ever the bridge to every square foot of grate, in a furnace in which the rate of combustion is 13 lb. of coal on each square foot per hour and so in proportion for any other rate. Taking this area as the proportion for the products of combustion immediately on their leaving the furnace, it may be gradually reduced as it approaches the chimney, on account of the reduction in the temperature and consequently in the bulk of the gases. Care must, however, be taken that the flues are nowhere so contracted, nor so constructed, as to cause, by awkward bends or in any other way, any obstruction to the draught, otherwise similar bad consequences will ensue.

An idea is very prevalent that it is advantageous to make the flame, or hot gases (as they may be termed, because we may look upon flame merely as a stream of gases heated to incandescence) impinge upon, or strike forcibly the plates of a boiler at any bend or change of direction in the flue. The turn in the flue is therefore made with a square end, and with square corners; but it is difficult to see on what rational grounds the idea of advantage can be upheld. The gases, if they are already in contact with the plate, cannot be brought closer to it, and any such violent action is not necessary to alter the arrangement of the particles of the gases and bring the hotter particles to the outside, while there is a great risk of an eddy being formed and of the gases being thrown back and returned upon themselves, when they strike the flat opposing surface; thus impeding the draught and injuring the performance of the boiler. That circulation will take place to a very great extent among the particles of heated gases, flowing in a stream even in a straight flue, will be apparent from those particles next the surface being retarded by the friction against the sides, and by their tendency to sink into a lower position in the stream from their having been cooled down and become more dense. An easy curve is sufficient to cause great change in the arrangement of the particles, as those which are towards the outside of the bend, have a much longer course to travel and are thus retarded in comparison with the others. From these causes the hotter particles in the centre of the flowing mass are in their turn brought to the outer surface and made to give out their heat. The worm of a still is never found returning upon itself with square turns, as if the vapour inside would be more rapidly cooled by its impinging on the opposite surface; yet the best form of worm is a subject which has engaged the attention of many able men, and therefore may well be taken by engineers as a guide in the management of a similar process, though carried on at a much higher temperature.

Another very prevalent practice, and which also would seem to be open to serious objections, is, that the flues are frequently made of much greater area in one part than in another. This arises from a desire to obtain a larger amount of heating surface than is consistent with the proper area of the flue, or with the amount of the heated gases which are passing through it. The flue is thus made shorter in its course than it ought to be in proportion to its sectional area. This is even sometimes done by placing a plate of iron partly across the flue, near the bottom of the chimney, thus suddenly contracting the passage for the gases. The effect of this is evidently to cause a very slow and languid current in the larger part of the flue, and the consequence is that a deposition of soot rapidly takes place there. In many marine and land boilers, having one internal flue in them, of too large a size, this will be found to be the case; soot being soon deposited, till the flue is so filled up that the area left is only such as is due to the quantity of heated gases passing through it; the value of those parts of the sides of the flue which are covered with soot is thus lost. This is well exemplified in Mr. Dinnen's paper on marine boilers in the Appendix to Weale's edition of Tredgold, where he states, that the flues of the boiler in H. M. Steamer "African," after she had performed a great deal of work, in the course of five weeks' time, during which period there was no opportunity of sweeping them, were found to be in exactly the same state as after a voyage of 5 days, or probably as they would have been found after a much shorter time, if they had been examined. These flues are about the same area throughout their whole length, but the chimney is of much less area. In the first portion of the flue from the fire no soot was deposited, but the deposit began after the first turn that the flue took, and gradually increased in amount to the foot of the chimney. The inference that may be drawn from this fact appears to be, that the gases, at first highly heated and thereby expanded, filled the first part of the flue, but as they were cooled they became more contracted in their bulk, regularly towards the chimney, and therefore allowed the soot to be deposited in the space not properly filled by them in their course, and all soot subsequently formed was carried out at the chimney top by the velocity and power of the current. The amount collected near the foot of the chimney, and in the portions of the flue furthest from the fire, diminished the amount of the surface of the boiler exposed to the action of the heated gases and the efficiency of the boiler was therefore impaired to the same extent. In those boilers in which the flues before reaching the chimney, are very much too large and are contracted, as has been stated, by a plate put across them, the extent to which their efficiency is thus impaired must evidently be much greater and to a serious extent, as this evil exists in them in a very much greater degree.

The due amount of heating surface that ought to be given in a flue to carry off the caloric, or to cool down a given quantity of heated gases, has not yet been investigated with any great degree of accuracy, and practice varies widely under different circumstances. The largest proportion is allowed in the Cornish boilers, some of which have not less than 30 feet and even 40 feet of heating surface to one foot of grate. This appears to be more than is justified by any corresponding gain, and certainly more than would be advisable in any marine or locomotive boilers. In boilers burning 13 lb. of coal per hour on each superficial foot of grate, a proportion of 18 feet to each foot of grate will be found to give good results. Where slow combustion is carried on, and where an extra size of boiler is not objectionable some advantage may be gained, by increasing the amount in proportion to the amount of fuel consumed. In calculating this surface, it is usual not to include the bottoms of the square flues in marine boilers, and in circular flues from ¼th to ⅓rd of the surface should be deducted as bottom surface, and therefore not efficient as heating surface. It is not usual to make any distinction between horizontal and vertical surfaces, though it is probable that the former are considerably more valuable. The efficiency, however, of some boilers which have been made with vertical tubes, would rather tend to make it doubtful whether so much difference exists between the value of horizontal and vertical surfaces as has been generally supposed. If the area, instead of being in one large flue, be subdivided into a number of small flues, or pipes, so as to expose the gases to the required amount of surface in a short course, the distance traversed between the fire-place and the chimney does not seem to be important. The velocity of the current of gases will not be materially influenced by their subdivision, as the whole amount of the surface with which the gases must come in contact, tending to impede their course by friction, will be the same in both cases. It is evident that numerous small flues, by subdividing the large stream of gases, which in the other case flow off in one body, bring the greater proportion of the particles at once into contact with the surfaces and therefore render it unnecessary to pay the same amount of attention to the turning of the stream and the bringing out the hotter particles from the centre of the flowing mass. If these proportions of area through the flues and of heating surface be duly attended to, the results anticipated may be depended upon, whether flues are of large area or are composed of a large number of small tubes.

The time occupied by the gases in passing through the boiler, from the instant of their generation to that of their leaving the boiler, and the length of the course through which they have travelled, have sometimes been looked upon as matters of great importance. Where the gases are travelling in one compact mass, it is evident that distance and consequently time (as the velocity with which the current flows is the same in all cases) must be allowed, for the different particles of this large mass so to circulate among themselves as that each may have an opportunity of coming into contact with a cooling medium, to give off its heat; but if the large mass of gases is so subdivided that the different particles are sooner brought into contact with the due amount of cooling medium, then the time the gases remain in the boiler ceases to be of importance. When the gases have reached the foot of the chimney, in a well-proportioned boiler, they will be found to be reduced to a temperature of about 500° Fah., or below it; their bulk will, in consequence, be reduced by about ⅓rd below their bulk on their first leaving the furnace. The reduction in the area of the flue ought not to be in the same proportion, because their velocity is no longer so great. The reduction ought to be made gradually, as has been stated before, and not by a sudden contraction at the foot of the chimney, as the effect of this is to cause a slowness of draught in the latter part of the flue, and consequently a deposition of soot; and then the surface so covered, which had been reckoned upon as effective heating surface, is lost. The area of a chimney, to allow the products of the combustion of each pound of coal consumed in an hour to pass off, should not be less than ¾ths of 2 square inches, this latter being the area given for the flue immediately behind the fire-place—that is, 1½ square inch; and for a boiler burning 13 lb. of coal per hour, on each superficial foot of its grate, the area should be ¾ths of 26 square inches, or 19½ square inches.

Theoretical research not having as yet given us any valuable assistance in determining the proper height of a chimney, we must again refer to practice as our guide. A good draught may be obtained with a very low chimney, but at a great expenditure of fuel, from the necessity, that exists in such a case for allowing the gases to pass off at a much higher temperature than would otherwise be necessary. For a chimney built of brickwork the height ought not to be less than 20 yards, and may be increased to 30 yards or 40 yards with advantage to the economy of fuel. When chimneys are carried to a still greater height, it is generally for the purpose of carrying off the smoke, or any deleterious gases, from the immediate neighbourhood, or to create a good draught with gases at a lower temperature than those from a steam-boiler furnace. On board steam vessels chimneys are limited in their height by the size of the ship, on account of the influence the chimney has on the stability and appearance. It will generally be found advantageous to make the chimney as high as these circumstances will permit. It will be found to tend greatly to the efficiency of a boiler to allow a large space in it as a reservoir for steam. The surface for ebullition does not seem to be of much importance in comparison with this point.

In the application of the foregoing proportions to practice, no reference need be had to the form of the boiler; the same results will be obtained whether the boiler be circular, wagon-shaped, or any other form, if all the other circumstances be made the same. By due management in the process of firing, when these proportions are given to the furnace and flues, the combustion will be found to be such that but little carbon will pass off to be converted into smoke, and the results will show great economy in the consumption of fuel.

THE ANTI-CORN-LAW BAZAAR.

(Continued from page 192.)

The *Model Room* is one of the most important in the Exposition. It exhibits Budding's machine for cutting grass plots, pleasure grounds bowling greens, &c., manufactured by John Ferrabee, Phœnix Iron Works, near Stroud, Gloucestershire.—W. G. Gover's patent removeable window sash, without taking off the bead.—Fryer's improved patent single, double, and treble washing and wringing machines,—a new invention, that washes, not by rubbing one part against another, (which wears out linen very much,) but by alternate pressure and the force of water through the linen, then over the top of the paddle, dashing down again upon the linen, which has just been pressed, and in the act of expanding.—Fryer's newly invented patent mangle and machine, to wash, wring, and mangle. It will be found that the linen is not only of a better colour, (from this mode of abstracting almost every particle of dirty water,) but it is much less injured than when wrung by the hands, and requires much less drying and folding for the mangle.

A model of the cast iron framing employed in the extensive London brewery belonging to Messrs. Truman, Hanbury, Buxton, and Co., in the support of their large fermenting tuns, as well as some of their vats. The first of these circular frames was erected in the month of September, 1832. On the 25th of October following, the vessel which it had to support was finished, and, in order to form some idea of the size of this vessel, it may be interesting to know that upwards of eighty persons dined very comfortably at the bottom of it.

A group of alabaster figures on a marble slab, which is sure to attract attention; in front of it are models of the Eddystone Lighthouse, and Cleopatra's needles. A case of horse-shoes, constructed on a new principle, by Mr. Rogers, veterinary surgeon;—a collection of beads used in the African markets for the purchase of slaves;—a collection of shells, ores, &c., from Cornwall, contributed by J. Parryn, Esq., of Devonport; and several specimens of the effects produced on various articles by the great fire of Hamburgh, are among the miscellanies in the room. The following machines are shown in full work: pillows for lace-making, worked by females; a very beautiful stocking-frame; Dyer's patent machine for making and fixing teeth in cards; an engine for striking coins or medals; a warp-lace machine.—Along the table are seen, the model of the front of a ship, constructed for the purpose of developing the principles of the lever applied to the working of the windlass in raising the anchor; several models of steam engines, exhibiting some new and ingenious improvements in construction.—Two surface-plates, on which so smooth a surface has been gained, that when one is laid upon the other, the upper plate will hold the under suspended by mere atmospheric pressure. In a case are shown the varied products that can be derived from potatoes and from wheat. A very interesting case exhibits all the stages of manufacture through which two sorts of flax pass from the raw state to the perfect cloth; and two other cases similarly illustrate the processes of the wool and cotton manufactures.—There are several beautiful models of ships and steamers.

The *Birmingham Stall* contains some magnificent specimens of glass dishes, of a delicate amber colour, with the ornamental parts plain. These are fully equal to any articles of the same description exhibited at the Parisian exposition. A bronze candelabrum, of exquisite design and finish, also demands attention; there is a totality in the original conception which we have often found wanting in modern candelabra, particularly those which are constructed in the style of Louis Quatorze, or Louis Quinze. The designer, in this instance, has kept steadily in view the great principle of decorative art, that ornamentation must be connected with adaptation, and that every detail, however minute, must have some reference, not necessarily direct, to the object and purpose of the article, as well as the original thought developed in the design. Among other articles on this stall, is a very fine sword for an infantry officer, of the pattern ordered in the new regulations; the temper of the blade could not be surpassed: also three papier mache trays, the shapes of which are newly-registered patterns, and the colouring perfectly gorgeous. While observing these objects, we overheard one bye-stander ask another why Birmingham was placed so near the Scotch Stalls? The answer was, that "Brummagem articles had on this occasion proved Sterling." Not the least interesting part of the exhibition on the Birmingham Stall, is a series of specimens of the beautiful results that have arisen from the recent application of Galvanism, or voltaic electricity, to plating; that is, covering one kind of metal with a thin plate or coating of another kind of metal. Electro-plating will no doubt produce a great revolution in the application of the Fine Arts, in increasing the mercantile value of industrial production in England; the coating which it deposits is imperishable. We have seen silver electrically plated on an iron surface, which could not be cut by the best engraver's tool. It is gratifying to the true friends of humanity, to learn that the process of electro-gilding involves no process injurious to the health; while that which it is about to supersede, exposed the workmen to the inhalation of the most noxious and deleterious of all gaseous exhalations, the fumes of sublimated mercury. We must omit to notice two beautiful finger plates of glass, cut into a rich design of floral wreaths; the finish of which is far beyond any that could be obtained elsewhere at such moderate expense. At the adjoining stall of Wolverhampton, we found a very fine collection of spurs, bits, and stirrups, manufactured for the South American market, by Messrs. Moreton and Langley. The Dudley Stall, well stocked, and contains, amongst other valuables, a fender and fire irons of exquisite workmanship, mounted with silver.

The *contributions from Coalbrookdale.*—The first object in this splendid collection, occupying almost the entire of the centre of the lower saloon, is the beautiful table that has been constructed for the exhibition of the articles. It is of wood, with richly ornamented legs, having successive rows of ranges for the display of articles, rising one above the other like the steps of stairs, the back of each range being formed of plate glass, so as to render the exhibition of the figures more complete and effective.

Nearly opposite to this is a Bronzed Fountain, seven feet six inches high, and three feet eight inches in diameter at the base. The outline of form combines, in varying proportions, the cylindrical and pyramidal, with figured details. The dominant figures in the design are the crocodile and the water snake, the plications and flexions of the latter being so judiciously managed as at all times to complete the details of general outline in a manner exceedingly creditable to the taste and skill of the artist. Near to this is a polished register-stove, set in a beautiful chimney-piece of white marble, with a telegraph back for regulating the draught of the chimney. The hearth-plate is peculiarly remarkable for the elegance of the workmanship, and the radiating ash-pan of polished steel is one of the most effective specimens of ornamentation applied to a domestic article, rarely brought within the range of decorative art, to be seen in the whole Bazaar. Five Fancy Tables of cast iron, and two Table Tops of decorated slate (contributed by Messrs. Allen and Co., of Augustus-street, Regent's Park), afford signal proof that new varieties of materials, susceptible of a high grade of decorative art, may be added to our means of domestic comfort and enjoyment. It is not necessary to mention the subjects of the paintings with which these tables are decorated; they are all executed with great spirit and taste.

The collection of vases at the lower end exhibits a range of inventive thought, both in form and pattern, such as we never expected to see developed. Without making any invidious distinction, we must say that the vases sent by Mr. Rose have not been surpassed, indeed have scarcely been equalled, by any similar products of the fictile art we have seen, whether belonging to ancient or modern time. And we say this with our examination of the magnificent display at the Louvre, Sévres, and the Parisian Exposition, still vivid in our recollection. We have next to notice the Garden and Hall Chairs. Though made of iron, they have an appearance of elegance and lightness which must commend them to general use. This is not the place to show that the distinction absurdly made between comfort and ornament is utterly without foundation, but we must say that the exhibition of Mr. Darby's contributions has established a truth on which we have often preached elsewhere, that *beauty is as cheap as ugliness*, and rather more agreeable.

Nearly all who have written on the Æsthetics of art, have found vases the most illustrative subjects of what they have termed the esoretic archetype which existed in the mind of the designer, and which, it is the perfection of art to suggest forcibly, and yet not thrust ostentatiously on the observance of the spectator. This perfection is attained in the Warwick Vase, and in some copies of Grecian Vases, but in one instance we feel that elaborate and and multiplied details have overlaid the original design. On many of the fancy castings we should gladly have dilated at great length, for they are suggestive of artistic thought, and lead at once to the consideration of the great question which lies at the foundation of all the higher departments of art, namely, how far an artist ought to be a creator, and aim at the realization of his own idealities, and how far he must be a copyist, and aim at accurate reproduction of the works of nature.

A plan for holding a *National Exposition* of the products of British industry, similar to that which was held last year in Paris, has been submitted to the Council, and is now under consideration. None of the articles exhibited will be sold, but those who send contributions to the Exposition will be allowed to distribute cards of address, directing visitors to the shops and establishment in London where articles of a similar character are on sale. A committee will be formed to decide on the admissibility of the articles offered for exhibition, and this body will be divided into sections corresponding with the principal departments of the vast and varied extent of British industry. It will, of course, not be necessary to have stall-keepers, as there will be no sales, and as the display of articles is the most efficient of all advertisements, it is expected that there will be no objection on the part of the exhibitors to defray the expenses of carriage. As Covent Garden Theatre would not afford anything like adequate room for such a display as is here proposed, it would be necessary in London, as it was in Paris, to erect a building for the special purpose, and the chief difficulty to be anticipated, in carrying the project into execution, is the obtaining of sufficient space in a convenient situation for this important purpose. There can be no doubt that the expenses would be defrayed by public subscription, for every manufacturer in the country, and every shopkeeper in London would have a deep interest in supporting such a project. It was stated on high authority in the French Chamber of Deputies, that the profits on goods sold to foreigners during the great Parisian Exposition, exceeded all the costs of preparation and maintenance four times over. A national Exposition in London would attract visitors from every quarter of the world, and prove even more attractive than the Bazaar. It will be necessary to give at least a year's notive of the Exposition, because manufacturers will feel that their own character, and that of the country, is, to a great extent, staked on the success of their efforts in scientific and artistic production. They will be very willing to risk a large outlay in order to produce the most perfect specimens of their respective manufacture, when they know that the several articles will still continue their own property, and when they are convinced that their display on such an occasion is certain to lead to a very large consumption of similar products. In no case is it desirable that any manufacturer should send a large number of articles; he must necessarily confine himself to specimens illustrative of his several varieties of production, and for his own sake he will be sure to send the best of each sort. There is no doubt that in many cases the duty of selection will be found very invidious and onerous by the gentlemen of the committe. In Paris this task was entrusted to a jury of supervision, in which were included several of the ministers, the most distinguished men of science in the Chamber of Peers and Chamber of Deputies, the professors of the University and the leading manufacturers of the kingdom; yet we know that some of their decisions were impugned, and that they themselves were fiercely assailed in the newspapers by disappointedi exhibitors. It would be a great improvement in the English Exposition, if power could be obtained, so as to exhibit the machinery sent up from various quarters in actual work. This was not done in Paris, and we shrewdly suspect that one cause of the omission was, that such a display would have given to the world signal proof of the inferiority of the French mechanicians in the construction and management of steam machinery. As a National Exposition involves little fatigue, and hardly any expense, after it has once been opened, there would be no reason for discontinuing it until the enlightened curiosity of the public had been completely and thoroughly gratified. We believe that it might profitably remain open for two or three months. Its extent would render it impossible to make a satisfactory survey of the whole without frequent and repeated visits.

RAILWAYS IN INDIA.

Sir,—In the Report as to Railways in India, p. 186 of the last number of your Journal, it is stated that the journey from Calcutta to Benares may be performed by palkee at the rate of 15 miles per day, requiring 15 to 18 days, from which the distance (not being stated) may be inferred to be about 250 miles; but "by dawk the charge is half a rupee per mile, or 22 rupees," this makes the distance 44 miles only. It may, perhaps, mean 22 rupees (for 44 miles) *per day*, which at 4½ or 5 days, the time given for travelling by dawk, gives 196 to 220 miles. Can you say what the real distance is, and what a dawk is, being as it appears three times as quick as any other mode of conveyance. I beg to observe that errors and confusion in these reports weaken the influence of such documents in a high degree, and of course ought to be avoided by both authors and quoters.

I am yours, &c.,

E. H.

*** Our correspondent might have saved himself the trouble of writing by reading the paper noticed by him carefully. It is there stated that the direct distance from Calcutta to Benares is 388 miles. Travelling by dawk is, we thought every one knew, travelling post with relays of palanquin bearers. On turning again to Mr. Stephenson's report, we find the paragraph on Expenses of Travelling to be correctly copied. We cannot hold ourselves responsible for inaccuracies which may have crept into Mr. Stephenson's statistics. How can an English editor be supposed able to correct numerical statements of the expenses of travelling from Calcutta to Benares?—Editor.

HOPE'S ARCHITECTURE.

Not seeing any solution of the obscure passage in Hope's Architecture, alluded to in the May number of the Journal, I will venture to offer a suggestion. Though, in its present wording, the passage is, as your correspondent observes, arrant nonsense, a glance at the plan will show at once the author's meaning; which may be expressed thus,—"The body presents a vast octagon shell and cupola, the pillars at the internal angles are prolonged in ribs, which, centering at the summit, meet in a single point: from the body, a high and wide flight of steps, rising opposite the entrance, leads to an altar, behind which is an oblong choir, whence, &c."

It has only been attempted here to clear up the obscurity of the passage, not to correct the errors in matter of fact,—for the octagon appears on the plan to be an irregular decagon, which moreover does not agree with the elevation,—nor to reform the English, which is singularly inelegant throughout.

I have not seen the second edition, but presume the index* alluded to is one which was published in a separate form by Cresy,—this, though a copious analytical index, has done but little to improve the book as a work of reference, on account of the subjects not being alphabetically arranged. The same deficiency exists in the volume of plates, rendering it necessary, in either case, to look through perhaps the whole index, until you find the subject of which you are in search.

I remain, &c.,

J. L.

* There is an alphabetical Index given in the second edition of Mr. Hope's work.—Ed.

DREDGE'S SUPENSION BRIDGE.

Sir,—In the ensuing number of your Journal may I beg a space to correct a trifling error that occurred in your last publication, what I allude to is at the bottom of page 194, "Accidents similar to the Yarmouth are unhappily by no means singular. The Menai, the Montrose suspension bridges, *one of those in the Regent's Park, London*," &c. This allusion to one of the bridges in the Regent's Park is a mistake, the only thing I know at all likely to give rise to such a supposition is detailed in Vol. VII. chap. 8, of the "Professional Papers of the Corps of Royal Engineers." On reference to this you will find that the clay embankment on which a foundation of one of the bridges stands slipped, and by so doing ruptured the wing walls, but the bridge itself was uninjured, at least comparatively so, for the damage done did not exceed £10. I have seen similar statements in several of the periodicals, but your cotemporaries have always allowed space for correction, and I am sure I may expect a like courtecy from you.

I remain, Sir,
Yours very obediently,
James Dredge.

Bath, June 16, 1845.

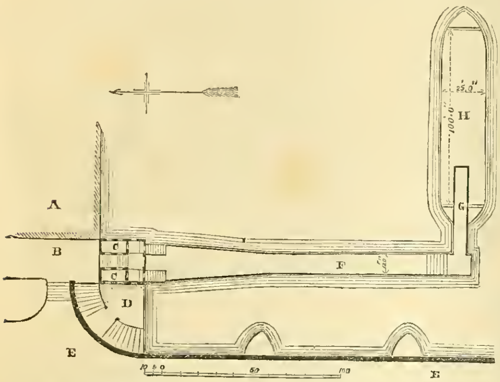
BLACKFRIAR'S PIER.

As long ago as the year 1840 the Committee appointed by the City to carry out the repairs to Blackfriar's Bridge entertained the idea of erecting a landing pier at this site, for the accommodation of steam boat passengers. Several designs were proposed, both for piers running out from Chatham Place, similar to the one now being executed, and also for stairs going down from the footpath of the bridge in front of one of the piers, the same as at Southwark and Vauxhall bridges. Nothing was determined, and no further notice was taken until last year, when the unfortunate accident which was attended with the loss of several lives again brought the subject before the City authorities.

It was then determined to carry out such a design as would ensure perfect safety to the public, and at the same time of such construction as would be the least expensive and most admissible of being easily removed should any embankment or other improvement of the Thames take place hereafter, with which the erection might be found to interfere.

The first design furnished to the Navigation Committee was of a cheaper construction than the one now being executed; it consisted of five thirty feet openings, with simple beams or girders resting upon a single row of piles, the width of the platform and the height of the seffit above Trinity standard was to have been the same as the present one. This design was approved by the Committee; the contract, plans, and specifications prepared and tenders advertised for, but, after matters had proceeded thus far, a few of the principal coal merchants and other gentlemen interested in the navigation of the Thames conceived that the thirty feet openings would not give sufficient width for the free passage of the coal barges and other craft which were intended to pass under the pier. These gentlemen made an application to the City to have the openings between the piers made wider, and in order to meet their views another design was prepared and finally adopted.

The accompanying engraving, which has been furnished to us by



A, Houses.—B, Chatham Place.—C, C, Waiting Rooms.—D, Quay.—E, Blackfriars' Bridge.—F, Pier.—G, Slope.—H, Dumby.

Mr. Hewett, (who has the charge of the works as assistant to Messrs. Walker and Burgess, the engineers to the City,) shows the plan of the work. It consists of three fifty feet openings, supporting a platform 12 feet wide, with a pier-head at the outer end 12 feet square, from which a sloping stage 8 feet wide leads down to a float or dumby 100 feet long by 25 feet wide, alongside of which there will be ample depth of water at all times of the tide. At the inner end of the pier there are commodious waiting rooms, with three flights of stairs communicating with Chatham Place. The centre of these staircases is intended to be used only as an entrance on to the Pier, and the two side ones as the exit off the pier, thus avoiding much of the confusion so often met with. It is expected that the Pier will be opened to the public in the course of a few days.

ON THE HISTORY AND PRACTICE OF SCULPTURE.

A series of Lectures delivered at the Royal Institute, by Mr. Westmacott, A.R.A.

Lecture I.—(From the Athenæum.)

(According to the plan set forth in a printed syllabus, this first discourse was chiefly occupied with definitions; a description was given of the materials used by sculptors ancient and modern; followed by an explanation of the different modes of execution.)

The admirera of the Arts may be divided into two classes: those who find in them subjects for reflection, and those who think of them as mere amusement. By this latter class, Sculpture would only be considered as an art intended to please the eye, and as a means of decoration; and sculptors,—perhaps in a superior grade, but, still, in the class of decorators. But the art had higher claims to attention. Its first claim of interest, is the very high antiquity of the art; its value as a record; and the high purposes to which it has been applied. Secondly, it is interesting for the evidence afforded by it of the intellectual condition of a nation, and of the progress or degree of its civilization; and for the influence the art has exercised, and is capable of exercising 'morally,' by supplying objects which interest the imagination and appeal to sympathy. And thirdly, from its position and value as an elegant art; in its function of presenting objects of beauty to the sense. With regard also to its value as a means of recording events, it must always be looked upon with interest, by those who judge of it by the remains of ancient monuments.

It was very long before sculpture could have had any qualities of 'beauty to recommend it. It was impossible in its early state that it could have been other than 'monstrous;' and, though sculptured figures may have arrested the attention, they could not have gratified the eye. Respect must have arisen from some other influence. A higher power was at work. Art, however rude the form in which it appeared, appeals to the feelings and imagination; and considered in this point of view, it is immediately invested with a character of the highest importance, as an instrument of teaching. It is no 'fanciful' value that attaches to the smallest fragment or basso rilievo that may reward the researches of the antiquary, if it but bear undoubled marks of ancient date. In it, and in it 'alone' sometimes, is found an authentic chapter in the book of history. A group, a piece of costume, or the representation of a ceremony, either informs the world for the first time, or may afford an explanation of some disputed or ill-understood passage in an ancient writer. The rilievi found in Egypt, in Ægina, in Sicily, and some portions of those more recently discovered in Lycia, though not admirable for any qualities of beauty, are most important links in the chain which unites existing nations with by-gone members of the great human family. Where such works not only illustrate the customs of former times, but charm us also by the beauties of art, as is the case with the rilievi from the Parthenon, they perform, first, the office of illustration; while, secondly, they show the high state of refinement to which a people had attained above two thousand years ago; and, at the same time, offer us objects for the improvement of our taste. Sculpture claims regard for the effect it may have upon the feelings, and through them the 'moral' influence it is capable of exercising. The incentive, the public vote for statues offered to honourable exertion, was traced through Greece, Rome, Italy after the revival of the arts, even to our time. As a means of collecting and fixing the most approved forms, with which nature has supplied us; of gratifying the eye with models of beauty. Sculpture must always be an object and a study of interest to any nation or people which lays claim to taste or intelligence. The fact of a considerable advance in civilization is established wherever the arts are found either practised or appreciated. Savages and barbarians cease to be such, when they become sensible of the beauties of art, for its presence must tend both to humanize and inform.

Sculpture, in the general acceptation of the term, the art of representing objects by form; and is thus applied to carving, modelling, and casting. In its strict sense it is the art of cutting or carving any hard or consistent material into a proposed form or shape. The arts of modelling and casting (and in the latter were included metallurgy and founding), were also described. The earlier practice in working objects in metal, was by simply hammering them into shape. When the metal was simply beaten out and plated, as it were, over a nucleus it received the former appellation, this was often done to save valuable metal, or to make the quantity go farther. The ancient authors describe works so executed in both ways; and the British Museum possesses a few very interesting examples of the practice. One of a head of Osiris, in which remains of the nucleus of wood still exist; another a portion of the decoration of a chariot; in which, part of the composition is in beaten silver, while the accessories and ornaments are of gold. The mode of working called by the ancients Toreutike, seems, generally, to mean metal chasing; and it is also applied by some writers to the union of metals with other materials; but though it appears always to be applied to metal working, it never seems to express 'casting.' It is tool working—ancient writers are not clear in defining Toreutic art; and critics, not being practical artists, have still more confused its meaning.

Terms used in Sculpture.

Mr. Westmacott next proceeded to explain the terms used in sculpture to designate entire figures or groups, viz., the Round; and objects with a back-ground—called Reliefs. The Elgin marbles were referred to as affording the finest specimens of two kinds of relief. The metopes for 'alto' and the sculptures of the frieze for the flat, 'basso-rilievo.' The Egyptian mode was also explained, and an example exhibited. In ordinary 'rilievo,' the outline or figure, is more or less raised; but in Egyptian work, the outline is sunk, and the figure so rounded within, and down to the outline, that no part of the work appears, or projects beyond the original surface of the slab to break the plane of the profile. There is another peculiarly flat style of 'basso-rilievo' which is known as that of Donatello and the artists of his time. The Italians call it 'stiacciato.' The object intended to be represented is, as it were, drawn on the slab, and then, in parts, slightly lowered or carved away. It resembles, in small works, engraving, rather than sculpture, in the usual meaning of the term.

Amateur judges often pronounce erroneously on the merits of 'alti' or 'bassi-rilievi,' from not being acquainted with a very essential principle which should prevail in works of the kind. There should be no foreshortening of the limbs in relief; and there should be no attempt, by diminishing the size of objects, to give the effect of distance. Exceptions may be found, but the ancients, who are the best masters in all that relates to the practical in sculpture, seem to have made this a general rule. Sculpture professes to represent 'form,' and can only represent by form. Foreshortening form must make it monstrous. To represent an arm extended, with the fingers pointed directly in front of the spectator, in 'basso-rilievo,' the tips of the fingers must be made to spring from the shoulder; for, for want of space, the intervening portions of the limb,—viz., the hand, wrist, and arm—could not be represented. The ancient sculptors seem to have acted so entirely on the principle here laid down that they scarcely ever attempted to represent a front face in 'basso-rilievo.'

The same principle precludes the representation of distance, or of remote objects. It is not possible to give the effect of distance or space when the colour remains the same on all objects, and is equally bright in all parts of the work. Sculpture is to give form in 'fact.' Painting has only to give it in 'appearance.' The attempts to overcome these difficulties by the sculptors of the seventeenth and eighteenth centuries, though ingenious, could not be referred to as good specimens of sculpture. They are many of them admirable for qualities of design, but they are fully as much, or more, painters' than sculptors' compositions.

Materials used for Sculpture.

The next branch of the subject was a statement of some of the materials used for sculpture. For modelling, clay, wax, stucco, or plaster have been universally employed. Among the ancients, clay was baked, acquiring by this process a hardness not inferior to stone. This is called by the Italians 'terra cotta. Granite, basalt, and other of the primary rocks, were used for works in sculpture; and our national Museum contains in the department of Egyptian Antiquities, some excellent specimens of workmanship in these hard materials. The list of marbles used by sculptors is almost endless. Among the Greeks, that of Paros and of Mount Pentelicus were the favourites. Both these marbles are white; but the Parian has a rich, creamy tone; while the Pentelic is of a cold, greyish, and sometimes a green tint; both are largely crystallized. Carrara marble, is of a fine texture, and of a soft, white colour. It seldom is found entirely free from spots of dark colour, or veins of grey or yellow. Metallic particles also occur, and crystals, which resist the chisel. The ancient sculptors extensively employed wood. Cedar, from its supposed durability, was much used for statues of the Gods. Among the conceits of ancient sculptors, in connexion with the subject of materials, Pliny, describes a statue of Venus made of loadstone, which was made to attract a Mars of iron!

The sculptors of antiquity occasionally introduced a variety of materials in the same work. When various marbles were used, it was called 'polylithic' sculpture, in distinction to sculpture in a simple material or stone ('monolithic'). In the period of the greatest glory of sculpture, the union of gold with ivory was resorted to. The favourite material for works in statuary, with the ancients, seems to have been bronze; and we can only account for the comparatively small number of works remaining in it to the various uses to which the metal could be applied; on this account it offered great temptation to the spoiler. The mixture used was copper and tin, which is called 'bronze,' probably from its brown colour. The term is taken from the Italian writers. The green tint usually seen on bronze is produced by acid—either by natural oxydation, or by artificial means. The mixture of bronze was much studied by the ancients. Modern sculptors have occasionally varied the proportions of their bronze since the use of zinc has been known.

It was a custom of the ancients to insert eyes in their statues, of different materials from the rest of the work; usually they were of silver, but precious stones and paste have also been found. Inscriptions in silver letters were sometimes inserted in figures of bronze. Specimens of this practice exist in all collections of bronzes. Some of the ancient writers refer to tinted bronzes, and describe the effect of paleness or of blushing being produced by the peculiar commixture of the different metals. A statue of Athamas sitting, after the murder of his son; in order to express the effect of confusion and shame, a mixture of iron is said to have been used with other metals; and that the change of the ferruginous parts caused an appearance like a blush. Plutarch speaks of a statue, by Silanio, in which, by a peculiar mixture of metals, a paleness was spread over the countenance. Callistratus describes a statue of Cupid, by Praxitcles, which had a vivid blush on the cheeks. The combination of metals in this way appears so inconsistent with known relations, that the accounts referred to must, in most respects, be treated as mere fancies, or inventions of their authors. Colour was undoubtedly extensively used to heighten the effect. 'Monochromic' sculpture was that in which a simple or one colour was used. When several colours were employed, the term used was 'polychromic.' It is not easy for us in this climate to judge of the probable effect of richly and variously coloured architecture and sculpture as it would appear against a bright blue sky, and in a clear, transparent atmosphere. Such applications to an art like sculpture, militate against our notions of good taste. But when we recollect that the greatest artists of the period of the finest art—in a country, too, in which sculpture was best understood and appreciated—had recourse to this practice, it becomes us to pause before we venture to impugn their taste, or pronounce judgment upon the propriety of their using such an accessory to heighten the effect of their works. The colours that are found most commonly used are red, blue, and yellow. Gilding, also, of the hair was not uncommon. Remains of colour have been found on the Elgin marbles.

Mr. Westmacott delivered his second lecture at the Royal Institution, on the 15th April. He commenced by stating that in the introductory lecture he had insisted upon the interest Sculpture was calculated to awaken 'independently' of its recommendation as an art representing beautiful forms. For, though it would be his object also to dwell upon its charm in this point of view, it was important in the first place to attract attention to Art upon higher grounds.

But few persons have time or opportunity to become intimately acquainted with the structure, the real beauty of form of the human figure; or with the gradations from manly strength to the extremes of female delicacy. The contemplation of Art was capable of affording even more pleasure to those who regard it æsthetically, that is, for its sentiment, intention and purpose, than to those who, mistaking means for ends, are too frequently in the habit of judging it by a merely 'technical' standard. The sculptors of Greece most happily united the two qualities; for, in their works, sentiment of the most elevated character is found expressed by the most exquisite form.

The earliest distinct allusions to imitative art appear in the sacred writings. The Israelites, after the Exodus, are warned to "put away false gods; and Rachel "stole the 'images' that were her father's." There are some curious details of the practice of the Babylonians in the arts in the time of the prophet Baruch (607 B.C.). "Now shall ye see in Babylon gods of silver, and of gold, and of wood, borne upon men's shoulders. They are gilded and laid over with gold, and covered with purple raiment"—precisely as the art was practised in Greece, for there also real drapery was sometimes used to decorate statues. The Persians seem to have contributed so little to the advancement of Art that they scarcely merit any notice. One powerful reason for their Art not attaining any great excellence, arose from the strong prejudice entertained by the Persians against statues as objects of worship, or representations of divinity. When sculpture is found in Persian buildings, it is remarkable that the naked human form is never exhibited. The sculptures found in the ruins of Persepolis consist of figures enveloped in long and heavy draperies, and the figures themselves are totally deficient in grace and variety.

'Egyptian sculpture' was next brought under consideration, as affording a subject of great interest. It was observed that when it is recollected that the history of the country is so involved in the obscurity of ages, that the dates of the foundations of its two capitals, Thebes and Memphis, are unknown; that sculptures—of a finished style of art—exist older than any historical record we possess, the imagination is troubled, and it almost seems to be hopeless to attempt to become acquainted with the history of a people apparently placed so far beyond our reach. Modern activity and research seem, however, to be opening, by degrees, the hitherto sealed book of Egypt. It must be remarked as a fact, which gives Egyptian Art its just claim to rank as a school, that, whether the works found be of the most ancient and, so to say, pure period of Egyptian history, or of the time of the Ptolemy's, or of that of Adrian, there still is a pervading, unmistakeable character in the art that stamps it as Egyptian, and distinguishes it from all other. The characteristics of its sculpture are, first, a simplicity so severe, that it at once affects us as sublime. The drapery of female figures has no folds. It can scarcely be called drapery, but that a slight edge or border appears near the feet. The colossal head of the so-called young Memnon in the British Museum merits all the admiration that it has met with, for its simplicity, its grandeur, and the mildness of it expression. In working basso-relievo and pictures, the Egyptians ventured beyond the limits to which they were confined in their sculpture. It was thought likely that prescribed forms were adhered to, in conformity with the types established and insisted upon by the priesthood, an influence that was probably exercised elsewhere in the same manner.

The principle of the arts of imitation never was the same in Egypt that it became in Greece. Their object was the expression of a certain order of ideas. It never was required to perpetuate the memory of forms, but that of persons and things. The gigantic colossus, and the minute amulet were 'equally' and 'only' signs of a fixed idea. But in Greece, when Art was fully developed there, the representations of 'the beautiful forms of nature' was the especial, till at last it became almost the only object and purpose.

No precise date could be assigned to the earliest Greek sculpture. Dædalus is one of the first names met with in the history of early Greek art; but it probably was a general, and not particular, appellation applied to a skilful man. The forms of the earliest sculptures—those found in Ægina, and those of Selinunte, in Sicily, as well as in other places—are short and thick, and there is not the slightest hint of, or feeling for, beauty. In Etrurian archaic sculpture, and in that of other countries, a somewhat slighter character of form seems to have been employed. The sculptors of Ægina seem to have been the first to step beyond the limitations to which Art had been confined, as may be seen in the sculptures brought from the ruins of the Temple of Jupiter Panhellenius, now at Munich, but of which there are casts in the British Museum. In these there is considerable improvement in the forms, a display of anatomical knowledge, and varied and expressive attitudes. The heads, however, are in the early archaic character, as if there had been a prescriptive form, which, in this respect, could not safely be departed from. Mention is made of 'bronze statues' at 800 B.C. These were probably in hammerwork. The revolt against Darius changed the promising condition of Art in Asia; but as it fell there, it seemed to acquire fresh vigour in Europe. It was then that the great schools of Ægina, Sicyon, and Corinth arose; and a new feeling began to display itself. The Selinuntine sculptures, discovered at Selinus, in Sicily, offer curious examples of the archaic style of art.

The history now approached a people who, equally with those already described, looked with awe and reverence upon an art which was associated with their religious creed and system; but in whose hands it eventually became a study of the highest refinement, and was endowed with such beauty of form, and such spirit of life, that the mere images themselves have become as it were immortal, when the gods they represented have passed away, and are forgotten as a dream.

'Grecian Sculpture.'—From about 500 B.C. the succession of sculptors in Greece, and the changes effected in the art, can be traced with tolerable accuracy. In the fifth century before our era an event occurred which had a great influence on the Arts. This was the failure of the expedition of Xerxes against Greece. Enormous wealth fell into the hands of the Greeks; and, as was customary, a tenth of all spoil was dedicated to the gods. Temples that had been destroyed by the Persian invaders had to be rebuilt; others were erected, and all were splendidly decorated with sculpture. The occasion called for ability and exertion, and the artists vied with each other in doing honour to it.

At so late a period as 500 B.C., and after some improvements had been introduced, especially by Ageladas and Myron, a certain character still pervaded such art as was employed to represent sacred personages; and whether it arose from popular prejudice, or, as has been hinted, from the resolution of the priesthood, primitive types were still, in a degree, preserved. But suddenly—for certainly it was suddenly that so 'complete' a revolution was effected—a new light burst upon Greece:—Phidias appeared. He was the scholar of Ageladas; and, having been educated in a school that had already effected improvements by giving more refinement and character to sculptured forms, he dared the greatest, the boldest innovation. In his statue of the tutelary divinity of Athens he delighted the nation, a people peculiarly sensible of beauty, by showing how the grand and beautiful in form might be made the true outward sign of godlike qualities. This statue, thirty-nine feet high, was made of gold and ivory; and no less than forty talents' weight of gold are said to have been employed in it.

The sculptured decorations of two remarkable temples in Greece are preserved in the British Museum, and form what are known as the Elgin and Phigalian marbles. The former are from the Parthenon at Athens; the latter from a temple of Apollo at Bassæ. The same architect, Ictinus, is known to have built both temples; and as Phidias was appointed to superintend all the works of the former, it is natural to believe that he also suggested the compositions for the decoration of the temple of Phigalia. The similarity of design that is observable in these latter and in the metopes of the Parthenon leaves no doubt that both were conceptions of the same master mind; though the different degrees of merit in the execution suggest the notion that they were not worked immediately under the eye of Phidias. Whether regarded for simple and severe dignity of character, for profound knowledge of the structure of the human figure, for various and expressive action, for harmonious combinations, or for most skilful execution and treatment, they claim the highest admiration that can be bestowed upon them. They also offer the finest examples of the technical in Art. The 'round,' the various kinds of 'relief,' the distinct character and treatment of the naked as contrasted with drapery, are all in their way excellent. It is also worthy of remark, how finely treated the animals are whenever they are introduced.

Art had now been relieved from the dry and hard manner of the Æginetan school, and Phidias produced out of it the grand style that marked his period; but some severity of character still remained. Under an artist, immortal in the annals of ancient sculpture, a fuller change was effected. The grand, the sublime, characterized the school of Phidias. Next appeared the lofty, the flowing, and the graceful in Art. Praxiteles may be called the founder of this school. He lived about 300 B.C. He chiefly delighted in the round, full forms which Nature exhibits in youth of both sexes; and Cupid, Bacchus, Apollo, and female figures charmed the Greeks by their appeal to the senses. Praxiteles executed many works in bronze, but he is said chiefly to have excelled in marble. In this age it is believed statues of females were first represented undraped; but the innovation was not immediately allowed; and though the Greeks were alive to the exquisite beauties of form thus exhibited, the practice was not at first fully admitted; and a sort of compromise seems to have been made. Statues of females were represented nude down to the middle; and the lower part of the figure was as usual enveloped in drapery. But soon after this, we find mention of numerous statues of the female figure, displaying all the exquisite beauty of form which is its admitted and peculiar characteristic. Execution was the 'forte' of Praxiteles. Of this period is the well known series of statues known as Niobe and her family, attributed to to Scopas, although by some thought to be the work of Praxiteles.

Lysippus was the next leading sculptor of the great Greek school. A statue which many believe to be a work of this master was referred to as a good example of the style which he introduced. It is a small bronze statue of Hercules, in the British Museum. He may be considered to have carried the art or style of Praxiteles to its extreme bounds,—within the limits of the grand style. Lysippus had the fortune to live in the age of an ambitious and vain prince, Alexander the Great, who gave this, his favourite sculptor, ample opportunities of exercising his art in his service and honour. He allowed no one to make statues of him but Lysippus. There was the same limitation in painting, and in representing him on gems. Apelles alone was allowed the former honour, and Pyrgoteles was the favoured artist in the latter branch of Art.

In concluding this portion of the history of Greek sculpture, Mr. Mr. Westmacott observed he thought the leading characteristics of the schools, omitting the archaic style, might be thus described. 'The first, that of Phidias,' was marked by sublime grandeur. 'The second, of Praxiteles,' by richness of form with voluptuous expression. 'The last, of Lysippus,' by force and energy. These were practised by all three within the limitations of the finest style. Their respective art was the full and perfect development of the qualities described; which none before them had reached, and which certainly none after them have surpassed.

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

MATERIAL FOR PAVING, &C.

Edwin Edward Cassel, of Millwall, Poplar, merchant, for, "*A material or combination suitable for paving, piping, roofing, and most other purposes to which wood and iron are applicable.*"—Granted September 26, 1844, ; Enrolled March 26, 1845.

This invention consists in forming an elastic compound, of four descriptions, to be used for a variety of purposes as hereafter described. No. 1 compound is prepared manner following:—Saturate a quantity of chalk, or marl, or lime, or loamy clay, or sandy earth, previously reduced to the state of a fine powder, with oil of tar, or mineral tar, or vegetable naphtha, or any other resinous, oily, or fatty matter. Take one cwt. of rosin, and melt it in a cauldron exposed to a gentle fire, until all the water in it has evaporated. Then throw into the cauldron two cwt. of the saturated chalk or other earth, and mix it well with the melted rosin. Next add from 3 to 6 lb. of liquid caoutchouc, or from 1 to 3 lb. of essential oil of tar, or turpentine or some other oily, or fatty, or cementitious substance, (varying the quantity according to the degree of elasticity desired to be given to the ultimate compound,) and after that from 3 to 5 lb. of sulphur; and finally, two cwt. of fine dry grit, keeping all the while the contents of the cauldron well stirred, till the whole are thoroughly amalgamated. When cool this compound is of a slatish grey colour, and of a close granular texture. No. 2 compound is prepared in the same way as No. 1, and composed of the same materials, and in like proportion, excepting only that the rosin vegetable pitch is substituted, and a larger proportion of sulphur is used, say from 6 to 8 lb. No. 3 is also prepared in the same way as Nos. 1 and 2, and composed of the same materials in the like proportions, excepting that instead of the rosin or vegetable pitch, equal parts of rosin and Stockton tar are used, and the quantity of sulphur reduced to about 4lb. No. 4 compound differs from No. 3 in the substitution of equal parts of rosin and mineral, or coal tar for the equal parts of rosin and vegetable pitch."

For forming piping, such as water pipes, drains, sewers, &c., I make use of any of the four compounds before described' combined with wood in manner ollowing: I place tw cylinders on en l one within the other, the inner being of the size of the desired pipe, and the space between it and the outer being of the diameter intended to be given to the case of the pipe, and form in the middle of the space between the two cylinder a ring of oblong or square pieces of wood from three inches thick to 4 or 5 wide, building one upon the other after tde manner of bricks, and cementing them together by any of the four compounds before mentioned in a hot and fluent state; when this ring has been completed, I fill up the spaces between the two cylinders outside of the ring with any of the four compounds aforesaid in a hot and fluent state after this compound has cooled the cylinders are withdrawn, when a complete pipe remains perfectly smooth on both surfaces; where pipes of very large dimensions are required, the internal rings may consist of two sets of wooden blocks side by side, and they may be further strengthened by vertical tie rods terminating at both ends in nuts and screws.

Casks, tanks, cisterns, garners, and other vessels of capacity are formed of prisms of wood, and put together with one of the four compounds in a similar way to forming the pipes.

For large blocks for wharfing, the construction of docks, &c., I combine in the manner following one or other of the four compounds previously mentioned with pieces of wood previously prepared with linseed oil, sulphate of copper, or some other anti-dry-rot composition in order to preserve the same from decay, I employ for the purpose of moulding the block cast iron frames of a quadrangular form, having a recess or grove at one end and a projecting piece at the other, adapted to fit into that groove mortice and tenon fashion; I pour into this mould any of the four compounds before described in a hot and fluent state, while it is yet hot I place in it a layer of pieces of the prepared wood, taking care to have them perfectly dry, and so shaping and arranging as they may be kept within about ¼ inch of the mould all round, I then cover this layer of wood with a coating of the compound, and set in that coating a second layer of pieces of wood laid with the grain the reverse way to the first, and I proceed until the block has acquired its required thickness, after which I fill up the quarter of an inch or thereabouts left vacant all round with the compound, which gives a good finish to the block on its outer surface; when several blocks so formed are laid down end to end the tenon pieces of the one take into the hollow or morticed parts of the other. Apertures may be left for the purpose of connecting them by ties transversely at suitable places.

For railway sleepers or other like purposes I use or other of the four compounds before mentioned, combined with wood in the same way as the blocks before described, and when such planks are used for railway sleepers they may have a hollow space in the centre or any other more convenient part which may be used for passing of gas, telegraphic wires, &c., the wood should in this instance also be previously prepared with some anti-dry-rot composition. While in a hot and fluent state it is filled into an iron hollow rail, which is raised a little above the rest of the rail in order that the wheels of the carriages may take the bearing upon it; should it be found in practice that the compound is unequal to the friction to which it is exposed, the grove may be half filled with it, and a rail of iron bevelled off at the sides dovetail fashion laid on the top of it, the cork compound would in that case form a sort of elastic cushion on which the iron rail would rise and fall as acted on by any superincumbent pressure. The same material may be used for roofing and flooring.

CONSTRUCTION OF BUILDINGS.

Francis Higginson, of Rochester, lieutenant in her Majesty's navy, and Edward Robert Coles, of the same place, merchant and ship-owner, for "*certain Improvements in the construction of buildings generally.*"—Granted Nov. 21, 1844; Enrolled May 1845.

The improvements consist in the substitution of iron for wood in joists, girders and other parts of buildings in the following manner: joists are made of cast or rolled iron, T shaped, and of any required length, with a dovetail projection all of one size at each end, made to fit into flanged mortices cast on the iron girders and bonding sockets. The iron girders, of proportionate strength, are likewise ⊥ shaped, but reversed, and have flanged dovetail mortices cast on each side of them, one foot or eighteen inches apart, as may be necessary, to receive the ends of the joists. The iron bonding sockets are of the size and shape of a brick, cut off angularly before, cone shaped, and cast hollow; the shorter side has a like dovetail mortice to receive the joists. The short iron trimmer joists compass the chimneys in the usual manner, fitting by dovetail ends into mortices cast on the principal trimmer, at one end, and into the bonding sockets, built into the house wall, beside the chimneys, at the other. The usual arch for the support of the hearth being provided for by iron bearing-pieces fitting in mortices between the short trimmer joists, with an iron plate to uphold the bed of mortar under the hearth stone; thus rendering the whole framework of the floor perfectly independent of support from the stack of chimneys, the entire isolation of which obviates all danger of that sinking which occasionally takes place from their greater weight in chimney stacks recently erected. The wells or openings for staircases, are formed by iron trimmers cast with dovetail mortices on them to receive the joists, and may be obtained of any required form, size, or description. Additional means of support being provided, when requisite, by iron pillars with a screw in the centre of the lower end, fitting into a female screw socket, drilled into the trimmer beneath—a tenon or projecting piece, at the upper end of the pillar, entering a recess, cast or drilled to receive it, in the trimmer of the floor above. Breast-trimmers for shop-fronts, gateways, and other purposes, may be cast with the mortices for the joists on the inside; and any description of ornamental device, name, or entablature without—trussing spans, to support great weights of superstructure, being likewise, where requisite, annexed. And when the non-transmi sion of sound between different apartments is required, however near, as a substitute for the usual filthy and destructive method of pugging, slight sheet iron, or tin cases, fitting in breadth and depth, between the iron joists, are inserted; which cases, when made, are supported internally from collapse by strong iron upright wires; and the atmospheric air within being displaced by passing a body of steam into them—upon hermetically sealing, and allowing the steam to condense, a sufficient approximation to a perfect vacuum is obtained to prevent the transmission of either heat or sound, Unlike the mould and and saw-dust now used, adding little to the superstructural weight, and effectually preventing extended combustion, should even the wooden floors and furniture of one apartment be ignited and destroyed.

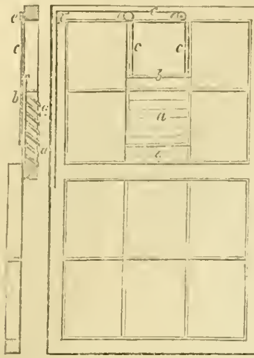
In cases where the floors are intended to be of wood, a groove is run along beneath the upper arms of the patent iron T joist, to receive an iron bracket. The floor planks being laid, and temporarily cramped, or shored down, upon the iron joists, a projecting, square-headed, shouldered screw is inserted by a spanner, through the upper arm of the bracket, into the lower surface of the floor plank, which is thus effectually secured to the joist. It being noticed, that should the boards shrink, they may be forced together and the interstices filled up by one piece in any convenient position, in consequence of the brackets moving along the grooves in the joists, and each plank being secured independently of the others. The unsightliness of a shrunken floor is thus not only remedied, but as no nail holes are visible, the screws beneath not perforating the entire thickness of the plank, one unbroken surface is presented, which for the purposes of cleanliness and appearance is alike desirable. Magazine or warehouse floors, for goods liable to spontaneous combustion, may however be laid of either metal, slate, or stone, rivets being substituted for screws in attaching such to the iron joists beneath—which joists are of many forms as well as that specified, when applied to different uses.

As respects internal ceiling and plastering, these iron joists admit of the common lath being used; in which case, to hold the lathing nails, a small fillet of wood is inserted into a recess formed to receive it in the lower edge of the joists. But as it is desirable that decay as well as fire should be provided against, perforated common tin, or thin galvanized iron plates, being punched full of holes, or rosed, like the nose of a watering pot, with the rough side towards the plaster, are substituted for the laths, to which the mortar, being applied by the usual process, forces itself through the perforations, and keys at the back of the plate in precisely the same manner it would do between laths. One half the ordinary labour, time, and material are in this instance likewise saved, two coats of plastering only being required—and the same sound-transmitting ceiling and wall surfaces preserved. These plastering plates are attached by means of pins cast in the joists, or a small double-ended iron key passing through them edgeways, into mortices in the iron joists and battens adapted to walls; being by a spanner afterwards turned across the entering orifice, and thereby effectually and immoveably annexed. A house thus constructed cannot be destroyed by fire, and has but little tendency to decay; whilst the expense of erection, taking all items into consideration, does not exceed that of the present method of building with perishable and inflammable materials.

GLASS VENTILATION.

Benjamin Baillie, of Henry-street, in the county of Middlesex, glazier, &c., for "*Improvements in regulating the ventilation of buildings.*"—Granted Nov. 25, 1844; Enrolled May 24, 1845.

This invention consists in arranging narrow plates of glass in combination with a flat sliding plate of glass, the whole of which are connected together by means of a suitable frame, and attached to that part of a window frame or sash best calculated for ventilating the room. The nature of this invention will be more readily understood on referring to the engravings, in which fig. 1 shows a front view and fig. 2 an edge view or transverse section of this improved ventilator. *a a* are the narrow plates of glass or "louvres," the whole being supported by means of a suitable frame in an angular position; in front of these plates, and in the same frame, is attached a plate *b*, which is also of glass, and is capable of being moved up and down by means of cords *c c*, which pass over guide pullies *e e*, and down the side of the window frame and round a pulley similar to a blind rack, or the same may pass round a suspended pulley, so that by pulling at the cord in a similar manner to drawing up a blind the sliding plate *b*, can be raised or lowered so as to admit of a greater or less quantity of air as may be required, it will be evident that the plate *b* may be made to slide in a lateral direction. The inven-

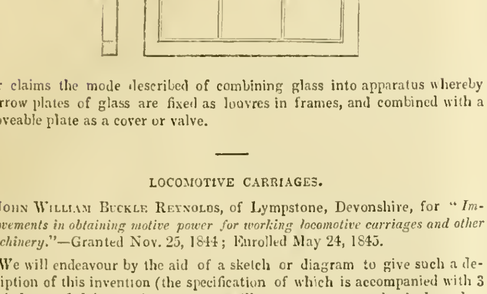


tor claims the mode described of combining glass into apparatus whereby narrow plates of glass are fixed as louvres in frames, and combined with a moveable plate as a cover or valve.

LOCOMOTIVE CARRIAGES.

John William Buckle Reynolds, of Lympstone, Devonshire, for "*Improvements in obtaining motive power for working locomotive carriages and other machinery.*"—Granted Nov. 25, 1844; Enrolled May 24, 1845.

We will endeavour by the aid of a sketch or diagram to give such a description of this invention (the specification of which is accompanied with 3 or 4 sheets of elaborate drawings,) as will convey to our mechanical readers an idea of this mode of obtaining motive power, which is effected by a peculiar combination of machinery aided by the explosive property of a mixture of gas and atmospheric air, that is to say, the invention consists in working locomotive engines by means of compressed or condensed air obtained by exploding gas in the manner hereafter described. The accompanying figure, which, as before stated, is merely a diagram, shows a longitudinal section of a locomotive constructed according to this invention. Suppose *a a* to represent the frame of the carriage, *b b* are two cylinders placed within a copper vessel *c c*, each of these cylinders is provided with a piston and piston-



rod passing through a stuffing box in the cylinder cover; the upper part o the cylinders *b' b'* communicates by means of pipes with the vessel *c c*, which communication is provided with a valve so as to prevent any air returning from the vessel *c c* to the cylinders; it will therefore be understood that if gas and atmospheric air be exploded within the cylinders on the underside of the pistons at *b b*, the said pistons will be driven upwards, and the air contained in the cylinders above the piston will be driven by the ascent of the pistons into the copper vessel *c c*. A B represent two vessels, one of which for the sake of perspicuity we have drawn larger than the other; A contains a mixture of gas and atmospheric air, the vessel B, which is supposed to be beyond the vessel A, may be termed a vacuum vessel, and is connected by means of a pipe *g* to the upper part of the cylinders *b' b'*, and also by means of pipes (hereafter described) to the working cylinders of the locomotive, which are supposed to be at C and are of the ordinary construction; the vessel A has a pipe communicating with the lower part of the cylinders marked *b*, for the admission of gas, which passes through valve boxes *e e*, there are also pipes *f f*, which pass from these valve boxes and form a communication between the underside of the pistons in the cylinders *b b* and an air pump D; the pistons of the cylinders C give motion in the ordinary manner to the driving axle of the locomotive, and the axle of the carrying wheels gives motion by means of a two-throw crank to the piston of the air-pump D; *i* is a valve for starting, stopping, or reversing the motion of the locomotive, the manner of preparing which for work is as follows. Suppose it were required to start the locomotive engine, it will be necessary in the first place to disconnect the piston of the air pump D and work the same a few strokes by hand, in order to exhaust the air from the underside of the pistons at *b b*, which space will be occupied by the admixture of gas from the vessel A; this being effected, the valves *e'* are moved so as to shut off the communication between the cylinders *b b* and air pump D; the mixture of gas and air is exploded by a galvanic battery, alternately in each cylinder, which has the effect of raising the pistons and forcing the air from between such pistons and the cylinder covers into the copper vessel *c c*; the oxygen and hydrogen portion of the gas having by reason of the explosion become converted into a very minute portion of water, leaving only the nitrogen within the cylinder, a partial vacuum will be formed on the underside of the pistons, and the air contained in the vessel B being allowed to pass into the upper part of the cylinders *b' b'* the pistons will descend, the cylinders are again filled with gas and another explosion takes place, and this operation is continued until the whole of the air is exhausted from the vessel B which then becomes a vacuum vessel, this operation of exploding is also continued until the air in the copper vessel *c c* has become sufficiently condensed to work the cylinders C of the locomotive; it should here be observed that the cylinders *b b* may be provided with air cocks should the density of air in the vessel *c c* not be sufficient to work the engines after the vessel B has been exhausted, but presuming the air in the vessel *c c* to have become sufficiently compressed, the piston rod of the air pump may be connected with the working part of the engines which will then be ready for starting in the following manner: that is to say, in order to set the engines in motion, the valve *i* is to be raised in the position shown in the drawing by means of the handle *j*, the compressed air in the vessel *c c* passing through the pipe *k* into the valve box *i* is then allowed to pass from thence through the pipe *l* to the working cylinders C, this being the case it will be evident that a pressure will be exerted on one side of the pistons equal to the density of the compressed air in the vessel *c c*, and will act upon the piston in the same manner as steam of equal pressure; the air contained in the cylinder on the opposite side of the piston passes from the eduction part of the cylinder through the pipe *m*, past or underneath the valve *i*, and through the pipe *n* into the vacuum vessel B; it will therefore be observed that the action of the engine are similar to condensing engines, viz., a pressure is exerted on one side of the piston equal to the compressed air in the vessel *c*, and on the other side of the piston equal to the vacuum in the vessel B. On the return stroke of the piston the air contained in the cylinder is, as before observed, passed into the vacuum vessel, and from thence to the cylinders *b' b'*, where at every stroke of the engines it is forced by the explosive gas into the copper vessel *c c*, to be worked o er again. Upon the valve rod *o* is fixed a brass ring *p*, which at every stroke comes in contact with the wires of a galvanic battery so as to complete the current, and thereby explode the gas which at every stroke is admitted into the lower part of the cylinders *b b*. In order to reverse the engines above described it will only be necessary to depress the lever *j*, so as to allow the compressed air to pass through the pipe *m*. And in order to stop the engine the lever is depressed so as to bring the valve in such a position as to cover the whole of the three openings *l, m, n*.

The inventor also proposes to form a vacuum in the traction pipes of atmospheric railways by the process above described, he also shows a mode of applying certain parts of his invention to propelling vessels.

IMPROVEMENTS IN SOAP.

John Barker Anderson, of Great Suffolk Street, Surrey, for "*Improvements in the manufacture of soap.*"—Granted Nov. 25, 1844; Enrolled May, 1845.

The patentee describes his invention as follows,—when curd soap is boiled to strength and subjected to a "fitting" process, somewhat similar to the fitting process used in making yellow soap, there separates from it a peculiar substance analogous to the niger or nigre of yellow soap, and that by removing this niger and boiling the remainder of the goods into curd soap there is obtained a curd soap of better quality than the original charge of goods would yield without this operation. The inventor finds that the niger which is removed is well adapted for making a "mottled soap," to which purpose he applies it accordingly. In carrying the invention into operation he proceeds in all respects in the manner commonly practised by soap boilers up to a certain point, that is, in the copper the ordinary materials are added for making curd soap to the ordinary leys, and boiled together until the goods are "to strength" and "ribbon out" well on the finger; but at this stage, instead of boiling-out the head and finishing as hertofore practised, the inventor commences the performance of his process; he pumps out the strong ley on which the goods have been boiled, and treats the goods with successive portions of weak ley or water, and boils them together until they assume the appearance of the goods of a fitting yellow colour. This condition being arrived at, the operation is stopped and time allowed for the niger to be deposited, which may require from 24 to 36 hours. This niger is then separated, either by pumping out from under the purified goods to an adjacent copper, or the purified goods are removed from above the niger to an adjacent copper, as is found most convenient; but in either case, upon the said goods being thus deprived of the niger, there is added to them the proper finishing ley for curd soap, and boiled to a suitable curd or until the soap is found to be in a condition for cleansing off into the frames. When a charge of very impure materials is to be operated upon, or when from any circumstance it is considered of advantage, this purifying or fitting process is to be repeated once or more times, in which case or cases after separating the niger from the goods as described there is to be added to the residual partially purified goods a ley of moderate strength only (instead of the finishing ley for curd soap) and boiled, taking care no "head" is formed; the ley is then pumped out and the goods again treated with weak ley or water until sufficiently diluted so as to perform tho fitting process; after which time is allowed for subsidence, the niger separated and the finishing ley added, and boiled to a curd as before described. The inventor's treatment of the niger and mode of converting it into mottled soap, is as follows. As above stated, the niger is pumped from under the purified goods to an adjacent copper, or the purified goods are removed from it, suffering it to remain in the copper which has been employed for its separation; in either case there is added to it the ordinary ley used for finishing a mottled soap, and boiled until the soap is fit for cleansing off into the frames. The qantity of niger obtained from one purifying or fitting operation is not large enough to be boiled conveniently by itself, therefore, in general, four, six, or more of the said nigers are pumped together and finished by one boiling in the manner above described, there is also occasionally addtd to the nigers a portion of tallow, bone fat, melted stuff, or other suitable material, and afterwards finished as with an ordinary charge for mottled soap.

The claim is, first, for the manufacture of curd soap by separating from the materials originally put into the copper the niger, and boiling the remainder of the materials into curd soap, by which is produced a purer and better soap; and secondly, the making of this niger into a mottled soap, with or without the addition of other materials as described.

INCRUSTATION OF BOILERS.

Louis Antoine Ritterbandt, of Gerard Street, Soho, Middlesex, for "*Improvements in preventing and removing incrustation and steam generators.*"—Granted Dec. 2, 1844; Enrolled May 28, 1845.

The object of this invention is to prevent, and also to remove, by the application of ammoniacal salts, muriatic or nitric acid, the incrustation in steam boilers and steam generators, which the inventor states is occasioned by the heat employed in generating steam causing the lime which exists in the water in the form of a soluble bicarbonate of lime to be converted into an insoluble carbonate of lime, the particles of which as they fall to the bottom carry with them other particles which may be held in suspension in the water. The object of the inventor is, therefore, to convert the insoluble carbonate of lime into a muriate, nitrate, or other soluble salt. He therefore proposes to introduce into the water, contained in the boiler or tank from which the boiler is supplied, muriate of ammonia, nitrate of ammonia or any other ammoniacal salt whose acid forms with the lime a soluble compound, the quantity of which will depend on the quantity of lime contained in the water to be employed in working the engines, and in order to ascertain this the inventor takes, for instance, a gallon of the water to be examined and evaporates it slowly in an open vessel. He then collects the solid matter found at the bottom of the vessel and weighs it, this matter is then placed in a glass vessel and mixed with equal quantities of muriatic acid and distilled water, after standing for a short time the mixture is to be filtered through white blotting paper, the solid is again collected and dried, and the difference between its weight now and before the application of the acid is said to give the amount of carbonate of lime dissolved in the muriatic acid. For instance, if a gallon of water give 10 grains of solid matter, and after digesting with muriatic acid there be only 6 grains left, the gallon contains four grains of carbonate of lime; having thus ascertained the quantity of lime in the water, and taken into consideration the quantity of water evaporated in a given time, the muriate of ammonia must be added a little in excess of the lime, say 54 of ammoniacal salt to 50 of carbonate of lime.

The inventor claims the application of ammoniacal salt to prevent and remove incrustation in boilers, and also the application of ammoniacal salt with muriatic or nitric acid for the purpose above described.

IMPROVEMENTS IN SUGAR BOILING.

John Ronald, for "*an Apparatus for boiling sugar-cane juice and other liquids.*"—Granted Dec. 5, 1844; Enrolled June 5, 1845.

The apparatus consists of an oblong chest or vessel with a high flange, made of wood or metal, and lined with copper or other metal, to contain the cane juice or liquid which is to be boiled by the heat of steam. In this chest are lengths of strong copper pipes, eight in number, for containing the steam; these pipes are formed into a continuous coil by baving bends of brass soldered on to their ends, which bends are jointed together by external and internal screws, and screwed up so as to permit a gradual descent on each piece of pipe from one end to the other, by which means the water formed by condensation in the pipes flows freely off; two of the tnese pipes are of greater diameter tha n the others, for the purpose of creating a greater boiling power in a particular part of the chest or vessel. There are forked copper supports for the pipes, each being about $\frac{1}{16}$th of an inch shorter than the preceding one, for the purpose of supporting the pipes at the gradual descent fixed by the screwing of the joints. Steam is admitted from a high pressure steam boiler or boilers at two places into the pipes in the chest; a valve in the bottom of the chest discharges the contents, the bottom of the chest being sloped down to the valve so as to discharge the whole contents quickly. There is a pipe with a descent for carrying forward the condensed water to a self-acting expansion valve. The chest contains also a revolving fan, or agitator, made of copper or other metal or wood; it is worked by the rolling motion of the boiling liquid, and is so constructed that it can be placed as low or as high in the chest as is necessary; it consists of a spindle with flanges fixed to it, the spindle being a hollow cylinder which gives sufficient buoyance to the fan or agitator so as to float it on the surface, the journals of the spindle being guided in slots.

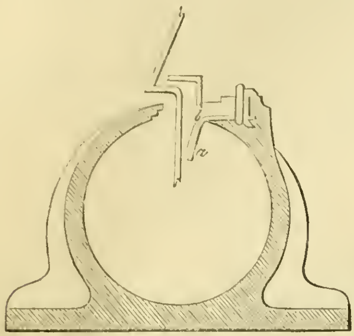
The chief claim is for the plan of admitting the steam into the pipes at two different places, by which means the heating power of the pipes is greatly increased, compared with what it is when admitted at one place only When the steam is admitted at one place only, a great deal of its heating power is exhausted before it reaches the farther end of the piping. The claim is also for the plan of creating a much greater degree of boiling, in a particular part of the chest or vessel, by introducing into that particular part piping of a greater diameter than what is in the other part of the chest or vessel—this causes a much greater ebullition; it also causes a constant and rapid rolling motion of the liquid from the one side of the chest to the other, thereby greatly increasing the evaporation, thereby causing the scum on the top to flow all to one side of the chest, where it can be skimmed off with ease, thereby preventing the liquid when it has become thick from settling down and charring on the pipes, and thereby driving or working the revolving fan or agitator. The invention of the self-acting expansion valve for keeping the pipes in the chest clear of the water formed by condensation is claimed. When no steam is in the piping, this valve remains fully open: but as soon as steam is admitted, the hot water from condensation, and, at first, a small portion of the steam, rush along the piping down to the valve; the piping is immediately lengthened by the heat, and the mouth of the valve advances up to the plug, which is kept fixed in its position by the pole; the valve is thereby shut, and the water collects in the piping, which thereby becomes less hot, and contracts in length just so much as to withdraw the mouth of the valve from the plug no farther than allows the water to trickle away without wasting steam.

The inventor states that when trying an experiment in this matter he discovered and has brought into use what cannot be considered anything else than a first moving power hitherto unknown, viz., moving machinery by the force of boiling liquid. It is noticed in the specification; the agitator or fan revolves with great steadiness and with considerable force. It has as yet been tried only in granulators; but in an evaporator heh as no doubt that the power will be equal to the strength of a man. This power can be obtained by the heat of a common fire as well as by the heat of steam.

IMPROVEMENTS IN ATMOSPHERIC RAILWAYS.

William Prosser, Jun., of Pimlico, and Jean Baptiste Carcano, of Milan, gent., for "*Improvements in working atmospheric railways.*"—Granted Dec. 1 1844; Enrolled June 18, 1845.

This invention consists in the first place of so arranging the valves for covering the longitudinal slit or opening that they shall open inwards, and in combining such valves with suitable transverse valves in the traction pipe for the air to act against whilst moving the piston; secondly, in the application of reservoirs, for receiving the air when in a compressed state, to such railways as have valves which open inwards; and lastly, the invention consists in causing the air in the traction pipe, which has been used for propelling, to be returned back into reservoirs to be again used. The accompanying figure shows a section of a traction pipe, in which *a* is the valve opening inwards, this valve, which move upon a hinge or joint at *b*, is composed of leather strengthened with metal plates, and is similar in every respect to those



now in use. The inventors state that these valves are to be combined with transverse valves, which they prefer to be flap valves, so constructed that they may allow the piston to pass freely, and also that they may act as a stop for the air to press against when propelling the piston, whether in one direction or the other, but, strange to say there are no drawings to show how this is to be accomplished. It is further stated that the valve, which will require no apparatus to close, it from being closed by means of the compressed air, is to be so constructed as to have a tendency to fall inwards, but if in practice it be found too stiff the specification states that a "projection must be fixed to the instrument which connects the *piston rod* to the carriage;"—this is certainly anything but intelligible, we presume the inventor means that a projection is to be attached to the piston rod itself, or to some convenient part of the carriage, for the purpose of opening the longitudinal valve. In working atmospheric railways according to this invention, the pantees state that the air may be forced into the traction pipe direct from the pumps, but they prefer to have reservoirs along the line, say three at each station, each reservoir being of the same capacity as the section of the tracton pipe it is to supply, and connected with such traction pipe by suitable branch pipes placed at or near the transverse valves, and in order to equalize the pressure of air passing from the reservoirs to the traction pipes, the branch pipes are to be provided with valves which are to be gradually opened as the piston proceeds along the traction pipe, the air besng what is technically called wire drawn.

The third part of the invention consists in pumping the air from the section of traction pipe along which the piston has just passed, instead of pumping or forcing such air from the atmosphere, the economy of which will be understood by the engineer without the aid of drawings, but with regard to some other parts of this invention we think a few diagrams would not have been out of place.

The claims are, first, the mode of working atmospheric railways as described, whereby the opening in the traction pipe is covered with a valve opening inwards, combined with the use of suitable transverse valves or slides at proper intervals; secondly, the mode of working atmospheric railways, whereby the use of reservoirs of compressed air are combined with traction pipes having suitable valves opening inwards, combined with transverse valves for the air to press against; thirdly, the mode of working atmospheric railways as described, whereby the compressed air is returned back into the reservoirs.

THAMES EMBANKMENT RAILWAY.

This project for extending the London and Birmingham and Great Western Railways to the City and the West End, appears likely to prove one of the greatest improvements which have taken place in the metropolis, and at the same time from the traffic that necessarily must come upon it, not only from the above railways, but also from the proposed Windsor Railway, the Hammersmith, Kensington, Fulham and Chelsea roads, besides the local traffic along the line may be expected to be highly profitable.

The line is to commence with a junction at the terminus of the West London Railway (now the property of the London and Birmingham Railway Companp) at Chelsea, thence it will continue along the banks of the river Thames on an embankment of an ornamental character to be raised on the shores that are now covered with mud, and in many situations producing miasma. It will not, however, interfere with the wharves, which will have increased accommodation, either by embanking the space between them and the railway, which will give additional land, or by inlets of water approached by arches under the railway of large span and ample height to allow barges to pass under: nor will the railway be so high as to interfere with the prospect of any of the houses, and will pass under the bridge clear of the arches. In front of the New Houses of Parliament it will pass through a water-tight tunnel on the site now occupied by the coffer-dam. The absence of locomotive engines will avoid all objection on account of noise. In front of the houses in Privy Gardens, Somerset House, the Temple Gardens, and the Marquis of Westminster's estate, there will be extensive ornamental pleasure grounds, and on the other part of the line the railway will have the appearance of an Italian terrace.

It is contemplated to have stations on various parts of the line, a terminus of considerable magnitude at Hungerford Market add at Queenhithe, near Southwark Bridge, in the very centre of the City.

This great project will not involve the necessity of taking down a single building, and the line of embankment will follow the course approved of by Government and the City authorities. Mr. Robert Stephenson is to be the Engineer, and Mr. Laxton the Architect and Surveyor, for carrying the project out.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Fifteenth Anniversary Meeting held at Cambridge.

The annual sittings of the British Association commenced this year at Cambridge on June 19. The President's address appears in the first sheet of this journal; we are indebted to the *Athenæum* for a copy of this valuable paper, which from the importance of its contents and the authority attached to it by Sir John Herschell's name, demands the most careful perusal. Our report necessarily excludes those matters which do not come within the province of this work, but will be found to detail pretty fully all those transactions of the Association which are of interest to our readers.

SECTION A.

Mathematical and Physical Science.

Place of Meeting—Union-room, Jesus-lane.

President—G. B. Airy, Esq., F.R.S., Astronomer Royal.

Vice-Presidents.—Sir D. Brewster, K.H., F.R.S., L and E; the Very Rev. the Dean of Ely; Sir Thomas Brisbane, F.R.S., L and E; Professor Challis, F.R.S.; Professor J. Forbes, F.R.S., L and E; Sir W. R. Hamilton, F.R.S.

Secretaries.—Rev. H. Goodwin; Professor Stevelly, L.L.D.; G. G. Stokes, Esq.

Committee.—The Earl of Burlington; M. Dove; Rev. Samuel Earnshaw; R. L. Ellis; Earl of Enniskillen; M. Erman; Colonel Everest; Dr. Green; Sir J. W. F. Herschel, Bart., F.R.S.; W. Hopkins, F.R.S.; Captain Johnston, R.N., F.R.S.; Eaton Hodgkinson, F.R.S.; Robert Hunt, Esq.; M. Kreil; M. Kupfer; Rev. Dr. Lee, F.R.S.; Rev. Dr. Lloyd, F.R.S.; Professor Miller; Professor Phillips, F.R.S.; Rev. J. Power; J. Scott Russel, F.R.S., L. and E.; Colonel Sabine, F.R.S.; Rev. W. Scoresby, D.D., F.R.S.; J. J. Sylvester, Esq.; Prof. Thomson, LL.D.; Prof. Willis, F.R.S.

Mr. E. Dent, F.R.A.S., explained a new mounting for the ship's compass. The proposed improvement consisted in suspending it precisely in the same way as the chronometer balance, working in jewels, and having adjusting screws similarly situated.

Dr. Scoresby read a paper on *The Construction of a large Magnetic Machine.* He showed that ordinarily a magnet of large dimensions was not powerful in proportion with those of smaller size, and his object on this occasion was to show how this failing of proportionate power, and beyond a certain size, the absolute negativing power were to be overcome.

Catalogue of Stars.

Sir J. F. W. Herschel reported the result of a grant of £1,200 made by the British Association for publishing a catalogue of stars. The catalogue is now completed and published, and a copy of it was shown on the table. It contains 8371 stars with the annual precessions and constants for reduction to apparent place.

SECTION B.

Chemical Science, including its application to Agriculture and Arts.

Place of Meeting—Lecture-room, Botanic Garden.

President.—Rev. Professor Cumming.

Vice-Presidents.—Dr. Daubeny, F.R.S.; Michael Faraday, LL.D., F.R.S.; Professor Graham, F.R.S., L and E; Rev. W. Harcourt, F.R.S.; Professor Miller, M.A., F.R.S.

Secretaries.—Robert Hunt; J. P. Joule; Dr. Miller, F.R.S.; E. Solly, F.R.S.

Committee.—Professor Schonbein; M. Boutigny; W. Armstrong; Peter Clare; W. Francis; Dr. Fowness; Professor Grove; Captain Ibbetson; W. Lucas; C. Oakes; T. J. Pearsall; Dr. Percy; Dr. Playfair; W. Sharp; C. W. Walker; R. Warrington.

Mr. Robert Hunt read a paper on the *Actinograph*, an apparatus for ascertaining the chemical effect of the luminous and calorific rays of the sun. He entered into an explanation of the merits of the machine, which was, he said, more applicable as a register of chemical than calorific rays. He hoped to present the machine in a more perfect state at the next meeting.

Mr. Solly, F.R.S., read a paper which had been communicated by Dr. Contor, civil-surgeon, Prince of Wales Island, on the subject of *Malayan Guano*, (or, in the native language, Ty. Burong; *Anglice*, offal of birds.) The Doctor entered into several instances of the benefits arising from the application of guano (already too well known in this country), and to state the freightage to different parts and the original cost. From this it appeared that it would cost to land a catgo in this country from Prince Edward's Island £8 11*s*. 6*d*. to £8 13*s*. 6*d*. per ton.

Properties of Ozone.

Professor Schonbein read a report of his experiments and researches on Ozone, which he had undertaken at the request of the Association. The subject had occupied his attention for about 6 years, and his attention had first been directed to it by the odours developed by electricity and lightning, the cause of which had hitherto defied investigation. His attention had also been drawn to the same odour in electrising water which pointed out the method of investigation to be pursued as it was only obtained at the positive electric end. The same power of producing odour was possessed by the electrical brush, and this odoriferous substance was destroyed by heat. By a variety of experiments and observations, he had succeeded in obtaining an an Ozonized atmosphere, with which he performed many interesting experiments, and in which though it could not be identified *per se*, the action of this peculiar substance was clearly developed. It possessed all the bleaching properties of chlorine when coloured bodies were introduced into it, and metals in a minute state of division when introduced into it were immediately oxinized. Iodine and phosphorus were quickly converted into Iodic and phosphoric acids, and sulphurous and nitrious acids, by taking their higher forms of combination with oxygen became converted into sulphuric and nitric acids. He retained his original views, considering it isomeric with the per-oxide of hydrogen, being similar in constitution though different in properties.

ON THE SPHEROIDAL CONDITION OF WATER.

Prof. Schonbein shewed by experiments the presence in the atmosphere of Ozone, a principle obtained from phosphorous, or, as he demonstrated, from Ether. The learned Professor then proceeded to read a paper on the subject of Ozone and the nature of the hydrate of nitric acid; Ozone he said was produced in the air by atmospheric electricity. Electric discharges did not exist merely during a thunder storm, but were continuous, and generated Ozone in such quantities as would endanger life if it were not removed as soon as it was formed by the agency of organic matter. The Professor attributed the phosphorous appearance of the sea to the presence of Ozone, and the luminous appearance of the glow-worm, &c. At the conclusion of a most interesting lecture the President expressed an opinion that the theory of Professor Schonbein was not quite solved by experiment. A conversation ensued, in the course of which Prof. Faraday confessed he had been in error with regard to the agency of the hydrate of nitric of acid, but he was by no means sure that Ozone was the universal agent. Prof. Schonbein supposed it. The learned professor had been rather influenced by his poetical imagination. Some further remarks ensued, after which Thomas Armstrong, Esq., read a description of a new Colossal Steam Electrical machine, and on some phenomena attending the production of electricity by steam. This was observed by the President and others to be the most powerful engine yet brought into action.

Freezing of Water in Red-hot Boilers.

2. Professor Boutigny related the results of experiments on the spheroidal state of bodies, and the application of this knowledge to steam-boilers, and on the freezing of water in red hot vessels. The chief points of the communication which was given in French were, that when water was projected upon a hot substance it assumes a spheroidal shape, and that although the vessel was above the boiling point the water was below it. When it is allowed to cool down, contact takes place and the water suddenly boils, thus showing the apparent phenomena of cooling and boiling. When a liquid substance which boils below the ordinary freezing point of water as liquid sulphurous acid is projected into an incandescent crucible, the sudden expansion produces such an intense cold that the water is frozen although contained in a white or red hot crucible.

In connection with the paper, Mr. Grove called attention to the following practical points:—1 As regards the tempering of metals. 2. The importance of the experiments in connection with the bursting of steam-boilers, as provided on a large scale any thing approaching the prevention of contact takes place, the engineer is lulled into security by the effects on the safety valve, whilst a sudden burst of vapour is developed; and 3 To their connection with the phenomena of radiant heat.

M. Boutigny lectured in his own language and his discourse was listened to with great attention, and elicited great applause. The skill and success which attended his experiment caused the greatest interest to a most crowded audience, there being above 300 members of the Associateon present. Water placed over a furnace of intense heat was found not to evaporate in the least degree until the vessel had grown to a certain degree of coolness when it disappeared in a volumn of steam. The most amusing experiment was the manufacture of ice, real genuine ice, from a chemical preparation and water boiled over a furnace of extreme heat! The mode in which pure water was made to change color by the application of heat excited much surprise, and the lecturer was most warmly applauded when he concluded, and a vote of thanks to him was carried by acclamation. The President observed that the almost incredible wonders they had witnessed were facts which came under their daily observations if they would but use their eyes. The whole of the experiments were but exhibitions of the same principle cognizant to every washerwoman who when she tested the heat of her iron moistened it to ascertain the proper degree of heat.

SECTION C.

Geology and Physical Geography.

Place of Meeting—Senate House.

President.—Rev. Professor Sedgwick, M.A., F.R.S.

Vice-Presidents.—Rev. W. Buckland, D.D., F.R.S.; the Earl of Enniskillen, F.R.S.; L. Horner, F.R.S.; W. J. Hamilton, F.R.S., M.P.

Secretaries.—Rev. J. Cumming, F.G.S.; A. C. Ramsay, F.G.S.; Rev. W. Thorp.

Committee.—Baron Leopold Von Buch; Baron Von Waltershausen, of Gottingen; R. C. Ansten, F.G.S.; Professor Ansted, F.R.S.; C. Bunbury, F.G.S.; Sir H. De la Beche, F.R.S.; Captain Sir E. Back, F.R.S.; S. Clarke; Dr. Dieffenbach; Sir Ph. de Grey Egerton, Bart. M.P.; Dr. Falconer, F.G.S.; Sir C. Fellowes,; Professor E. Forbes, F.G.S.; Professor Forbes, F.R.S.S; G. B. Greeoough, F.R.S.; R. Griffith, M.R.I.A.; R. Hutton, F.G.S.; W. Hopkins, F.R.S.; H. L. Lindsay; R. I. Murchison, F.R.S.; Lord Northampton, Pres. R.S.; Prof. Oldham, M.R.I.A.; Professor Owen, F.R.S.; Professor Phillips, F.R.S.; H. E. Strickland, F.G.S.; the Dean of Westminster, F.G.S.

The Geological Section is usually the most attractive at meetings of the British Association, and the committee consequently appointed the largest and most important room at their disposal as its place of meeting—the Senate-house. A large platform was erected at the west end for the officers and committee of the Section, and there were present Professors Sedgwick, Buckland, Murchison, Ansted, &c., &c.

Professor Sedgwick read the first paper on *The Geology in the vicinity of Cambridge.*

Mr. Murchison read the substance of a letter he had received from Mr. Ferdinand Oswald, of Breslau, in Germany, stating that in the neighbourhood of where he lived had been discovered an oasis of Silurian rocks, rarely discovered in Germany, and what was of the greatest interest, in this spot which covered only about 1500 acres were to be found Russian, English, Scandinavian fossils mixed in a manner never seen before.

Organization of Shells.

The President said that the attention of the meeting would be first called to the continuajion of the report of Dr. Carpenter, on the *Structure of Shells*, deduced from microscopic observation.

Dr. Carpenter said he appeared before the meeting under great difficulties. His year had been curtailed three months, and as there was but one artist in London who could properly make the drawings, and he had been engaged in completing what was required by the Association for the publication of the first part of his report, he could not produce the large drawings he had expected for the illustration of his subjects. He was glad to hear the learned President introduce him as with the avowal of his belief that shells do possess an organic structure, because a most distinguished foreigner had very recently doubted this, because they break in crystalline fractures. The foundation of his theory was his belief in the analogy that he could now prove to subsist between shells and the skins of animals, and there was no *à priori* reasons against the theory, for he expected to find in shells a cellular construction, and when be examined into them he found it. He then called the attention of the meeting to sections highly magnified of the *Terebratulæ* which, among other extraordinary appearances, had perforations which showed that the animal matter must have passed through them. He had at first thought they were to let in the water, but he was now convinced that they were part of a glandular process. He had come to this conclusion from microscopic observations of fossil *Terebratulæ*. He had found perfect uniformity in all kinds of shells he had cut up; the *Pandora* at first from its irregularities had occasioned him some doubt, but he now found it corroborating his theory. The *Echinus*, with its network of calcareous structure also corroborates it, and on examining the soft skinned creatures of its kind, he had even been enabled to recognise in them very easily the charactesistics of Echinodermata. He showed drawings of the magnified spine of the Cidaris, and he had no doubt the animal every year added a layer to the spine. He found in the stems of the *Pentacrinus* perfectly symmetrical reticulations, and the *Nummulites* supported the theory, which showed the advantage of it to Geology.

Dr. Buckland said he considered the discovery of this theory of the highest importance both to Geology and Physiology, which gave the power of fixing genus and even species to fragments no larger than a pin's head. A new aim had been afforded to the geologist by it, and he as well as the physiologists must hail the microscope with joy. Dr. Carpenter has stated that species might be determined by this theory. In his (Dr. Buckland's) Bridgewater treatise he had approached somewhat near to it, for he had there exhibited patterns which all resembled each other when belonging to the same species. He entirely agreed with Professor Sedgwick in his encomium on the skill and ability with which Dr. Carpenter had conducted this important investigation.

Power of Land Snails to form Holes in Rocks.

Dr. Buckland said he had now to lay before the meeting the result of his investigation "On the agency of land snails in forming holes in compact rocks." He was now convinced that by means of an acid with which they were provided snails could make perforations upon the most solid forms of limestone. He had been often asked why, if this be true, they do not find where snails were abundant that they had holes like mice. Now he had been enabled to get at something like the rapidity at which these creatures worked, and he now felt assured that when a hole was found two or three inches deep, it had two or three thousand years to make it. His attention had first been called to this subject by a discussion on the perforations 60 ft. high at Tenby Castle, which by some were taken to be evidenced of a raised beach, but by himself as the workmanship of land snails. At Plymouth, where he had first avowed his conviction, he had been met with a courteous laugh almost amounting to scorn, but since then he had caught snails in the very act, and what was more he had them with him. The perforations were unlike those made by any other animals, or those made by the salt of the sea combined with the carbonic acid of the atmosphere. At Boulogne his attention had been called to the odd appearance of the rocks by the road side, and on stopping to examine it he had found the snails actually at work. The rocks were carboniferous lime-stone, and what was also remarkable, they were in a neighbourhood that offered abundant food for the snails. These perforations were never found where the rain and frosts could operate, but always having the apertures downwards. They were never to be found in the south-west projecting towards the stormy region, but under the first projecting sheltered rock where there are pastures for the snails, there you will find them. How he had come at the time taken by the snails to complete a certain depth was from his having last summer visited Risborough Castle, where he found perforations such as he had spoken of, but none more than an inch deep. Now the Romans had left this 1,500 years ago, and presuming that the snails took possession at their exit, they have worked at the rate of one inch in a thousand years. This formed his chronometer. How he had ascertained that they worked by means of an acid was from taking a snail in the fact, and not having chemical tests with him, a lady had devoted a piece of the beautiful purple ribbon of her bonnet to the enquiry, and on gently stimulating the snail, the purple had, by means of the creatures emission, been turned as beautiful a red as ever adorned the gills of a turkey cock. Since then many who doubted his theory had believed it.

Fossil Icthyosaurus, near Cambridge.

Mr. Carter, of Cambridge, exhibited to the section a magnificent fossil, consisting of portions of the head and jaws of a large saurian animal belonging to the genus Ichthyosaurus, which he recently procured from the lower chalk, near Cambridge. Mr. C. stated, that the discovery of so large a portion of the most important part of the skeleton was especially interesting, as the remains of this genus of reptile were but very rarely met with in the chalk formation, and had hitherto been confined to detached bones and teeth. The characters which enabled Mr. C. to refer the present fossil to the genus Ichthyosaurus were pointed out, and he then proceeded to notice those in which it was distinguished from any of the species hitherto described. The name which he proposed for this new species was Ichtyosaurus campylodon, in reference to the peculiarly curved form of the teeth of the lower jaw. Mr. C. mentioned, that the present fossil was also interesting as it proved that the Ichthyosaurus of the chalk was different from any of the species of that genus which had been hitherto discovered in the lias and oolitic formations; and therefore confirmed the observations of geologists, that hitherto no species of fossil reptile, common to any two great geological formations, has been discovered.

Geology of New Zealand.

Dr. Ernest Dieffenbach read an account of the geological features of New Zealand. It appears from his paper, that a mountain chain of ancient stratified rocks runs through the island with dykes of greenstone, anterior to the coal formation. At both sides of this chain are horizontal sedimentary strata with fossil remains, shewing them to belong to a very recent formation. There exists many older volcanic rocks, as basalts and agate porphyries, but the most interesting feature is a chain of modern volcanic phenomena on the grandest scale, a burning volcano in the centre and hot springs, resembling those of Iceland and St. Michael, depositing a great quantity of siliceous silt. It appeared from Dr. Dieffenbach's paper, that the interior is occupied by a great formation of barren pumice stone gravel, and the coasts offer no extent of level land. Dr. Buckland drew the conclusion from the nature of the rocks, that the island was little suited to agriculture.

SECTION D.

Zoology and Botany.

Place of Meeting—Philosophical Society's Rooms.

President.—The Rev. Professor Henslow.

Vice-Presidents.—Bishop of Norwich; Professor E. Forbes; C. C. Babington, F.L.S.; Rev. L. Jenyns, F.L.S.; W. Ogilby.

Secretaries—E. Lankester, M.D., F.L.S., T. V. Wolleston.

Committee—Professor Allman, R. Ball, Professor T. Bell, Dr. Carpenter, W. Clear, Dr. Daubeny, Dr. Falconer, Dr. Fleming, J. E. Gray, Dr. Hodgkin, F. W. Hope, Dr. King, Dr. R. Latham, R. MacAndrew, A. Nasmyth, Professor R. Owen, Dr. Pritchard, Dr. Richardson, W. Spence, W. Thompson, W. Yarrell.

On Mons. Fizeau's *process of etching daguerreotype plates by* Mr. Goadby.

In a Daguerreotype portrait the black parts of the plate consist of silver, the white portions of mercury, and the intermediate tint of a mixture of the two, the degree of darkness or light depending upon the excess either of the silver or of the mercury.

In converting a Daguerreotype into an engraved plate it is necessary to etch away tho dark parts and to leave the white untouched. The important part or the process therefore, consists in the production of a menstruum capable of receiving the silver without attacking the mercury, and the fluid used for this purpose is the following:—Dilute nitric acid; nitrous acid; chloride of sodium, and nitrite of potash.

The nitric acid is so far diluted that no decomposition can take place until the mixture be heated when the chloride of sodium and nitrite of potash are decomposed and chlorine and nitrous acid are evolved; these attack the silver and consequently those portions of the daguerreotype which are undefended by the mercury, whilst the mercurial deposit becomes analogous to the ordinary etching ground of engravers, and protects all those parts of the plate that are covered with from the action of the corroding fluid.

After a time those portions of the plate that have been acted upon by the chlorine, &c. become covered with a protecting coat of chloride of silver; this must be removed by dilute liquid ammonia, when the biting may be continued (if necessary), by a fresh supply of the mixed acid.

The plate being now slightly *bitten*, it is to be inked and allowed to dry, the surface is then thoroughly polished, the ink still remaining in the corroded portions of the plate. It must then be gilded by the electrotype, those parts alone receiving the gold that has been previously polished. The ink is then dissolved out of the hollows by potash, and the gilded surface now constitutes the etching ground in place of the mercury, and the biting may be continued by nitric acid after the manner of engravers. It cannot be expected that the above process should produce a finished picture, but slight assistance from the hand of an engraver will speedily accomplish this.

The engravings produced of the nervous systems of Aplysia and Tritonia, the latter much magnified, and the nutrimental organs *in situ* of a caterpillar, sufficiently demonstrate the successful application of the daguerreotype to the purposes of Natural History; the details being faithful and minute, and the *texture* of the several tissues represented to an extent that is truly wonderful.

Guano.

Mr. Trevelyan made a communication on the guano of the Faro islands. As the supplies of this manure from the African coasts have become greatly lessened, and in many parts almost exhausted, it is desirable to look out for new sources from whence it may be obtained. The guano of these islands is derived from the Cormorants and is to be obtained in large quantities, whilst the quality is considered to be quite equal to that obtained from Peru or Ichaboe.

SECTION E.—[Medical Science.]

Place of meeting—Anatomical Lecture-room, near the Botanic Garden.

President—Dr. Haviland.

Vice-Presidents—Professor Clarke; Professor Fisher; Dr. Hodgkin: Dr. Lathum.

Secretaries—R. Sargent, M. A., M. R. I. A.; Dr. Webster.

Committee—Dr. Budd; Dr. Laycock; Dr. Merriman.

SECTION F.

Statistics.

Place of meeting—Lecture Room, Great-court, Trin-coll.

President—Earl Fitzwilliam. M. A., F. R. S.

Vice-Presidents—Lord Sandon, M. P.; Colonel Sykes, F. R. S., Sir Charles Lemon, Bart., F. R. S.; Professor Pryme.

Secretaries—Joseph Fletcher, Esq., Dr. Cooke Taylor.

Committee—Sir. J. Boileau, Colonel Everest, His Excellency Edward Everett, J. Heywood, F. R. S., Eaton Hodgkinson, Sir J. Johnston, Bart., Sir C. Lemon, Bart., R. Moncton Milnes, M. P., G. R. Porter, M. Julien, Shafto Adair.

Trade and Navigation of Norway

The first paper was read by Mr. Porter, and consisted of observations on the Trade and Navigation of Norway, arranged by Mr. Richard Valpy. It stated that the chief export trade of Norway consists of the produce of her forests, fisheries, and mines. The most extensive forests are in the interior, and chiefly are property belonging to the peasantry. For some years the timber trade has been gradually changing its course; formerly England was looked upon as the chief market, and in return England retained almost the exclusive trade in manufactures, but a few found its way from other countries. From 1809, the period when the English protection system extended in favour of Canada. the decline of the trade with England commenced, and in the same proportion as the exports to England fell off, did the use of British manufactures decrease. Hamburgh and the German States also became new markets for this description of Norwegian produce, and German manufactures superseded in a great measure those of England. A table was then read, showing the great exports of Norwegian timber. The paper then treated of the managment of forest in that country (Norway.) Much has been said about the decrease of the woods in Norway, but it is generally admitted by those conversant with the subject that the reproduction is as rapid as the consumption. The fishing trade is next in importance to the timber market, fish being exported to a great degree (the paper here gave a list of the various fish to be found in this interesting country,) all of which increased with the exception of lobsters. In the last three years, since 1841, the annual average exports have not much exceeded 500,000. The chief market for salmon was Denmark. For several years the salmon trade was very prosperous, but of late it had been very limited. This was found to be owing to immense shoals of sharks. The discovery was made by two ships being sent out for salmon; when eight ships were fittted out for shark fishsng in 1841, and 20,000 of these voracious animals were captured, and their numbers did not appear at all diminished. Norway was increasing in importations, especially in coffee, tobacco, cotton twist, and an immense number of other articles which the paper enumerated; and there was a great probability of our trade with Norway increasing from the impetus given to trade by the revision of the tariff. The paper was very elaborate and appeared to yield great satisfaction.

SECTION G.

MECHANICS.

Place of meeting—Lecture Room under Public Library.

President—Sir George Rennie, F. R. S.

Vice-Presidents—Professor Willis, F. R. S., Wm. Fairbairn, Sir John Guest, M. P., F. Scott Russell, F. R. S., Edin.

Secretary—Rev. W. T. Kingsley.

Committee—John Taylor. F. R. S. Richard Roberts, C. E., Eaton Hodgkinson, F.R.S. J. F. Bateman, C. E., J. Dent, Peter Claref Joseph Whitworth, C. E., J. Jessop, Rev. B. M. Cowie, T. Cooper.

A paper was read by Dr. Booth *On a method of converting Rectilinear into Rotary motion.* The following paper was read by Dr. Greene.

On Mr. Nasmyth's steam hammer for pile driving.

Before entering upon the action of Mr. James Nasmyth's patent steam pile driver, as many members may be present who have not heard my description of it at our last meeting, I shall with permission briefly advert to to its principle, without entering into a detail of its construction. It consists of a steam cylinder, closed at the bottom, but the top has openings to allow the passage of air. A piston works in it, having its rod passing through a steam tight aperture in the bottom. To this piston rod the monkey, or driver, which weighs $2\frac{1}{2}$ tons, is attached, and by which it is suspended. The machine is worked by high pressure steam, which being admitted at the bottom of the cylinder by the induction pipe raises the piston, and with it the monkey attached to it. The instant it arrives at the height required, it closes the induction pipe, and opening the eduction pipe (also at the bottom of the cylinder,) the steam escapes, and the piston with the monkey attached to its rod falls freely upon the head of the pile. A large heavy cap of iron with a hole to allow the head of the pile to pass through slides between two upright standards, and guides the direction of the pile. The monkey and cylinder also follow the course of the pile, guided by the same uprights, between which they slide.

I am highly gratified in being able to lay before the Association an account of the action of the very ingenious machine of which I have just given a brief outline. I extract the report from a letter from Devonport which I yesterday received from my friend James Nasmyth, the inventor. In the first trial with a part of the machine at the manufactory it drove a pile 14 inches square and 18 feet in length 15 feet into the ground with 20 blows of the monkey, the machine then working 70 strokes a minute; the ground was a coarse ground embedded in a strong tenacious clay, performing this work in 17 seconds. The entire machine is now in full action at Devonport for the embankment to be erected there to keep out the sea, and form an immense wet dock to contain the royal steam navy. He describes it as going far beyond what he had dared even to hope for, and that it is truly laughable to see it stick vast 66 feet piles into the ground as a lady would stick pins into her pincushion. The entire time of operations required to be performed on each pile from the time it is floated alongside of the stage until it is embedded in the solid foundation of slate rock is only $4\frac{1}{2}$ minutes. The great stage which carries the machine, boiler, workmen, and everything necessary trots along on its own railway like a wheelbarrow, it moves on the diameter of a pile the moment it has finished the last. It picks the pile up out of the water, hoists it high in the air, drops it into its exact place, then covers it with the great magic cap, which follows it as it sinks into the ground, then thump goes the monkey on its head, jumping away 75 jumps a minite. At the first stroke the pile sank 6 ft., its advance gradually diminishing until in the hard ground above the sound slate rock it was reduced to 9 inches. Nothing can prove the superiority of the principle of Nasmyth's brilliant invention of getting his momentum by a heavy weight moving with small velocity, over the same momentum, as got on the old principle, by a light weight moving with great velocity, than the state of the heads of the piles as driven by each process. I beg leave to call your attention to this sketch of two heads of piles, one 56 feet long driven by a monkey of 12 cwt, falling from a great height, and making only one blow in five minutes, and requiring 20 hours to drive it; this, though protected by a hoop of iron, is so split and shattered on the head that it would require to be re-headed to drive it any further. The other, although 66 feet long, was not even supported by an iron hoop. and the head is as smooth as if it were dressed off with a new plane. It was driven with a hammer 50 cwt. and only 3 feet fall, making 75 blows a minute, and was put in its place and finished in $4\frac{1}{2}$ minutes. I beg leave to observe that in addition to other great advantages of driving by a heavy weight over that of driving by a light weight is the immense saving of labour, or whatever moving power is employed. Momentum being the product of weight multiplied by velocity, you may get the same momentum in various ways by varying both the factors; but where the velocity employed is that produced by the action of gravitation the greater the velocity employed, the greater is the loss of power. Suppose for example we want a momentum 16, a weight 8, with velocity 2 will give it, and let us suppose that velocity created by the weight of falling from a height of 3 feet, we can get the same velocity by employing a weight of 4, and velocity 4, but to create that velocity by falling, the body must fall from a height of 12 feet, or four times the former height, the velocities being only as the square roots of heights; now it is evident that it will require double the power to raise 4lb. 12 ft. high as to raise 8lb. 3ft. high, so that there is a loss of one half of the power employed in the latter case. This new and powerful agent I expect will produce great national results in the contemplated harbours of refuge which are to be formed along our coasts, and the recovery of vast tracts of land from the sea, and which it will now be as easy to effect, as, before the operation of this new power, it would have been difficult, and in many instances impossible. I shall only add in conclusion that the site of that great national work the Royal Steam dock at Devonport was actually planned and laid out on the faith of the powers of the pile driver; as inferred from those of its sister machine the patent steam hammer with whose worderful performance the Admiralty had been previously acquainted, and which is also the invention of the same talented individual to whom not only his own country, but the most remote regions of the civilized world are so deeply indebted.

A meeting took place at Section A room to take into consideration the best mode of conducting simultaneously the Magnetical and Meteorological Observations, in all the first class observatories. The meeting was attended by several distinguished foreigners interested in the question, and by Mr. Airy, and other English philosophers; Sir J. F. W. Herschel was in the chair. Mr. Airy objected to a proposal of three hours, and also of four, and proposed a resolution as follows:—"That where it is found inconvenient or impossible to take the observations at every hour, they should be made every two hours, and these hours should be the even hours of Gottingen mean time." This motion was assented to, and also another that mean Gottingen time should be used.

TERRESTRIAL MAGNETISM.

The Astronomer Royal delivered a discourse in the Senate House, on the recent progress of Terrestrial Magnetism.

Sir J. F. W. HERSCHEL was in the chair.

Mr. AIRY, the Astronomer Royal, began by stating that he should treat the subject in a large and general view, though it would be necessarily very imperfect. He presumed every one knew the construction of the compass and the properties of the mognetic needle, and explained the meaning of the "dip of the needle," at Cambridge the dip at this time was 70 deg. from the horizontal. The dip and horizontal directions were different at different parts of the eauth. The horizontal force of the attractive power of magnetism was determined by the vibratory motion given to a needle, by removing it by another force from its own directive power; power would endeavour to restore the needle to its true position, but the impetus gained in the action carried it beyond the magnetic north, and thus caused vibration as of a pendulum, and the horizontal force could then be determined by the number of vibrations in a given time. This much of magnetism was known at the beginning of the of the present century, together with the fact that about the year 1600 the needle pointed east of the north meridian, that soon after it pointed to west of north, and increased in this direction until it attained an angle of more than 23 degrees; it is now so nearly stationary that it cannot be determinately settled whether it will go farther westward or return; suspicion was strong that it was on the point of returning. The construction, or rather the mounting of the present dip needle was explained; it has an axis at right angles to its directive power, resting on knife edges, that is, steel exceedingly hard and sharpened, or agate; with this it was found that the dip could be determined within a few seconds. It had been discovered by Graham that the needle had a diurnal oscillation, and that it mady a great western spring at 2 P.M., and was most eastern at 8 A.M. and 8 P.M.; this occurred with great regularity, and attracted much attention, and the Astronomer Royal thought it might be in some way caused by the sun. The next portion of the subject was on magnetic storms or disturbances, the first of which observed to be simultaneous was noticed by Graham and a Swedish philosopher, and so far as they could then judge, the times of oscillation seemed simultaneous. Afterwards similar coincident disturbances were noticed at Paris and Stockholm, and it was always perceived that these great disturbances were occasioned by, or at least accompanied with, an exhibition of the Aurora Borealis. This peculiarity had been fully confirmed by the observations at Greenwich, it having appeared that in all extraordinary oscillations of the needle, an Aurora Borealis was either visible there, or at no very great distance. The needles for these nice determinations of magnetic force were suspended by two threads of unspun silk, and not on the old construction of being supported on a pin; by this method friction was hardly possible to interrupt the full play of the needle to any sensible amount. The magnets in common use, at present in the magnetic observatories, were from 2 to 4 feet long; but a German philosopher was now using a "pigmy" magnet of only an inch in length, and found it much more powerful than the longer kind, owing to the greater facility of thoroughly hardening so small a piece of steel. Mr. Airy thought these "pigmy" magnets would ultimately take place of larger ones. Mr. Airy concluded his long and deeply interesting lecture by a hope that ere long one of the swings of the needle should be thoroughly compared: the observations of this particular swing being collected from all the magnetic observatories now in existence; then we might hope for some knowledge on this obscure science.

In recording that portion of the annual labours of the British Association which bears more immediately on the interests of practical art, we cannot conclude our report without an observation or two on the results exhibited. An annual meeting for the express purpose of advancing science might fairly be expected to obtain the entire concurrence of public respect. A society bearing on its muster-roll the names of the Astronomer Royal, M. Boutigny, Dr. Buckland, Sir William Hamilton, Dr. Peacock, Baden Powell, Prof. Pryme, Sir George Rennie, Professors Sedgwick and Wheatstone, &c., ought, one would suppose, to have authority almost supreme in the matters of which it takes cognizance; and yet it will seem an incomprehensible mystery to the succeeding generation, that this society has been *more* ridiculed and *more* abused than *any* other learned society in England. The national feeling for some reason or another is directly against *Peripatetic* philosophy. On the continent, indeed, the *séances* of ambulatory *savants* are reported in the public journals with all the gravity with which journalists usually record what they do not understand. But the English people have the idea that men of science ought *not* to be *fêted*, ought *not* to chaperon ladies at flower-shows, ought *not* to wear white kid gloves and polished French boots, ought *not* to travel from town to town with their boxes of models and diagrams and specimens like licensed philosophic hawkers. No one can fancy Newton doing anything of the kind, nor Euler, nor Des Cartes. The old philosophers were not itinerants. The results of their labours were not displayed to "fashionable audiences," they did not dispute before "ladies in full evening dresses." Their discoveries were the result of patient midnight labours; of quiet undisturbed reflection; long painful night-watchings, and secret toil in solitary chambers. The fruits of their industry appeared before the world in scientific "memoirs" and "transactions," in public letters, or in academical theses; but the excitement and noise of a "fashionable audience" were deemed altogether inconsistent with the successful pursuit of science. We scarcely know why this feeling, which seemed obviously just in days of yore, should be false now. The vehicles for communicating scientific discoveries in the form of memoirs are surely as accessible, and more accessible than ever. We see in the transactions of the British Association this year much that is valuable and more that is interesting, but we see *nothing* which might not have been published to the whole world without the expense and trouble of a meeting like the present. Ridicule is always disagreeable, but when it falls upon those who are really greatest of modern philosophers it becomes a positive public injury. It is folly, if no worse, to affect, as some do, to treat these great men with ridicule. Contempt aimed at such men as Sir William Hamilton and Professor Airy must necessarily be reflected back upon the puny assailants. But still there must be some real tangible cause of complaint when the sneer is constantly reiterated, and the dissatisfaction universal. Were that cause removed, there is little doubt that the respect, which Englishmen usually pay to men of science, would be liberally bestowed upon the British Association; and they who bear office in it would advance not only their own dignity but the interests of science itself, by devoting a portion of their time to investigate the causes of the present public dissatisfaction and consider the means of removing it.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

June 9.—H. E. Kendall, V.P., in the Chair.

A paper was read, illustrated by models, explanatory of an "*Improved Mode of Ventilation of Buildings, Ships, &c.*," invented by Mr. J. Kite. The plan is likewise adapted for the prevention or cure of smoky chimneys, for which purpose it has been successfully applied. The improvement consists in the employment of what Mr. Lite denominates "a deflecting roof, or cowl," consisting of a number of Louvres or deflectors, arranged in a peculiar manner at certain angles fixed on the ridge of a roof or on the shaft of a chimney, instead of an ordinary chimney-pot; which, by presenting their oblique surfaces to the action of the wind or external air, a continuous current is produced across the roof or cowl, which occasions a strong upward draft, whereby the vitiated air of a crowded apartment or church may be rapidly drawn off, or the passage of smoke up a flue greatly facilitated, without the employment of any mechanical arrangements that require to be kept in constant motion, and consequently soon worn out, or the necessity for the application of any costly prime-moving power.

A portfolio of sketches made in India and Egypt by J. H. Pillau, Esq., and some drawings of Indian Monuments, forwarded by General Monteith, were exhibited.

THE ROYAL SCOTTISH SOCIETY OF ARTS.

The Society met in the Saloon, 91, Prince's Street, on Monday May 12, 1845, the President in the chair.

The following communications were made:—

1. At the request of the Council, an *Exposition of Geology, in its application to the Useful Arts*, was given by Alexander Ross, Esq. This exposition formed the second part of the address, the first on Mineralogy, having been delivered at a former meeting. On this occasion, he limited himself to the geological phenomena which might lead to the discovery of the useful metals, briefly describing the formations in which they occur, and the peculiarity of the circumstances which might tend to their detection.

2. *Additional communication on the Photographic Register Thermometer.* By Mongo Ponton, Esq., F.R.S.E. The instrument was exhibited, with Time-Piece and other mechanical adaptations attached. The author described the method by which the clock was made to turn the cylinder, carrying the paper for the purpose of Registration; also a peculiar plan for raising and lowering, at the proper intervals of time, the gas flame, by which the registration is produced, the flame being maintained at its full height for five minutes every half-hour,—a period sufficient to impress the image of the mercurial column on the paper—and then lowered to a mere point. He farther discribed a method by which the registering cylinder might be moved by the clock at a considerable distance, a thread being the only connecting link between them, so that the thermometer might be placed outside of the window, while the clock and gas flame remained inside. He farther stated that, by proper arrangement, the same clock might be made to register the indications both of a barometer and a thermometer, or even of a barometer and two thermometers, one placed in the sun, the other in the shade.

3. Additional Notice of Mr. R. Bryson's *Self-Registering Barometer*, with remarks, showing that no Correction for Temperature will be necessary in this Instrument. By Alex. Bryson, Esq., V.P.—He exhibited an accurate method of determining the expansion of mercury from increased temperature in the standard barometer; and demonstrated that the syphon barometer, used as a self-registering instrument (as formerly described to the Society), and observed by the shorter limb of the syphon, requires only a correction of 0·006 inches for 60 degrees Fahrenheit. Mr. Bryson also described the results obtained from his hourly barometric register kept during two years, and remarked the extreme similarity existing between these and the observations of Professor Forbes during three years at Colinton.

4. Description and Drawing of a *Compress for checking Hæmorrhage* following the extraction of a Tooth. By W. A. Roberts, M.D.—The difficulty of arresting alveolar hæmorrhage, or continued bleeding from the sockets, after the extraction of a tooth, which in some instances has terminated fatally, led Dr. Roberts to turn his attention to the subject. He expects by the aid of his compress, one being adapted for the upper jaw, the other for the lower, to be able to apply the necessary pressure upon the bleeding vessel, doing away with the tieing up of the head with bandages, &c. He effects this by means of a small padded bolster, so arranged as to communicate, by means of a moveable bar or rod, with a small stopper fitted on the end of the bar, and which can be placed in any position in the mouth, and secured there by means of small regulating screws, the bolster externally, and the stopper internally, forming the antagonist pressure; the expected advantages being a continuous and uniform pressure, with little annoyance to the patient.

5. Mr. Alexander Bain, the patentee, exhibited and described his *Electro-Magnetic Telegraph.*—One of the varieties of this telegraph was exhibited in action. This was stated to be by far the simplest of the electric telegraphs which have been invented. It acts by means of a *single* wire, and can be laid down at the rate of about 50*l.* per mile, besides the telegraph apparatus, which will cost about 12*l.* for each station. When any signal is given, it is

known at *all* the stations instantaneously, and by a simple contrivance, it is known *to* which, or *from* which statinn the message has heen sent. One of these telegraphs is to be shortly laid down on the railway from Edinburgh to Glasgow. Mr. Bain also explained the way in which he made the discovery leading to the simplification of the electric telegraph.

PRICES OF PLATE GLASS.

(From Laxton's Builder's Price Book.)

The following are the priccs of plate glass agreed upon by the manufacturing companies. The table shews that the public receive more than the full benefit nf the reduction of the tariff.

In.	16			18			20			22			24			26			28			30		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	a.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
16	0	7	1		....			....			....			....			....			....			....	
18	0	8	2	0	9	11		....			....			....			....			....			....	
20	0	9	9	0	11	9	0	13	9		....			....			....			....			....	
22	0	11	4	0	13	7	0	15	10	0	18	5		....			....			....			....	
24	0	13	0	0	15	5	0	18	3	1	1	1	1	3	11		....			....			....	
26	0	14	7	0	17	6	1	0	7	1	3	8	1	6	8	1	9	8		....			....	
28	0	16	4	0	19	8	1	2	11	1	6	3	1	9	6	1	12	10	1	16	4		....	
30	0	18	3	1	1	9	1	5	3	1	8	10	1	12	5	1	16	1	1	19	9	2	3	11
32	1	0	1	1	3	11	1	7	8	1	11	5	1	15	4	1	19	3	2	3	8	2	8	6
34	1	2	0	1	6	0	1	9	11	1	14	1	1	18	3	2	2	9	2	7	11	2	13	0
36	1	3	11	1	8	2	1	12	5	1	16	10	2	1	3	2	6	8	2	12	2	2	17	7
38	1	5	9	1	10	3	1	14	10	1	19	6	2	4	10	2	10	7	2	16	4	3	2	1
40	1	7	8	1	12	5	1	17	3	2	2	5	2	8	6	2	14	6	3	0	7	3	6	3
42	1	9	6	1	14	7	1	19	9	2	5	9	2	12	2	2	18	5	3	4	7	3	10	5
44	1	11	5	1	16	10	2	2	5	2	9	1	2	15	9	3	2	4	3	8	6	3	14	6
46	1	13	4	1	19	0	2	5	5	2	12	5	2	19	4	3	6	0	3	12	4	3	18	11
48	1	15	4	2	1	3	2	8	6	2	15	9	3	3	0	3	9	7	3	16	4	4	3	4
50	1	17	3	2	3	11	2	11	6	2	19	1	3	6	3	3	13	2	4	0	5	4	9	2
52	1	19	3	2	6	8	2	14	6	3	2	4	3	9	7	3	16	11	4	4	10	4	15	0
54	2	1	3	2	9	5	2	17	7	3	5	5	3	12	11	4	0	8	4	10	4	5	1	4
56	2	3	8	2	12	2	3	0	7	3	8	6	3	16	4	4	4	10	4	15	9	5	8	0
58	2	6	1	2	14	10	3	3	6	3	11	6	3	19	10	4	9	11	5	1	9	5	14	7
60	2	8	6	2	17	7	3	6	3	3	14	7	4	3	4	4	15	0	5	8	0	6	0	11

FLAXMAN'S SHIELD OF ACHILLES.—The enduring celebrity of this truly great work, and the high hooour it has conferred upon this country by vindicating the national claims of British sculptors to a high rank among those pre-eminent for taste, judgment, and execution, have suggested the propriety of making a series of engravings from what Sir Thomas Lawrence, in his eulogium oo Flaxman at the Royal Academy, described as "a divine work, unequalled in combination of beauty, variety, and grandeur, which the genius of Michael Angelo could not have surpassed. We have been favoured with an iaspection of these eograviogs by Mr. Freebairn, who has been long employed upon them; and feel that we scarce can adequately express our appreciation of his efforts and success. The compartments are seven in number, of which six, forming the series of consecutive groupings—the embodiments of Homer's mighty shadows; the Marriage, the Judgment, the Battle, the Reaping and Ploughing, the Vintage, and the Attack on the Flock by Lions—are already completed; the seventh, Apollo in the Car, forming the centre piece, is at present in progress. The exquisite finish of these engravings, the chasteness of the execution, and the boldness of relief, so perfect that the sight requires the aid of a grosser sense to convince the miod that the surface is not embossed, place them nearer the level of their great original than can well be conceived. The whole are so arranged that they are capable of being combined in one, forming to the eye an exact counterpart of the original, the size being precisely the same.—'Times.'

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM MAY 29, TO JUNE 25, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Charles William Firchild, of Birmiogham, gentleman, for "an improved cutting, slicing, gruiding, and rasping machine."—Sealed May 29.

Charles Keene, of Sussex-place, Regent's-park, Esq., for "Improvements in hoots, shoes, gaiters, overalls, and other like articles of apparel."—May 29.

John Naylor, of Goole, in the West Riding of York, agricultural implement manufacturer, for "Improvements in the machinery or apparatus for crushing, tearing, and pulverizing arable land."—May 31.

John Masters, of Welford-place, Leicester, gentleman, for "certain improvements in trouser fastenings, and in attaching the same, and also in the application of an elastic material or fabric to trousers, and other articles of dress."—May 31.

William Palmer, of Sutton-street, Clerkenwell, for "Improvements in the manufacture of candles and lamps, and shades or chimneys."—June 2.

Cornelius Whitehouse, of Wolverhampton, gun barrel manufacturer, for "Improvements in machinery for welding and hammering, and in the manufacture of gun barrels and other tubes."—June 3.

William Lucy, of Birmingham, miller and baker, for "Improvements in preparing dough."—June 3.

Moses Poole, of the Patent Office, Chancery-lane, London, gentleman, for "Improvements in the construction of vessels to contain liquids and substances, and in the means of impregnating liquids with gases, and in drawing off such liquids from such vessels, and in closing such vessels."—June 3.

John Reading, of Birmingham, manufacturer, for "certain improvements in fastenings for articles of dress."—June 3.

John Davis, of Brettell-lane, Stafford, glass manufacturer, for "a certain improvement or certain improvements in or applicable to lamps."—June 3.

William Coston Aitken, of Birmingham, clerk of works, for "a certain improvement, or certain improvements in ornamenting cornices, ends for cornice poles, and other rods, curtain bands, and certain other articles."—June 3.

John Lionel Hood, of Saint John's Wood, gentleman, for "Improvements in the application of motive power for locomotive and other purposes." (A communication.—June 3.

William Newton, of Chancery-lane, civil engineer, for "certain improvements in dyeing cotton, flaxen and hempen yarns and fabrics." (A communication.)—June 3.

Pierre Thirion, of Hitt's place, Clerkenwell, fur skin dresser, for "certain improvements in dressing furs and skins." (A communication.)—June 3.

William Brent Brent, of Gower-street, Bedford-square, barrister-at-law, for "certain improvements in machinery for cutting or excavating and removing earth."—June 3.

Thomas Lawes, of Old Kent Road, Surrey, gentleman, for "Improvements in propelling carriages on rail and other roads, and boats or vessels on canals or rivers, which improvements are also applicable to machinery in general."—June 3.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for "Improvements in working atmospheric railways, and in lubricating railway and other machinery."—June 3.

Joseph Cliff, of Wortley, fire brick manufacturer, for "Improvements in the manufacture of alum, and of aluminous compounds, from a substance not hitherto used for that purpose, and in the production of an improved fire-clay from the residuum thereof."—June 5.

Henry Carr, of Abingdon, Berks, butcher, for "certain improvements in the construction of temporary roofs or coverings."—June 5.

James Hardy, of Birmingham, gentleman, for "Improvements in the manufacture of metallic tubes or pipes by machinery."—June 5.

William Willcocks Sleigh, of Stamford Brook House, Chiswick, doctor of medicine and surgeon, for a hydro-mechanic apparatus for producing motive power. To extend to the colonies only."—June 7.

Samuel Harvey, of Halesworth, Suffolk, cabinet-maker, for "certain Improvements in sawing machinery."—June 7.

David Henderson, of London Works, Renfrew, civil engineer, for "certain improvements in cranes."—June 10.

Thomas Silver Shaw, of Birmingham, pawnbroker, for "a certain improvement, or certain improvements in the construction of roasting jacks."—June 10.

James Murdoch, of Staple Inn, mechanical draughtsman, for "a certain improvement, or certain improvements in dyeing." (A communication.)—June 10.

John Fisher, the younger, of Radford Works, Nottingham, gentleman, James Gibbons, of New Radford, machinist, and Thomas Rot, of New Radford, machinist, for "certain improvements in the manufacture of lace or net, and other fabrics, and certain improvements in machinery for figuring or ornamenting lace or net, and other fabrics."—June 10.

Thomas Smith, of Wood-street, Cheapside, gentleman, for "Improvements in suspending carriages, and in the construction of wheels for carriages."—June 10.

Joseph Washington Tyson, of Burton Crescent, esq., for "Improvements in fire arms and ordnance." (A communication.)—June 10.

Robert Brooks, jun., of St. Alban's, tallow chandler, for "certain apparatus for facilitating the playing on stringed musical instruments."—June 12.

Thomas Willis, of Manchester, machine maker and iron founder, for "certain improvements in machinery for spinning, doubling, and winding cotton, silk, woollen, and linen yarns, warp and weft, to be used for all manufacturing purposes to which the same are applicable."—June 12.

Frederick Rosenborg, of Kingston-upon-Hull, gentleman, for "Improvements in the arrangement or construction of machinery or apparatus for propelling or impelling vessels, and in steering or manœuvring the same."—June 12.

Benjamin Fothergill, of Manchester, machine maker, for "Improvements in certain parts of machinery used in the preparation for spinning, and in the spinning and doubling of cotton, wool, and other fibrous substances."—June 17.

Auguste Cherot, of Nantes, in the kingdom of France, for "certain improvements in machinery for spinning flax, hemp, and other fibrous materials."—June 17.

Richard Archibald Brooman, of Fleet-street, London, gentleman, for "certain improvements in machinery for weaving." (A communication.)—June 18.

Charles Hague, of Oldham, brass founder, and William Madeley, of Manchester, machine maker, for "Improvements in, or applicable to, certain machines employed in the slubbing, roving, or preparing to be spun, of cotton and other fibrous substances, and an improved apparatus for lubricating shafts and bearings of or in such machines for the purpose of reducing friction, and which apparatus is also applicable to other shafting and machinery."—June 19.

Michel Antoine Bertin Burin du Buisson, of Lamb's Conduit-street, chemist, for "new and improved methods for the distillation of bituminous schistus, and other bituminous substances, as well as for the purification, rectification, and preparation necessary for the employment of the productions obtained by such distillation for various useful purposes."—June 23.

Moses Poole, of Lincoln's Inn, Middlesex, gentleman, for "Improvements in apparatus for withdrawing air, gases, and other vapours." (A communication.)—June 23.

Thomas Aspinwall, of Bishopsgate Church-yard, esq., for "Improvements in ordnance carriages, comprising apparatus for governing the recoil, and likewise for moving the piece of ordnance backwards and forwards." (A communication.)—June 23.

John Field, jun., of West Brixton, gentleman, for "Improvements in apparatus for ascertaining the alcoholic strength of liquids." (A communication.)—June 23.

William Morris, of Thanet place, Strand, civil engineer, for "Improvements in the apparatus and machinery for tilling and draining land."—June 23.

Thomas Clarke, of Hackney, engineer, and John Varley, of Poplar, engineer, for "an improvement on the atmospheric system of propulsion, which is also applicable to other purposes."—June 23.

Henry Whiting, of Southwark Bridge-road, hatters' furrier, for "certain improvements in machinery or apparatus for shaping the brims of hats." (A communication.)—June 23.

William Pollard, of Newcastle-upon-Tyne, gentleman, for "certain improvements of the production of combustible gases, and in the application of the same as fuel."—June 23.

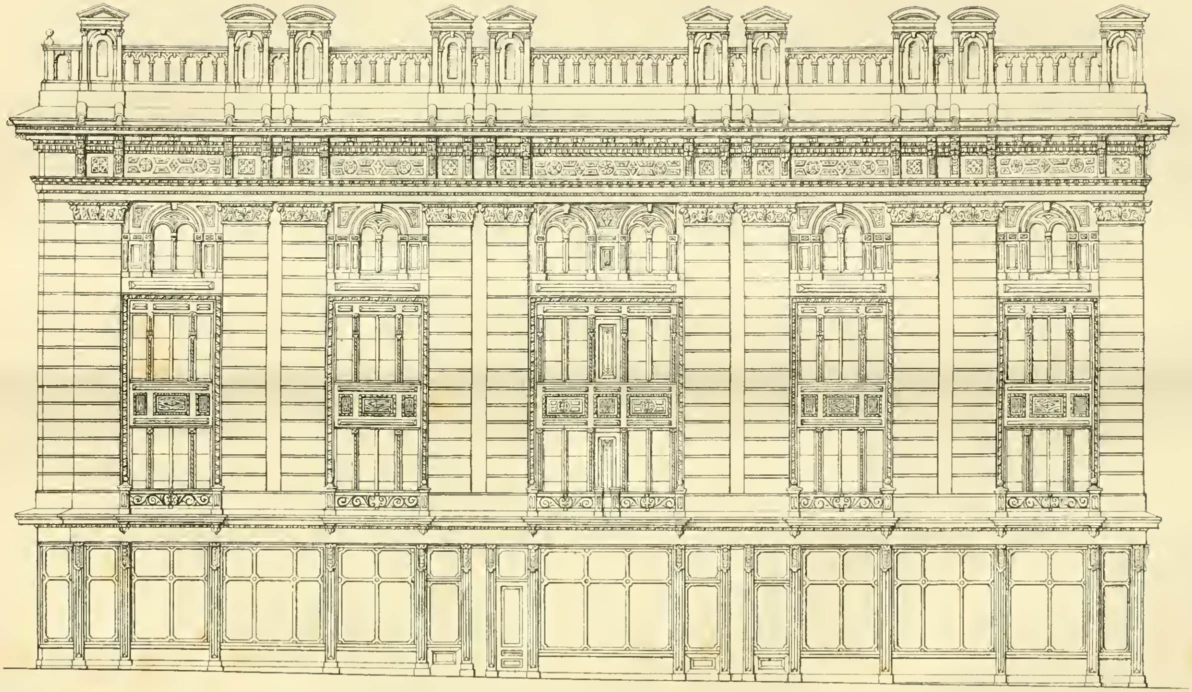
Robert Griffiths, of Havre, George Hinton Bovill, of Millwall, and George Hennett, of Bristol, engineers, for "Improvements in the construction of parts of apparatus used for propelling carriages and vessels by the atmosphere, and improvements in propelling carriages and vessels by atmospheric pressure."—June 23.

Joseph Zambaux, of Paris, chemist, for "Improvements in atmospheric railways."—June 25.

William Sykes Ward, of Leeds, gent., for "Improvements in exhausting air from tubes or vessels for the purpose of working atmospheric railways, and for other purposes."—June 25.

James Augustus Dorr, of the city, county, and state of New York, of the United States of America, for "certain improvements in machinery or apparatus for knitting." (A communication.)—June 25.

PLATE XVII



NEW COVENTRY STREET - LEICESTER SQUARE

CHARLES MAYHEW – ARCHT.

NEW COVENTRY-STREET, LEICESTER-SQUARE.

(With an Engraving, Plate XVIII.)

But for the shops along the ground floor, this piece of street architecture might pass for the façade of some large single edifice; not that we object to the shops, as shops, and because they are occupied by persons in trade; but because they occasion a continuity of openings below, that is quite destructive of the appearance of solidity, and that ill accords with the boldness of all the rest. Still we admit the architect has done the best which circumstances will allow; for your shopkeepers are a very self-willed and intractable race in such matters, and insist upon having the utmost possible extent of window. There is more of the appearance of support than usual; and windows do not actually shoot round corners. There is besides a degree of good taste and quietness in the general design of the shops, which we hope will be kept up, by its being conditioned for in the leases that the tenants shall not be at liberty to alter their respective fronts at their own discretion (which means discretion with an *in* before it), nor to do anything at all to destroy uniformity, out of the amiable ambition of cutting a more dashing appearance than their neighbours, and throwing them into the shade. Overlooking the ground floor, as what cannot fairly be taken into account, and looking only at what is above it, we perceive a marked improvement upon the ordinary system of architectural embellishment for a series of street-houses. It was rather a favourable circumstance than the contrary, that the street itself is so short—a mere avenue opened from Coventry-street into the square, so that the extent of frontage does not at all exceed that of an ordinary façade (the length being only 105 feet, and the height 60 feet), and loftiness is not overpowered by length. There is, moreover, what is so seldom found in similar cases, the appearance of sufficiency of mass, the elevation being returned on the east and west ends, instead of the design being confined to the mere front, after the fashion of what Punch, or some such malicious varlet, has termed an architectural '*pinafore*.' The style here adopted, or we ought perhaps to say *introduced*, is certainly open to objection from those who make 'has been' the measure and standard of "can be and ought to be," and who disapprove of what does not accord with established authority, knowing that to be at least a safe course. Nor would it be difficult to show, by quoting "bookish *dicta*," that we ought not to allow ourselves to approve of this design because it smacks terribly of innovation, and is in a *composed* or mixed, consequently in an 'impure' style,—one in which elements and ideas borrowed from different styles and different modes of the same general style are made to coalesce into something distinct from every one of them. In art the successful becomes the *legitimate*, and we are well-disposed to accept what Mr. Mayhew has done in new Coventry-street, as a very successful experiment, and a most laudable effort to get us out of the confined and beaten track, which has hitherto been too exclusively pursued. He may be allowed to have "opened up," as the Scotch say, a new one for general street architecture, as distinct from monumental edifices, therefore very well admitting of much greater freedom of treatment. Yet though the style which has been here thus far wrought out, is sufficiently consistent, and well enough applied in this particular instance, the same degree of floridness of character would not be always suitable: on the contrary, might be apt to pall upon the eye in a very extended range of building. There is also great danger of its being overdone and caricatured by second hand copyists; because, unless there be artistic feeling and intelligence of composition, what is meant for decoration is apt to become little better than mere trumpery in unskilful hands. Here, reminiscences of both continental and our own English *renaissance* are so skilfully wrought into what may be designated by the generic and comprehensive term 'Italian architecture,' that the ensemble is sufficiently consistent and of a piece. We do not say that it will satisfy those who make *simplicity* a *sine qua non*,—an indispensable quality, and what ought also to be the predominating one on every occasion. We too admire simplicity; but we should be very sorry to be able to admire nothing else, as some seem to make a very great merit of doing; for we can even admire the very reverse of it when, though there may not be what is generally understood by simplicity,—which, by the by, is frequently quite misunderstood,—there is that correspondence of charact.r kept up throughout, which arises from the confluence of ideas all intermingling, and expanding into one stream. Most assuredly there is very far more of the simplicity of unity, and less of mongrelism, in this New Coventry-Street façade than there is in such a pseudo-Greek design as the east elevation of the Union Club-house in Trafalgar-square.

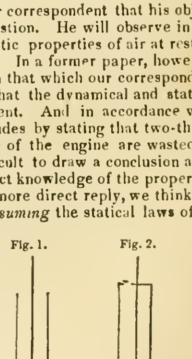
THE MECHANICAL PROPERTIES OF AIR AND STEAM.

We have received a letter from a correspondent who assumes a jocular signature, controverting the accuracy of two papers which we inserted last month, one on "The Properties of Air as a Mechanical Agent," the other on "The Mechanical Theory of Steam proposed by the Artizan Club." We greatly regret that we cannot find room to insert the present letter entire (it extends to 19 pages of note paper), as we are very anxious to encourage free discussion of scientific subjects; but as a great part of the letter is written in a jocular discursive strain, we will insert those parts only which are argumentative, assuring our correspondent that we will not knowingly weaken any of his arguments by omission. In the paper on the Mechanical Properties of Air, he objects to the passage which states that after the preliminary exhaustion is complete, and the train-piston in motion, if the rarefaction be uniform, "the work done by the prime mover is exactly measured by the quantity of motion transferred to the train of carriages: for every cubic foot of air pumped out at the station, the travelling piston describes a foot of space." On this passage our correspondent observes,

Now this assertion of the equality of the work done and the power expended by the prime mover, made here as an axiom almost too evident to require even to be stated, and on which the whole argument turns, so far from being an axiom is not true, as a very slight consideration will show. Suppose, for the sake of easy illustration, that the the piston of the air pump is the same size and moves at the same speed as the piston attached to the train. This evidently accords with the condition stated by "H. C.," that the air discharged must be equal in volume to the space described by the travelling piston, and if the equality of power expended by the prime mover and the work done in propelling the train were equal, as stated in his axiom, the constant retarding pressure on the air pump piston ought to be the same as the moving pressure on the travelling piston—the two pistons moving at the same velocity and being of the same area. What is the fact? Why, that at the beginning of each stroke of the air pump there is *no* retarding pressure on the piston, the pressure of the air on both sides being equal. From this point till the piston has made $\frac{2}{3}$ of the stroke the air is gradually compressed between the piston and discharge valve, thus creating a constantly retarding force, which at $\frac{2}{3}$ of the stroke, and not before, becomes equal to the motive force on the travelling piston. We thus sec that these two forces, so far from being on the whole exactly balanced, are only in this state during $\frac{1}{3}$ of the stroke; dur ng the other $\frac{2}{3}$ the retarding power on the air pump piston is much less tkan the motive power necessary to maintain the motion of the train.

We hope to be able to convince our correspondent that his objection does not affect the argument in question. He will observe in the first place that he is assuming the elastic properties of air at rest to be the same as those of air in motion. In a former paper, however, on Atmospheric Traction, referred to in that which our correspondent reviews, it was distinctly laid down that the dynamical and static.l properties of air are essentially different. And in accordance with this fact, the paper of last month concludes by stating that two-thirds —not of the power—but of the *strokes* of the engine are wasted by the preliminary exhaustion. It is difficult to draw a conclusion as to the *power* wasted, owing to our imperfect knowledge of the properties of air in motion; but to proceed to a more direct reply, we think we can convince our correspondent that *assuming* the statical laws of air to obtain, his objection is untenable.

Fig. 1. Fig. 2.



There are two distinct classes of air-pumps—in the one the upper surface of the piston or sucker is open to atmospheric pressure fig. 1, in the other fig. 2, the cylinder in which the piston works is closed at top, having a centre aperture through which the piston-rod works, and being provided also with a valve opening upwards. Now for the first of these it is *obvious* that our correspondent's objection cannot apply. The air-pressure after preliminary exhaustion being supposed 5 lb. to the inch the pressure on a is $15 - 5$ lb. to the inch. If a move upwards through any distance, say a foot the *train-pision* will also move through an inch and the pressure on *that* piston is also $15 - 5$ lb., so that it is clear that for a pump such as fig. 1, the work done and the power exerted are equal.

Before however we proceed to fig. 2, we must remark that though in fig. 1 the train-piston moves continously forward, the pump-piston has an *alternate* action. It is undeniable we think that power expended in causing the pump-piston to *descend* is so much loss, because it has no useful effect in drawing the train-piston forward. We make the remark because it might otherwise be made a point of argument that the atmospheric pressure assists the piston's descent as much as it impeded its ascent. The case is exactly analogous to that of a man *hauling* up a weight by a rope. When he has raised the weight a certain distance, he takes a lower part of the rope in his hand, and again raises the weight a certain distance, and so on. But it is certain that the alternate action of *depressing* his hands has no direct useful effect: the whole amount of available force is that exerted in *raising* his hands.

Now then for fig. 2. Here, as our correspondent observes, if the pressure in the main pipe be 5 lb. to the inch, the pressure on b will not be equal to the full atmospheric pressure till ⅔rds of the upward stroke have been accomplished. It will therefore be only through one-third of the stroke that the retarding force on the pump-piston is 15 − 5 lb., whereas that force is exerted on the *train-piston* through a distance equal to the *whole* stoke: for the remaining two-thirds the retarding pressure on the pump-piston varies according to its height: when it is at the bottom of the cylinder the retarding force is 0, when ⅔rds of the way up, 10 lb. Thus therefore by the contrivance of a cap and valve in the top of the cylinder a saving is effected in the upward stroke. But it is all lost again in the downward stroke. For whatever pressure is by this contrivance removed from the upper surface of the sucker in the upward stroke, the same is also lost in the downward stroke. And as that downward stroke, although it do contribute nothing to the progress of the train, *has* to be made, it is obviously no economy of power, to diminish the *resisting* force on the piston *upwards* to the same extent that we lose the *accelerating* force on it *downwards*.

It seems, then, that with either kind of pump the force lost is in effect the same; *assuming always* that the statical pressure of air is supposed to operate. But as this is obviously not true (in all probability not even approximately true), it were much to be preferred that the statement of power wasted should be expressed as in the paper under discussion—namely, as terms of *strokes of the engine*. In this way, all difficulty as to the unknown properties of air in motion is avoided, and we think our correspondent will allow that for any kind of pump the *number of strokes* wasted is as stated in the paper. Indeed the waste is there underrated, for the *return strokes* of the air pumps are clearly so much loss. This consideration certainly ought not to have been omitted in the paper, that while the train is moving the number of strokes is twice as many as they ought to be, because for every foot the train piston advances the pump piston advances *and returns* the same distance.

The strictures on the paper on the Artizan Club's Treatise we cannot so satisfactorily answer, simply because we do not comprehend them. In saying this, we are using no editorial figure of speech, but stating the plain truth, that we cannot find out the meaning of our correspondent. However, to deal by him fairly, we must give his own words. After asserting that the paper is full of blunders, he proceeds—

Many of them have arisen from "H. C." having got the idea of steam and steam engines so conglomerated in his brain that he cannot separate them, and when the Club is talking learnedly on steam "H. C.'s" ideas are running riot among steam engines. You may increase the mechanical effect of a certain weight of steam by the very same operation that diminishes the power of the engine. In the Cornish engine, the sooner the steam is cut off the greater is the effect produced by a cubic foot of water as steam, but the less is the power of the engine.

On the last dozen lines of the paper he observes—

Mark how adroitly the power of the *engine* is here ascertained from a formula for the power of *steam*.

We do not know what private interpretation our correspondent gives to the term "mechanical effect of steam," but surely he must allow that if the Artizan Club assert that an infinitely great mechanical effect can be produced with *no* steam, they utter an absurdity; that if they assert that the friction of the piston depends on the temperature of the steam which *has* acted upon it some time previously, they utter an absurdity; if they say that the power of an engine is always exactly doubled by using a condenser, they utter an absurdity; and if they say that the amount of a force is dependent on the work it has to do, they utter an absurdity. Will our correspondent undertake to say that these blunders cease to be blunders by giving a particular meaning to the phrase "mechanical effect?" Will he deny that such errors would be disgraceful in a common mechanic, and are absolutely revolting in those who undertake to teach, armed with all the authority of mathematical symbols?

The last argument of our correspondent is, that many of the Artizan Club's theories are taken from Tredgold. This makes the matter no better. We are amongst those who think that it is *not* a necessary consequence that, because a theory comes from Tredgold, it is therefore true. His own editor, Woolhouse, has been compelled to correct mathematical errors for which a schoolboy would be punished. We allude now, more especially, to the investigations connected with rotary engines. The position, then, in which our correspondent puts the treatise of the Artizan Club is this,—that it is not only an erroneous but a dishonest production, for the matter is taken from Tredgold without the slightest acknowledgment. Our correspondent, however—to do him justice—reprobates the plagiarism as warmly (or more warmly) than we ourselves should have done. To conclude—he is clearly one who *thinks*, though sometimes, he will forgive us for saying, he thinks hastily. It is a hard matter to attain the truth in physical investigations; but we put ourselves absolutely beyond the pale of philosophy by forming intemperate and undigested conclusions.

ACCOUNT OF IMPROVEMENT OF THE NAVIGATION OF THE RIVER CLYDE.

(With an Engraving, Plate XIX.)

(From a Memoir addressed to M. Arago, *for the Royal Institute of France, by* W. Bald, Esq., C.E., *Fellow of the Royal Society of Edinburgh, and the Geological Society, London, &c., &c.)*

As the improvement of the navigation of the river Clyde has been one of the most successful engineering operations achieved in Great Britain, a few short observations regarding this subject may be interesting. The river Clyde may be said to have been the cradle of steam navigation in Europe, and on the banks of that river was born the illustrious Watt.

The following is a list of the various reports which have been made regarding the improvement of the navigation of the river Clyde.

In 1755 Mr. John Smeaton, civil engineer, made a report upon the improvement of the river Clyde, and he recommended that there should be a lock and a dam across the Clyde at Marlinford, but which was never executed. At that period vessels drawing 3 feet 3 inches to 3 feet 6 inches of water could only ascend the Clyde to the harbour of Glasgow.

In 1768 Mr. John Golborne, civil engineer, made a report upon the improvement of the river Clyde. He recommended that a series of jetties should be constructed on the right and left banks of the river, so as to narrow the Clyde, fix the channel of the navigation, and increase the scouring power of the river; he also recommended the removal of several shoals or banks lying in the channel of the river. These works were carried into execution, and did considerably improve the navigation.

In 1769 Mr. James Watt, whose name has been so illustriously connected with the steam engine, made out a short report upon the Clyde: it refers to levels and depths of water only.

In 1781 Mr. John Golborne again reported on the river Clyde, and the works of the jetties, &c.

In 1799 Mr. John Rennie, of London, reported upon the improvement of the Clyde. He recommended longitudinal dykes, and that the jetties should be shortened in several places.

In 1806 Mr. Thomas Telford reported upon the improvement of the Clyde. At this period vessels drawing 8 feet 6 inches of water could ascend the Clyde to the harbour of Glasgow.

January 26,	1807.	Mr. Rennie reported upon the Clyde. He recommended wet docks.
June 15,	1807.	Mr. Rennie again reported.
Dec. 24,	1807.	Ditto.
Dec. 26,	1807.	Ditto.
	1809.	Ditto.
Dec. 29,	1819.	Mr. Telford reported on a wet dock.
Dec. 20,	1821.	Ditto.
	1824.	Mr. Whidbey reported upon the improvement of the River Clyde.
	1826.	Mr. Telford reported.
	1834.	Mr. J. Hartley reported.
	1835.	Mr. Logan reported.
	1836.	Mr. Walker reported.
	1838.	Mr. John Scott Russel reported.
	1839.	Mr. Bald reported.
	1841.	Ditto.
	1843.	Ditto.

Within the last six years the following impediments to the free navigation of the river Clyde have been removed, by cutting channels through the Port Glasgow bank, the Garmoyle bank, the bank opposite to Dunbarton Castle, the bank at the head of the Long Dyke, and also through all the hard ground shoals, consequently the channel of the navigation has been considerably deepened, so that vessels now


- THE RIVER CLYDE -
DUMBARTON
LOW WATER LINE
LOW WATER LINE
LOW WATER LINE
A
B
C
A
B
PORT-GLASGOW
PUBLIC GREEN OR PARK
GLASGOW WATER WORKS
D
E
OLD KILPATRICK
DOUGLAS CASTLE
ERSKINE-FERRY
CHEMICAL WORKS
NEWSHOT ISLE
YOKER
RIVER CART
SCALE
FURS. 8 7 6 5 4 3 2 1 0
1 MILE
PATRICK
RENFREW
GLASGOW
GOVAN
C
D

C Bagster

drawing a depth of water of from 17 feet 9 inches to 18 feet can ascend the Clyde at high water to the harbour of Glasgow; both East and West Indiaman and all the large American vessels, &c., now sail up and discharge their cargoes in Glasgow; while it may be observed that in 1755 the depth of water in the Clyde would only allow vessels to ascend up to Glasgow harbour drawing from 3 feet 3 inches to 3 feet 6 inches of water.

The amount of shipping now frequenting the harbour of Glasgow annually is about 1,200,000 tons. The amount of revenue arising from river and harbour dues is now annually about from £40,000 to £45,000 —in 1771 it was only £1,071 per annum.

There are employed in deepening and improving the Clyde five deepening machines, a steam tug boat, two diving bell boats, with about 160 punts. The value of the whole working machinery may be taken at £39,000.

The following are the quantities of sand, mud, clay and gravel dredged up from the bed of the river Clyde during the last four years by the five steam dredging boats, and also the amount of the expense. As there is more dredging in the river Clyde than in any other river in the world, it may perhaps be interesting to state the following practical results.

To preserve the present depth of water in the harbour of Glasgow and the river Clyde requires an annual dredging of about from 160,000 cubic yards to 180,000 cubic yards, taking this at 8*d*. per cubic yard, on 180,000 cubic yards amounts to £6,000 annually; this is on a river line 18 English miles in length.

1st. The improvement of the navigation of the river Clyde is due to the construction of jetties, which fixed the channel and increased the scouring power of the river.

2nd. The construction of longitudinal dykes, by which the velocity of the water was equalized, thereby removing the shoals and pouls formed by the jetties.

3rd. To the dredging machinery and diving bells, in removing all kinds of shoals, banks, and bars from the channel of the navigation which the works of the jetties and longitudinal dykes could not accomplish by the increased scouring power of the river.

Dredge boat	No. 1	commenced in	1824	10	horse power.
Do.	No. 2	do.	1826	16	do.
Do.	No. 3	do.	1830	16	do.
Do.	No. 4	do.	1836	20	do.
Do.	No. 5	do.	1841	22	do.

In concluding these very few and short observations, I beg leave to mention that I shall be very happy at any time to give the Institute a minute detailed account of the whole or any part of the works which ave been done to improve the navigation of the river Clyde; or the dredging machinery, diving bells, &c.; or the tides, currents, or velocity of the water; for, unfortunately, nothing of the kind has yet been published, either in Great Britain or elsewhere, embracing all these subjects.

The improvement of the tidal harbours and tidal river navigation is of national importance to every country, and more particularly since the application of steam to navigation, because steamers can so rapidly navigate every river where sufficient depth of water exists; so important is this considered that at this very moment a Royal Tidal Commission is now sitting in the Admiralty in London examining into the improvement of all the tidal harbours and river tidal navigations of England, Ireland, and Scotland, also into the invasions and encroachments which have been made upon many of the tidal river navigations and tidal harbours by embanking and shutting out the sea water, and which has in many instances ruined several of the English harbours.

William Bald.

Paris, June 2, 1845.

Statement of Sums spent in the Improvements of Rivers.

The Shannon, Ireland	£350,000
The Clyde and the Port of Glasgow	550,000
The Boyne and the Port of Drogheda	50,000
The Liffey and the Port of Dublin, including quays, &c.	1,250,000
Kingston, six miles below Dublin (south side of the bay)	600,000
Howth, nine miles below Dublin (north side of the bay)	500,000

In addition to the above we have been able to obtain some valuable information relative to the cost of dredging and quantity of work performed by m e hine on the river Clyde.

The following statements have been taken from the official records of the Clyde trustees. But no account can be found in their books of the annual quantities of material which has been dredged up in the harbour of Glasgow and the Clyde previous to 1838, and which was one year before Mr. Bald was appointed engineer.

Extract showing the amount of the Performance of the Labouring Force, and time of the Five Steam Dredge Boats on the river Clyde, by Manual Labour propelling forward, and also by Steam Power propelling forward.

By Manual Labour Working Forward.

	Dredge No. 1.		Dredge No. 2.		Dredge No. 3.		Dredge No. 4.		Dredge No. 5.	
	Weeks.	Punt Loads.	Weeks.	Punt Loads	Weeks	Punt Loads	Weeks	Punt Loads	Weeks	Punt Loads
1838	28	2,268	34	3,075	30	2,746	38	5,451	..	..
1839	38	3,366	38	3,312	50	3,538	42	4,001	..	..
1840	28	2,133	44	5,069	46	6,169	46	5,845	..	..
1841	50	5,354	46	3,307	40	4,894	42	4,888	30	3,438

By Steam Power Working Forward.

1842	40	4,740	28	4,469	46	6,090	46	7,150	46	8 832
1843	38	4,957	44	4,965	40	4,768	44	7,248	40	7,506
1844	42	5,483	46	8,191	32	4,504	38	5,717	42	6,683

Total Amount of Excavation dredged from the bottom of the river Clyde and harbour of Glasgow in the following Years.

No. of Dredge Boat	In 1838	In 18 9	In 1840	In 1841	In 1842	In 1843	In 1844
	Punt Loads.	Punt Loads.	Punt Loads.	Pont Loads.	Punt Loads.	Punt Loads.	Punt Loads.
No. 1 .	2,268	3 366	2,433	5,354	4,740	4,957	5,483
2 .	3,075	3,312	5,069	3,307	4,469	4,965	8,191
3 .	2 746	3 538	6,169	4,894	6,090	4,763	4,504
4 .	5,451	4,001	5,845	4,888	7,150	7,248	5,717
	13,540	14,217	19,516	18,4 3	22,449	21,938	23,895
5 .	..	..	..	3,438	8,832	7,506	6,683
Totals .	13,540	14,217	19,516	21,881	31,281	29,444	30,578
Excavation in Upper Harbour, per Contract							1,188
							31,766

Total quantity excavated 161,845 Punt Loads, from the beginning of 1838 to the end of 1844

The Velocity of the Water in the River.

"The mean velocity of four sets of observations of the water passing down the Clyde, from the harbour of Glasgow to the junction of the Cart river with the Clyde, in ordinary fair weather may be taken at 1576 yards per hour, and the ascending current at 771 yards per hour; and from the junction of the river Cart with the Clyde, to opposite Dunbarton Castle, the mean of five observations assigns the descending velocity of the Clyde at 1 mile 1069 yards per hour, and the ascending current at 1561 yards per hour.

"In the river Clyde during high floods, immediately below the harbour of Glasgow, I have found the velocities of the descending currents run at the rate of 2 miles 1613 yards per hour; and in the narrow parts of the river 3 miles 1148 yards per hour; this was in the middle of the river, and at the water's surface."

The Rise of the Tide and the Time of Ebbing and Flowing.

Spring Tides.

The mean result of six observations, taken on the 18th, 19th and 20th March, 1840, o the rise and fall of the tide at the following places, was as follows (full moon March 18 :—

	Ft.	In.
Mean rise and fall of six tides in the harbour of Glasgow ..	8	4
Ditto at Clyde Bank, 5 miles 866 yards from Glasgow Bridge	8	0
Ditto at Bowling Bay, 10 miles 1166 yards from ditto	8	9
Ditto, 18 miles 1166 yards from ditto	10	5
	H.	M.
Mean rime of flowing in Glasgow Harbour	5	10
Ditto of ebbing in ditto	7	13
Mean time of flowing at Clyde Bank	5	15
Ditto of ebbing at ditto	7	6
Mean time of flowing at Bowling Bay	5	24
Ditto of ebbing at ditto	6	56
Mean time of flowing at Port Glasgow	6	6
Dittto of ebbing at ditto	6	1

Neap Tides.

Taken at the following places on the 25th, 26th, and 27th March, 1840.

	Ft.	In.
Mean result of six observations of the rise and fall of the tide in the harbour of Glasgow	6	3
At Clyde Bank, mean of six tides	5	10
At Bowling, ditto	5	11
At Port Glasgow, ditto	6	1
	H.	M.
Mean time of flowing at Glasgow	5	14
Ditto of ebbing at ditto	7	16
Mean time of flowing at Clyde Bank	5	43
Ditto of ebbing at ditto	7	1
Mean time of flowing at Bowling	5	52
Ditto of ebbing at ditto	6	37
Mean time of flowing at Port Glasgow	6	26
Ditto of ebbing at ditto	5	59

Extract from Mr. Bald's Report read before the General Meeting of the Clyde Trustees, Sept. 3, 1844.

The improvement of the navigation of the Clyde and the harbour of Glasgow by deepening is principally due to the labouring force of the steam dredgers, and which is attended with a very considerable annual expense. A question has arisen, whether it might not be possible to work them a longer period of time each day, and perform a greater quantity of work.

In order to throw some light on this very interesting subject as regards expenditure, the preservation of the depth of the present navigation and its further improvement. It may be first observed that there are five steam dredgers employed in the deepening operations of the harbour and river: their power and depth of working are as follows :—

No. 1	steam dredge	has an engine	12	horse power	which works	in 10½	feet depth of water.
No. 2	ditto	ditto	16	ditto	ditto	14	ditto.
No. 3	ditto	ditto	16	ditto	ditto	14	ditto.
No. 4	ditto	ditto	20	ditto	ditto	15½	ditto.
No. 5	ditto	ditto	22	ditto	ditto	17 to 19	feet ditto.

Looking at the small depth of water which these steam dredgers work in, with the exception of two of them, and again at the depth in the ship channel of the river Clyde and harbour of Glasgow at high water; and which frequently extends from 15 to 20 feet in depth at lofty tides in gales blowing from south and south-west, it must therefore be manifest that there is a very large portion of time each day in which none of these steam dredges can work, their bucket frames not being able to reach the bottom, and it must be further observed that both the harbour of Glasgow and the river channel of the Clyde are becoming deeper, and consequently lessening the time of working these dredgers.

Steam Dredgers—Dimensions of Engines.

Number of Boat.	Depth of Working.	Least Depth of Working.	Dismeter of Cylinder.	Length of Stroke.	Number of Buckets on Frame.	Strokes per Minute.	Length of Frames.	Nom. Power of Engine
No.	Ft. In.	Ft. In.	Inches.	Ft In.			Ft. In.	
1	10 6	3 9	21	2 6	31	38	47 9	12 h. p.
2	14 0	4 0	24	2 6	33	38	52 11	16 h. p.
3	14 0	4 0	24	2 6	33	38	52 11	16 h. p.
4	15 6	4 3	26	2 6	34	38	54 7½	20 h. p.
5	17 to 19	4 4	27½	2 6	34	38	58 0	22 h. p.

Steam-tug, two engines each 30 h. p.; diameter of cylinder 30 inches; length of stroke 3 feet 9 inches; strokes per minute 40.

All the steam dredgers have governors which regulate the speed to about 28 strokes per minute in ordinary working stuff.

Average pressure in boilers about 3½ lb. to the square inch.

In general 14 buckets are discharged per minute.

The speed of the buckets on the frames in Nos. 1, 2, 3 and 4, is (3 ft. 5½ in. × 14 = 48 ft. 5 in.) 48 feet 5 inches per minute.

And No. 5 is (3 ft. 8 in. × 14 = 49 ft. 8 in.) 49 feet 8 inches per minute.

The larger the engine the less is the consumption of fuel on board the dredgers. The small engines are worked to their full power, and consequently consume more fuel in proportion to their power than the larger engines, which are not so much pressed; for example, No. 1 consumes about 18 lb. of coal per horse power per hour; while No. 5 only consumes 15½ lb. per horse power per hour.

Details of the Working Operations of Deepening and Cleansing the river Clyde and the harbour of Glasgow.

	Amount Expended.	Quantity of Work Executed.	Rate per Cubic Yard.
	£ s. d.	Cubic Yards.	£ s. d.
Year ending 25th December, 1841 ..	11,841 18 2	218,110	0 1 1
Year ending 24th December, 1842 ..	13,612 11 3	313,810	0 0 10½
Year ending 23rd December, 1843 ..	9,742 7 6½	294,440	0 0 8
Year ending 21st December, 1844 ..	10,659 3 8	317,660	0 0 8

The expense of dredging and depositing the material taken up from the bed of the river Clyde and the harbour of Glasgow varies considerably, on account of the nature of the material in the bottom and the distance it has to be carried for deposition.

A punt load may be taken at an average at about 10 cubic yards.

Value of Machinery employed on the river Clyde.

	£
5 deepening machines with engines and gearing ..	20 000
Steam tug, with two engines each 30 h. p.	3,300
157 punts	12,560
13 punts for stones	650
2 diving-bells	750
Fifteen additional iron punts amount to about ..	2,025
Total	£39,285

IMPROVEMENT OF THE RIVER SEINE.

The *Chambre de Commerce* at Rouen being anxious to remove obstructions in the navigation of the Seine, from that city to the sea ports of Havre and Honfleur, addressed a letter of enquiry to Mr. Bald, the engineer for the improvement of the Clyde. The following extracts from his letters have been obligingly communicated to us, and afford interesting information on this important subject.

Extracts from a part of Mr. Bald's correspondence on the improvement of a portion of the Seine, addressed to the President of the Chamber of Commerce of Rouen, 1845.

"I have seen your river Seine, but it is 19 years ago, and I have not been in France since 1831; but, nevertheless, reading your letter carefully over, I can readily understand what your objects are.

"All the celebrated engineers of this country,—Smeaton, Rennie, Telford, Nimmo, &c., have all concurred in opinion that the improvement of tidal rivers for navigable purposes depends upon obtaining a greater flow and a greater quantity of tidal water upwards into them. Now, this principle being admitted, it is manifest that all obstructions to the tidal flow upwards should be removed, such as shoals, bars, &c.; and that all means should be adopted to increase the quantity of tidal water into all the higher and upper reaches of tidal rivers. This will give a greater scouring power to keep the navigable channel free from shoals; but it may also considerably deepen and improve it. Besides, if there are any bars or shoals at the mouth of a tidal river, their removal can best be achieved by obtaining and procuring a larger quantity of additional tidal water up into the higher reaches of the river.

"Now, you state that it is proposed to deepen the river Seine by contracting its banks, and to prevent the water of the river from spreading so widely as it used to do; and that this operation is to be limited at first to the upper part of the river, always allowing the free course of the tide, &c.

"I really do not see how you can contract the banks of any river so as to prevent the water spreading, without in some measure intercepting the tidal flow. I should be wanting in duty if I did not warn you, on no account to give the least obstruction to the tidal waters upwards by narrowing the banks of the river, by the construction of dykes. To achieve this important object requires much careful consideration and great reflection in the execution of the works; because, if you shall in any measure diminish the tidal flow upwards into the highest recesses of the Seine, you will lessen your tidal scour outwards, and in all likelihood diminish the depth of water at the mouth of your river, and also at your ports of Havre and Honfleur. My advice is, to try and carry the tidal waters as high up as possible into the upper recesses of the Seine, and to be cautious and careful how you narrow the river. I am not able to convey to you all my ideas regarding this great and important improvement for France; because I am not in possession of many details connected with the speed and volumes of the fresh and salt water ascending and descending, the nature of the bottom, soil, tides, &c. &c.; nor am I in possession of any detailed plans to enable me to arrive at anything definite on this interesting subject; but, nevertheless, I am strongly impressed with the idea, from my recollection of the Seine, that a great improvement could be effected as regards its navigation.

"I am not able to refer you to any river in Europe where so much has been done as in the Clyde in improving a tidal river navigation; in 1755 the river Clyde could only float vessels drawing three feet six inches of water; now the river Clyde can float vessels drawing 18 feet of water, notwithstanding the many errors which have been committed in improving it during the ninety years it has been under the hands of the engineer. And I really do not see why you should not, with care and attention in the construction of works, attain a depth of 20 feet of water instead of 10 or 12, as you mention; and that fleets of both merchantmen and also of-men-of-war should be able to obtain perfect shelter and security within the embouchure of the river Seine.

"I again take the liberty to caution you that any works which shall be proposed for the deepening of the navigation of the Seine should be carefully considered, because a great deal has been done on this river Clyde which must be undone at a great expense; errors of the gravest kind have been committed, notwithstanding the great success in deepening it, and this depth is now only preserved by an annual dredging of about 180,000 *cubic yards* of deposit on a river line of 18 miles long. Now the great object should be to get *the tidal scour, to preserve the depth, and save this great annual expenditure*; therefore the operations of nature should everywhere be assisted in deepening by the aid of works which have been found to be successful."

à Monsieur J. Rondeaux, President of the Chamber of Commerce at Rouen.

Translation of a letter addressed by request to the Chambre de Commerce, May 22, 1845.

"Some months back I promised you that on my next visit to France I would examine the plans proposed for the improvement of the Seine. I have in consequence examined the river from Havre to Rouen, and also different plans for its improvement. I have also questioned a great number of pilots and seamen well acquainted with the peculiarities of the river.

"It may be observed that the river Seine from Villequier to Rouen, is a deep river navigation fit to float merchant ships of large size, there being not less than from thirteen feet to thirty feet depth of water; but between Villequier and Tancarville, some serious difficulties exist as to the navigation; because the navigable channel is constantly changing from side to side, and also the depth of water frequently varies so that the pilots require to be always examining the channel so as to know where the deep water exists.

"Below Tancarville point on the north shore, and Cap la Roque on the south, down to Havre is a wide estuary, which offers at high tide a tolerable depth of water for navigation, but this lower section of the river estuary is not to be submitted to consideration at present, although it offers to the engineer engaged in the amelioration of river navigation a highly interesting field of inquiry: it is only the improvement of that part of the navigation of the river Seine, between Villequier and Tancarville, which I shall now venture to offer a very few and limited observations on, and which may be observed is the most difficult part of the river Seine to navigate.

"It appears to me that the principal object would be *to fix and render permanent the river and tidal channel of the Seine between Villequier and Tancarville point,* and to obtain an additional depth of water, but this I do frankly confess is a serious work, and requires much consideration; but then on the other hand looking at the great and successful improvements which have been made on many of the tidal rivers of Great Britain and Ireland, namely, the Clyde, the Shannon, the Boyne, &c. &c., and the many hundreds of thousands of pounds which have been expended upon them, whereby those rivers have been greatly improved in their navigation. Is it not an object of national importance to France, and also to its capital to improve the navigation of the river Seine, so that not only French ships, but also those of all the nations in the world may be able to pass up, into, and through one of the most fertile and populous districts of France? It may again be asked is it not remarkable that nothing has as yet been done to improve the navigation of the river Seine? and that it is at this moment as formed by nature, while so many noble examples of river improvements have been achieved in other countries; this again is still more to be wondered at considering that since the application of the steam engine to maritime affairs, that navigable rivers have become more valuable for commercial purposes than canals, and a case can even be mentioned where a river navigation has successfully competed with a railway in carrying both goods and passengers.

"*I do think it quite within the power of the engineers to construct works both on the north and south sides of the river Seine, which shall render the navigable channel not only permanent but also increase its depth between Tancarville and Villequier,* and it is on this section of the river Seine which I would recommend works to be first constructed. These works should consist of longitudinal rubble stone dykes, and perhaps some short jetties, which description of works have been found to have been successful elsewhere in improving several tidal river navigations—but I am not prepared at present to state in detail the dimensions of those works; but I beg leave to observe that all these river works should be so constructed, and of such forms as not to interfere with the tidal flow upwards into the river Seine. My opinion is that if the channel be deepened between Tancarville and Villequier, that not only will the Barre be robbed of a portion of its dangers, but more tidal water will flow up the river Seine, *which is generally the great principle to improve the navigation of all tidal rivers,* therefore no works should be constructed *which would interfere with the tidal flow upwards.*

"I should recommend a working plan upon a large scale to be made of the river Seine between Tancarville and Villequier, with transverse sections at every three hundred meters apart, shewing the depth of water and the velocities of the tidal and river currents during spring and neap tides: also borings should be made along the lines of the proposed longitudinal dykes, which it has been proposed should be erected on the right and left sides of the river, in order as before mentioned, to fix and deepen the channel of the navigation.

"When the longitudinal dykes shall have been constructed adjacent to the Bank called the Traverse, I do say that a steam dredging machine would be found useful in removing that obstacle to the navigation, besides I am satisfied that any deepening which shall be made at the Traverse to improve the navigation so as to allow ships to pass freely up and down, will not lessen the depth of water in the harbour of Rouen.

"I am impressed with a deep conviction that a *very great improvement can be effected on this part of the navigation of the river Seine,* and that there is not within the whole French empire a work so justly deserving the immediate attention of the government as the improvement of the river Seine, and I sincerely hope that your great and important river navigation may receive all that attention as to its improvement which it so justly merits and deserves, as it is one of natures great arteries, designed for the extension of the trade and commerce of France."

Rouen, May, 1845.

REVIEWS.

Geology as a Branch of Education. By D. T. Ansted, M.A., F.R.S. Fellow of Jesus College, Cambridge; Professor of Geology in King's College, London; Vice-Secretary of the Geological Society. London: Van Voorst, 1, Paternoster Row. pp. 143, 16mo.

In proportion as the science of Geology has advanced in systematic exactness, its accuracy has been more and more loudly impugned. In this respect the early history of geology resembles that of all other sciences. They too have, each in turn as it progressed from birth to maturity, been the subject of dispute and persecution. The science of astronomy had no sooner begun to develope itself logically and free from the crudities of vague speculation, than it was sapiently discovered to be subversive of religion and morality! The imprisonment of Galileo could not, however, subvert the glorious scheme of the heavenly mechanism which he revealed; nor, still later, could the writings of a sect which became more conspicuous for its zeal than knowledge prevail against the splendid investigatiens of Newton and Laplace. While the efforts of the foolish religionists are now forgotten, the *Principia* and *Méchanique Céleste* will continue to the end of time the noblest monumeuts of human intellect. Men have now discovered that the object of religion is not to teach astronomy—they *will* find that religion does not inculcate any particular scheme of Geology.

And, after all, Geology is a science of *facts*. It *is* true that certain rocks are filled with remains of plants and animals; it *is* true that the earth is not made up of one material, but of several; it *is* true that these material are arranged in a certain order. These truths are not speculative—not even arguable—they are *matters of eyesight.* Men may dispute about the Mosaic meaning of the word "day," they may write letters to newspapers about it, but they have only to go into a coal-pit or a railway cutting, and they *must* do one of two things—give up either their polemical notions or the evidence of their senses.[1]

At no time could the work before us come more opportunely than at the present. The name of its author is a sufficient guarantee that it is philosophical and trustworthy. Without professing to teach a profound and varied science in a pocket volume, it gives a fair and accurate outline of the science, and is presented in that inviting form which will induce many to acquaint themselves with the leading facts of geology who have hitherto been content to remain in ignorance of its principles, because deterred by the size of the larger treatises or disgusted by the shallowness of the elementary writings on this science. The present work just hits the medium between the heaviness of an elaborate quarto and the superficial ostentation of penny-a-week philosophy.

Professor Ansted has very conveniently divided his work into three parts—*Descriptive Geology*, a description of the materials of which the earth is composed; *Practical Geology,* an account of the purposes to which a knowledge of descriptive geology may be applied; and *Physical Geology,* or a statement of the various theories accounting for the phenomena recorded by descriptive geology.

We have selected from the first part of the work, for its interest to the engineer the following extract, giving an account of

The Countries and Districts possessing Coal Measures.

The *Coal measures* must be considered with reference to the various districts in which their vast value and importance are chiefly felt. The great North of England or Newcastle coal field, is partly covered up by the Magnesian limestone in Durham, and is worked through this bed. It contains about thirty seams of coal (whose total thickness is about ten yards) alternating with shale and sandstone, and greatly disturbed by faults and dykes.

[1] Some of these wiseacres think the Mosaic "day" means twenty four hours;—it was not till the "fourth day" that the sun was set in the firmament!! The word "day" has been constantly used in all ancient and modern languages to signify an indefinite period. See the Book of Daniel especially.

The coal is the most bituminous and the best adapted for economical purposes of any yet known.

The Lancashire coal field occupies a considerable area, and is connected with that of Yorkshire. It includes perhaps the most perfect series of the rocks of the period anywhere existing, and consists as usual of sandy beds and shales, alternating with a large number of coal seams, seventy-five of which (whose total thickness is 150 feet) are described. In its upper part occurs a pale blue limestone of freshwater origin, which is again met with in other coal fields nearly a hundred miles distant, and appears also at various intermediate points.

The South Staffordshire coal field is remarkable as the only representative of the Carboniferous rocks in that part of England, the millstone grit and Carboniferous limestone being both absent. It exhibits a great preponderance of shale, and the number of its coal seams is only eleven, but the thickness of one of these is unusually great, amounting to upwards of 30 feet in some places.

The South Welsh coal field contains about 95 feet of coal distributed in about a hundred seams, the most powerful of which is about nine feet thick. The associated shales and sandstones are of very unusual thickness, and they contain besides coal an abundant supply of ironstone ore. A considerable part of the coal in this district is non-bituminous, and distinguished by the name of *Anthracite.*

Besides these, there are numerous smaller deposits of coal in the Middle and of West, and in Wales, all of which possess local importance, but which we cannot now stop to describe.

The basin of Clyde in Scotland, is no less interesting for its carboniferous deposits than important from extent and value. In this district, the Old red sandstone is the general base of the coal strata, thick sandstones occasionally containing coal, taking the place of the lower carboniferous limestone. Thin beds of limestone then succeed, and on these rest the greet mass of the coal-bearing strata, which greatly resemble the similarly situated beds in England, but which include seams of ironstone ore yet more valuable. There appears, however, to be a freshwater limestone in this part of Scotland underlying the coal measures, and possibly contemporaneous with a bituminous shale in the North Staffordshire coal field.

The coal seams in the Clyde valley amount in number to eighty-four, but they are mostly thin; the coal, however, is good. The total thickness of the deposit is estimated at about 5,000 feet.

The coal fields of Ireland are not unimportant, though they have hitherto been little worked. The principle one worked is that of Leinster, and as much as 20 or 30 feet of bituminous coal have been found in another small field near Tyrone. In Connaught there is also a supply of ironstone ore.

France and Belgium both contain a considerable number of coal fields, but they are mostly of small dimensions, and in the latter country are greatly disturbed, inclining at a considerable angle to the horizon, and worked like mineral veins. The French coal fields are all of very small size.

Russia is not without an extensive series of strata of the date of the Carboniferous rocks; and in the northern part of the empire there seems to be a prospect of workable coal, the lowest beds of the system containing (as in Yorkshire) a few seams of variable thickness, but of great value. In the south of Russia, very good bituminous and anthracite coal is found in considerable abundance, but the beds are much disturbed by faults.

North America contains coal-bearing strata of great value, and of enormous extent, a gigantic coal-field existing in the Western States, and offering every prospect of success in the working. The coal measures here, as in Europe, form the uppermost part of the carboniferous series, and the number of seams hitherto know is about ten, having an aggregate thickness of 50 feet. There is one bed of 30 feet, worked like a quarry from the surface.

In Van Diemen's Land, and probably in several parts of Asia, there are strata of the Carboniferous period, greatly resembling those of our own island, and consisting of limestones overlaid by coal-bearing strata. Much yet remains to be done in making out satisfactorily the true position of these strata with referenre to the well-known Carboniferous series of Europe.

We could make many other interesting extracts, but as the book is a small one we do not like to borrow much from its pages. We will, however, conclude with another extract taken from the second part, Practical Geology.

Mineral Veins, and the extraction of Metallic Ores from them.

Mineral veins are repositories in rocks of a flat or tabular shape, which traverse strata without regard to their stratification, having the appearance of rents formed in the rocks, and afterwards filled up by mineral matter, which differs, more or less, from that of the rocks themselves.*

Both veins and dykes, however, are fissures filled with mineral matter, and they differ from one another rather in their contents than in the form and nature of their bounding walls. The cracks are called veins when they contain crystalline minerals, usually associated with metalliferous ores; they vary greatly in horizontal extent, they pass, though not indifferently, through all the rocks met with in their downward progress, their breadth is infinitely irregular, and their contents are rarely of equal value for any great distance, but have become richer or poorer, according to the action of causes which at present are very litt e un lerstood.

Veins usually occur in a position nearly vertical, but this is by no means always the case, although the amount of inclination to the horizon is seldom less than 45°; they have, in most cases, a very regular direction, appearing in sets parallel or else at right angles to one another. The veins profitable for working, in England, usually run east and west, or nearly in that direction, and they appear to have reference to the general structure of the country. . . . .

The indications on the surface by which the existence of metalliferous veins is made known to the miner, form an interesting subject of inquiry, immediately connected with Geology; but it is rarely the case that any very direct application of science gives the first hint of the presence of subterraneous riches, because the surface has almost always been exposed to some denuding action by which the out-crop of the vein has become distributed in the form of gravel, while, on the other hand, a similar action has covered the original surface with the debris of other rocks, preventing the Geologist from tracing the line of the vein, or determining its direction and other attendant circumstances. Practically, almost all mining operations in a district are preceded by the occasional discovery of metalliferous ores in gravel, and the tracing this gravel to its source is usually a work in which no knowledge of the subject or science of mining is called into play. In many countries, especially in the rich gold districts of Russia, and even of America, and in the tin mines of Banca, the method of washing river sands and gravels for the sake of the heavier particles of ore which they contain, and which sink in water more readily than the sand itself, forms not only an important but almost the only source of supply, and the actual veins have not been reached. In our own country, the search after *Stream tin,* as the Cornish stanniferous gravels are called, is still occasionally a profitable employment, although the source of supply is very soon discovered and the vein worked regularly and systematically.

The art of tracing stream ores to the vein, called in Cornwall *shoading,* is generally followed by the sinking of shallow pits, by means of which there is obtained a rough approximation to the direction and probable extent of the vein. If it is found to be *right-running,* that is, to have the same general direction as the valuable mines of the same mineral in the district, it is then advisable to commence work regularly and systematically, by sinking a vertical shaft at some distance from the vein, with the intention of coming upon it at a certain depth. When the hang or dip of the vein is considerable this is however somewhat hazardous; and in cases where it is very slight, it is not unusual, in some districts, to sink upon the actual vein itself, although this method is hardly considered economical mining, or advisable, if the vein be likely to yield a good return.

Connected with these first operations, and almost at the same time as the commencement of the sinkings, it is generally necessary to drive what is called an adit level, or, in other words, a nearly horizontal gallery at the lowest convenient depth which will admit of the water of the mine running off and escaping. If the vein be discovered near a hill side, the adit level is so driven as to drain the mine at the lowest point of the hill into the nearest stream in the valley. Drainage is one of the very first things to be considered in mining, since, without a convenient system adopted to get rid of superfluous water, the operations must soon be stopped, either by water running in from the neighbouring strata, or the accumulation of surface water and rain entering by the shaft.

Although the method of discovering the existence of mineral veins by tracing metalliferous gravel to its source is often applicable, it is by no means always so; and, in a district known, either in this or other ways, to contain numerous veins, it is often worth while to speculate even where there are no surface indications whatever. A method is adopted in Cornwall, called *costeaning,* in cases of this kind. It is derived from the knowledge of the law of the distribution of mineral veins in the district, and is more or less likely to succeed, according as the knowledge of the experimenters is more or less accurate In this case a spot is selected by an experienced person, as the most likely to be near the outcrop of a good vein. On this spot a pit is sunk to a small depth, and there is, of course, a chance of success in this first operation. Should it, however, fail, the next step is to drive a gallery from the pit a short distance in opposite directions, at right angles to the general direction of the lodes in the neighbourhood. If, in this way, they do not "cut the lode," they next remove a few fathoms in the direction of the galleries, and repeat the same process, and this they do till they either find the vein or give up the speculation in despair. It is not easy to imagine a method simpler or more certain than this, and it is peculiarly interesting as being founded on correct Geological and mining principles.

The underground-work of a mine, when the vein has been discovered and its extent and probable value are ascertained, is a part of the subject on which I shall not here dwell. Systems of galleries are usually driven at depths about ten fathoms asunder and the ore is taken away between each of these in succession, the roof of the mine being kept from falling in, partly by timber props and partly by rubbish left to support it. The ore is separated from the rock almost always by blasting, and is generally lifted by machinery from the bottom of the shaft to the surface.

* This is the definition given by Werner, and can hardly be improved or added to at the present day.

The Gauge Question. Evils of a diversity of Gauge and a Remedy. By Wyndham Harding. With a Map. Weale: 8vo., pp. 62.

Though it be neither a short nor easy task to turn public attention in England to a new subject, it cannot be denied that the general feeling when it *has* acquired a new direction is exhibited with ample warmth and energy. "The Gauge Question," is a case in point.

Before the Great Western Railway was constructed, the departure from uniformity of the gauge of English railways attracted the deepest and most careful attention of engineers and others interested in examining the question. Inquiries were instituted, experiments made, long and elaborate reports were written, and all to settle whether the Great Western was to have the same gauge as other lines. But the public looked on coldly: they had not *yet* suffered any inconvenience from the change. *Now* however we have Parliamentary Debates, Royal Commissions, leading articles in newspapers, pamphlets and public meetings to discuss the subject. The question assumes the technicalities of partizanship. "Broad Gauge" and "Narrow Gauge" might be mistaken for the war-cries, and the "Battle of the Gauges," for the conflict of two hosts. We are now hotly determined on *remedying* the evil: alas! we did not think much about *preventing* it. John Bull never sees any thing till it is thrust under his nose.

Among the various dissertations to which the present excitement has given birth, not the least important is the pamphlet before us. Mr. Wyndham Harding has under his control the British and Gloucester Railway, a broad gauge line; he has also had the management of narrow gauge railways. In listening to him we are therefore listening to one who brings practical experience as a powerful support of his arguments. He tells us also, what the tenor of his memoir confirms, that he examines the question impartially and has not "the slightest personal interest in the decision of the question, either as it may affect the extension of any particular gauge or the success or failure of any particular railway company." After giving a description of the different gauges, he proceeds to consider the argument brought forward when the broad gauge was proposed by Mr. Brunel, that the Great Western Railway would not be connected with any other, and that the company were therefore at liberty to choose what gauge they pleased. In answer to this Mr. Harding observes—

The completed or projected branches of the Great Western railway itself—which was expected, as we have seen, to have no connection with any other existing line—now join it to most of the other main lines in the country. For instance:—

To the Grand Junction, and to the projected Shrewsbury and Birmingham railways at Wolverhampton. To the Grand Junction, London and Birmingham, and Midland railways, at Birmingham. To the London and Birmingham, the Midland, and the proposed Trent Valley and Churnet Valley Lines, at Rugby. To the London and Birmingham railway again, at Warwick. To the Birmingham and Gloucester railway, at Cheltenham and Worcester. To the South-Western railway, at Basingstoke and Salisbury. To the projected Dorchester and Southampton railway, at Dorchester. To the proposed Welsh Midland Line, at Hereford and Swansea. To the Bristol and Gloucester Line, with which it is already connected, at Bristol and Stonehouse.*

And if the Great Western railway, with its broad gauge branches, does not go to these lines, they with their narrow gauge branches will come to the Great Western. Thus connecting by railway almost every county and town in the kingdom with every other.

And in answer to the argument that the peculiarity of the Great Western gauge had no direct tendency to exclude the engines of other companies from running on that line, because, in fact, each company used only its own engines and carriages, it is remarked—

It is a well-known fact to all who are conversant with the working of the narrow gauge railways, that the carrying stock of all narrow gauge lines are used very much in common by the different companies; that carriages and wagons, the property of one company, are sent over other companies' lines according to the distinction of the passengers or goods with which they are laden; thus you may continually find Darlington and Hull wagons at Gloucester, and the reverse.

To facilitate this interchange, there is a central office, called the Railway Clearing-Hou e, established in London, to which daily returns from the stations in the narrow gauge district are made, and each company is there charged for the use it has made of the carrying stock of the neighbouring lines.

Mr. Harding then proceeds to consider whether mechanical contrivances could be successfully introduced by which carriages could be shifted from one gauge to another.

The present railways are generally well furnished with carriages and wagons; so well, indeed, as usually to be able to work branch lines of considerable length, without additional carrying stock;† their aggregate stock is of great value; but unless the existing lines of the broad and narrow gauge will consent to destroy their present stock, and to build in lieu of it the newly contrived stock capable of running on both gauges, no contrivance of this class will remove the difficulties of a change of gauge. For if, comparatively, only a few of the new vehicles are introduced, they will be scattered throughout the country, and not available when wanted for the purpose for which they are intended; and the contrivance will thus fail to affect its obect, of remedying the evil of a change of conveyance. To make this clear: Take the case of the general goods trade;* the arrangement we are considering involves the keeping up throughout the country of three distinct descriptions of wagons; namely, the ordinary narrow gauge, the ordinary broad gauge wagon, and the new and peculiarly constructed wagon, capable of running on both gauges, to be used exclusively for traffic, going beyond the point of meeting of the gauges, and therefore having to pass over lines of both gauges; these wagons we will call, for the sake of distinction, "shifting wagons; and we will call traffic which has to go over lines of both gauges, and consequently to pass the point of a change of gauge, "through traffic:" —a ton of wool, for instance, going from Bristol to Birmingham, and having to pass the point of meeting of the gauges at Gloucester, would be "thorough traffic."

Now in practice it would be found that "through goods" would come to a station at times when the new "shifting wagons" were not there; at another time the new "shifting wagons" would be there when there were no "through goods" to be conveyed.

Here however, though we do not speak decisively, it seems to us at present that the agreement is defective. The principal disadvantage in passing from one gauge to another is the delay not to goods trains, but passenger trains, and it seems to us by no means certain that this difficulty could not be overcome. Without incurring the expense of changing one or both the gauges. It is well known that on a long line the engine is generally changed about every fifty miles. The engine which takes a train from London to Wolverton will be there replaced by another which continues the journey to Birmingham. In the same way the engine is changed at Swindon, while the passengers from London to Bristol are stopping for refreshments. Now supposing at the meeting of the two gauges a "refreshment station" exists where in *any case* the engine would be changed, it does seem to matter that that engine should be one adapted to a new gauge. The passengers will have left their seats in the carriages, and it will be of small consequence to them whether they step back into their former carriages or others of different width, nor would there be any more delay by this process than by the present, where the engine only is changed.† The comparatively small quantity of goods which the passengers bring could surely be packed in receptacles which by a crane could be shifted from a broad gauge truck to a narrow one in a few seconds. And surely there would be no difficulty, and certainly little expense in providing each through train with such a truck and such a receptacle for the passengers luggage. To be sure, as Mr. Harding pathetically observes, the passengers must shift their "accompaniments in the shape of hats, great coats, cloaks, shawls, sticks, umbrellas, small parcels, &c.," but then it may possibly have been observed by Mr. Harding, that when a man gets out at a station he usually takes his hat with him; his great coat also not unfrequently. The ladies also whom we have had the honour of meeting in the refreshment rooms of a station, have usually worn their shawls, and if a fidgetty old gentleman *will* encumber himself with his *sac de nuit*, instead of having it securely packed away for him, he ought to think it no great hardship to take it from one carriage to another.

With respect however to goods trains, things need not be done in such a hurry: ten minutes more or less is of little moment in the transit of merchandise; the principal matter here is *regularity* of transit; and we may fairly hope that with a little system and experience this point would be perfectly attained.

Mr. Wyndham considers the impediments to the rapid transit of troops, which a change of gauge would cause; he says—

Take for instance the case of an invading army suddenly landing in force on the coast of Norfolk; it becomes of the last importance to bring troops and matériel from the South of Ireland, (where a large force has always been stationed,) and we will assume that the termini of the metropolitan railways are connected by railway, as they shortly will be. The troops and stores are conveyed from Waterford to London, (say in twenty-fours); on arriving in London, instead of being carried on to the place required in two hours more, every thing has to be shifted into other vehicles—a process which would occupy, even a single division, a space of time, to say the least of it, much greater than would be sufficient with a uniform gauge, to place the troops on the spot when they were required.

His instance is however not a happy one, for the removal of troops from *Ireland* to England would be comparatively little facilitated by the most perfect uniformity of gauge. With an intervening sea, it little matters that the Irish gauge should be the same as the English.

Another consideration is that even when lines for through traffic

* All these are narrow gauges, with the exception of the last, which is a broad gauge line at present; but its proprietors have announced their desire and attention of obtaining powers to convert it into a narrow gauge line.

† Carrying stock implies carriages, wagons, horse-boxes, &c., and their accessaries.

* The terms "goods trade" and "goods" include merchandise of every description, as distinguished from passengers and parcels; cattle and pigs are included among the articles of the "goods trade," except where the contrary is expressed.

† At the station the new carriages might be brought alongside to the same places where the former carriages stopped, by laying parallel rails in the neighbourhood of the station, so that the line should have "both" the broad and narrow gauge.

have uniform gauges, there is at this time a stoppage when two companies meet. Passengers from London to Liverpool, when they reach Birmingham, have to shift themselves from the Birmingham Railway to the Grand Junction, and get fresh tickets, though the two lines have both the same gauge. And surely facility in travelling from London to Liverpool is quite as important as that in travelling from Bristol to Birmingham.

Of the mechanical superiority of one gauge over another we cannot now speak; Mr. Harding also omits to consider this part of the question. This at least seems *clear* that the superiority of neither broad nor narrow gauge is at present *exclusively* determined. With each great rapidity may be attained: the express trains travel with equally great speed on each, and apparently with equal security—though perhaps lately the probability of accidents is rather against the broad gauge system.

Mr. Harding truly observes, that if an alteration of gauge *be* determined upon—it would be better to alter the broad gauge, for the total length of railway on that principal is scarcely one-seventh of that constructed to a narrow gauge.

The Royal Commissioners now appointed to report on the subject are men of science, and the highest standing. Not being engineers, their decision will be unprejudiced, and it will probably be final also, unless personal interests prevail in the parliamentary discussion. Our own impression is that the superiority of neither gauge is at present shown to be sufficiently great to warrant an alteration of existing railways; at the same time there are most conclusive reasons for not extending the broad gauge system to *new* railways which are proposed to be connected with narrow gauge lines. Of the work before us, though we have not been quite convinced by some of its arguments, it must be acknowledged that it is ably, impartially, and above all, systematically written. Of Mr. Harding's practical knowledge, undeniable proofs are given throughout, we therefore have not ventured to meet his arguments without some reflection on the subject.

The following table occurs in the work, and will be read with interest.

Cost of Locomotive Power, per Train per Mile, on various Railways.

Narrow Gauge.	s.	d.
Edinburgh and Glasgow (average of Passengers and Goods Trains)	0	11
Great North of England ditto	0	7
Hull and Selby (Passengers Trains only)	0	9
Grand Junction ditto	1	0
Glasgow and Greenock ditto	0	8
London and South Western, ditto	1	0⅝
Birmingham and Gloucester, ditto	0	9½
London and Birmingham:—(Passengers Trains only)		
Engines with 12-inch cylinders	1	3
Engines with 13-inch cylinders	0	10¾
Manchester and Leeds (Passengers Trains only)	0	6
Sheffield and Manchester ditto	0	6
Broad Gauge.		
Great Western (Passengers Trains only)	0	10⅝

The Westminster Review, No. II., Vol. 43.

Only one article in this number concerns us,—it bears the title of "Old and New London." With respect to "New London" there is scarcely anything at all in the whole paper, except a very hurried glance at general improvements and the increasing extent of the metropolis, condensed into a few lines, in which we are told of "the palatial magnificence of Eaton and Belgrave Squares,"—very palatical truly! more especially the Eaton one—an insipid assemblage of mere spruce and prim houses just garnished here and there with "slices of pilasters," whereby what would else be respectable and decent dulness is converted into the very Brummagem of architecture, so truly Pecksniffian is the sort of gusto there manifested. The wholesale admiration bestowed on those precious specimens of "palatial magnificence" says more for the complaisance than for the taste and discernment of the critic, who, had he been less dazzled by them, might have discerned something infinitely more palatial in what he has now overlooked altogether, viz., the fine range of Italian façade, called Freeman's Place, opposite the east front of the Royal Exchange; which is so imposing in mass, and offers so superior an example of well-proportioned *fenestration*. Neither is mention made of any other of the more recent additions to our metropolitan architecture, whether individual structures, such as the New Hall and Library of Lincoln's Inn and the Conservative Club-house, or street façades, as in New Coventry and Cranbourne Streets; for not even the existence of any thing of the kind is so much as indicated in what nevertheless holds out the promise of some account of them, as being among the last and certainly not the least successful architectural attempts which "New London" has to boast of. Equally strange is it that there is not a syllable in regard to the Royal Exchange now that it is finished, although it was made the subject of such very warm debate in the Westminster Review before the building was begun. Towards the Houses of Parliament the writer is not particularly complimentary, for he speaks of them as being on "the worst site that could have been found in England for a similar edifice; a mistake which has led to more money being sunk in the mud of the river to secure a foundation for them, than would have purchased the fee simple of the whole mass of ruinous third and fourth rate tenements between Millbank and Buckingham Palace." Nor is the money sunk in the mud the worst part of the matter, for the site is such that no tolerably satisfactory view can ever be obtained of the principal or river front. It is true the west side and other parts of the exterior may ultimately make us amends for what we there lose in consequence of its being to be seen—as far as will be to be seen at all—only in the most tantalizing manner. But then to what purpose will it have been to expend so much money in prodigally adorning the river front with exuberant and minute embellishment? If little more than the general masses and outlines can be made out, it would surely have been quite sufficient to have secured all the effect that could be derived from *them*, without squandering away money upon what will produce no effect at all. We do not mean to say that no attention should have been paid to architectural expression, or that the river front might just as well have been left to *look* a bare and naked range of building—that it ought to have been treated with the same admirable economy as is manifested in the sides and back side of the British Museum; but in our opinion it would have been sufficient to bestow on it just as much finish and no more than what would *tell* at the distances and points from which it can be seen.* Ceiling-painters and scene-painters do not work up their productions like easel pieces, but judiciously calculate their effect from the intended distance; so, also, ought the architect to do, where circumstances render it impossible that his building should be closely inspected and its details examined. However, excess in the way of over-finishing is by no means a common fault; far more occasion is there to warn against the opposite one—that of neglecting to make what cannot be shut out of view consistent in character and of a piece with what is meant not only to be seen but to be admired also. For the river front of the Palace of Westminster elaborate detail was assuredly quite out of the question, and no better than wasteful, because purposeless, expenditure. Captivated by the beauty of its design, no one—not even the architect himself—seems to have given a thought as to how it would show itself in execution, erected upon an inaccessible site, with no more than a narrow strip of terrace between it and the river, so that, even should that terrace ever be thrown open to the public (which is exceedingly doubtful), the building can be seen only very much foreshortened both in horizontal and vertical direction; viewed from the bridge it can be seen only obliquely and by being looked down upon, and seen from the opposite shore of the river its features are lost in shadow and mass. However luminous the merits of that east elevation might be upon paper, if the light was afterwards to be concealed under a bushel, it mattered little whether it was bright or dim.

These remarks, we should observe, are not suggested by what is said in the Westminster, for that animadverts only upon the site of the Houses, and not upon the *no sight* which we shall get of the river front. The real gist of the article in the Review is at the end, protesting against the line of approach from Pimlico to the Abbey adopted by the Commissioners, and strongly advocating the one recommended by the Metropolitan Improvement Society, which would lead in a direct course from the Palace to the Victoria Tower along the *south side* of the Abbey, which would thus be thrown open to view. Both lines are shown in a plan, where they are distinguished by different colours; and there can be no doubt that the one recommended by the "Society" *ought* to obtain the preference, yet it is not therefore the less likely to be scornfully rejected, and hurriedly got rid of, even should a feint be made of taking it into consideration.

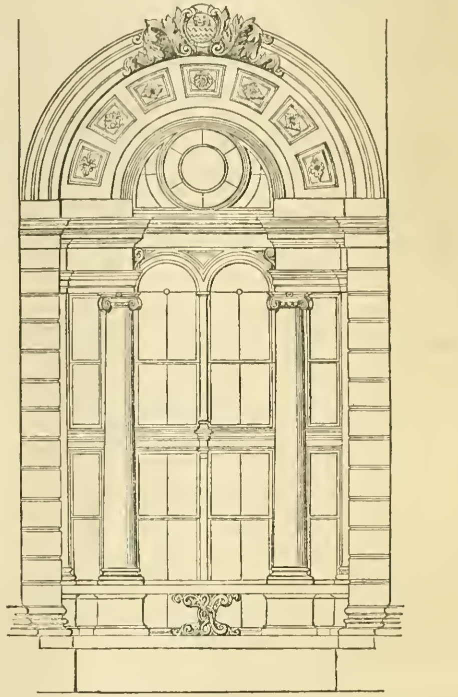
*** The rest of the Reviews are postponed for want of space to next month.

* Among the faults captiously alleged against the Royal Exchange, it was objected by one writer who spoke of it, that the capitals of the columns were of rude workmanship, a point upon which he could speak confidently, having examined some of them when they were l y i n g u p o n t h e g r o u n d! Had they been intended to remain there, or to be put up on a level with the eye, their want of greater finish would undoubtedly have been a defect, but not at the height where they are now seen. So, too, in the upper parts and parapets of Gothic buildings, what shows from below like delicate filagree and net work will be found on ascending to the top of the roof to be very rude and coarse in execution.

ROYAL EXCHANGE: WINDOWS OF PORTICO.

Were it not that the time for publications of the class is now, apparently, quite gone by, we might perhaps expect to see an architectural monograph on the Royal Exchange, it being a structure that would require at least two dozen plates to illustrate it at all satisfactorily. But either there is so little demand for such works in this country that they would be attended with a certain and positive loss, or our architects—even those who have been employed upon monumental edifices—shrink from the imputation of vanity which they might incur, were they to follow the example of some of their continental brethren who have published plans and other drawings of their principal buildings—*illustrations* of what they now are, and *memorials* hereafter of what they once were, when time or accident shall have destroyed the fabrics themselves. We do not, indeed, recommend publication to Sir Robert Smirke, because any collection of his designs would only render more glaringly obvious than ever the utter barrenness of his imagination, and the poverty and paucity of his ideas. Happily there are others who would extend their own fame, and also promote the cause of art and good taste, by exhibiting some of their productions to the world in a shape that would render them accessible as studies to every one—abroad as well as at home; studies that really answer to their name, because they can be referred to whenever we want,—examined as minutely as we please; and because they supply accurate information as to a variety of particulars not to be learnt by viewing or going over the buildings themselves. There are beauties of plan—skilful combinations either for effect or for surmounting inconveniences, which cannot be fully understood and appreciated by *autopsy*, but require to be deliberately investigated and carefully dwelt upon. No doubt striking effects make themselves felt, or else they would not be such; yet though the effect reveals itself to the spectator, the *cause* of it may be very imperfectly understood—perhaps altogether mistaken, and that even by those who are tolerably conversant with architecture,—not to say by architects themselves. It is not every one among the latter who can detect at sight those merits which are not to be judged of without more than a general and cursory inspection. It is not only "the Reviewer-critics of the day" who, as Gwilt assures us, confine their observation almost exclusively to to the façades of buildings, "well knowing how quickly their ignorance would be discovered the moment they should pass the threshold, and discourse on the economy and distribution of a building. The fact is, the number is very limited of those who can comprehend the plan of a building, or who on walking over it, can so arrange in their mind the distribution of the several portions as to have the smallest notion whether it has been skilfully composed." This last remark is true enough; but the taunt thrown out against reviewers, critics, and writers is somewhat illiberal, for if not altogether unmerited, professional persons also must at any rate come in for some share of it; for we do not find them ever take any pains to point out for our particular notice, and explain for our instruction, those peculiarities and beauties of plan and section which deserve to be studied, for the sake of the originality and happiness of the ideas they contain, and the valuable lessons to be derived from them. On the contrary, such collections as the Vitruvius Britannicus contain no letterpress at all, although some commentary, or if not commentary, some little matter-of-fact account of the respective buildings would by no means have been superfluous. To us, this sort of omission is quite as strange, as in Gwilt's own opinion "it is singular in these days of art-reviewing, that for the last twenty years not a single paper of any *value* has appeared in any of the periodicals, in which the writer has ventured on that part of the subject"—namely, distribution of plan. Now if Mr. Gwilt can point out to us any thing of "*value*," and containing fresh and original remark, on the same subject, which has proceeded from the pen of a professional man, we shall feel ourselves his debtor, and should lose no time in becoming acquainted with such a *rara avis*. That something has been written on the subject by others he does not deny; but he gives us to understand that they have shown themselves utterly incompetent, and have produced nothing of "*value*,"—not a single paper deserving to be excepted from his general condemnation. Whatever ability or the contrary has been shown in such remarks, the readers of this Journal hardly require to be told that observations bearing upon plan and arrangement have been brought forward in it from time to time. The papers entitled "Episodes of Plan," showed some tolerable intelligence of the subject, and also contained some fresh and novel ideas;—at least so we thought at the time, and so many others thought too; but we now stand corrected, and are now bound to bow to the superior judgment of a great writer—of one who has written an entire Encyclopædia, therefore in comparison with whom we are at the best but puny literary dwarfs. This is not the first time that Gwilt has got a rub or two in this Journal, and some may be of opinion that he is dragged into notice oftener than there is occasion for doing; yet there surely can be nothing strange in adverting to the opinions formally given in what pretends to be a standard work, and an authority; and if in such a work Mr. Gwilt chose to go out of his way, and take every opportunity of sneering at those who write in reviews and journals, neither he nor any one else can be surprized if some of them occasionally go a little out of their direct way too, in order to return his compliments with what interest they may.

We now must proceed with our remarks on the subject of those two windows in the Royal Exchange whose design is here represented.



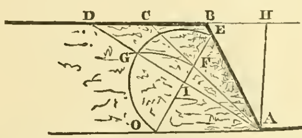
We feel much satisfaction at being able to give this example in addition to those of other windows in the same building, both because it is an original and well adjusted composition in itself, and because it shows skilful contrivance in surmounting a great difficulty, and imparting nobleness of character to features that threatened to prove sad eye-sores. And if not always absolutely eye-sores, windows within a portico are more or less a drawback on that superior architectural character which is affected by that part of a structure and which it ought to maintain. In the first place, they are quite at variance with the classical costume assumed by such application of the antique temple frontispiece, since they disturb consistency by showing a modern façade immediately behind it. In the next place, besides being attended with too much of an ordinary and every-day look, a number of such apertures quite destroy that breadth and repose of background so essential to the due effect of columniation; nor is it quite free from objection that windows so situated cause the columns placed in advance of that part of the front to appear obstructions,—at least to be so considered by many who complain that porticos serve only to darken the rooms behind them, and intercept the view from their windows. In fact, a portico ought not to be attempted on that side of a building where a number of windows are indispensable, since even though there may be none within the portico itself, they interfere with general unity of composition by causing the other parts to appear quite distinct in character from the portico, as is the case with the front of the Post Office, where two opposite modes of treatment are brought together in violent contrast, viz., columniation for the centre and fenestration on each side of it. In the West façade of the Exchange, there was, fortunately, not occasion for many windows,—very luckily for none just immediately adjoining the portico, where any apertures of the kind would have cut up the mass from which it projects; still it was necessary to obtain several windows, and those immediately over each other, for rooms on four different floors. To combine so many distinct apertures into a single architectural composition that would accord with all the rest of the portico was no small difficulty, yet the problem has been so happily solved that those two features produce the effect of inner loggias with a smaller order, and instead of there being scattered spots and patches, there are what are adequate to deep *masses* of shadow. Even taken as an example of a Venetian window set within an arcade, the composition is marked both by originality and good taste. It even exceeds two squares in height, and therefore has a dignified air of loftiness, and of compactness as to columniation, the very reverse of the meagre and sprawling appearance which is so offensive in many windows of the kind. We take it for granted that our readers are aware that there are no more than two of these windows within the portico of the Exchange, viz., one on each side of the central recess in which the entrance is placed, and that each of them fills up a compartment answering to two intercolumns and an intervening column of the external elevation, in other words, that the pilasters, whose edges are indicated in the cut, answer to the first and third column of the portico from either end. The entire width within the clear of the pilasters is 20 feet, consequently the scale of the cut is as nearly as may be one inch and $\frac{2}{10}$ to ten feet, from which the other measurements may be ascertained without difficulty.

ON THE RESISTANCE REQUIRED TO SUSTAIN BANKS OF EARTH OR OTHER MATERIALS.

Being an Abstract of Papers read before the Royal Irish Academy and the Institution of Civil Engineers, Ireland.

By JOHN NEVILLE, C.E., Dundalk.

A B D is any bank with a vertical or inclined face A B, and a hori-



zontal or inclined top B D, then if A D be the position of the plane of repose, the horizontal resistance required to sustain a fractured wedge A B C is equal to

$$A\,B\,C \times \tan D\,A\,C \qquad (1.)$$

and the position of A C when this resistance is a maximum is determined as follows:—

Through A draw A O parallel to B D. Draw any line E O cutting A D at right angles; on E O describe a semicircle, and from G, where the circumference cuts the plane of repose, as distance, with O as centre, describe an arc cutting E O in F, join A F and produce it to C, then the resistance required to support F D C is a maximum. Also, let fall A H perpendicular on B D produced. Put A H $= h$, B A H $= b$, D A H $= c$, and W = the weight of a cubical unit of the bank. Then

$$R = \frac{h^2 W}{2}\left(\frac{\sec C - \sqrt{\tan b \tan c + 1}}{\tan c}\right) \qquad (2.)$$

or,

$$R = \frac{h^2 W}{2 \tan c}\left(\sqrt{\tan c + \cot c} - \sqrt{\tan b \cot c}\right)^2 \qquad (2'.)$$

For the particular case where B D is horizontal the equation

$$(25) \qquad R = \frac{h^2 S}{2 \tan i}\left\{\tan i + \tan c + \frac{2}{\tan i} - 2\left(\tan c \tan i + \frac{\tan c + 1}{\tan i} + 1\right)^{\frac{1}{2}}\right\}$$

is given by Tredgold in the Article Masonry, Encyclopædia Brittanica, 7th Edition, where i is the complement of the angle of repose, C $= b$ in equation (2) or (2′), and S = W. Now this equation (25) is incorrect, as the term $\frac{\tan c + 1}{\tan i}$ under the vinculum should be $\frac{\tan c \tan i + 1}{\tan i}$, in which case the equation is merely the development of equation (2′), which is general whether the top is horizontal or inclined, and is easily calculated from.

The first table is given by Tredgold as calculated from equation (25) in the work referred to, and the second is calculated from equation (2) or (2′) to the same data, where the values in the last column are about double those determined by Tredgold. The other differences are immaterial.

	Angle of Repose.	Weight of S.	Value of R when c = 0°.	Value of R when c = 10°.
1. Water	0°	62·5 lb.	$31\frac{1}{4}$ h2	$31\frac{1}{4}$ h2
2. Fine dry sand ..	33	92	13·8 h2	4·8 h2
3. Ditto most	—	119	17·85 h2	6·2 h2
4. Dry quartz sand ..	35	102	13·77 h2	4·6 h2

	Angle of Repose.	Weight of W.	Value of R when h = 0°, and A B vertical.	Value of R when b = 10°, and B D horizontal.
1. Water	0°	62·5 lb.	$31\frac{1}{4}$ h2	$31\frac{1}{4}$ h2
2. Fine dry sand ..	33	92	13·5 h2	9·7 h2
3. Ditto moist	—	119	17·5 h2	12·6 h2
4. Dry quartz sand ..	35	102	13·8 h2	9·7 h2

The general geometrical constructions render—from equation (1)—the calculation of R easy for any particular case. When A B is at right angles to B D, it is easy to show that A C bisects the angle B A D, *hence the equation of Prony holds good when* A B *is perpendicular to* B D, *whether* A B *is vertical or inclined.*

Equation (2) or (2′) gives the resistance required for dwarf walls at the toes of cuttings or embankments.

It was shown that however the top B D may slope up to the angle of repose, that the resistance for the same height of wall when B D is horizontal could not exceed the ratio of 4 to 1 whatever the angle of repose and height of the embankment may be, and that in slopes of repose of $1\frac{1}{2}$ to 1 the ratio of the resistances could not exceed 7 to 3 for dwarf walls.

EVAPORATIVE POWER OF DIFFERENT KINDS OF COAL AND THEIR RELATIVE VALUES.

Experiments made under the authority of the Navy Department of the United States.

An Act of the American Congress, approved Sep. 11, 1841, authorized the making experiments upon the properties and relative values of different kinds of coal. In virtue of this authority, Prof. Johnson of Philadelphia commenced an investigation on which he has long been zealously engaged: the result of his labours is communicated in a large volume ordered to be printed for the use of the Senate.* This volume is in large octavo, and contains upwards of 600 pages of closely printed matter; it would therefore be quite impossible to make a faithful abstract of its whole contents, but it is confidently hoped that the following extracts, giving some account of the manner in which the experiments were conducted, and detailing a portion of the ultimate results, will form a valuable and acceptable paper.

The experiments have been conducted by Prof. Johnson with the greatest skill and care. To his qualifications as an experimenter he has added the knowledge of mathematical philosophy and the few mathematical notes which occur in his report appear quite satisfactory and add to the reader's confidence in his calculations. His report is beyond doubt one of the most valuable contributions which have been made in modern times to practical science. We have given the results arrived at respecting part only of the coals experimented upon. Each of the numerous samples was made the subject of several experiments from which general averages have been deduced. Of all the numerous tables which accompany the volume, we have been able to give the last only, which exhibits the results ultimately arrived at; and of this table we transcribe that part only which refers to the British and the principal American coals.

EXTRACTS FROM THE REPORT.

Object of the Inquiry.

The inquiry, now nearly completed, was instituted primarily on account of the difficulty which had been experienced, and the complaints which had been made, relative to the qualities of the coals procured for the naval service. It had been found that articles fur-

* The number of copies ordered to be printed was 11,000.

nished to the Government at full prices did not answer the expectations of those concerned in their consumption. While paying the highest prices for fuel, the efficiency of our steam vessels was sometimes impaired by its inferior quality, and the large amount of its impurity.

While so large an amount of both labour and capital is embarked in the mining and transportation of coal, and so many branches of industry depend on it for the successful prosecution of their labours; while so much of domestic comfort and so much of national wealth are, even *now*, in the infancy of our mining operations, made to rely on this material; and while steam navigation upon the ocean, and, eventually, that upon our internal waters, must all be performed by its aid, we are warranted in the assertion that few subjects of a practical nature are more deeply and immediately interesting to the public.

In this view we are sustained by observing how essentially it has contributed to the power and influence of one of the most commercial nations of the world. The coal deposits of a small island, which would itself scarcely cover one of the United States, have afforded the chief means of carrying her conquests to the remotest parts of the globe.

Different standards of heating power.

The heating power of combustibles has, heretofore, been sought to be determined by several different methods.

(1.) The standard proposed by *Lavoisier*, and adopted by other chemists, was, the *weight of ice melted by the combustion*, either in atmospheric air, or in pure oxygen gas, of a given weight of the combustible body.

(2.) The standard adopted by *Mr. Marcus Bull*, who some years since gave to the world a valuable series of experiments on the heating power of wood and coal, was the *length of time during which a given difference could be maintained between an interior apartment in which combustion was conducted*, and an exterior one which was exposed to the cooling effect of the surrounding air, by the consumption of a given weight of each kind of fuel.

(3.) The *mining engineers of Cornwall*, and other parts of Great Britain, have formerly used, as a measure of heating power, the *weight of water which could be raised one foot high* by the consumption of a given *bulk* of coal, when burned under steam boilers which supplied the pumping engines at their mines.

(4.) The distinguished mining engineer, *Berthier*, of Paris, proposed the employment of the oxide of lead as a material from which to obtain oxygen to effect the combustion of different substances, and made the *weight of lead reduced from the state of oxide, by a given weight of each combustible*, a standard of its heating power.

(5.) The *German* and other European chemists have sought to attain a knowledge of the heating power of fuel by ascertaining the precise chemical composition of the combustible portion, and thence inferring the weight of oxygen which must enter into chemical combination with it during combustion.

Method here employed.

None of the above described methods appeared to fulfil the conditions required in a practical determination of the evaporative power of the several kinds of coal. Preference was therefore given to that which had, to a limited extent, been employed by Mr. Fyfe, of Edinburgh; Mr. Schaufhautl, Messrs. Parkes and Manby, in England; and by Dr. Dana, Mr. Hayes, and Mr. Francis, in this country. This method consists in burning the coals under a steam boiler, so arranged and furnished with apparatus as to be capable of complete regulation. The water delivered to the boiler, and the coals supplied to the furnace, are determined both by weight and measure.

"The supply of air, the rate of combustion, the pressure and temperature of steam, the proportion and character of the products of combustion, both fixed and volatile, whether left on the grate or passing through the flues, are subject to careful observation and experiment. Here, the standard by which we measure the heating power of different coals is *the weight of water which a given weight of each can evaporate from the temperature of* 212° *Fahrenheit.* This standard is probably as constant as any in nature.

With *experiments* conducted on this principle, the *practice* of generating heat for steam navigation, and for many other useful purposes, will be found to correspond in all essential circumstances.

List of the samples of coals examined.

The number of samples of coal on which trials of evaporative power have been made, is forty-one.

Of these, *nine* were *anthracites* from Pennsylvania.

Of the *free-burning* or semi-bituminous coals *twelve* samples have been tried for evaporative power.

The next class of coals is that from the *bituminous* coal fields in the neighbourhood of Richmond and Petersburg, in Virginia; of which *eleven* samples were examined.

Of *foreign bituminous* coals *six* varieties were tried, viz., one from Sydney, Nova Scotia, sent by the Cunard Coal Mining Company; one of Picton coal, sent by the same; also, one sample of Scotch, one of Newcastle, one of Liverpool, and one of Picton.

Two *mixtures* of anthracite and bituminous coal, in certain proportions, and two species of coke, (one from the Midlothian coal of Virginia, and the other from Neff's Cumberland coal,) were also tried.

The mean weight per cubic foot of these artificial cokes, was found to be 32·57 pounds.

The series of experiments on evaporation was terminated by a single trial of the effect of dry pine wood, of which a quantity had been used daily in heating up the apparatus and preparing it for the reception of coal.

Nature of the experiments.

On each sample of coal were made from one to six trials, according to the quantity furnished. The coal consumed in one trial never exceeded 1567 pounds—this being the greatest quantity which the apparatus could receive in the period allotted to each experiment, including the time requisite for clearing out the residua, making the necessary adjustments, and preparing for a new trial. The total weight of coal consumed in the trials of evaporative power has been nearly 62½ tons; and the weight used, on an average, 978 *pounds per trial.* This statement may be sufficient to indicate that the experiment have been made on a scale unobjectionable on the score of magnitude.

Including the trial of wood, the whole number of experiments occupied 144 days. On each day continuous observations were made during a period averaging from 12 to 14 hours, according to the requisitions of the experiment.

General Characters of the Anthracite Class.

The anthracites have specific gravities varying from 1·39 to 1·61; retain their form when exposed to a heat of ignition, and undergo no proper intumescence while parting with the small portion of volatile matter which they contain; or, if changed at all, are only disintegrated into angular fragments. Their flame is generally short, of a blue colour, and consequently of little illuminating power. They are ignited with difficulty; give an intense concentrated heat; but generally become extinct while yet a considerable quantity remains unburnt on the grate.

It appears that the anthracites proper weigh, on an average, 53·35 pounds per cubic foot; and, consequently, require 42 cubic feet of space to stow 1 ton. The natural coke of Virginia requires 48, and the artificial coke from Midlothian and from Cumberland coal an average of 69·7 cubic feet to accommodate the same weight. The average effect of 1 pound of anthracite was to convert into steam, from water at 212°, 9·565 pounds.

Weight of Cokes compared with Coal.

The weight lost by coal in the operation of coking varies according to the various modes in which the operation is effected. The principal methods are as follows:—

1. By coking in uncovered heaps of coarse lumps, (as at many of the iron works in Great Britain, France, and elsewhere,) and only covering up the ignited mass when flame ceases to be emitted, the loss in weight at Plymouth is stated to be 17, at Penn-y-darran 20, and at Dowlais 34 per cent. This last is, no doubt, far greater than is necessary, owing to the cheapness of coal, and the consequent neglect of economy in the management of the coking process. The coals at Dowlais and at Penn-y-darran bear a strong analogy to that of Cumberland, but have rather less volatile matter. Highly bituminous coals, coked in uncovered heaps, lose from 55 to 60 per cent. of their weight, and those of medium quality from 45 to 50, and those of still lower bituminousness from 30 to 40 per cent. In all these cases, a considerable loss occurs from burning away some portion of the solid carbon on the exterior of the heap, before the slack and cinders are placed upon the coke to extinguish the fire.

2. By coking in stacks, (that is, in well-covered heaps of coal from 10 to 15 feet in diameter,) as followed in Staffordshire, coals of high bituminousness lose from 50 to 55, and those of a drier nature from 35 to 40 per cent.

3. By coking in close ovens, the coal of Rive-de-Gier yields 69 per cent. of coke, whereas by the first of the above methods it gives but 45 or 50. In the close oven, the *gain* of bulk is from 22 to 23 per cent. In the close oven, highly bituminous coals yield from 65 to 66 per cent.; but in the open heap only from 40 to 45, and this with an actual diminution of bulk.

4. By coking in gas retorts, the Deane coal of Cumberland (Eng-

land) gains in bulk nearly 30 per cent., and loses in weight 25 per cent.; Carlisle coal nearly the same; while Cannel and Cardiff coals gain in bulk 30, and lose in weight 36·5 per cent. Bewick's Wallsend coal loses 30, and Russell's Wallsend 30·7 per cent. by the same process.

General Characters of Bituminous Coals.

In specific gravity, coals of the free-burning class fall a little below the anthracites, ranging from 1·28 to 1·44. Their mean weight per cubic foot is, however, only two-thirds of a pound less than that of the first class. As they contain but a small portion of matter to be vaporized, they soon come to the temperature of full ignition. The considerable increase of volume which they take in coking, favours the subsequent rapid and effective combustion of their fixed carbon. In some cases, especially when brought very gradually to ignition, their masses of coke scarcely cohere, and the original forms of their lumps are in a measure preserved.

In many respects, this class of coals bears a strong analogy to the preceding. The ratio of the fixed to the volatile combustible matter is, however, something less. The exterior presents often a resinous lustre. The surfaces of deposition are easily developed by fracture. Great facility of ignition, and a high degree of activity in the combustion of their volatile constituents, are also general properties of this class. Their high proportion of volatile combustible matter renders these coals, when nearly free from sulphur, eminently suitable for the production of illuminating gas; and the tendency of their cokes, with few exceptions, to intumesce strongly, renders them, in common with the preceding class, highly serviceable in forming large hollow fires for smithing purposes.

SIX TABLES,

Exhibiting the Relative Value of Coals according to their Various Qualities.

Names of coals, arranged in the order of their Relative Weights.	Pounds to a cubic foot, by experiment.	Relative weights.
Beaver Meadow, slope No. 5	56·19	1·000
Atkinson and Templeman's..	52·92	·942
Scotch	51·0b	·909
Newcastle	50 82	·904
Picton, (Cunard's)	49·25	·876
Liverpool	47·88	·852
Cannelton, (Indiana)	47·65	·848
Dry pine wood..	21·00	·374

Names, in the order of Rapidity of Ignition.	Time required to bring the boiler to steady action, in hours.	Relative rapidities of ignition.
Cannelton, (Indiana)	0 50	1·000
Newcastle	0·84	·595
Picton, (Cunard's)	0·85	·588
Liverpool	0·86	·581
Scotch	0·96	·521
Atkinson and Templeman's..	0·99	·505
Beaver Meadow, slope No. 5	2·42	·207

Names, in the order of Completeness of Combustion.	Pounds of unburnt coke on the grate after each trial.	Relative completeness of combustion.
Picton, (Cunard's)	3·7	1·000
Atkinson and Templeman's..	5·1	·725
Scotch	5·7	·649
Cannelton, (Indiana)	6·4	·578
Newcastle	10·7	·346
Liverpool	11·1	·333
Beaver Meadow, slope No. 5	61·2	·060

Names, in the order of Evaporative Power for Equal Weights.	Pounds of steam produced from water at 212°, by 1 lb. of fuel.	Relative evaporative power for equal weights.
Atkinson and Templeman's..	10·70	1·000
Beaver Meadow, slope No. 5	9 88	·923
Newcastle	8 66	·809
Picton, (Cunard's)	8·48	·792
Liverpool	7·84	·733
Cannelton, (Indiana)	7 34	·686
Scotch	6·95	·649
Dry pine wood..	4·69	·436

Names of coals, in the order of Evaporative Power under Equal Bulks.	Pounds of steam from 212°, produced by 1 cubic foot of each coal.	Relative evaporative power for equal bulks of coal.
Atkinson and Templeman's..	566·2	1·000
Beavor Meadow, slope No. 5	556·1	·982
Newcastle	439 6	·776
Picton, (Cunard's)	417·9	738
Liverpool	375·4	·663
Scotch	353·8	·625
Cannelton, (Indiana)	348 8	·616
Dry pine wood..	98·6	·175

Names, in the order of Freedom from Waste in Burning.	Per centage of total waste, in clinker and ashes.	Relative freedom from waste.
Dry pine wood..	0·307	6·417
Liverpool	5 04	1·000
Cannelton, (Indiana)	5 12	·984
Newcastle	5 68	·887
Beavor Meadow, slope No. 5	6 74	·748
Atkinsoo and Templeman's..	7 96	·633
Scotch	10 10	·499
Picton (Cunard's)	12·05	·418

Review.

The tables here presented, containing, first, a general synoptical view of the character and efficiency of the several coals, and, secondly, a number of distinct classifications in reference to different characters considered to be of the most practical importance, and based, in every instance, on the numerical results of experiment, will, I trust, be found highly serviceable in guiding those whose duty it may be to make choice of fuel for the naval or other public service, to the selection of such as will answer the specific object for which they may be procured.

If an equal importance could be attached to every one of the qualities of coals which form the bases of the ten ranks above given, then the *sum* of the ratios or relative values found in the last columns would, for any sample, give nearly its true relative value in the market. Such equality does not, however, exist. Nor is it easy to assign the exact relative weight or importance of the several qualities indicated. For different purposes they must be differently estimated. Thus, when sold by weight and used on shore, the weight per cubic foot, as given in the first rank, is a point of little moment. Space for stowage is easily obtained. But in steam navigation, bulk, as well as weight, demands attention; and a difference of *twenty per cent.*, which experiment shows to exist between the highest and the lowest average weight of a cubic foot of different coals, assumes a value of no little magnitude.

For the purposes of steam navigation, therefore, the rank most important to be considered is that in which the names of coals stand in the order of their *evaporative* power, under given bulks. This is obviously true, since, if other things be equal, the length of a voyage must depend on the amount of evaporative power afforded by the fuel which can be stowed in the bunkers of a steamer, always of limited capacity.

As every sample of coal has been allowed a fair opportunity to exhibit its own distinctive character, it would be useless to attempt to substitute for the results of practical experiments, on such a scale as is here presented, any mere *opinions* or conjectures derived from observations made at random, with no standards of time, weight, or magnitude; or even any *theoretical conclusions* drawn from tests, however skilfully applied, merely to single hand specimens. It has been my aim in all these researches to avoid matters extraneous to the experiments themselves and to their legitimate interpretation. It has not been deemed expedient to swell this report by the introduction of matters not within my own cognizance.

Comparison with British Coal.

It will not fail to be remarked, that the justly celebrated foreign bituminous coals of Newcastle, Liverpool, Scotland, Picton, and Sidney—coals which constitute the present reliance of the great lines of Atlantic steamers—are fully equalled, or rather surpassed in strength, by the analagous coals of eastern Virginia; that they are decidedly surpassed by all the free-burning coals of Maryland and Pennsylvania; and that an equally decided advantage in steam-generating power is enjoyed by the anthracites over the foreign coals tried, whether we consider them under equal weights or equal bulks.

Experiment appears to demonstrate that, for the purposes of *rapid* evaporation, and for the production of illuminating gas, the coal of Indiana, though neither very heavy nor very durable, is inferior to none of the highly bituminous class to which it belongs; since in heating power, and in freedom from impurity, it surpasses the splint and cannel coal of Scotland.

Necessity of further experiments.

I cannot by any means regard the *investigation of American coals* as an exhausted subject.

A glance at any good geological map of the United States, in which the coal fields are laid down, will show how exceedingly limited is the whole amount of space covered by the several detached coal troughs from which the samples here presented were derived, compared with the immense extent of that formation which covers western Pennsylvania and Virginia, eastern Ohio, the eastern part of Kentucky, a part of middle Tennessee, and an undefined portion of Alabama; and much more when compared with the vast tracts of coal country in Illinois, Iowa, Missouri, Arkansas, and a considerable portion of Michigan.

The surprising extension of steam navigation on the western rivers and the north-western lakes, as well as on the gulf of Mexico and the adjacent seas, the increase of population, and the consequent clearing of woodlands, all point significantly to a necessity which must be felt, at no distant day, to have recourse to mineral fuel for supplying this rapidly increasing demand.

To understand the relative strength and usefulness of the coals from the several parts of the three great western coal regions, requires that they be examined with no less care than has been applied to the limited spaces from which were derived the materials operated on during these experiments. It may be added, that the products of many coal districts *east* of the Allegany mountains are yet unexamined.

If in any case *knowledge be power*, it is pre-eminently so when it relates to a subject which constitutes the greatest element of power in the physical world, and in the present age of marvellous developments.

ON THE STRENGTH OF WOOD AND CAST IRON.

Sir,—I had intended to lay before the Mechanical Section of the British Association for the Advancement of Science, at their late meeting at Cambridge, a few remarks on some important points connected with the Experimental Determination of the Strength of Wood and Cast Iron. The fewness of those who attended that Section rendered it advisable to forego this intention; and in fact, by mistake, my paper was described as "On the Strength of Iron Castings," which was not my main object, but merely incidental to the other enquiry "On the Strength of Timber." However, though the meeting of the Section was a failure, I of course met there with Mr. Eaton Hodgkinson, whose labours in the cause of science are so well known, and we had some short conversation on the subject of Cast Iron. He informed me that he had now preparing for publication a great mass of experimental results which would contain results bearing on my views. As, however, it may be some time before we are favoured with these tables, and my object is to address the practical man rather than the scientific, I will trouble you to notice the point I wished should be attended to. It was suggested by Mr. Edward Bell, the Professor of Machinery in our College, that by increasing the length of runner head the strength of a horizontal bar might be made equal to that of a vertical bar, and would be much more uniform in its texture. He therefore prepared some bars for determining experimentally the advantage —and found that it was as he had apprehended. The reason of course is obvious. The iron when in a fluid state obeys the laws of hydrostatics, and the pressure increases with the depth, and a very small vertical column of iron will produce a great pressure throughout the liquid mass, a pressure proportional to its length. If, then, the column is kept in a state of fusion while the metal in the flask is cooling and setting, the particles will be packed more closely together, the density will be increased, and a stronger bar obtained. In an economical view this is very important, for a very inferior iron will by this means give as strong a bar, or stronger, than a much better, and therefore dearer, iron.

Experiments have been made only on a small scale as yet, but we purpose to extend them in number so as to generalize on the subject, and ascertain whether, by a proper depth of runner head, we cannot make bars of a mixture of Gartsberrie II. and old fire-bars of the worst scrap iron which shall be as strong as the best irons will give.

I had hoped that I should have had time to write a short account of the researches we have made on the strength of timber, but I have found it impossible for the present,—I will only draw your attention to this point. In ascertaining the strength of timber, these two points must be kept quite distinct, viz., the constant expressing the *relative strength*, and the constant to be used in the formulæ, such as those given in Turnbull, which we may call the constant representing the absolute strength.

If a hundred experiments are made on a particular kind of fir, the breaking weight in each case being taken under exactly similar circumstances, the 100th part of the sum of all these weights represents fairly enough the mean strength of that particular wood, *i. e.*, it will do to compare with a number determined in the same way for another kind of fir, and the greater this *mean* weight is, the stronger the wood. So far, then, as scientific research is concerned, this method is fair,—but the same constant will not do for the practical man. I say that for this we must take the *least* weight that broke the beam, and not the mean,—for the workman wants to know not what the average strength of the wood is, but how much he may trust to a particular specimen of it; and therefore he wants to know what is the *least* weight that broke a fair, uniform, sound beam under given circumstances.

The first set of constants will guide him in the choice of his material, but if he begins to calculate the dimensions from the formula, as in Turnbull, he wants a different constant, viz., the one I have above pointed out.

My attention was drawn to this subject by reading the following passage in Professor Barlow's book on Strength of Materials, page 26.

> *Practical Rule.*—Since the strength of direct cohesion must necessarily be proportional to the number of fibres, or to the area of the section, it follows, that the strength of any iron rod will be found by multiplying the number of square inches in its section by the corresponding tabular number as given above.
>
> This, however, gives the absolute strength, or rather the weight that would destroy the bar; and practical men assert that not more than one-fourth of this ought to be employed. I have, however, left more than three-fourths of the whole weight hanging for twenty-four or forty-eight hours without perceiving the least change in the state of the fibres, or any diminution of their ultimate strength.

It will be seen that Professor Barlow uses the expression "absolute strength" in the way in which I have proposed to use "relative strength."

I say that if he proposed the smallest weight instead of the mean, the result would be one which practical men ought to trust. As to the arbitrary "one-fourth," it only shows that we have not yet succeeded in proving to practical men that we can do them any good, and Mr. Barlow justly intimates that there is a great sacrifice of the powers of the material in this very arbitrary reduction.

I trust to offer some further remarks on this interesting subject,—as well as be able to lay before your readers at a future time results of experimental enquiries made by Mr. Ranger, our lecturer and professor of general construction. I hope we shall be able to point out some very important features in the case, to which as yet but little attention seems to have been given.

I remain, Sir,
Your obedient servant,

College, Putney, July, 1845. M. Cowie, *Principal.*

COMPARISON OF ENGLISH, FRENCH, AND BELGIAN RAILWAYS.

The Fares charged, the Expenses and the Profits.

(From the Journal des Débats, July 14.—Translated for this Journal.)

While so many railways are in the course of construction, it is interesting to know as exactly as possible every item of expenditure connected with them. An able engineer, M. Jullien, under whose direction are the works on the line from Paris to Lyons, has undertaken to give an idea of these expenses. The reports of the railways of France and abroad supply him wit materials which he has admirably digested and arranged.

Average Cost of Railway per mile.

The first thing that strikes us in M. Jullien's Memoire is the observation that the average of 300,000 fr. per kilomètre (£19,200 per mile), generally admitted as the probable cost of construction of the main lines in France, *is certainly too small.* Of this M. Jullien has given proofs. This is an important consideration at a time like the present, when speculation is so eagerly directed towards railways. On many of the English lines the expense has been from 700,000 to 800,000 fr. (£44,800 to £50,200 per mile. In France we cannot expect the cost to be less than 350,000 to 400,000 fr. on the average (£22,400 to £25,600 per mile).

Comparison of Fares charged in England, Belgium, and France.

On the first view, one would imagine the difference between one railway and another to be so great that it would be vain to attempt to reconcile them and deduce general laws. The fares, the number of passengers, their distribution among the classes of carriages, would seem liable to infinite variation according to the frequency of trains, the gradients, the curves, and every thing else which has an influence on the expense and profits. M. Jullien has, however, in the general results, collected some very singular coincidences. What can be more dissimilar than the rate of fares in England, France, and Belgium? The fare per mile actually received appears on the average—

	First Class.	Second Class.	Third Class.
*In England ..	2·88 d.	1·824 d.	1·2 d.
†In Belgium ..	1·2	·88	·56
In France ..	1·6	1·2	·8

Then, again, the manner in which the passengers are distributed into the three classes differs very considerably. Of 100 passengers the average proportion in each kind of carriages will be—

In England 18 passengers in the first class, 46 in the second, 36 in the third.
In France 15 „ „ 30 „ 55 „
In Belgium 10 „ „ 27 „ 63 „

The total return per mile is in England £2,526, in Belgium £1,160. It is nevertheless a curious fact that the traffic is apparently the same in Belgium as in England, and it is the traffic which affords the criterion of public utility. The Birmingham railway now produces £7,208 per mile; the Orleans line returns are stated at less than £3,200 per mile; M. Bartholony in a recent work has stated the amount at £2,816; but the Orleans railway will have numerous extensions, and will produce probably one half the return of the Birmingham, with a rate of fare half less, and on the supposition of an equal traffic.

M. Jullien has also pointed out another resemblance. The English lines, on the average, derive two-thirds of their revenues from passengers and one-third from luggage, and the proportion is found to be as nearly as possible the same in Belgium.

Comparison of the Actual Cost of Conveyance in the Three Countries.

What is most singular is that, on the railways of all countries, the total amount of general expenses corresponding to the running of a train over one kilometre of ground is as nearly as possible 3 fr. (about 3*s.* 10*d.* per mile), and this expense is divided into two equal parts, of which one represents the force of locomotion and the wear of material, the other the expense of management by clerks and superintendents and the general working of the railway.

To express by a clear formula the expense of working a railway, M. Jullien has drawn a relation between the goods carried and the passengers who form the principal item of the receipts. The basis of this relation is perfectly plausible. He has accordingly expressed the whole amount of traffic, both for goods and passengers, by a certain number of passengers. His unit of calculation is *one passenger carried one mile*, and all he has to find is the cost of this unit including every expense. He has found that it is—

	Per kilometre.		Per mile.	
On the Belgian lines	2·7 cents	or	·432	of a penny
On the Orleans in 1844	2·9	„	·464	„
On the Gard in 1842	2·7	„	·432	„
„ in 1843	2·5	„	·4	„
On the St. Etienne and Lyon in 1843 when the difficulties were peculiarly great	3·5	„	·56	„
On the Strasburg and Basle, the traffic being small ..	4·5	„	·72	„
On the English lines, exactly	4·8	„	·738	„

The last amount however includes the English Government tax, and is accounted for by the smaller number of passengers in each train, for the English companies, correctly or erroneously, prefer a few passengers paying well to a great number paying little: they also have very frequent trains, persuaded justly that what most concerns them is not to spend comparatively little but to obtain a large gross return. If the passengers of an average train were the same in number in England as in France, and if the government tax were equal also, the cost of each passenger per mile would be the same as with us.

Merchandise.

According to M. Jullien's comparison a ton of merchandise carried by slow trains costs rather more than 5 centimes in France and Belgium, (·8 of a penny per mile), and in England 7 centimes (1·12 *d.* per mile.)

Proportion of Expenses to Profits in the three countries.

With us the Government often, and the committees of the Chamber of Deputies always, have admitted as an absolute rule, that on a railway the expense represents 45 per cent. of the returns whatever their amount, from which it is concluded that the net profit is 55 per cent. of the receipts. This opinion has had the unfortunate effect of greatly exaggerating the net profit of poor railways. M. Jullien has not had much trouble in proving the inaccuracy of this opinion, all accredited as it is. The more railways are frequented, or, the traffic remaining the same, the more the fares are raised, the greater proportion will the profit bear to the total returns. For there are a large number of constant expenses which have to be incurred *in every case.* On the English railways, which in 1842 gave altogether a receipt of 111 millions of francs, or (£4,625,000), and an expenditure 48 millions of francs, or (£2,000,000), the expense was not more than 43 per cent. of the total receipts; consequently the net profit was 57 per cent.; and it would have been as much as 62 per cent. if the English Government tax were as moderate as our own. On the Belgian lines however the expenses are 60 per cent. instead of 43, and on the Strasburgh and Basle 73 per cent.

In the expenses as stated above, the interest of capital is not included; all that is reckoned is the actual cost of working the lines: otherwise we should have to add in France to the expense a sum of 17,500 fr., or 20,000 fr. per kilometre (£1,120 to £1,280 per mile), representing an interest of 5 per cent. on the cost of constructing a railway with a double line of rails. And since we can scarcely expect in France an average total return much larger than that of the Belgian lines, which is about 20,000 fr. per kilometre, this item alone swallows up the total receipt.

Reserve Fund for renewal of rails.

In the accounts of railways an item ought to be presented which has not hitherto been introduced into them, because the railways are at present new, but which will soon have to find a place: and that is—an annual reserve to collect the capital necessary for a future renewal of the rails. How long will the rails last? Twenty years, perhaps, and the crossings and sidings ten or twelve. A double line costs about 80,060 fr. per kilometre (£5,120 per mile). To form this capital M. Jullien proposes to reserve annually 4,000 fr. per kilometre of the line (£256 per mile.) M. Jullien is right, and the commissioners have made a great mistake in omitting this consideration in their calculations. The capitalists, if they be wise, and seek, not adventurous speculations, but sound investments, will not commit the same error. On the whole the perusal of M. Jullien's Memoir is of the nature to abate any very exalted notions on the subject of railways, and will give valuable information to those about to embark their fortune in those enterprises.

THE RAILWAY GUAGE.

The investigation of the merits of the guages has occasioned much excitement in the public mind, and much has been said *pro* and con respecting the advantages of the different width of the rails on the various roads now extant —indeed, on the question of whether a 4 ft. 8½ in., or a 7 ft. 6 in.* guage is the better; the real question, as to the nature and effect of the difference has not been much attended to. In ushering in the question, Mr. Cobden observes that a 4 ft. 8½ in. answers *very well,* as does a 7 ft. 6 in. guage—consequently, it is to be deduced that it does not much matter what the guage is at all. It must be admitted, that at the present rate of travelling, the passengers are conveyed along the different lines to their destination, with moderate punctuality, and with only occasional accident—in point of fact, that there is some degree of certainty of proceeding from station to station, at a speed of at least twenty miles an hour—that there is 100 chances to 1 that none of the axles break—200 to 1 that there is not an empty carriage or two accidentally left on the line—and 1000 to 1 that the embankment has not broken down, or that the engine does not blow up altogether; thereby affording much consolation to the passengers, and reflecting great credit upon the engineer, clerks, and porters, who thus provide for their safety; but this is not a sufficient answer to the inquiry, nor, in point of fact, does it much help the investigation. The question is, is it possible by any arrangement to get greater speed and greater security? There can be little doubt that twenty-five miles an hour might be obtained with an engine on a 2 feet guage; but here the question being pushed to the verge of absurdity—the answer to the inquiry, of whether it is politic to lay down such lines, becomes self-evident—the engineer would be scouted who would propose it, and the public, without knowing the philosophical reasoning upon the sub-

* It is singular to observe in the above table that the fare of a third class passenger in England is that of a second class passenger in France and of a first class passenger in Belgium. In the above calculation we have reckoned the centime = $\frac{1}{10}$ of a penny, but its real value is at present rather less.—Ed.

† We were much struck with the low charges of railway travelling in Belgium, as compared with those of England. From Antwerp to Brussels, for example, a distance of 24 miles, the fares are,—diligences' 3 francs 50 cents; chars-a-bancs, 2 francs 25 cents; and wagons, 1 franc 75 cents; that is 2s. 9½d., 1s. 7¾d., and 1s. 4¾d.; whereas the same distance upon any of the great lines in England would be above 6s., 4s. and 2s. Upon an average we found it to be only about one-half the expense of similar travelling at home. The consequence is, that far more people travel by railway in Belgium than in England. We were astonished at the crowds that went with us in every direction, but more particularly between Brussels and Antwerp, and towards Ghent and Bruges. The increase in the receipts of the different lines has been great, as the advantages have been developed. The lines now in operation were completed in October, 1843; since which time their receipts have increased in an extraordinary proportion. During the past year (1844) the traffic of heavy merchandise was nearly double the amount of the preceding year, amounting to about 500,000 tons. The increase of passengers was still more extraordinary, that traffic alone having realized something not far short, it is said, of 10,000,000 of francs.—'Ramsay's Belgium and the Rhine.'

* It is rather surprising to hear so good an authority as the "Mining Journal" talking of a "7 ft. 6 in. guage." The broadest guage which we are acquainted with is that of 7 feet.

ject of guages, would instinctively shrink from travelling upon such a pigmy contrivance—and yet, what engineer is bold enough to say that, in fifty years' time, our present lines may not be treated as equally Liliputian affairs, and our engineering science be subject to the smile of ridicule of the Brunels and Stephensons of that day; perhaps, even the inquiry at this stage of our progress in locomotive travelling, be then a subject very well fitted for a joke—as the advertisements of the fast coaches of fifty years ago, are not only to our able engineers, but, indeed, to the whole community—the speed of the old coach was increased to double, and, perhaps, treble, its pace in the period alluded to, by the same instrumentality—viz., horses, turnpikes, and a little more elegance and accomplishment in using the thong and holding the ribbons; and to such perfection had this delightful method of travelling arrived, that a modern jarvey could not only well have afforded a sly smile at his old fashioned prototype, but our nobles were not ashamed to be seen in his position. Nay, who was a finished gentlemen, who could not gracefully guide his trap and four through a crowded thoroughfare? and where is now this swift and elegant system of transit—the British mail—the boast of the nation?—nearly among the things that have been. Shall we, then, in the infancy of knowledge of steam-power—and with such a power, and subject to such modification at our command—or the absence of experience of sufficient engineering skill, trammel ourselves to imperfection, and bind ourselves, by Act of Parliament, to slow coaches, accidents, and 4 ft. 8½ in. guages? Suppose, if the experiment of introducing 10 ft. 6 in. diameter wheels, by Brunel, had answered the calculations he had made for them, by one revolution of the engine, one stroke of the piston, had sent us as far as two of the first that were invented, and the old speed of twenty-five miles would have been doubled, while the old engine would have been entirely discarded, and 7 feet 6 inch rails would then have been the true width, until some better one was discovered? And yet, who is able to decide, that, if the passenger carriages had been raised upon wheels equally high, that the experiment would not have answered in every way the expectation? One thing is certain, the propelling power would have borne better upon the weight, and in a more direct line, and most likely the object in view would have been accomplished; but, suppose, with even this alteration, it had failed, is that a reason that rails and carriages cannot be so constructed as to work much larger wheels, and much larger and firmer rails, and a much wider guage, than, perhaps, any thing that has been yet considered practicable? Is it inconsistent with the spirit of improvement, that we may gain not only greater speed, but with it greater safety and security?—We think not.—*Mining Journal.*

RAILWAY CLASSIFIED ACCORDING TO THEIR GAUGES.

The following is a list of the principal railways of Great Britain, classified according to the breadth of their gauges. The column giving the length of each railway refers only to the number of miles of rails laid down and used for traffic. Branch lines are distinguished from main line, so that in no case is the same length of railway reckoned twice over.

(1.) *Gauge 4 feet 6 inches.*

	Miles.
Ballochney	6
Garnkirk to Glasgow	8
Slamannan Railway	12
Total	26

(2.) *Gauge 4 feet 8½ inches.*

(In this class are included some railways of which the gauge is half an inch wider to allow for the play of the wheels.)

Birmingham (from London)	112
Peterborough Branch	47
Birmingham to Gloucester	53
Bishop's Auckland and Weardale	8
Bodmin to Wadebridge	14
Bolton, Leigh and Kenyon	9
Brandling Junction	17
Brighton (from Croydon to Shoreham)	48
Chester to Birkenhead	15
Chester and Crewe	21
Croydon	10
Dover (from Reigate Junction)	66
Dublin and Kingston	6
Eastern Counties (to Colchester)	50
Edinburgh to Glasgow	46
Glasgow and Greenock (from Paisley)	16
Glasgow, Kilmarnock and Ayr	51
Grand Junction (to Lancaster)	126
Gravesend and Rochester	7
Great North of England (Darlington to York and North Midland Railway)	45
Hull to Selby	31
Lancaster and Preston	20
Leicester and Swannington	16
Liverpool and Manchester	31
Manchester and Crewe	29
Manchester to Leeds	60
Maryport to Carlisle	30
Midland. Derby to Birmingham	41
Derby to Leeds	78
Rugby to Derby	48
Newcastle to Carlisle	60
Newcastle to Darlington	35
Newcastle and North Shields	7
North and Eastern (from Eastern Counties Railway)	48
North Union. Preston to Manchester and Liverpool Railway	22
Norwich to Yarmouth	20
Preston and Wyre	19
South Western (to Southampton)	76
Gosport Branch	16
Stockton to Darlington	11
Stockton, Hartlepool and Clarence	32
Taff Vale	30
York and North Midland	27
Total	1554

(3.) *Gauge 5 feet 3 inches.*

Dublin and Drogheda	31

(4.) *Gauge 5 feet 6 inches.*

* Abroath to Forfar	15
* Dundee to Abroath	16
Total	31

† (5.) *Gauge 6 feet 2 inches.*

Belfast to Portadown	25

(6.) *Gauge 7 feet.*

Great Western: Bristol and Gloucester*: Cheltenham and Great Western: Bristol and Exeter	278

* About to be altered to the 4 ft. 8½ in. gauge.
† According to the recommendation of the Irish Railway Commissioners.

CHRISTIAN ICONOGRAPHY.

On the Application of the Form of the Cross during the Middle Ages.

(From the Histoire de Dieu, par M. Didron.*)*

(Continued from Page 217.)

In the West our churches are usually in the form of the Latin Cross of unequal parts; the apex and arms being shorter than the shaft or trunk. The foot or shaft forms the longitudinal nave, the arms form the transept or transversal nave, the apex forms the choir. In the Middle Ages the choir was shorter and the nave longer In the basilicas of Constantine the transverse nave (called the transepts or cross aisles) cuts the longitudinal nave immediately adjoining the apsis, it leaves no room for the choir. In the 13th century the choir lengthens and forces the transept towards the west; there are even some churches in which the transverse nave is nearer to the portal than to the apsis, so that it is still a Latin Cross, the divisions being unequal, and the cross aisle cutting the transverse nave into two unequal portions, but it is a Latin Cross reversed, the apex of which is longer than the pedestal. The church of St. Germain-l'Auxerrois at Paris is of this form; from the portal to the transept the nave is four widths in length, from the transept to the bottom of the church the distance is nine widths: the top, which ought to be much longer, is really shorter than the bottom: the arms are short, as is usual in the Latin Cross, only occupying three widths between them.

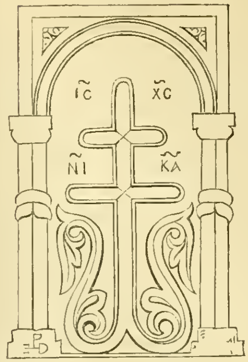
Many of the English cathedral churches have a form which is neither that of the Latin Cross nor of the Greek Cross, nor even that of the simple tau. These singular edifices are divided not by one transept but by two. The first cuts the longitudinal nave in half; the western or inferior end forms the nave properly speaking, and the eastern end forms the apsis of the church; this apsis itself is divided by a second transept, usually shorter than the first. On this side, viz., from the first to the second transept, is the choir; on the other, viz., from the second transept to the bottom of the church, is the sanctuary. The cathedrals at Salisbury, Lincoln, Beverley, Rochester, and Worcester are of this character. Let a figure be drawn of the Cross of Christ, with a long and wide label attached to it bearing the inscription "Jesus of Nazareth, King of the Jews." This label, as it were, is adopted in English churches, and forms the eastern transept, that which divides the top of the Cross into two parts; then comes the usual cross aisle or transept, on which the arms of Christ were extended. This is derived from the Cross of Lorraine, the Cross of the Knights Hospitallers, and from that which denotes at present the archiepiscopal dignity, it is the double Cross; it seems to be borrowed from Greece, for we meet with it frequently in Attica, in the Morea, and at Mount Athos.

The designs for churches in the form of a Cross were often revealed in visions. In the night an angel appeared to a sleeping saint, perhaps to a bishop, and made known to him the form of a monument which was to be erected by the command of God; immediately the work was put in hand according to the model seen in the dream. Sometimes bright lines were observed in the sky, tracing on the clouds the form of the church to be erected. In this way Constantine caused his Labarum to be executed in the form of that which he had seen traced in lines of fire in the sky, and according to which luminous design the edifice was erected. Sometimes the plan and form of a basilica might be discovered traced with drops of dew on the dry ground; at another time it was the snow which indicated the spot and marked the form in which the walls should rise. Thus the French abbey and church of St. Michael in the department de la Manche, and the Italian church St. Michael at Gargano were traced upon the earth by the steps of a bull.

Since, as we have seen, even the severe science of architecture accommodates its plans and designs to the varied forms and details of the Cross, it is not surprising that the arts of sculpture and painting should employ it in all its varieties, numerous and capricious as these varieties often are. Thus, not only do they employ the Cross with *one* or *two* transverse beams, but the number is often increased to *three*; this Cross has eight arms, each transept dividing it into two, which makes six, to which the shaft adds two others, viz., the foot and the apex. These Crosses with one, two, or three transverse arms denote degrees of rank, in the same way as the tiara, the hat, and the mitre. The pope alone was entitled to the triple Cross, the archbishop and cardinal to the double Cross, the simple Cross remaining for the bishop. The capitals of columns, sarcophagi with their covers, mosaics and frescoes, windows and wainscotings, are adorned with innumerable Crosses, and their variety is equal to their number. These Crosses are sometimes simple, sometimes interlaced with other emblems.

When the Cross is simple and without other attributes or ornaments it must be divided into two classes—the Cross of the Passion and the Cross of the Resurrection. The Cross of the Passion, the real Cross on which Christ was crucified, is the square unhewn tree, composed of the trunk and transverse beam; it is this which is generally placed in the arms of the Father with the Christ nailed thereon; it is this which is planted in our fields, in our highways. The Cross of the Resurrection is the emblem of the real Cross; it was with this that Jesus rose from the tomb and ascended to Heaven. A banner, a flame, usually floats around the Cross of the Resurrection, it is indeed a standard, the top of which terminates in a Cross rather than in a point. The Cross which the Paschal Lamb bears on its foot, and the Cross which precedes religious processions, are the Crosses of the Resurrection and of the Ascension; in these cases it is no longer a tree, as in the Cross of the Passion, but a staff.

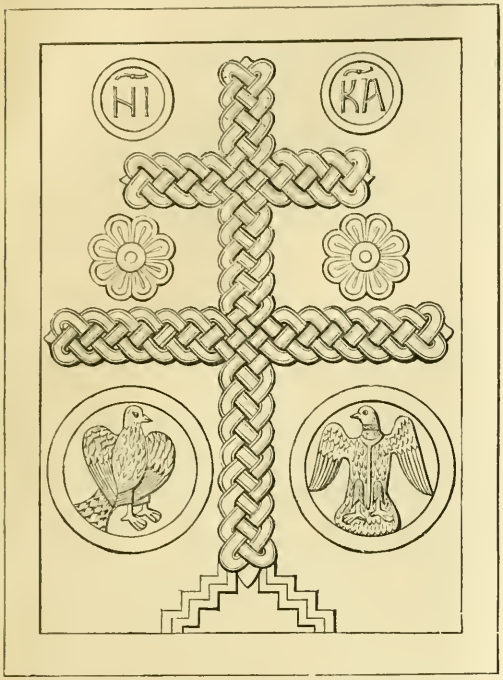
Sometimes, Christ in Heaven is represented as seated near to the Father and to the Holy Ghost, bearing the Cross of the Resurrection rather than that of the Passion. The Cross of the Passion, the true Cross, is a suffering one,—the Cross of the Resurrection is a triumphant one; the last has the same general form as the former one, but it is spiritualized—it is the Cross transfigured. These two Crosses are historical, because they were employed at the Crucifixion and Resurrection of Jesus Christ; but the number of those which are purely emblematical is infinitely greater. Heraldry adopts many of these, to which it assigns names which characterizes their nature and form. When the Cross is interlaced or accompanied by ornaments or emblems, the variety is so great that it is impossible to describe all, we must therefore select some examples.



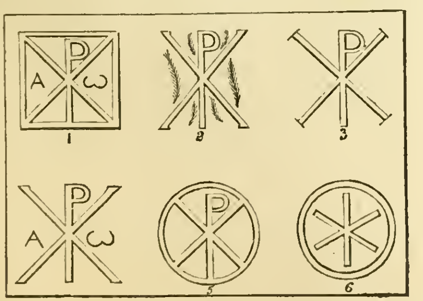
In Greece, the representations of the Cross usually bear this inscription "Jesus Christ the Conqueror." The following is an example of the double Cross, which we call the Cross of Lorraine, which furnishes also the plan of the English churches already mentioned, as well as that of the three French churches. The foot of this Cross is divided into two forks or branches, and expands itself in leaves of the acanthus. The inscription surrounds the upper Cross only. Sometimes this inscription is divided into two parts; the first portion is engraved above a Cross and is placed on the left, and the second portion above another Cross placed on the right. Beneath the first inscriptionare two peacocks, which appear to be allegorical, since a manuscript and a tabulary stone in the Museum at Narbonne represent them crowned with a nimbus, like saints. Beneath the second and within medallions there is an eagle with its wings folded, and a falcon with its wings likewise folded; the falcon wears the collar, the leash, and the little bell. The foot of the first Cross is clawed, that of the second is *perronné;* both cut by the double transverse. The Cross with the peacocks is formed of bands interlaced, that with the eagle and falcon is twisted in narrower bands.

These two Crosses ornament the western door of a church at Athens, and are sculptured in slabs of white marble. We have given the Cross with the eagle and falcon, it seems as well therefore to make this example complete by giving also the Cross with the peacocks, for this is to the left and furnishes the first part of the inscription.

In Greece, at the base of the sculptured and painted Cross which ornament the churches, we almost always find animals facing each other, who seem to gaze with love or fear on the emblem, beneath which they appear to humble themselves. The lion, the eagle, the peacock and the falcon are the animals we generally find. The peacock and the eagle are the emblems of pride, the falcon and the lion which betoken violence and cruelty, may well signify that these evil passions must bend under the yoke of the Cross. The dove and the lamb, which we frequently find in the frescoes, on the catacombs, and on the ancient sarcophagi, may signify, that as virtue arises *from* the Cross so vice is overthrown *by* it.



We have already described several designs where a figure of Jesus Christ surrounded by a glory, either elliptical or circular, is accompanied by the attributes of the four Evangelists. Christ is also represented by his Cross, and the Evangelists by their Gospels; not only is the Cross accompanied by signs and ornaments, but it is also interlaced by them so to speak. The monogram of Christ, the Chi (X), and the Rho (P) of Χριστος, the Iota (I) of Ιησους, uniting form the Greek and Roman Cross and stars with six equal or unequal parts; these Crosses are simple or enclosed in circular medallions, and are sometimes square. In the next illustration composed of six cyphers the *Chi* is in the St. Andrew's Cross. In the first five figures the *Rho* cuts the *Chi* vertically, at the point in which the two branches are intersected; we have thus the two first letters of ΧΡΙΣΤΟΣ. The cyphers of No. 2, 3 and 4 are simple or open, and the No. 3 is composed only of X and of P; No. 2 is accompanied by palms, which pro-



bably signify triumph and glory; No. 4 like No. 1 is completed by the A and Ω, which signify that Christ is the beginning and end of all things; No. 5 is inclosed in a medallion, but the rays of this mystical wheel touch the circumference and mingle in it, while those of No. 6 do not touch it. This last figure does not present a *Rho* but an *Iota*, which is the first letter of the Greek word ΙΗΣΟΥΣ, as the *Chi* is the first letter of ΧΡΙΣΤΟΣ. The sixth cypher is then the most complete.

There is yet a vast number of inscriptions and allegorical ornaments besides those which accompany the sign of the Cross and detail its facts and significations; but we have been compelled to confine ourselves to the more essential points of this important subject.

REMARKS ON THE MATHEMATICAL PRINCIPLES OF MR. DREDGE'S PATENT SUSPENSION BRIDGE.

By F. Bashforth, B.A., *Fellow of St. John's College, Cambridge, and Member of the Cambridge Philosophical Society.*

"The constant destruction of bridges so fatal to life and property, arises solely from the erroneous principles upon which they are constructed."—Mr. Dredge's Advertisement.

The recent fatal catastrophe at Yarmouth renders it imperative on all persons to make use of every means in their power to guard against the recurrence of a similar event. It is to me a matter of surprise that there has been no exposure of what Mr. Dredge calls his "System mathematically demonstrated, showing, by the most searching investigation, the true principles of the novel and economical invention." !!

In the work on Bridges, published by Mr. Weale, we have a Supplement of 64 pages of demonstration, illustration, and examples. In vol. xxxviii. of the *Mechanics Magazine* we have the "Mathematical Demonstration of the Principles of Dredge's Patent Iron Bridges. By the Inventor." In addition to these Mr. Dredge has printed for distribution a number of letters extracted from newspapers, &c., explaining in glowing colours the advantages in strength and cheapness of his bridge. But most unfortunately not one of the writers even *professes* to have any knowledge of mathematics, and consequently all their opinions are worthless. In one of Mr. Dredge's advertisements we are informed that "in such a structure as the Menai Bridge it (the patent bridge) effects a *saving of* 1865 *tons of iron in the main chains alone*," and in a note we are told that the "Menai *chains weigh* 1935 *tons*." We will now compare this with the statement in Mr. Page's Report, printed by order of the House of Commons, May 9, 1844, page 21, and reprinted in Weale's Quarterly Papers, Part V. page 20. "The weight of the bridge (including 130 tons additional weight due to repairs in 1839 and 1840) is 774 tons"! In Mr. Proves' work we have a similar statement. Again, we are informed that the "tension of the chain must be nearly 3750 tons, half of it acting *in each direction*." Did Mr. Dredge ever know such a method of measuring tension before made use of? I compare this with another of Mr. Dredge's circulating letters, written by Lord Western to Lord Melbourne, which states that according to Drewry "the strain at the middle is 1875 tons." I make no remark,—I have merely collected statements, and I leave the world to judge.

To proceed to the mathematical demonstration.—

These are copies of figs. 6 and 8 alluded to below. In both figures

Fig. 8.

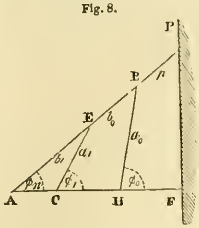
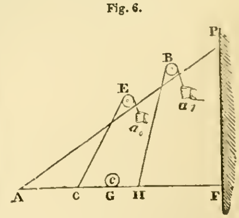


Fig. 6.



the same letters refer to the same. The pulleys E and B, fig. 6, are supposed to turn about fixed axes, and a_1, a_0, denote the tensions of the strings C E, H B, attached to the platform at C, H, and passing over the pullies E, B; P F is the pier, P A a chain passing from the top of the pier. Let

$$F H B = \varphi_0,\ F C E = \phi_1 \ldots\ F A P = \phi n$$

$$F H = d_0,\quad F C = d_1 \ldots\quad F A = d_n$$

ω the weight to be supported at G, G F $= \delta$.

b_1 = tension of A P.

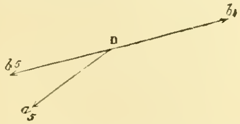
If now we suppose A F to be a rigid lever capable of turning about F, and if the momenta tending to turn it in opposite directions be equal, we get

$a_0\, d_0 \sin\phi_0 + a_1\, d_1 \sin\phi_1 + b\, d_n \sin\varphi_n = \omega\,\delta$ (R). Page xxxi.

This equation we may allow, but it must be observed that the pulleys E, B, are fixed quite independently of the main chain A P, and we may therefore suppose that the chain A P remains straight. a_0 a_1 &c. are called subsidiary forces.

At page xxxii. we read "If, instead of supposing the cords, to which the subsidiary forces are attached, to be brought over pulleys and stretched according to the intensities of their respective forces, let them be *simply attached* to the primary cord or chain A P, as represented figs. 7 and 8 following, then if stretched to the same degree by means of the load which they are employed to support, the nature of the action will be *precisely the same* as in figs. 2 and 6 &c." I am quite at a loss to imagine how any one, possessing the least possible knowledge of mechanics, could make such an absurd and totally unwarrantable supposition. If the subsidiary forces are to be anything, they *must* bend the main chain,—thus the position of the whole will be altered, and consequently the tensions of the rods will be changed. The main chain A P would of course be bent, and the arrangement of the whole be so altered that all the previous investigation would be rendered utterly worthless for the object in view. It appears that this learned theorist has found his subsidiary forces to produce a great saving in material, but although it may be always possible to attach the ends C, H, &c., fig. 6, to the platform, it is not generally practicable in actual constructions to find other *fixed* points, as E B, just above to which we may tie the other ends quite *independently of the main chain*. It does not appear necessary to continue the investigation any further, as its foundations are undermined. A bridge built on *this principle may* stand for two reasons, it is seldom or never loaded to the full extent of its calculated power, and the actual strength of iron is about three times as much as is used in the calculation.

Thus we see that Mr. Dredge's "principle" is built on the fallacious assumption that we may attach one end of a supporting rod to the platform, and the other end to some convenient point just above, quite independently of the main chain.



At pages xxxviii. and following, we have an example, and the tensions b_1, b_2, &c., a_1, a_2, &c., for that case are most obligingly afforded us with the greatest nicety, even to four decimal places. The above figure represents a part of the main chain, b_4, b_5, the tensions on each side of the joint D, a_5 the tension of the subsidiary force connected to the main chain at D. It is found by applying the mathematical calculations to this particular case that

$$b_4 = 151{\cdot}6906;\ b_5 = 101{\cdot}1270;\ a_5 = 28{\cdot}9617$$

$\therefore b_4 > b_5 + a_5$, or two of the forces are together less than the third. Now, since three forces, acting at a point, when they keep it at rest, are proportional to the sides of a plane triangle, formed by drawing lines parallel to the direction of the forces; if this be true there may be a plane triangle having two sides together less the third. But see Euclid, Book I., Prop. xx.

I have merely taken the values of the tensions for one point. The sets of tensions $(b_1\ b_2\ a_2)$, $(b_2\ b_3\ a_3)$, $(b_3\ b_4\ a_4)$, and $(b_5\ b_6\ a_6)$ when applied at one point cannot keep it at rest for the reasons above given. It is a decisive proof that an author's calculations are erroneous when they lead to an absurdity or an impossibility.

I think I have already written enough to show that the *principle* is wrong, and that its application to an example by the author leads to an absurdity. I have compared Mr. Dredge's statements together and with other accounts, and they are contradictory,—and I leave things as I find them.

It has become usual for persons to speak of the Menai Bridge as a complete failure—in one respect it has been a failure, in another a triumph. The failure is, however, no discredit to the mathematical abilities of Davies Gilbert nor to those of Telford the engineer. They were not then aware of the effects that the wind could produce; but everything that they did take into account was amply provided for. This, however, will be no excuse for neglecting such lessons as experience has taught, in future structures of a similar kind.

If Mr. Dredge had examined the *Philosophical Transactions* for 1826 he would have found that the plan for tapering the chains was no new discovery in 1836, and perhaps he might have been led to doubt the accuracy of his own conclusions, when he found that the quantity of iron that could be thus saved with safety was so small as not to be worthy of notice.

All the patent bridges that have been constructed ought to be carefully examined; the lengths and strengths of all the links, together with their inclinations to the horizon, should be measured when the bridge is loaded uniformly to the full extent of its estimated power, it would then be possible to form some estimate of the security of the structure. In the general case the data are insufficient for a mathematical solution, but with given positions and magnitudes of all the parts we may calculate the tension of each portion for a given load, and pronounce for or against after a comparison of the calculated tensions with the capabilities of the several parts. We have in a great measure to thank such writers as this theorist and Mr. POLE for the distrust with which practical men regard theories.

ON THE PREPARATION OF LIME FOR FRESCO AND OTHER PURPOSES OF PAINTING AND ARCHITECTURE.

It is amply known to most men that lime is a calcined chalk, or other stone containing this earth, in the state of carbonate, and that we must develope its caustic state by divesting it of carbonic acid by means of the kiln, and still further change its character by slaking, when it becomes a hydrate of the earth, which is now and has long been considered a mere union of water with oxide of calcium; and, although I demur[1] on the absolute correctness of the theory, it might have been considered supererogation to have dwelled upon it here had it not been industriously published to the world, especially to painters,—first, that by washing, as practised by Pallomino, its caustic powers and well known destructiveness among pigments, especially the sulphurets and carbonates, could be not only ameliorated but *removed;* secondly, that the long continued burial of the hydrate in the state of fine putty, as practised by Cornelius and other German painters in fresco so pertinaciously that the director will use no lime which has not been so buried from six to eight years; thirdly, but it is almost too silly to notice, that hydrate of lime is not formed by slaking, but is a salt indigenous in all lime stones[2]! fourthly, that to make a complete job, we should dissolve lime, precipitate artificial carbonates, and further deteriorate its powers by foolish experimental[3] mixtures! Alas, what shall we be told next?

Fourcroy published some forty-five years ago his valuable experiments and many incontrovertible truths, but, as will always be the case with the mere theorist as regards practical arts, many errors: hydrate of lime is stated by him to be less caustic (the great obstacle of the misled fresco painter) than the earth before slaking. This was an error of the closet man; Fourcroy used, as an experimentalist, Carrara marble; now, obviously the lime of Carrara marble, however well adapted to philosophical purposes, must be a poor, trashy and worthless one for building, tanning, fresco painting, &c., nor does its hydrate *resemble that* of Dorking lime.

Convinced as I am that fresco painting is not at all adapted to English taste, and much less so to English rooms or halls even of the larger class—what, let us ask, is the essence of the art? why, inherent crudeness but real transparence and permanence, the very foundation of which is the permanence of the stucco. If, then, a caustic lime be necessary to a permanent intonaco—and such intonaco be necessary to fresco—obviously a caustic lime, in this climate especially, is the *sine quâ non* of a permanent fresco, and, as obviously, every attempt to lessen the causticity of the lime, so as to adapt it to the pigment, is a retrogradation; the pigment must, in the nature of things, be adapted to the lime, and the whole series of obstacles, hitherto re-echoed from Pliny to Pallomino, sink before the ordinary expedients of the painter's art.

1 That a something more takes places is obvious, and was seen by the older masters of physic and painting; the first directed "all first waters in which lime had been slaked to be thrown away as 'too furious for medicine;' the last chose these first waters (in which "lime had boiled up") to prepare vermillion for fresco, which they do, not by "embuing it with lime," but by abstracting the excess of sulphur.

2 An axiom actually promulgated in print by a Mr. Weld Taylor, who states also, that vermillion has a tendency to turn 'black' by heat, apparently innocent of the fact that it is absolutely a 'black' sulphuret of mercury turned red by heat! Vide his Essay on Fresco Painting.

3 Dr. David Boswell Reid. Vide the Royal Commission on Fine Arts, 1st Report, page 45 of the Appendix.

A great mass of error exists with reference to the statements of the older writers on this subject, as well as that for architectural purposes. Arminini, for instance, tells us about boiling; now if absolute boiling ever were practised in his day it could only have been the boiling of pigmental lime, then the only white[4] permitted, and here any English manufacturer of whiting would laugh him to scorn. I am satisfied however, boiling of another kind *was* practised from the earliest ages,—and continues to be practised to this day by cunning plasterers whenever the stock of putty is exhausted and a supply required rapidly,—that is, the throwing lime into water and—often with fine sand—covering it down with sacks and thus boiling the mixture *per se*.

In my earliest experiments, after being applied to by the Secretary of the Royal Commission on the Fine Arts, I saw the obvious necessity for a caustic and not an ameliorated lime, and prepared a small frame to show that fierce Dorking lime, properly treated, although a better stucco, was even less destructive to pigments than lime buried behind the Houses of Parliament and deteriorated by two years keeping. I then prepared a larger frame, of a practical character for painting on, with such Dorking lime only four days old; and this frame remained beautifully perfect more than nine months at Gwydyr House, and is still in existence without a blemish, and in lieu of cracking and crumbling into dust is harder in texture than any stucco or intonaco in the metropolis; but, unfortunately, Her Majesty's Commissioners, who very naturally were perplexed amid the conflict of opinions, instead of submitting such proof to two plasterers and a painter, as to its practical nature, submitted it, as to its *mere theory*, to three theoretic men, neither of whom knew one iota about intonacos, or pigments, or fresco, or oil, neither of whom ever once examined the practical frame then in the room, and one of whom had actually declared in their previous report,[5] "*He knew nothing of the subject, his attention never having been called to it*," and for fear any men should doubt his word, on the score of modesty, followed up the assertion by a string of ludicrous suggestions before alluded to, viz., the making and mixing *artificial precipitated carbonates* with intonaco limes. Ultimately these referees, after making certain trifling theoretic experiments, such as "*stirring brushes* about EQUALLY" (mark the word, as if for an apothecary's potion), for seventeen days without any effect, received their fees and damned the plan neither of them comprehended for one moment, nay not even in its theory, for a long rambling report denied many assertions I never made and touched not one I did make. Such is the invariable result of references to mere theorists, because of a misunderstood *locus standi*: surely the public eye will be opened ere long. The schoolmaster, as I have before said, may teach the elements of navigation—he may lecture upon it, he may make a book upon it, and any silly fellow *can* compile a volume, nay he may be a highly gifted man and justly obtain this *locus standi*—but who would be governed by his judgment on an experienced seaman's practical work at the helm, or ask him to steer a ship?

This is no vituperation; I have not any interest at stake, and never had, save the waste of time and pelf to remove error and serve the cause of man.

The report alluded to states, that "brushes thus diligently stirred about in lime and water for seventeen days were not acted on at all by lime." I admire the *naïveté* and genuine innocence of some very elevated men (?). Painters in fresco do not stir brushes about in lime and water *equally*, but use them unequally on a drying and nearly set intonaco, from which is oozing a fierce water of lime aided by an abrasive surface, and of brushes so destroyed all history tells; Cornelius gave evidence, and living painters in the metropolis could supply dozens,—while every bricklayer by his shoes, every tanner's pitman by his hides, every perfumer by his depilatory mixtures, amply testifies the fact.

The same Report states that "Hydrogen (streams of which I pass through my caustic lime when slaked, and before washing,) has no action on lime." This is good: Fourcroy, whose experiments I had a practical occasion to repeat twenty years ago, told us this twenty-five years before that; and I therefore had never dreamed of asserting either that hydrogen acted on lime or lime on hydrogen; but I did assert, and do now repeat the assertion, that by passing it through such recent hydrate of lime, in the state of cream, we are enabled to wash off—especially if hot instead of cold waters be used, (lime being *less* while the salts existing in it after slaking are *more* soluble therein)—all those noxious elements which infinitely more affect pigments and brushes than the mere alkaline causticity of lime; and, I repeat, that in slaking lime something more occurs than the mere solidification of water as a hydrate. I assert that some water is decomposed, some oxygen combined with the lime as a peroxide, and hydrogen set free along with the heat of fluidity. By such passing of streams of hydrogen through it we are enabled therefore to destroy this noxious agency, and gain a purer, better, and more cohesive, plastic and yet caustic hydrate for immediate use.

The Report further asserts that "Fine plasters improve in texture by keeping, merely from a separation and commination of particles!" Now every plasterer's man knows that by keeping, they which were *loose, sandy, incoherent*, become close, waxy, tenacious and plastic,—how, therefore, the obvious exertion of attraction can be a specimen of repulsion I leave the theoretic LL.D.'s to illustrate.

Again, if nothing more than a mere and almost mechanical hydrate be formed by slaking, I should be glad to be (not theoretically—no, no —I mean practically,) enlightened as to how it comes that in all the fiercer limes—Dorking, Bath, or blue lias—after rapid slaking, sulphur becomes oxygenized, sulphuric acid formed, and sulphates of lime, magnesia, &c., ooze from every joint of brickwork in less than a month.

Again, how is it after passing hydrogen through them in the creamy state, and washing them, no such oxygenizement takes place and no salts form?

Again, how is it that in the tanner's pit the skin is swelled and gelatinized, and the hair and epidermis are acted on, and then suddenly—although the lime, *under a water valve*, is quite caustic—such power is lost, and fresh lime *must* be used to procure these effects before the skin is destroyed?

I assume no wire-drawn degree of knowledge; I look with contempt on the gingerbread of science and mere jargon of a sesquicarbonated nomenclature; but I am not to be put down in plain, practical matters to which I have devoted years: and a mere assumption, on parchment brains, I so much detest I treat my *own degree* as waste paper.

On other matters intended to be developed by the frame alluded to, and I humbly opine perfectly demonstrated therein, such as the defects and absurdities of all ordinary plaster-keying, and the inestimable worth of native carbonate of barytes as proposed by me thirty years ago, I must dwell more at large in my next paper, which more properly may claim them as appertaining to architecture.

With reference to hydrofuges, on which much research has been displayed, and more time thrown away, I merely say—hydrofuges to walls are strictly empirical applications, and advisable only when old and defective walls are to be painted on, and they produce, in the nature of things, bad effects on the walls themselves. Good strong lime, well washed coarse sand, tolerably pure water, with that addition which was proposed by me and referred to Mr. Barry, would have secured to his cement, ere this, a greater hardness than that of the bricks and a perfect freedom from circulatory damp, and, I may add, afforded a cement more worthy of his splendid foundation.

There is a gross error, retailed from Pallomino, with reference to salts, viz., "that if the rough cast be not dry saltpetre will form." The rough east ought never to be dry; and saltpetre, that is nitrate of potas, *never can*, while the salt he means—nitrate of lime—*rarely will* be formed, and then only when the elements had existed, *à priori*, in the sand, water, or hydrate of lime. The same applies also to a Mr. Smith's advice to the Commissioners, (2nd Report, page 53,) "*not to permit the workmen to urinate in the chimney corners*;" the writer being, apparently, unacquainted with the fact that the preparers of nitre, in artificial beds, in despite of great quantities of urine, never form nitrate of potas but this nitrate of lime.

W. MARRIS DINSDALE.

July 8, 1845.

[4] Now we have artificial carbonate of barytes, infinitely 'more beautiful' and requiring only pure water to ensure its permanence.

[5] Dr. Reid, as before stated in Note 3.

SECOND REPORT OF COMMISSIONERS OF INQUIRY INTO THE STATE OF LARGE TOWNS AND POPULOUS DISTRICTS.

The following is an abstract from part of a most important and elaborate report presented to the House of Commons. From the extent of the document (it consists of two large folio volumes), we can present but a small part of its contents notwithstanding their interest, but we hope to recur to the subject.

In pursuance of the terms of your Majesty's Commission, whereby we are enjoined to report to your Majesty, from time to time, our proceedings, we, the undersigned Commissioners, do now humbly present this our further Report. We stated in our First Report the course which we considered it our duty to pursue in prosecution of our inquiry, to which we appended the evidence we had then received, and also an abstract of the replies then given from fifty towns visited, showing their condition in respect to drainage, cleansing, and the supply of water.

Having stated the causes, to which our investigations into the condition of the inhabitants of large towns and populous districts have led us to ascribe much of the prevalent disease and mortality, we proceed, in obedience to the instructions contained in your Majesty's Commission, to offer recommendations for the amendment of the laws at present in force relating to the sanatory condition of your Majesty's subjects.

We now lay before your Majesty a short outline of the measures which appear to us to be necessary for this purpose; and then proceed more in detail to state our reasons and such observations as occur to us on each branch of the subject.

We have arranged the different branches of the subject in the following order:—

1. Drainage, including house and main drainage, and the drainage of any space not covered with houses, yet influencing the health of the inhabitants.
2. The paving of public streets, and courts and alleys.
3. Cleansing; comprising the removal of all refuse matter not carried off by drainage, and the removal of nuisances.
4. A supply of water for public purposes and private use.
5. The construction and ventilation of buildings for promoting and securing the health of the inhabitants.

General deficiency of drainage.

Among the evils, which appear to operate with the greatest severity on the condition of all, and especially of the labouring classes, are those arising from the absence of a proper attention to drainage. They prevail almost universally, to an extent altogether incompatible with the maintenance of the public health; and even in those places where recent improvements have been effected, a desirable standard is far from having been attained, either in respect to the perfection of the necessary arrangements for drainage, or of economy in executing the works.

Defective drainage in Towns of Staffordshire and S. Wales.

The most serious deficiencies in drainage are found to exist in these towns' which have advanced within a brief period from the condition of villages' chiefly the seats of the pottery and iron manufactures in *Staffordshire*, and the mining districts in *South Wales, Monmouthshire*, and the north of England. As an example of this description of towns, *Merthyr Tydvil*, at present containing above 37,000 inhabitants, presents the most lamentable instance of the total absence of all drainage. The rapidly increasiog suburbs of large towns which are without the municiple boundary, or to which the jurisdiction of a local Act does not extend, present similar examples of neglect, and strongly exhibit the necessity of the establishment of an efficient local authority for such purposes.

An instance of the extent to which these deficiencies of legislative powers prevail, even in towns which have long been the resort of the wealthy and luxurious classes, is presented in the city of *Bath*. We there find that—

"The commissioners for the outpart of the parish of Walcot have power, under a local Act, to order the construction of new sewers and the alteration and reparation of old ones when they see occasion: their power extends over about a fourth or fifth of the city. There is no such power vested in any body for the remainder of the city."

In the city of Gloucester, although there are three Acts of Parliament in force fur the local government of that city, none of them apply to the sewerage or drainage, which is in a most neglected state.

To remedy evils of such magnitude and so extensively prevalent, we are of opinion—That new legislative measures, applicable to all towns and populous districts, are required, for the introduction and maintenance—not only of an efficient and economical system of house drainage and sewerage, paving and cleansing, in all towns and populous districts, but also for providing ample supplies of water for public and private purposes, and for the adoption of other means for promoting and securing the health and comfort of the inhabitants.

New Surveys required.

The first and most important step in providing for the efficient and economical execution of any plan of drainage, is the preparation of an accurate general survey, upon a large scale, of the area which it is proposed to drain. This view is supported by a large mass of valuable and important testimony, proving it to be the necessary preliminary to any such work. The extent of country to be comprised within the jurisdiction of any local authority, should be the entire natural area for drainage. At present no such plans or surveys are accessible to builders or others engaged in works requiring a knowledge of the level of the adjacent lands. Hence serious losses have been entailed on the public by the construction of sewers and drains at improper levels, and of a capacity insufficient for the probable wants of a future population; and houses have been placed in situations regardless of the means of drainage. Great loss and inconvenience from this cause have very generally occurred, and even very lately it has become necessary to enlarge and deepen some of the sewers recently put in. The prevailing want of information among the surveyors and other officers having the charge of the drainage of towns, regarding the levels of the sewers, and frequently even the entire ignorance of their existence, may be traced to the absence of any proper survey. At Bristol the first attempt to form a complete map of the sewers was commenced during the inquiry of the visiting commissioners, and in the town of Preston it was a work of several weeks to open the streets in order to ascertain the lines and the depths of the sewers. In some large towns as Wigan, Rochdale, and Bolton, there is not the slightest knowledge of the sewers.

The benefit of an authorized survey has already been demonstrated in devising a plan for supplying the city of Paris with water. It is manifest that no works can be executed on a system and with a proper attention to scientific arrangement, unless they are based upon a general survey, comprehending such levels as above described. Builders of all classes have borne evidence of the great value of such a survey. The importance and the necesity of such surveys for the efficient execution of the usual works of improvement in towns is not confined to drainage. It extends to building, laying out and leveling streets, and laying down gas and water-pipes. At present, such surveys as exist having been generally executed under the direction of independent sets of surveyors and workmen, it necessarily happens that a survey made for the one purpose is either inapplicable for another, within the same district, or that the private interests of parties limit the use of it to those at whose instance it was made.

Ordnance Survey for sanatory purposes.

In those parts of the northern counties of England, where the Ordnance survey is still in progress, there appears to be an opportunity of obtaining surveys for sanatory purposes, executed by public officers under a system of control checks, calculated to ensure a degree of accuracy, which it is very difficult to attain in any other manner, and which will acquire for this work a permanent authenticity and confidence. We are more anxious to recommend that the services of these officers should be made available for such purposes in those districts, where the surveys for the Ordnance map are not yet completed, as, we believe, that independently of their accuracy, the work could be executed by them at a comparatively trifling cost, provided the additions to the plans of towns, necessary for sanatory purposes, be made while the surveys for the Ordnance map are in progress.

We therefore recommend, that before the adoption of any general measure for drainage a plan and survey upon a proper scale, including all necessary details, be obtained, and submitted for approval to a competent authority.

Extension of Jurisdiction of Local Commissioners.

In the course of our investigations in the country, frequent instances have been brought under our notice of the difficulties arising to a complete system of drainage by the impediments that exist, whether natural or artificial, beyond the present limits of the jurisdiction of the local authority. No means are at present provided for the gradual enlargement of the jurisdiction simultaneously with the extension and the increasing wants of the newly-built districts of towns.

Instances in Bath and the Manufacturing Towns.

It is shown on the examination of the drainage of *Bath*, that the only authority having powers for the construction of new or the reparation of old sewers, was constituted was a local Act, authorizing the appointment of commissioners, whose powers were restricted to the parish of *Walcot*, containing about one-fourth or one-fifth of the whole population.

Tottenham, which has a population of 9,000 inhabitants, will serve as a comparatively simple example of another large class of cases, where an insufficiency in the area included in the jurisdiction for drainage operates as a barrier almost insuperable to the execution of effectual works by the most competent officers.

Liverpool is surrounded with undrained tracts of land, over which the suburbs, with new habitations for the working classes, are in the course of extension; and new houses are being built beside stagnant pools beyond the jurisdiction of the town drainage. The interior of the proper area of drainage comprising the town itself is split into two districts, and those districts are placed under divided and imperfect authorities, so clashing with each other as to render systematic drainage impracticable.

Much of the proper drainage district, within which the town of *Manchester* is situated, consists principally of clay, wet and overrun with rushes, and of partially drained land. The chairman of the Committee of Sewers in Manchester complained that the proper drainage and improvement of the worst district in that town, inhabited by the poorest population, is prevented by the want of authority over the dams thrown across the river Medlock, which, in consequence of these dams, at times overflows the lower districts.

It was found that one source of the insalubrity of the town of *Bradford*, which is situated in a valley between two hills, was traced to the emanations arising from the natural watercourse running between the hills, now dammed up for mill-power, and made the receptacle for all the drainage of the houses. The escape of gas from the source was stated to be at times so considerable as to discolour silver in the habitations or workshops near its banks. Over this outfall there was no proper authority possessed or exercised for the public protection.

The outfall of the surplus water of the drainage of *Halifax* was found to to be similarly dammed up.

The inspection of *Leeds*, showed (as had been previously stated by Captain Vetch, the engineer called in by the local authorities to examine and report on the means of improving the health of that town) that the river Aire, which would in its natural state have had a strong and regular current, had been dammed up in several places for mill power, and for the purposes of an important water communication. These dams thus act as a series of catch-pits for the sewage of a population of 120,000 persons. In this case, also, the authorities having control over the town drainage, even if they had been so constituted as to have been competent to execute or maintain systematic works, would have no jurisdiction or control over the natural outfalls; and, in consequence of this original want of jurisdiction and care, rights have apparently been acquired, which can now only be fairly redeemed, for the relief of the town, by purchase. It may be observed, however, as a favourable circumstance, that at the present time the increasing cheapness and convenience of substituting steam power would in many localities, greatly facilitate the resumption of important public rights, and the extension of proper drainage jurisdictions over natural outfalls.

At *Lancaster* the upper portion of the drainage area, was found to be under the control of the authorities who have charge of the Castle, and who were endeavouring to improve its salubrity by a better drainage. In this they were obstructed by the officers having charge of the lower portion of the area, who refused to permit the authorities, having charge of the upper portion, to use the sewers forming the proper outfalls.

The artificial drainage area under the care of the authorities having charge of the drainage of the town of *Nottingham*, comprehends only a portion of the natural and proper area. One part of that area is above the site of the houses of the town, within the municipal jurisdiction, and another part comprehending the outfalls of the drainage of the uplands, and of the town itself, is beneath it, and partly without the municipal jurisdiction. This subdivision of the natural area is found to be attended, as it has been almost everywhere, by the creation of rival and clashing interests, and with mutual and general injury to the inhabitants, and to the houses and land within the natural area, or contiguous to it.

At *Norwich* a part only of the natural drainage area is held by the commissioners having charge of the drainage of the town. In the upper portions of the town there are stagnant pools of water, for which relief by the natural outfall, through the municipal jurisdiction, was refused by the city commissioners, the sewers for that portion of the area being ill constructed, on rude conceptions of what was deemed sufficient for that portion only of the district. It was considered by the commissioners that these sewers were insufficient for the reception of the additional upland drainage; and yet no alterations were proposed for the relief of the inhabitants of the upper portion of the area, it not being understood, or apparently not considered, that a lower district benefits by the increased rapidity in the force of the flush, for cleaning purposes, by all ordinary additions of upland water.

At *Leicester* the natural water-course of the town is obstructed, dammed up, and converted into a sluggish receptacle of a large proportion of the sewage from the town, and in a great measure formed into a barrier to the effectual drainage of the low and flat site on which the chief part of the town is built.

At *Coventry* the drainage of the natural area is similarly obstructed by mill dams within the city, and the effluvia from them have formed the subject of loud and just complaint for many years past, but no proper authority or available remedy is apparently provided.

As a remedy for these evils and to render unnecessary the frequent applications to Parliament for additional powers, and extension of jurisdiction, we recommend that the Crown be empowered to define and to enlarge from time to time the area for drainage included within the jurisdiction of the local administrative body.

State of crowded suburbs of Towns.

The evidence that we have received, and the reports of the commissioners, who have visited the several towns, are uniform in their representations of the lamentable condition, in which the suburban districts, and sometimes even the more crowded parts of large towns are generally found from the presence of open pools, and ditches of stagnant water. Patches of land, which the gradual encroachments of buildings have rendered useless for the purposes of cultivation, frequently lie unoccupied, and become receptacles for refuse of the most offensive description. If the soil be of a retentive nature, the evil is increased by the formation of stagnant pools, which constantly load the air with an excess of moisture, rendered most noxious to health by the effluvia arising from the decomposing animal and vegetable matter thrown into them. The extent of these evils at *Liverpool* is described by Mr. Holme.

The account of the condition of a part of the township of Pendleton, a suburb of *Salford*, affords an example of the facility, by no means unfrequent, with which such evils may be remedied by a better division of jurisdiction. The replies to the questions on this subject are almost, without exception, of the same character; sometimes the pools are described as merely stagnant water, not receiving any drainage into them; but more frequently they assume the form of open ditches, and receive the contents of the sewers and drains of the surrounding houses. Evils of this kind are as frequent in the vicinity of the metropolis as in any other part of the country.

We cannot but view the operation of the clauses, limiting the powers under local Acts to streets where less than one-half of the buildings are complete, as offering a serious impediment to the due extension of drains. By excluding the authority of the commissioners until half of a street is completed, houses may be standing for several years without any communication with a public sewer, and in the mean time the occupiers are compelled to have recourse to very objectionable modes of drainage. Under such a provision, the drainage cannot be made to precede the buildings, which a due attention to economy, as well as to health requires. When at last the sewer is made, and the drains laid in at a subsequent period, the work is executed at a considerable increase of expense, and always to the inconvenience and discomfort of the inhabitants as well as interruption to the traffic of the streets.

In *Manchester* there are no less than 450 streets in which repairs have not yet been commenced by the authority appointed for such duties, and those being, for the most part, small back streets, require the greatest attention to their cleansing and drainage.

Liverpool—state of courts and alleys.

Deplorable as the neglect has been with regard to streets, it sinks into insignificance, when compared with the state, in which we have generally found the courts, and those places not commonly considered thoroughfares. In the number and the undrained condition of courts, *Liverpool* appears to have an unhappy pre-eminence, and to surpass all other towns, bad as many of them are in this respect. Mr. Holme states " there are thousands of houses and hundreds of courts in this town without a single drain of any description."

The return made in the year 1841 to the Town Council of Liverpool, by their surveyors, shows that at that time there were 2398 courts, containing a population of 68,345 persons. In these courts, 1272 cellars were occupied by 6290 persons, and of the number of cellars occupied in streets, 2848 were described as damp, and 140 as wet. As these places were subject to no local regulations whatever, until the year 1842, their present condition cannot be a matter of surprise. We may also refer to the report of Dr. Duncan, who traces a large amount of the mortality in Liverpool to the state of these undrained courts. Although it has been stated to us that considerable progress has been made of late years in Liverpool in the extent of main sewers laid down (more than 21 miles having been constructed since 1830, and about the same length being now projected), some time must elapse before the great arrear of works can be recovered, and the proper means afforded for the drainage of these courts.

Leeds, Manchester and Southampton.

The legislative provisions, that have been specially extended to courts at Liverpool, are now found in several late Acts for other towns. At *Leeds*, *Rochdale*, *Southampton*, and *Manchester*, the courts are placed upon the same footing in all matters of sewering, paving, and cleansing, and are now entitled to the same care and protection, as the more public and frequented portions of the town. Greater facilities are also afforded in all the later Acts, for making the newly laid out streets public highways, and for bringing them under the jurisdiction of the local authorities. In the great majority of towns, however, the law still requires alteration.

The universal deficiency of main drains and sewers has hitherto rendered it impossible, to carry out an extensive system of minor drains for the proper conveyance of refuse from the houses. But a more frequent introduction of a system of main drains, and an improvement in the supplies of water have facilitated the use of the minor branches, as the cheapest and most effectual mode of removing all offensive matter from the interior of dwellings. The legislature has lately granted powers to local authorities to compel them to be made. The earliest local Act brought under our notice that contains provisions for this purpose is that for the town of Leeds, passed in the year 1842. The Acts for Rochdale and Southampton contain the same power, and they all forbid the building of any houses, until a proper drain is provided, to the satisfaction of the authority, from the intended site to the sewer, if there is one within ten yards, but if not, to some cesspool not more than that distance.

We turn from these satisfactory proofs of improvement in the principles of legislation on the subject of the public health, to notice a most objectionable clause in an Act relating to Liverpool, passed in the year 1842, the same year, that the Act for Leeds, above-mentioned, containing a provision of exactly the opposite tendency, received the sanction of the legislature. The clause in question renders the owner of any house liable to a penalty of 10*l*. for permitting offensive matter to flow from a privy or water-closet into any sewers, under the jurisdiction of the commissioners.

We therefore recommend that the construction of sewers, branch sewers, and house drains, be entrusted to the local administrative body.

Paving.

The good arrangement of the surfaces of streets, and their proper inclinations for the speedy discharge of the surface water, is a subject of considerable importance, as affecting the health and condition of the inhabitants of towns, and deserving much more attention than has hitherto been paid to it. We have already adverted to the neglected condition of many of the streets, inhabited by the labouring classes in all large towns from want of underground drainage. These evils are most seriously aggravated by the condition of the surface; this is frequently left without any pavement or harder substance for its protection that what the natural soil affords. In this condition it remains, the inequalities of the surface gradually increasing, and forming larger basins for the reception not only of the rain and refuse water, but of much of the refuse of the adjoining houses; and although the inhabitants are liable to pay rates, no local commissioners are bound to repair the street, until it has been once put into good condition by the owner, and has been accepted by them as a public highway.

The town of *Wolverhampton* has been under a local Act since the year 1814, by which the owners of property in new streets are required to pave them, as soon as three-fourths of the houses are completed, " in such manner as the commissioners direct;" and in return the owners have the privilege of an exemption from rates for ten years. Yet we are informed, on the authority of a Committee of Inhabitants, that the new streets are not paved nor laid out with proper inclinations for the discharge of surface water, and they add, that there are pools and open ditches in some of the streets. This neglected condition of the streets is attributed by them to the want of a controlling power before the houses are built. At *Derby*, by an Act passed in 1825, the commissioners are empowered to pave all present and new streets; but the reply on this subject from a Committe of the Inhabitants states, that many new streets require paving and draining. We could multiply these instances by a repetition of the examples before given by us with respect to drainage. But except in places where the jurisdiction of commissioners is excluded, as at *Salford*, and a few other towns, until the streets are more than half formed, there is less excuse for this neglect, the powers for this neglect, the powers for this purpose being generally more stringent, and more frequently found in the local Acts; the jurisdiction of the local authorities is, however, equally excluded from the courts and alleys. The same disregard to their condition is also exhibited in respect to the paving, that we have above shown to exist with regard to the drainage. At Bath, where, as we have before stated, four local Acts are in force, one only contains a power for making sewers. In the report upon that city, it is stated as an instance of the effect of such subdivisions of jurisdiction, that in York-street, near the Abbey, one-half of the street was paved (longitudinally) and the other half was Macadamised. The two divisions of the street were not on the same level. At Manchester we find that although the streets are formed in the first instance by the town council under the local Act, they are subsequently repaired by the surveyors of the Highway Board.

GEOLOGY AS A BRANCH OF EDUCATION.

(From a Lecture delivered before the College of Civil Engineers, at Putney.)

By Professor Ansted.

As a subject of education, I believe Geology is the best adapted of all the Natural History sciences, and requires most immediately the exercise of those intellectual powers which it is desirable to cultivate by such pursuits. This is the case for many reasons. In the first place, Geology is the link by which the sciences of observation, properly called Natural History, connect themselves with Astronomy, and become capable of the application of the principles of pure mathematics. Its leading conception also seems to be that of historical clause: in the consideration of its details, every other department of Natural History must necessarily enter: it admits of both those methods of investigation, an habitual practice of which is most conducive to the advance of the student; and while it opens a new and more extended field to the mathematician, it brings back to simple analytical principles the discursive habits acquired by the observer of Nature's works in the field, and leads him to stricter investigations and habits of closer thought.

But it may be necessary to show how this is the case, and what is the nature of Geological science, and its relations with general science—and this I proceed to do.

Geology, as I have already observed, is not merely an important department of Natural History, but is that particular department by means of which Natural History is connected with mathematical science. Its object is to observe and describe the structure of the external crust of our globe, and from the consideration of phenomena thus presented to view, to trace the successive changes that have taken place upon the earth, and the various laws or modes of action employed in effecting these changes.

The facts of Geology are derived from, and partly consist of, observations made concerning the nature of the earth's crust in all parts of the known world; and they may be comprised under three distinct heads. These are, 1st, the fact of stratification, in other words, the fact that the earth's surface, examined to as great a depth as we are able to penetrate, exhibits not a miscellaneous assemblage of rocks and stones, promiscuously huddled together; but a very regular series of beds or strata, each stratum being itself regular and evenly-disposed, and differing from those above and beneath it. 2nd, The fact of the existence in these beds of the remains of animals and vegetables characteristic of them, and differing for the most part from the species at present inhabiting the earth and seas; and 3rdly, the fact that these different fossiliferous strata are frequently altered from the originally horizontal position in which they must have been deposited; and rocks are occasionally present, which seem to have been subsequently intruded, and their intrusion to have been accompanied by mechanical violence. The three great classes of facts thus grouped and considered in their bearing upon one another, and upon Natural History, form the ground-work of all geological speculation; and the statement of the details with reference to each of them forms together what is called Descriptive Geology. * * *

Practical applications of Geology.

The applications that hear most distinctly and immediately on practical conclusions, are more numerous and direct with respect to Geology than other of the Natural History Sciences. Thus in mining, the selection of a mining ground in an untried district, the determination of the spot where boring for coal or other embedded minerals shall take place, the method of proceeding when a fault or a system of disturbances is unexpectedly met with, are all dependent on the structure of the earth, and are, therefore, in so far, directly geological questions. In engineering, again, the selection of a spot for sinking an Artesian well, the determination as to which is most expedient of two conflicting lines of railway, the actual construction of a railway with regard to cuttings and tunnels, and many other matters of like kind, are also immediate applications of geological principles; and so, likewise, must be considered the selection of a safe foundation, or a good material for building, as geological results not less important to the architect, and the proper management of the soil and subsoil to the agriculturist. In all these cases, however. it is by a knowledge of the principles upon which the science is founded, and not merely upon a slight and popular acquaintance with its general results, that Geology is a useful guide, and an important aid in arriving at practical conclusions.

It cannot possibly be impressed too forcibly upon you that a mere superficial knowledge of facts is absolutely useless, and may even be mischievous, and that this is nowhere more true than with reference to Geology and its application to practice. Every day renders it more important that practical men should be acquainted with Geology; for this science is constantly exhibiting new analogies, new relations of cause and effect are traced, and modifications of laws are discovered, all bearing more or less directly on questions affecting the stability and permanence of engineering and architectural works, whether undertaken on the surface or in the bowels of the earth. But the very vigour of life which causes these discoveries to multiply so rapidly, renders it the more necessary to be cautious and philosophical in arriving at conclusions: and it is therefore a familiarity with the fundamental principles, not an empirical knowledge of results, that can alone be permanently useful.

The general usefulness of a science seems to depend on two conditions: first, on the degree of definiteness of which it is capable; and next, on the nature of its applications. In both these respects Geology ranks very high, and in the latter, more especially, it is hardly surpassed by any science. The importance of distinctness in fundamental principles also will be evident when we consider how much we depend in forming our opinions on the degree of certainty that can be reposed upon the system to which we refer. Now, in Geology, all the main facts are clear and undeniable, and may be made evident to the eye and understanding of every one who will honestly and patiently search for them.

These facts are indeed startling, and seem perhaps to oppose themselves in some measure to preconceived notions; but they are not, for that reason the less certain; nor because they are unexpected, may we venture to set them aside unconsidered. The applications of Geology are, in like manner, numerous, direct, and highly important, bearing immediately on pursuits in which large sums of money are employed, and many thousands of human beings exposed daily to frightful risks, and scarcely less immediately on other occupations, as for example, those of Engineering, Architecture, and Agriculture, certainly most important to the well being and progress of society. In point therefore, of general usefulness and importance in its bearing on practical pursuits, it will, I trust, be clear that our science is well worthy of investigation. * * * *

Geology not speculative but demonstrative.

The point to be chiefly borne in mind in studying Geology, is that it is *real*—a statement of facts, not of opinions. The importance of this can hardly be overrated; for, instead of expressing as a mere probability that the earth was formed according to certain views we may have of the matter, and that if this view should prove correct, the phenomena, whatever they may be, possess a certain significance, Geology simply states as a matter of fact, that there are such and such appearances, account for them how we will, or whether we account for them at all or not. Say what we will, and think as we will, the surface of the earth *is* formed for the most part of beds lying one over another, amounting to a very great number; these beds contain fossils in a certain condition, and they exhibit certain marks of disturbance. These are facts, not speculations—Geology has to describe these facts, and to make use of them; and this is perfectly independent of any attempt to account for them. It is, indeed, true, that half a century ago, these facts were not known, or if known, were not recognised; but the wild speculations of those days of ignorance were not more thoroughly irrational than would be at this day the questioning the existence of observed phenomena, or attempting to account for them by any methods but those we should apply in investigations of other kinds, where no conclusion was to be dreaded, and where common sense and reason were our only guides.

But, besides the general structure of the earth's crust, Geology, we find, also introduces us to a knowledge of certain remains of organic beings, embedded in the different strata at the time of their formation. The study of these introduces another, and a large class of facts, bearing upon general Zoology and Botany; but strengthening, in a singular manner, the conclusions to which we otherwise arrive in the study of pure Geology, or the arrangement and superposition of strata. This subject also involves difficulties, and requires careful investigation; but, like the former, it is real, and not in any sense an opinion or a speculation.

The rocks and their contents, which appear to have been regularly deposited, are now irregular, and exhibit marks of disturbance. The study of these disturbances is one which properly, and even necessarily belongs to our subject; but it is perhaps the most difficult of all the departments of Descriptive Geology, requiring great experience and the exercise of a cautious and philosophic spirit.

The practical applications of Geology form another and somewhat different class of investigations. They, so far as they result immediately from geological principles, offer the strongest testimony to the truth of geological conclusions. Practical men assume the correctness of these conclusions, and act upon them; and in proportion as they are tried by this test, and found to succeed, the confidence felt by the miner, the engineer, and the architect, will be diffused generally in society, and Geology become a part of the necessary information required from those entering on such professions. With regard to this, I would only remind you, that, to arrive at any of these practical results, and to draw conclusions safely, clear and definite notions of the fundamental principles, and the methods of Geology, must be attained; for without these, however you may be able to exhibit superficial knowledge, you cannot possibly be trusted to make an observation, or draw a conclusion.

It is sometimes, and indeed not unfrequently said, that there is hardly enough yet known in Geology to justify these assumptions of importance; and that its systems and arrangements, and conclusions, are constantly changing, so that what is learnt to-day will have to be unlearnt to-morrow. This, however, is the statement of persons who do not know the subject. It is not true, either in fact or in inference. The foundations of Geology are sound and firm, and cannot be disturbed—they are based on a rock, and they may safely defy the storm of ignorance and prejudice. As fact after fact is made known and added to the great store of accumulated knowledge, each now finds its appointed place; the corner stones are set in, the walls are rising rapidly around us, and the temple of our science already shows its broad front, its noble proportions, and something even of its finished beauty. It is true, indeed, that the structure is yet incomplete: here a tower is wanting to strengthen and unite into a solid mass one portion of the edifice—there we may conclude, that another portion has still to be commenced; but what is done is done well. It is work that will endure, for it is based on unchangeable truth.

ON THE CONSTRUCTION AND REGULATION OF CLOCKS FOR RAILWAY STATIONS.

By B. L. Vulliamy, *Assoc. Inst. C.E.*

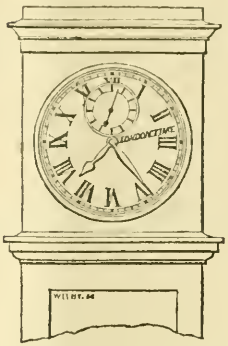
The fact of all the Mails in Great Britain being regulated, by order of the General Post-office, by Greenwich mean time, causes the accurate performance of the clocks at the different railway stations to be a matter of more importance than it would otherwise appear, and offers a sufficient reason for an inquiry as to the sort of clocks best adapted for the purpose, and which can be procured at such a reasonable cost as might be afforded for all much frequented stations.

Great practical inconvenience results from the difference between what is commonly called London time and the correct mean time at the different railway stations on the line. It should be noticed that the term "London time" is not strictly correct, because most of the public clocks in London are intended to be kept to Greenwich mean time. According to the trigonometrical survey, St. Paul's Cathedral, the most important building near the Post-office, is slow of Greenwich time 23·1 seconds; but in this paper Greenwich time will always be referred to as "London time."

By a certain class of individuals the variations due to the difference of longitude of a place is perfectly well understood; but a large proportion of the travellers by railway, possess only vague notions on the subject, and many disappointments ensue from their arriving too late, in consequence of their not understanding that their own clocks show one time while the trains work by another. For example, take the difference between Greenwich and Devonport Block-house flag-staff, which according to the trigonometrical survey is 16 minutes 39·8 seconds (to avoid fractions of seconds say 16 minutes 40 seconds) slow; consequently when it is 12 o'clock at Devonport it is 16 minutes 40 seconds past 12 o'clock in London. Now, supposing a train to leave London at 8 o'clock, A.M., and to arrive at Devonport at 2 o'clock, P.M., performing the distance in 6 hours. A train to arrive in London at 2 o'clok, P.M., must leave Devonport at 16 minutes 40 seconds before 8 o'clock by Devonport time, or the speed must be sufficiently increased to cause the train to accomplish the distance in 5 hours 43 minutes and 20 seconds. This unavoidable inconvenience is increased by the circumstance that the difference is never the same at two consecutive stations, but varies constantly, unless it be in the case of a train on the meridian of Greenwich.

Method of showing London and local time on the same clock.

It appears, therefore, evident that the difficulty just noticed would be in a great degree obviated, if all railway clocks were made to show both Greenwich mean time, or London time, and the actual mean time at the station where the clock is placed. The difference being always the same at the same place, this could be done without any difficulty, and at very little expense, merely by applying two minute hands to the clock, one pointing to Greenwich mean time, the other showing the time of the place where the clock is situated. Greenwich time should be indicated by a gilt hand forming the words **LONDON TIME**, and the other minute hand and the hour hand would be made of steel as usual.



According as the station is east or west of Greenwich, the gilt hand must be placed before or after the steel hand. Upon this plan, in the case of a clock at the Devonport station, the two hands would be 16 minutes 40 seconds apart; and when the steel hands showed 60 on the dial, the gilt hand would show 16 minutes 40 seconds past the hour; in like manner, when the gilt hand showed 60 minutes the steel hand would show 43 minutes 20 seconds, or wanting 16 minutes 40 seconds of the hour. By this contrivance the public would immediately understand that the train which was stated in the railway bill to leave at any given hour, really left 16 minutes 40 seconds before that time, as shown by the clocks at the place; the time announced in the printed bill, referring to London, and not to Devonport time. On the other hand, suppose a country town, Canterbury for example, east of Greenwich. The Cathedral, as shown in the trigonometrical survey, is fast of Greenwich 4 minutes 19 seconds, so in this case the reverse would take place, and the train would take its departure 4 minutes 19 seconds after the time shown by the Canterbury clocks.

All railway clocks should be furnished with a seconds hand, which hand should be set to agree with that which shows Greenwich mean time. This is an additional reason for employing a seconds pendulum.

When clocks are required to be kept to a particular time, fast or slow of Greenwich, which is frequently the case, and that in setting the clock a difference is to be allowed; there is always some risk of a mistake being made, which is much increased by the very short time that in many cases can be allowed for winding it and, if necessary, setting the clock, and more attention is required than can reasonably be expected from an ordinary clock winder. With the double minute hand a mistake of this sort cannot occur; moreover the two hands would afford great facilities for comparing, setting, and regulating the clocks by a chronometer set to Greenwich mean time; for this reason the seconds hand is indispensable.

Electric clocks for Railways.

Mr. Whishaw was of opinion, that the plan of marking different times on the same dial would create confusion, and that it would be better that Greenwich mean time should be adopted for ordinary purposes throughout the kingdom.

Four years ago he proposed, that by means of the electric telegraph, all the clocks along the line of a railway should be regulated to similar time, and it was to be hoped that now the electrical communication was complete between London and Gosport the plan would be adopted.

Mr. Horne thought the subject of considerable importance to the public and to the railway companies. If one uniform rate of time keeping was adopted on railways, it would tend greatly to diminish the risk of collision of trains. He hoped, therefore, that the suggestions of the paper would be attended to.

He had paid much attention to the manufacture of turret and other clocks, and in suspending clocks, he found the simplest method to be by passing a stout bolt through the back of the case, traversing the wall against which the clock was to be suspended, and screwing it up with a nut on the outside; the case could thus be adjusted with great exactness, and being isolated from the wall and from the floor was not subjected to any vibration.

The paper recommended occasionally oiling the pallets. Now Mr. Horne always found that however small a quantity of oil was applied, the rate of going of the clock was altered. He would rather recommend that railway clocks should be placed under the care of a competent person, who should wind them regularly, examine and correct their rate of going, and at the same time clean the pallets, so that they would rarely require oiling.

Mr. Vulliamy was quite aware that oiling the pallets altered, for a time, the rate of going; but he found, practically, that unless unusual care were taken to clean the pallets occasionally, so much dust accumulated upon them that a certain amount of abrasion ensued, and that a greater variation of time was occasioned than could arise from oiling them. He had frequently tried the method of suspension from a single point, and approved of it, but it was not always practicable, and it was more expensive than the system he had proposed.

Adoption of Greenwich time throughout the Kingdom.

Mr. Walker said, that he entirely agreed with Mr. Vulliamy in proposing that the clocks at railway stations, in all parts of the kingdom, should keep Greenwich mean time; but he thought, that Mr. Vulliamy did not go far enough, for it appeared to him that a misunderstanding might still arise, particularly to strangers, who would be unacquainted with the difference between the clocks in the town and those at the railway stations. This would be entirely removed, by all the public clocks in the kingdom being made to keep Greenwich mean time. He had recommended this measure in a report on the Communication with Ireland, made to the Government in

October 1843, when it was also suggested that the true time, at the different towns, might also be shown for astronomical purposes. The dial of the clock upon Granton Pier, Edinburgh, made by Mr. Bryson and which had been finished for some time, was, by Mr. Walker's orders, made upon this principle; but for all ordinary purposes one minute hand, showing Greenwich mean time, would be sufficient and no more inconvenience would be experienced, than was now felt by the difference between mean and solar time, by which clocks are a quarter of an hour before the sun at one season of the year, and as much after the sun at another season. He thought that engineers, particularly those who had the management of railways, would confer a public benefit by advising and promoting an uniformity of time, until that measure should be an effectual mode of accomplishing that desirable object.

Materials for pendulums.

Mr. HORNE said, that with regard to the material of the pendulums of clocks, he had tried almost all the hard woods, and also glass; but he had obtained the best result from using straight-grained white deal, well baked, then painted and varnished, and lastly covered with gold leaf, with a coat of copal varnish over all. This preparation had the additional advantage of preventing the effects of damp.

Mr. GILES stated, on the opinion of the late Mr. Troughton, that straight-grained white deal, when well dried, was less subject to variation than any other wood. When Mr. Giles was instructed by the late Mr. Rennie to take the preparatory measurements for setting out the foundations of Waterloo Bridge, as he could not take them directly across the river, he constructed a platform of a quarter of a mile in length along the shore, and upon that platform he laid down a line with extreme accuracy, by using three deal rods, which he found retained their dimensions better than any other measuring instruments.

Mr. VULLIAMY said, that he had recommended teak for pendulums, because it really was an excellent wood, and it was frequently more easy to be procured of a proper quality, than to find deal which could be depended upon; but he principally approved of teak, because it resisted the attacks of of the white ants in India and as it was not possible to foresee where clocks might be sent to, it was better to provide for the possibility of their going to the East, where a deal pendulum would probably not last above a few days. He frequently used deal for pendulums of clocks that he knew would not leave England, and he thought it, if properly prepared, a sufficiently good material for pendulums.

Mr. DAVISON stated, in reply to some remarks on the difficulty of perfectly drying timber even when cut into small dimensions, that in his process for seasoning casks the wood was frequently subjected to a current of air heated up to 600° Fah. He was of opinion that if wood for pendulums was seasoned by a similar process, and while hot was plunged into oil, the result would prove very successful.

Errors from variation in length and elasticity of the pendulum spring.

Mr. DENT stated, that he had constructed, for Mr. Airy, the escapement which had been mentioned, and he believed that its action was perfectly satisfactory.

He then drew attention to the causes of the variation of time in clocks, which in his opinion was not to be attributed entirely to an alteration of length in a part of the pendulum spring, but in some degree to a change in the amount of elasticity in that spring, arising from a variation of temperature. The subject had been fully treated by Mr. Dent, in a paper read at meetings of the British Association at Cambridge in 1833, and at Newcastle-upon-Tyne in 1838. He extended the inquiry to pendulums and succeeded in separating and demonstrating the respective amounts of effect which changes of temperature produced upon the elasticity of the spring and the length of the rod. When the temperature was increased the clock lost, and when a current of cold air was introduced the clock gained. By careful analysis it had been shown, that of a loss of 12 seconds in a given time, 8½ seconds were attributable to the elongation of the rod, and the remaining 1½ second to the decreased elasticity of the spring. His experience induced him to recommend straight-grained split American deal as the best material for pendulums. He found much difficulty in seasoning it. On one occasion he had prepared some wood by partially exhausting the air, and boiling it for three weeks in a mixture of turpentine and wax; but even at the end of that time air bubbles still rose to the surface. He had also tried boiling the wood under pressure, but with the same result. He was induced to believe that a very good pendulum could be constructed by a combination of a zinc tube 1 inch diameter with a small steel rod. The expense would not be considerable, and he thought the effect would be good.

He approved of the proposed plan for adopting Greenwich mean time generally throughout the kingdom; in some lectures, delivered at the United Service Museum in 1844, he had strongly insisted on the advantages of that system, suggesting its being termed "British time."

Mr. BROCKEDON suggested the possibility of some portion of the variation being due to an enlargement of the diameter of the rod, from the increased temperature, and thus opposing a greater surface to the air during its oscillation; this was in reality very slight, but with such delicate machinery as clock-work the smallest causes produced unexpected results.

Mr. HORNE stated that the weight used as a moving power, for well made clocks, was generally too great, occasioning wear and destruction of the oil. He had a month-regulator, which had gone well for many years, with a weight of only 6 lb. upon the train, which was equal to 1½ lb. upon an eight-day clock. He was of opinion, that the power impinging on the pendulum should be at, or very near to the point of suspension, so as to interfere as little as possible with the natural gravitation of the bob, the principle which is admitted as the most accurate for the admeasurement of intervals of time. In making this statement he considered, that in the best kind of time-pieces the pendulum spring should be entirely discarded, substituting a well hardened knife edge moving upon agate.

Objections to keeping the same time at different places.

Mr. BIDDER believed that the general working of a line by London time had been first introduced upon the Great Western Railway, and the effect had been to oblige two clocks to be kept at the inns adjacent to the line—one showing London time, and the other the correct time of the place. He could not approve of the system proposed, as although it might be observed correctly along the line, it would not be adopted in the tracts of country between the railways, and hence constant errors would occur. The errors would be still aggravated by the London time differing both from the solar time and the mean time of the various localities. He thought, that the time tables of railways should be calculated in accordance with the real mean time, consistent with the longitude of the stations; then, by causing all the railway clocks to be corrected, at given periods, by a person appointed for the purpose, accuracy would be insured, without disturbing the present system of local time.

If the proposed system were applied to a railway of the length of those on the continent, the difference of time between the two termini would be immense, and the plan would disturb all existing arrangements as to time. However the plan might be found to answer practically upon our comparatively short lines, it must not be supposed to be advocated by engineers for more extensive lines.

Mr. G. C. B. CURTIS drew attention to the effect of an uniform time in deranging all calculations as to tides; if the proposed system was adopted, an almanac would be required for every town.

Mr. WALKER could not agree with Mr. Bidder in the position he had taken up. The proposal for keeping one uniform time was not applicable to countries whose great extent would render variation between the two extremities of a line so great as to be objectionable; the plan only applied to the railways in Great Britain, and upon them he must contend that the general adoption of London time, for the periods of arrival and departure of the trains, would induce a regularity which did not now exist. He was glad when that plan was adopted on the Great Western Railway, as it showed that the necessity for it was already felt. If the system was established on all the railways, it would by degrees extend to the tract of country situated between the lines, and even all the private clocks would have the two minute hands showing the London time and that of the locality. As solar time had been mentioned, it should not be forgotten that a difference now existed between that and mean time, and that therefore no argument could be deduced from an aggravation of error, as regarded the time shown by the sun-dials.

At present, great discrepancies existed; for instance, on the Great Western Railway London time was observed along the line. On the London and Birmingham Railway, he believed that at Birmingham, Liverpool time was observed for trains going down and London time for trains going up; so that the passengers who stopped at Birmingham for a short time frequently arrived at the station too late for the trains, relying upon their watches, which had proved correct on the first part of the journey.

Mr. Walker must still adhere to the opinion that for all except astronomical purposes, London time might be advantageously adopted; and even where the tides were concerned; because the difference of time on such a limited extent as the coasts of Great Britain, could not be of any practical disadvantage; he thought that the recommendation of Mr. Vulliamy's paper should be adopted, and he drew particular attention to the arrangement of the hands on the dial, which was practically the same as that which had been placed on Granton pier some time since; but he thought it a great improvement in having one of the hands formed of the letters composing the words "London time."

Solar or true time.

Mr. VULLIAMY regretted having omitted in the paper all notice of solar or true time. Formerly, when the use of clocks was very limited, and that sun-dials supplied their place, solar time was constantly referred to, and the best clocks were made with two minute hands, one with a sun at the end indicating solar time, the other marking mean time. These machines were called "equation clocks," because they showed the difference between solar and mean time; they were, however, complicated, and consequently expensive; their great convenience consisted in the hand showing solar time, necessarily agreeing with the time shown by the sun-dial.

The ordinary equation tables indicated the difference between the time shown by the two minute hands, which was constantly varying; at certain periods of the year the difference was only a few seconds, at others it was upwards of 15 minutes; during part of the year the clock was "fast of the sun," which was indicated by the hand showing mean time being in advance of the hand showing the sun's time; the remainder of the year the contrary was the case. The sun-dial only showing the solar time, there was always an equation table engraved on all good horizontal dials, without which precaution it would have been impossible to compare the time shown by a watch with the time shown by the sun-dial. From this it is sufficiently obvious that for all practical purposes mean time could alone be employed.

The principal public clocks at Paris, including them at the Hotel de Ville, which cost the city of Paris 90,000 francs (£3,600), were originally made to show solar time; this had long been felt to be a great inconvenience, and on the 24th of December, 1826, they were made to show mean time.

Previously however to this being done, an inquiry was made of Mr. Taylor of the Royal Observatory, Greenwich, to know at what period the public clocks in London ceased to show solar time. Mr. Taylor applied to Mr. Vulliamy on the subject, who, having examined three of the oldest Palace clocks, arrived at the conclusion that they had never shown any other than mean time, and he did not believe that any other time was ever shown by the public clocks in this country.

RISE AND PROGRESS OF BIRKENHEAD.

(From the Liverpool Chronicle.)

Few places within a short period have risen so rapidly into importance as Birkenhead; twenty-five years have not passed since it contained only about one hundred persons occupying the three houses, which with the ruins of the ancient priory, the ferry-house and a few straggling cottages, were all the buildings then comprised in the township, vill, chapelry, or place,—for there is some difficulty in accurately denominating this now flourishing town,—which suddenly, under the fostering care of men, whose names will for ages be associated with its history, has been ushered into a new state of existence.

Never were works of immense public utility, grand in conception, and admirable in design, commenced with greater spirit and energy than in Birkenhead: within the last few years the whole neighbourhood has assumed a different aspect,—a town now stands where then only a few scattered houses could be seen. Upon green fields which scarcely served for pasture, stately mansions, and magnificent streets, squares, and terraces, have risen; and where the tidal waters, even last year, flowed uninterrupted in their course, hundreds and thousands of labourers are now employed, transforming the sanded shores and weed-clad banks of the Mersey into immense docks, for the accommodation of vessels from every nation and of every clime.

In 1821, steam-boats were first established by the late Mr. George La French, between Birkenhead and Liverpool. The anticipation of the benefit expected from their introduction was soon realised. Previously, the only mode of crossing the Mersey was by boats, propelled either by the oar or by sails, and at certain states of the tide, hours were required to accomplish the short passage. A residence in Cheshire was, therefore, incompatible with any trading avocations in Liverpool, but the mighty revolution which has been effected by the powers of steam, reducing that distance to a mere ten minutes' sail, in a short time caused a current of immigration to set in upon the Cheshire shore of the river, which regularly and progressively added to its prosperity.

The next following years witnessed considerable additions to the number of inhabitants, and to the accommodations provided for them. In 1822 the new church was opened, and several piles of houses erected.

In 1824, the late Mr. Laird, in conjunction with Mr. Forsyth of Liverpool, purchased a large quantity of land about the centre of the town, with the intention of erecting upon it buildings in a style of magnificence unsurpassed in this part of the kingdom. The execution of their plans was confided to Mr. Gillespie Graham, of Edinburgh, from whose designs Hamilton-square and the street immediately adjacent were laid out.

The number of persons who settled in Birkenhead continuing to increase, and much inconvenience being experienced from the want of a public market in the township, an application to parliament was proposed for an act to supply the deficiency, and to establish a police. The suggestion was, however, violently opposed, and it was with much difficulty its promoters were enabled to carry the measure, which received the Royal assent on the 10th June, 1833.

The Commissioners immediately proceeded to carry the provisions of their act into effect; a police force was appointed, the sewerage of the town commenced, and in the following year, the market-house and other public offices were completed, which the increased number of inhabitants had rendered quite requisite. Large masses were now building, and the greatest activity exhibited in this and the adjoining townships. To the southward, joining to Birkenhead, in Tranmere, a pier, graving dock, and ship-building yard, were constructed and in full operation; on the northern side of Wallasey Pool, in Poulton, various chemical works were erected; while in Birkenhead several large ships were building, and to the extensive boiler works, which had for several years been carried on by the late Mr. Laird, an important addition was made by the establishment of the iron ship-building yard, from which, in this year (1834) the John Randolph, the first iron vessel for America, was dispatched.

Hitherto the greater portion of the houses in Birkenhead, and particularly those in the southern, the most densely populated part, had been erected without any regard to regularity of plan or elevation, in narrow and confined streets. In the later purchases, it is true, restrictions had been made for the construction of wider and more regular streets; but little had been done to promote that uniformity of design which it had been the object of Messrs. Laird and Forsyth to attain. In 1836 a considerable area was purchased in the middle of the township, of which a portion was laid out as a park, bounded with wide streets, which crossed it at right angles. The enclosure was soon studded with detached villas, giving a character and appearance to the town that it had not previously enjoyed.

A railway between Chester and Birkenhead, a measure which had been rejected in Parliament some years before, was sanctioned by the legislature in 1837. The greatest activity continued to prevail in the affairs of the township, in which a large Wesleyan chapel, Roman Catholic chapel, a church dedicated to the Holy Trinity, a Scotch church, an Independent chapel, with other edifices dedicated to religious and educational purposes, were successively erected.

A considerable addition was made in 1839 to the larger houses in the township, in another side of Hamilton-square being completed: the Independent chapel was opened, and the foundation of the elegant Scotch Kirk was laid.

New Market.

The Commissioners for the Improvement of Birkenhead, by the act of their incorporation, were empowered to erect a Town-hall for the transaction of magisterial and parochial business, and a prison, together with a Public Market. Towards these purposes Mr. Price contributed an acre of land for the site, in additinn to paying a moiety of the expenses of obtaining the act of parliament. The erection of the buildings was committed to Mr. Rampling, architect, of Liverpool and Birkenhead; his designs having been approved by the Commissioners, they immediately entered into a contract with Mr. Walter Walker for the completion of the works. The front elevation, which is of Storeton stone, in the Grecian style, comprehends an entrance gate to the market and two wings, the one to the left extending 74 feet, containing offices for the magistrates, overseers, and commissioners; behind which, and communicating with them, is a capacious room 72 feet by 24 feet, divided by two screens of columns and folding doors, this room is lighted by three handsome cast-iron dome lights, and has an entrance hall and other requisites. The opposite wing, the entrance of which is in Hamilton-street, contains public offices for the police, a dwelling-house for the constable, and also day-rooms and cells for the prisoners.

But extensive as was the building, it was soon evident that it would be utterly inadequate to the wants and exigencies of the rapidly increasing population of the neighbourhood; and rather than attempt to increase the present the commissioners resolved to erect another market on a far larger scale. Availing themselves of a portion of their lands remaining unoccupied, they purchased some immediately adjacent, so as to afford them a more eligible site for the market, of greater dimensions than any in Liverpool, except the far celebrated St. John's Market.*

The internal dimensions of this light and elegant market are 130 feet by 130. The roof is in three spans—two of 50 feet and one of 30 feet, and is supported by 46 cast-iron columns, 25 feet high. The market is vaulted, the floor supported by 115 columns, and is the largest floor, we believe, ever constructed on cast-iron columns. There is water laid on to each, which is supplied from four tanks over the shops. 700 tons of iron have been consumed, and the total cost of the erection is £23,000. The market was commenced last year, but was thrown back somewhat in consequence of the devastating effects of the hurricane in January, which swept away a portion of the walls. There are two fountains, composed of Portland cement, which throw up columns of water, and are constantly playing at the intersections of the entrances. There are six entrances—two from Hamilton-street, two from Albion-street, and the other two from Market-street and Oliver street. The whole is surrounded by iron railing. There are four rows of gas pillars, and 92 gas lamps. These lights, called "globe lamps," have a peculiarly unique appearance, and are much more elegant than the lamps which are ordinarily seen in the markets. The building, it ought to be stated, is fire-proof. The iron roof, with its louvres and sky-lights for ventilation, is an elegant piece of workmanship, and is similar in appearance to most of the roofs which are to be seen at railway stations, the majority of which have been erected by the same manufacturers. In the vaults are eight ice-houses for the use of the fish shops; the fish stalls are lined with marble. There are two illuminated clocks over each end entrance. The contract was undertaken by Messrs. Fox and Henderson, of the London iron-works, near Birmingham, and under the able and skilful judgment of Mr. Wilson, who has superintended the building from its commencement, Birkenhead is enabled to boast the possession of one of the most graceful and perfect structures of the kind in the kingdom—perhaps in Europe.

* Its dimensions, as compared with the different covered Markets, are as follows.—

St. John's Market ..	.. 555 feet long	by	135 feet broad.
Scotland Road Market	.. 219	ditto	138 ditto.
Great George-street Market	.. 201	ditto	198 ditto.
Gill-street ..	.. 184	ditto	131 ditto.
Birkenhead New Market	.. 430	ditto	130 ditto.
Birkenhead Old Market	.. 185	ditto	90 ditto.

NEW BUILDINGS AND IMPROVEMENTS IN EDINBURGH.

[Of information so seldom and so scantily afforded as is that which reaches us from our Northern capital, in regard to architecture, every mite is acceptable, and we therefore gladly communicate to our readers, the following notice from the *Edinburgh Evening Post.* It would have been more welcome had not every one of the buildings mentioned, been *anonymous,* owing, we suppose, to the excessive modesty of the architects employed upon them. At any rate, they do not seem to be very proud of the share they have had in transforming "Auld Reekie" into a "city of palaces," as we find it here called.]

"Since the building of the New Town of Edinburgh, there has never been a time so rife in new buildings as within the last few years. The city, highly picturesque and beautiful before, has received several fine improvements in its appearance. *Sir Walter Scott's monument,* newly finished, is a grand object, and its great elevation overcomes the disadvantage arising from the somewhat low site on which it is erected. The spire of the *Assembly Hall,* a charming piece of architecture, is now one of the principal landmarks of the city. The only pity is that the building is in a neighbourhood which does not at all harmonise with it in anything, if we except some new edifices in the Elizabethan style, on which the old gloomy houses of other centuries seem to frown displeasure. It is nearly opposite, and down a close too—and that close the abode of poverty—where Mary of Lorraine, the mother of our beautiful but unhappy Mary had her palace and oratory. On the Calton Hill there is being erected a *Debtors' Prison;* the building is to the east of the gaol and bridewell, and will be included within the sweep of the same wall. Talking of this wall, we ought to observe that it is built exactly in the style of the battlements of an ancient fortress, and with its abutting watch-towers harmonises well with the rocky elevation from which, on the south side, it rises. On witnessing the good taste indicated here one cannot help contrasting it with the gross blockheadism which was unaccountably allowed to perpetrate the new barracks erected in Edinburgh Castle. They remind us of a manufactory or union workhouse, and one could almost wish they would tumble down when the inmates were engaged elsewhere. Additions are being made at the end to the north of the *Advocates' Library.* It strikes us that this building has been too much doctored—that it is spoiled and deteriorated by the patchwork addenda which are inflicted upon it. A new edifice would have been the preferable, perhaps the cheapest, expedient of the learned faculty. The new *Physicians' Hall,* a fine building on the north of the New Town, is nearly finished. The front will be highly ornamented, and will form a choice acquisition to Queen-street, rather wanting in striking buildings. The *Commercial Bank,* erecting on the site of the former Physicians' Hall, in George-street, is advancing. It will add another attraction to a street already one of the finest in Europe. It appears to be designed in the Italian palace style. Near it some striking improvements have been made in the buildings intended for public companies and banks. Nothing can be finer than the light, graceful, and ornamental fronts which we meet in this locality. *Donaldson's Hospital,* to the west of the city, is progressing rapidly. It is a truly grand and noble structure, and nothing could have been more judiciously chosen than the fine elevation which forms its site. We understand that no less a sum than 100,000*l.* is to be expended in getting up the building, and adapting its internal economy to the purpose for which it is intended. A new *Heriot's School,* situated at the west end of Rose-street, is nearly finished. The *Political Martyrs'* monument in the Calton burying ground is so far advanced that it can be seen from the North Bridge. Additional erections—stations of railways, and other buildings are soon to be set a-going. And we believe, that in addition to the commodious and elegant villas, and other buildings existing at Newington, a large number of houses are to be erected by one of our banks, which has recently obtained the greater part of the ground. A better site for building cannot be imagined, with its delightful southern exposure and salubrious air. It is a peculiar feature of the present era of improvement, that houses in streets occupied by the highest order of gentry who keep mansions in Edinburgh have been converted into shops and business establishments. This is particularly observable in George street. The stream of rank has a tendency to flow northward in the direction of the back part of the New Town. The shops in several parts of Edinburgh have, in many cases, been improved to a high degree of elegance, and, in some cases, decorated with very fine ornaments. One great evil has been removed from the city, in the covering up of that huge, unsightly stream of dirty water which passed to the sea through the Queen's Park. A sad infliction it was. The laying out of the splendid carriage road, and the excellent arrangement of the grounds, will form permanent attractions to this delightful promenade. A wall around a part of the Royal domains is still wanting, and should be set about:—miserable hedges of whinstone are out of keeping in such a place. It is the felicity of Edinburgh, that close at hand to its busy streets and closely wedged buildings are solitudes such as Zimmerman might have envied. From the park under notice a very short walk conducts to scenes as still and picturesque as are to be found in the secluded spots of the Grampians, while, at some point suddenly attained, there bursts forth the full majestic spectacle of a great and sublime city, and the hum of voices falls upon the ear like soft and distant music. To the stranger and tourist this city of palaces and solitudes forms an abiding theme of interest. We are glad to find that much has recently been done in the way of improving the drainage of the town. We have not a great deal to complain on this point at present, but we think it would be well if some of the common sewers had their outlets at a distance. It is quite unseemly to find, just at Canonmills, a huge common sewer disemboguing itself into the Leith River, and polluting the stream, so that the whole has the appearance of water used in cleaning out a dirty stable. Another foul stream is still permitted to irrigate some meadows towards the back of Piershill Barracks. We cannot help feeling surprised that government, for the sake of the health of the soldiers, does not interfere to have this dangerous nuisance removed."

WORKS ON THE CALEDONIAN CANAL.

(From the Inverness Courier.)

The improvements on the Caledonian Canal, constituting a truly national undertaking, on a scale of great magnitude and importance, are proceeding in a highly satissactory manner, and form an interesting and novel subject of contemplation in our northern region. Along the whole line operations are in full activity. The new lock, intended to provide against the rise of extreme floods in Loch Lochy, is now far advanced, and forms a huge mass of masonry, moulded into shape from the chaos of materials that overspread the adjoining banks. The depth of these solid and massive walls, from the foundation to the coping is about forty feet—the length upwards of four hundred and fifty. The lock gates have yet to be added, and these are to be constructed of oak framing, for which nearly all England and Wales have been searched, in order to procure timber of the paoper shape and dimensions. Indeed, the gate posts are so large, that suitable beams of oak could not be obtained, and blocks of mahogany and teak are to be substituted.

The extensive repairs of the present locks in the Lochabar, or western district of the line, were for the most part completed last year; and those for the central district are now in progress. The first stone of the lower lock at Fort-Augustus was laid on the 21st of June, by Captain Spalding, barrack-master of the fort. Large dams or mounds had to be thrown across the canal channels to exclude the water, and in various instances steam engines, and other machinery, have been erected for pumping. It was necessary to have excess to the foundations of the lower lock, which forms the point of junction with Loch Ness, and where the ground is of a very open and porous nature; and hence a vast power was requisite to drain the site of the works. No less than three steam-engines, of 30, 28, and 6 horse-power, are employed. A quantity of water, amounting to nearly 12,000 gallons in a minute, iz raised in a continuous volume, from a depth of about twenty feet, and discharged into Loch Ness. It may give some idea of this quantity to mention that it would afford a supply of some ten or twelve gallons per day of the purest filtered water to every inhabitant of London, man, woman and child! For moving the huge blocks of stone used in the quoins, and other principal portions of the new buildings, setting frames, with a curious apparatus of cranes (fixed and moveable), windlasses, and other machinery, have been provided; and it is interesting to witness the regularity and ease with which the various operations are directed towards their common object. A similar variety of processes, although on a smaller scale, may be seen at Muirtown, near this town, where additional wharfs are in progress.

The dredging operations on the summit level of the Canal are among the most arduous of the works. A new steam dredger had to be procured, after the most improved model, the hull being entirely of iron, and the machinery of great power. Both this and the steam-dredger formerly belonging to the Canal are engaged in deepening the channel of Loch Oich, and through the district of Laggan, which separates Loch Oich from Loch Lochy. The ground there is for the most exceedingly difficult of excavation, consisting of hard mountain clay, in which are embedded huge boulders of whinstone. Through such intractable substances the progress is necessarily slow, but occasionally nearly one thousand tons are removed in the course of a day. Throughout a part of Loch Oich the bottom was much incumbered with large trunks of trees, some of them containing from four to five loads of timber: these relics of our primeval forests had slumbered for centuries in the bosom of the lake, and many bore traces of fire and the axe.

At certain portions of the line where the leakage in dry seasons was wont to diminish the available depth of water, it has been necessary to add a coating or lining of *puddle* or clay; and this is required to a considerable extent in the reaches above Fort-Augustes and Muirtown. In the former place the process is already in active operation, and in the latter preparations are making for a speedy commencement. The space requisite for the insertion of the lining is first excavated, and the materials are moved from the bottom and sides of the Canal, chiefly by means of numerous horse-runs—the workmen careering up and down planks of timber, at steep inclines, each aided by a horse at the top, and the whole forming a ready and somewhat picturesque mode of transit and conveyance.

The number of men employed varies from fifteen to eighteen hundred. The greater portion of the labourers are natives of the Highlands: the masons are chiefly from Morayshire; and the carpenters and others from Inverness and its neighbourhood. We may add that the works were lately inspected by Mr. Burges of London, one of the principal engineers; and we believe his opinion was, that the greatest credit is due to Mr. Jackson and Mr. Bean, the contractors, whose arrangements have hitherto so fully realized the wishes of government and the public.

COLLEGE FOR CIVIL ENGINEERS, PUTNEY, SURREY.

The Annual Meeting for the Distribution of Prizes and receiving the Report of the Principal on the Progress of Studies in the Institution was held in the College on Tuesday, July 15. His R. H. the Duke of Cambridge had been expected, but was unfortunately prevented from attending.*

The Chair was taken at ½-past 2 o'clock by the Hon. R. E. Howard, one of the Members of the Council, who opened the proceedings by expressing his regret at the absence of the Duke of Buccleuch and Lord Devon, the latter being expected before the termination of the meeting. He then called on the Principal to make a Report.

The Principal, the Rev. M. Cowie, then addressed the meeting. He began by adverting to the main object of Education, viz., to instil *principles* as distinguished from *facts* merely, to lead students to form a system for themselves and not treasure up mere isolated truisms. It was, therefore, more important that the result of the year's work should exhibit the students as having made progress in this argument of principles than in showing a vast amount of mechanical work. He stated that he had traced out for every one a regular system, which comprised the *rudiments* of construction necessary for a civil engineer. He then pointed out a peculiar feature, which here was kept in view, to invite the students as much as possible to combine knowledge of one department with that of another, and instanced the Prize Essays, which would be mentioned, viz., on the "Manufacture of Iron" and on "Ventilation;" intended, the one as an exercise in "Chemistry of the Principles and Practice of Machinery," and the other in "Chemistry of Architecture." He finally referred to the general moral conduct of the students as exemplary,—and explained his position as a *clergyman* at the head of an *engineering* institution, which did not, at first sight, seem compatible, but which would cease to appear so when we reflect that all *education* ought to be carried on under the superintendence of the clergy.

He then proceeded to give the prizes, and announce the names of those who were worthy of mention.

Mathematics—Class I. Kingsbury, Shillito P, Æq.: Class II. Bartholomew: Class III. Neale P. Essay on Iron—Kingsbury. Essay on Ventilation—Codrington. Chemistry—Bridgeman P. Geodesy—Levelling, Iwine P.: Surveying, Codrington P.: General Attention, Clarke P. General Construction and Architecture—Classes I. and II. Bemey P.: Classes II. and III. Woodifield P. Machinery—Classes I. and II. Male P.: Class III. Willett P.: Manipulation, Bartholomew P. Classics—Fraser P. French—Class I. Stephenson P., Class II. Lloyd. German—Class I. Bridgeman: Class II. Hausen. Landscape Drawing—Shillito P., Forde P. Geography—Class I. Shillito P.: Class II. Porter, Legeyt. Geology—Kingsbury. General Industry and Improvement in Several Branches—Brown P.: Encouragement to Improvement—Butley P.

Before the end of the Principal's Report the Earl of Devon had arrived, and taken the Chair, temporarily occupied by the Hon. R. E. Howard.

Mr. Edwin Chadwick spoke most favourably of the past creditable work of the students, whose maps and plans and contour drawings of part of London had been published in the Government Reports of the Commission for Enquiring into the Health of Towns, &c. He showed several instances in which large sums of public money had been completely wasted through the inefficiency of the persons employed in surveys and drainage, and all of which would have been saved to the country if the education here given had been insisted upon as necessary to the holding such important offices.

Dr. Lyon Playfair then made a few remarks on the extreme importance of scientific instruction in connexion with human health. The subject of Ventilation was of immense importance to human welfare, of which he cited instances, and he also particularized how important it was to join Chemistry with the Arts, by referring to the enquiries made for the Smelting of Iron ores, by which it appeared that in some cases 92 per cent. of fuel was wasted in the process as at present carried on. He concluded by proposing a vote of thanks to Lord Devon for his kind and able conduct in the chair.

Mr. Babbage then addressed the meeting, stating that he was extremely gratified with the proceedings. He then enforced on the students the necessity of application to ensure success, by the fact that even in cases where the world generally gave credit for spontaneous natural abilities forcing themselves out in brilliant displays, the real fact of the case was that much study and preparation were resorted to. He instanced Burke (from private information which he mentioned), Sheridan, and Dr. Playfair.

The Earl of Devon in returning thanks repudiated the idea that the College was meant to produce perfect practical engineers, on the contrary, we only meant to lay a *solid foundation* on which practical experience would build a solid superstructure.

Mr. I. K. Brunel said that he fully concurred in these remarks. He wished to assure the students that though they might not perceive at every step of their subsequent practical work science in full action, yet they *would* from time to time feel their own strength when compelled to fall back on first principle, and this he would certify to them from his own personal experience.

After the addresses were delivered the company inspected the College grounds, Lecture Rooms, the Students' Models of Steam Engines, specimens of constructive carpentry, &c. The visitors witnessed the casting of iron, the ladies standing in close proximity to the liquid metal with perfect confidence, and taking apparently the greatest interest in the operation. In the evening the company attended service with the students in the College Chapel.

* Among the company present, in addition to those mentioned, were Sir Patrick Ross, Sir Charles Sullivan, Sir Howard Douglas, Cap. Dawson, R.E., J. T. Leader, Esq., M.P., Col. Hutchinson, Capt. Goldie, Mr. Wilberforce Bird and several other gentlemen connected with the E. I. Company, the Revs. C. T. Robinson, R. Baker, Derwent Coleridge, T. Helmore, S. R. Cattley, and others.

ON THE STRENGTH OF STONE COLUMNS,

By Mr. E. Hodgkinson.

Read at the British Association.

The columns were of different heights, varying from 1 inch to 40 inches; they were square uniform prisms, the sides of the bases of which were 1 inch and 1¾ inch, and the crushing weight was applied in the direction of the strata. From the experiments on the two series of pillars it appears that there is a falling off in strength in all columns from the shortest to the longest; but that the diminution is so small, when the height of the column is not greater than about 12 the side of its square, that the strength may be considered as uniform, the mean being 10,000 lb. per square inch, or upwards. From the experiments on the columns one inch square, it appears that when the height is 15 times the side of the square the strength is slightly reduced; when the height is 24 times the base, the falling off is from 138 to 96 nearly; when it is 30 times the base, the strength is reduced from 138 to 75; and when it is 40 times the base the strength is reduced to 52, or to little more than one-third. These numbers will be modified to some extent by the experiments in progress. In all columns shorter than 30 times the side of the square, fracture took place by one of the ends falling; showing the ends to be the weakest parts; and the increased weakness of the longer columns over that of the shorter ones seemed to arise from the former being deflected more than the latter, and therefore exposing a smaller part of the ends to the crushing force. The cause of failure is the tendency of rigid materials to form wedges with sharp ends, these Wedges splitting the body up in a manner which is always pretty nearly the same; some attempts to explain this matter theoretically were made by Coulomb. As long columns always give way first at the ends—showing that part to be the weakest—we might economise the material by making the areas of the ends longer than that of the middle, increasing the strength of the middle both ways towards the ends. If the area of the ends be to the area in the middle as the strength of a short column is to that of a long one, we should have for a column whose height was 24 times the breadth, the area of the ends and middle as 13,766 to 5,595 nearly. This, however, would make the ends too strong; since the weakness of long columns arises from their flexure, and increasing the ends would diminish that flexure. Another mode of increasing the strength of the ends would be that of preventing flexure by increasing the dimensions of the middle. From the experiments it would appear that the Grecian columns, which seldom had their lengths more than about 10 times the diameter, were nearly of the form capable of bearing the greatest weight when their shaftt were uniform; and that columns tapering from the bottom to the top were only capable of bearing weights due to the smallest part of their section, though the larger end might serve to prevent lateral thrusts. This last remark applies, too, to the Egyptian columns, the strength of the column being only that of the smallest part of the section. From the two series of experiments, it appeared that the strength of a short column is nearly in proportion to the area of the section, though the strength of the larger one is somewhat less than in that proportion.

Mr. Hodgkinson added that he had found the columns to give way chiefly in the direction of the cleavages of the stone; and that hence the same size and shape of the stone cut out of the same block, required very different forces to crush them across the grain from what they did with it.—Prof. Stevelly said, that it was one peculiarity of Mr. Hodgkinson's researches, that they opened up so many collateral objects of interest and wide fields of inquiry. It was easy to see that the present researches might become important to the geologist, by leading him to the source from which originated the splitting up of extended rocks into beds and strata, and the contortions of them; for example, to some volcanic matter forced up vertically in such a manner as to exercise a crushing force upon even distant masses.—Prof. Willis showed, by examples deduced by various styles of architecture, that the ancients must have been practically in possession of similar principles; and from several examples which he gave, it would appear that columns of a shape suited to these principles were again coming into use.

Newcastle-on-Tyne—The monument at the mouth of the Tyne to Lord Collingwood, near to the Spanish battery, is proceding with, and the pedestal for the figure nearly completed. Scaffolding of whole timber is used. The figure will be collosal, and by Lough; and the whole will be about 30 feet high. Nothing definite is done with the high level bridge, or joint railway station. [The grand stand at Newcastle has been much improved by Messrs. Green.

PROGRESS OF THE NEW HOUSES OF PARLIAMENT.

Notwithstanding the public interest respecting the progress of the new Houses of Parliament, little or no information has been published respecting the advances made in their construction. The vast and magnificent pile begins now to exhibit itself distinctly, and as we have been favoured with a permission to examine the whole works, we can give a general idea of their present state.

The ground plan of the building may be described with sufficient accuracy for our purpose, as a rectangular parallelogram. It will be necessary for the explanation of the following account to point out the position of this parallelogram with respect to the points of the compass. The eastern side is the river front: the northern is the front parallel to Bridge-street and Westminster-bridge: the western front of the building, or that towards Westminstar Hall and the Abbey, is less regular than the others; this arises from the broken outline of the site, for at the end nearest Westminster-bridge the depth of the building is comparatively small, whereas at the other extremity it extends much further back from the river. It is therefore obvious that the *south* front or that *farthest* from Westminster-bridge will be much larger than the north front: in New Palace Yard—the large square in front of the entrance to Westminster Hall—a considerable space intervenes between the Hall and that part of the façade of the New Houses towards the square, whereas beyond, in the southern half of the building the façade is in a line with the side of Westminster Hall. The readers idea of the position of the building with reference to the compass will be fixed by reflecting that the the abbey is built east and west, the north transept being towards Parliament-street, and Henry the Seventh's Chapel at the east end.

Of the Towers belonging to the New Houses.

There are, beside some of inferior dimensions, seven towers of great size and height. Of these four are in the river front, two being equidistant from the centre of the building, and two being wing towers at the extremities of the façade. Of the wing towers, that nearest the bridge is completed externally and roofed. The tracery and paneling is finished; the delicate carving of the beautiful turrets at the angles of this tower, has received almost the last touch; the scaffolding is also all removed except a small portion on the roof; and the exterior appearance here has assumed, in every respect, except the glazing of the windows, its permanent form. The Wing Tower at the other end is nearly as complete, but the scaffolding remains, and its turrets are not yet constructed. The design of the Wing Towers are similar.

The two centre towers of the river front, though very much resembling the wing towers, are one stage higher than they. Of the centre towers, also, all the masonry is complete, except the turrets. It is to be observed that the central part of the river front, namely, the portion between the two central towers is one stage higher than the portions to the north and south. Of the whole river façade the external work is completed, with very trifling exceptions; the carving of the central entrance-way from the river terrace to the houses for instance, is not quite complete. In passing along the river terrace the observer is as much astonished by the enormous extent of the building as delighted with its wonderful architecture. The eye becomes almost satiated with beauty. Foliations as delicate and multiform as those of nature, enriched paneling, sculptured bosses and corbels, canopies and niches decorated with the minuteness rather of the pencil than the chisel, long slender mullions springing upwards in moulded lines which at their height branch out into the intricate ramifications of rich window tracery, crockets and finials, and perforated parapet work which from below appear to stand against the sky like lace-work, are repeated apparently in interminable succession. The architectural enrichment seems almost excessive; from the narrowness of the terrace, each portion of the building is brought so close to the eye of the observer, that he is compelled per-force to examine every part in succession. He can never look at the whole or even a considerable portion at once without fatigue, and from his comparative proximity to the the façade itself, it is almost impossible to see the upper portions of it satisfactorily. In order to obtain a *coup d'œil*, he must either go on to Westminster-bridge, where his position is most unfavourable, as he is above the level of the building; or else he must get access to the opposite bank of the river, where, on account of the distance, the delicacy of the details is inappreciable. This is a great misfortune. Considering the river front of the Houses of Parliament as the noblest specimen of civil architecture in Europe—and *incontestably* this is the rank which the judgment of posterity will assign to it—it seems unendurable that any opportunity should be lost for its adequate display. The lowering of the bridge would but partially remove the evil—a general display of the building would be afforded from one side, and in one direction only, and that too from an inconveniently crowded thoroughfare. No! let there be a free uninterrupted view of the magnificence of the structure *on every side*. It is worth examining, and can indeed well endure the examination. Let there be a *broad* PUBLIC terrace, from which a free adequate view may be obtained on the river side; and let a little expense be incurred ungrudgingly in clearing away *all* the houses which surround and encumber the building. After all the intellect and labour that have been devoted to its construction, it were well nigh a sin, that it should be in any way concealed; and, above all, it is a NATIONAL building; it *will be* also a national boast, and the people have a *right* to be able to examine its surpassing beauty on every side.

Beside the four towers on the river side, there are three other principal towers; one at the south-east corner of the building, and therefore at the corner of New Palace-yard. The site of this tower projects considerably beyond the northern or Bridge-street side of the building; it is not yet much advanced towards completion, being scarcely built up to the second range of windows.

There is another large tower in the very centre building, that is, midway between Westminster Hall and the river front. This is called the central tower, but as it belongs to the inner part of the building we shall describe it more fully when we come to that portion of our notice which refers to the interior.

The largest and highest tower of all is the great *Victoria Tower*. This is situated at the south-eastern corner, that is, exactly at the point further from the bridge. At the base of this tower are four enormous shafts at its four corners: from these shafts at a certain height spring arches on which and the groinings between them, the lower is supported. It is to be observed that the lower part of the tower between the archways will be left unenclosed. The arches will remain quite open; this part serving as an enormous porch to the royal entrance. At present the greater part of the four shafts have been nearly completed, and the four great arches which are to spring from them are just beginning to be turned.

With respect to the legitimacy of a lofty tower in civil architecture, it may be observed that in the finest specimens of civil pointed architecture of the continent, examples exist. A lofty elevation such at the Victoria Tower is by no means exclusively appropriated to ecclesiastical buildings. The spire of the Hotel de Ville of Brussels exceeds in height the ball and cross of St. Pauls, and is one of the puress and most splendid specimens of mediæval architecture extant.

The description of the exterior of the New House may be concluded with an enumeration of the parts in which the roof has been put up. They are these—the whole river front, the great part of the Bridge-street front—and on the side towards the Abbey, nearly the whole of that portion of the building opposite Henry the Seventh's Chapel, namely, of that portion between Westminster Hall and the Victoria Tower. The roofs are high pitched, and consist of large plates of galvanised iron pierced by dormer windows.

Of the Inner parts of the Building.

In order to understand the arrangement of the interior it is necessary that the reader should be reminded that the building within contains numerous courts or open spaces from which light and air are obtained for the parts surrending them. There are two series of courts parallel to each other and the river front. Immediately behind the river front and parallel to it are the following courts enumerated in their order from the northern end—the Speaker's Court, the Commons Court, the Commons Inner Court, the Peers Inner Court. On the side next Westminster Abbey and Hall is the Western range of Courts, which enumerated also in their order from the north are these—Star Chamber Court, St. Stephen's Court, House Court, Printers Court.

Of the architecture of these courts it may be said generally that it is characterised by simplicity and an absence of ornaments which give the parts a severe and almost naked appearance. The Courts consist of little but flat stone walls, of which the surface is unbroken, except in the upper part by a few plain windows. Doubtless precedents might be found for this almost monastic severity, but to the eye, excited by the wonderfully elaborate beauty of the exterior façades, the contrast appears unnecessarily abrupt.

The explanation of the interior arrangements requires also that the reader should understand that the principal apartments of the building are all raised above a series of inferior offices—that is, in common parlance, the legislative chambers, the state rooms and royal gallery are all *on the first floor*. To the arrangement of this floor then we will confine our attention.

The building being, as we said, divided throughout its length interiorly by two series of courts, it follows that between these is a continuous pile running *through* the building. This pile is midway between the river range and the range next the Abbey, and is in its purposes the most important part of the structure. Reckoning from the north, this middle range contains the following—residences of Librarian and Clerk of the House (these apartments are visible from New Palace Yard), House of Commons, Commons Lobby and Corridor, Central Hall, Peers Corridor, Peers' Lobby, House of Lords, Victoria Gallery. Of these the House of Lords is by far the most advanced, the roof is on, the masonry wholly finished, and the painters at work at the interior decorations. A stranger would be struck probably at the small size of the two houses compared with the whole building. The House of Lords is but 93 feet long, and the House of Commons 83 feet. The interior decorations of both will be very splendid, gilding and colour being freely employed, especially in the former. In the House of Lords there will be statues also, but the fittings for accommodation for the business of the houses will preclude paintings from forming a part of their decorations.

The House of Commons is comparatively little advanced, the walls are up as high as the top of the windows.

The Victoria Gallery is up to the level of the Lords, though the masonry is not nearly completed. This Gallery will be 130 feet long, and will be most gorgeously decorated with statues and paintings.

The Central Hall forms the interior of the Central *Tower*, the form of both being octagonal. The support is from eight clustered pillars in the angles of the octagon, which in the interior meet and form the pointed roof of the Hall. This structure is raised to the level of the House of Lords, but the masonry is in a very incomplete state.

St. Stephen's Hall is behind the Central Hall: and is raised on the old groining which formed part of the original St. Stephen's Chapel. This relic has been carefully preserved; it consists of a low fan groined roof, supported within by clustered pillars. On the exterior, new buttresses of massive proportions have been built. The solidity and depth of these buttresses form a most gratifying contrast to the rest of the new building. They accord completely with the ecclesiastical character of this portion, and afford a convincing proof of the architect's appreciation of the *spirit* of pointed architecture.

Before concluding this paper, we wish to say a few words respecting the general character of the architecture throughout. It has been brought, as a serious objection to the building, that, notwithstanding its accuracy of detail, it wants the boldness, the play of light and shadow, the vast buttresses, the long drawn aisles, the dim religious light, of olden buildings. We could say much in reply, but our notice has already outran its proper limits: the substance of our answer is this, that the *massive* is not the characteristic of *civil* mediæval architecture. The plain deep buttresses of Westminster Abbey have a stern majestic simplicity in a cathedral; in a legislative palace they would be naked colossal deformities. Did not the old architects understand the spirit and very poetry of their own architecture as well as we? And they uniformly confined the display of strong contrasts of light and shadow to ecclesiastical structures. Look at those most perfect specimens of civil mediæval architecture, the Hotels de Ville of Belgium and the ducal palaces of Normandy and Picardy. In them the façades of the building are made up of elaborate paneling, foliations and parapet work. The buttresses, where they exist, are uniformly small. The Hotel de Ville of Brussels, already referred to, is a rectangular building, supported on an open colonnade, the piers of which are continued upward in slender lines between the windows; at the four corners of the building are four lofty turrets, and in the centre rises the magnificent spire—the design exhibiting an almost magical appearance of lightness. The town-hall of Louvain is an almost unbroken façade, decorated with sculpture of extraordinary minuteness throughout. The façade of the Palais de Justice of Rouen is decorated with the richest and most delicate architecture; the windows are surrounded with multiplied ornaments, statues, and niches; and above is a perforated parapet, ornamented by a light and elegant tower; but there is nothing in the whole building which gives the idea of stern massiveness; though in its ecclesiastical edifices Rouen is full of wonderful specimens of that kind of architecture. Of the new houses of Parliament, to say that they will be the most magnificent public building in London, is but feeble praise. In size they have of course no parallel; but, irrespectively of their vastness, their beauty is beyond comparison. The reviving taste, and the better knowledge of the true principles of architecture are beginning to lead the people to look with dissatisfaction on Sir Christopher Wren's principles of design; and of Westminster Abbey, the original beauty has been so marred, that little remains on which the eye can look with unmingled satisfaction. But this is instituting a comparison of the new and old buildings, merely as to their general relative merit as works of genius; the more accurate method, however, is to consider the new building, in comparison with others of a civil character only; and then indeed there can be little doubt of the rank which it will occupy in the architecture of Europe.

In conclusion, we venture to make a strong and earnest appeal to the architect, to give every facility to the recording the history of the building as it advances. It is a duty which he owes to himself, to architecture, to the English people, He has already elevated the national taste. This exhibition of his genius, although as yet incomplete, has rendered public criticism severer; and buildings which ten years backs had been admired now obtain nothing but contempt. Strange and almost incredible as it may appear, the present building is the *only* one of modern structures which has not provoked more or less dissatisfaction. Every detail of its progress ought then to be carefully chronicled for the benefit of posterity. All the difficulties overcome, all the contrivances to save labour, plans, working drawings, measurements, and even the alterations—we ought to have them all. In the very deviations from the original plans there would be some instruction to be gleaned.

One remark, and only one more; and that is, to notice the admirable regularity and system with which the work is apportioned to the artificers. Though nine hundred men are employed on the works, each one goes through his appointed task with as much method and precision as if the eye of the master were on him alone.

PATENT LAW CASE.

Bunnett & Corpe *v.* Smith.

This was an action for an alleged infringement of the plaintiff's patent for revolving iron safety shutters, and was tried before the Lord Chief Baron and a special jury, in the Court of Exchequer. The trial lasted two whole days; and the jury deliberated for two hours without giving their verdict, which was ultimately returned for the plaintiffs.

The Lord Chief Baron laid down the following points of law, which for their importance we extract from the short hand copy of his summing-up.

"Where a patent is running for anything, if you improve it, when the patent is out, you may have a patent for your improvement. If the improvement be such that you could not use it independent of the patent, you could not have a patent till the expiration of the original patent."

"*A patent cannot be taken out for a principle.* A patent must be taken out according to the statute for *a new manufacture.* If a man make an important discovery, he can take out a patent for the result as a new manufacture for the process as a mode of attaining it. But if anybody else can do the same thing another way, it is not an infringement of that patent. A man cannot have a patent for a result a part from the mode in which it is produced."

"If the person who calls himself the inventor go to the shop of another man, and there see his model, the result, as far as he is concerned, is just the same as if the matter had come into use in the most public manner in the world."

"A partial disclosure to the public, if followed by an abandonment has been treated, under the verdict of a jury, as no publication at all." Some of these points will probably prove new to our readers.

THE PAVILION AT BUCKINGHAM PALACE.

From the 'Times.'

A very curious and striking exhibition in now afforded by the decorations just completed in the interior of the Pavilion, erected on a mount, in the gardens of Buckingham Palace. The favour of a private admission, granted a few days ago, enables us to give a brief description of it. It is known that within the last few years the attention of artists has been directed to the combination of decorative painting with architecture, after the examples of the great Italian masters of the "cinque-cento" school, whilst the introduction of fresco painting, towards the accomplishment of that end, was certainly talked of. Her Majesty and the Prince Consort resolved to try the experiment on a small scale, so as to adorn a summer-house in the gardens of the Palace, and at the same time to offer to British artists a high motive and a fair opportunity for the display, or rather trial, of their powers in the old method.

The "Garden Pavilion" (to speak technically) is a small Swiss-looking edifice, on the summit of an artificial eminence, overlooking the spacious lawn and piece of water in the gardens of Buckingham Palace, which is seen in the distance. The external appearance of the Pavilion is picturesque and fantastic, without any regular style of architecture. The interior consists of three rooms and a kitchen. The principal apartment is an octagon, 15 feet 8 inches by 15 feet 9 inches; and from the floor to the centre of the vaulted ceiling, 14 feet 11 inches in height. This room opens on each side into another of smaller size, 8 feet 10 inches by 9 feet 7 inches, and 12 feet in height.

The central room is the octagon; of the eight sides five are occupied by windows and the glazed entrance; three others by the doors opening on the two side rooms, and by the fire-place, over which is a large mirror, reflecting the whole.

The roof rises into a dome, sustained and divided by eight ribs; and in each compartment is a circular opening, with a a sky background. A rich cornice runs round the room, and below the cornice are the eight lunettes, containing the frescos, by eight different painters. Each lunette is 6 feet by 3 feet; and over each is a tablet, on which is inscribed, in gilt letters, on a brownish-red ground, the particular passage of the poem which has suggested the subject of the painting below. The subject of all these frescos is Milton's masque of *Comus*—a work perfectly adapted to the object in view. The artists selected to try their talent were Stanfield, Uwins, Leslie, Sir William Ross, Eastlake, Maclise, Landseer, and Etty, but the fresco of the last-mentioned gentleman was subsequently removed, and one by Mr. Dyce substituted in its place. Judging from the displaced fresco, which was shown to us afterwards, we cannot wonder at the stern decree which removed such a performance from the walls of the Pavilion. We proceed to notice the eight frescos according to the order in which they are arranged around the apartment. The lines of course form the text of the painting, extracted as they are, from various parts of the masque.

I.—STANFIELD, R.A.

" Yet some there be that by due steps aspire
" To lay their just hands on that golden key,
" That opes the palace of Eternity.
" To such my errand is."—*Comus*, v. 12—17.

Landscape; a forest scene, through which a torrent, broken by rocks and pebbles, flows towards the foreground. The attendant spirit is seen in his shepherd guise, leaning on his crook, in a meditative anxious attitude; while, in the background, through the glade, we see the rabble rout of Comus engaged in their nocturnal revels. The spandrils represent, on the right, a cherub weeping; on the left, a fiend exulting.

II.—T. UWINS, R.A.

" This is the place, as well as I may guess,
" Whence even now the tumult of loud mirth
" Was rife."—*Comus*, v. 200—219.

Comus and the lady. She is standing " near a huge oak, the centre of the grove," as one meditating. Comus stands half hidden by the foliage, and listening to her soliloquy. In the spandrils a seraph looks down with anguish, and a satyr with triumph.

III.—LESLIE, R.A.

" Hence with thy brew'd enchantments,
" Hast thou betrayed my credulous innocence
" With visor'd falsehood and base forgery ?"
Comus, v. 696—705.

The lady, spell-bound in the chair, repels Comus who offers her the enchanted goblet. A bacchante reclining and a young satyr are in the foreground. In the spandrils, white antique masks and white flowers.

IV.—SIR WILLIAM ROSS, R.A.

" What! have you let the false enchanter 'scape ?
" O ye mistook; ye should have snatch'd his wand,
" And bound him fast."—*Comus*, v. 812—816.

The two brother, with drawn swords, drive out Comus and his crew. The attendant spirit stands in front; the lady is seated behind. In the spandrils a bacchante and a Diana.

V.—C. L. EASTLAKE, R.A.

" ——— If virtue feeble were,
" Heav'n itself would stoop to her."—*Comus*, v. 1022.

Virtue, ascending to the " sphery chime," faints on the steep and rugged path. A seraph, with a countenence beaming with tendernes and pity, bends, from above to encourage and aid her. Angels on each side, holding the lily, the emblem of purity, are leaning from the clouds to welcome her, while Vice, under the semblance of a serpent, is seen gliding away. In the spandrils are two pensive cherub heads with an expression of adoration.

VI.—DANIEL MACLISE, R.A.

" Brightest lady, look on me;
" Thus I sprinkle on thy breast
" Drops, that from my fountain pure
" I have kept, of precious cure."
Comus, v. 910—919.

The lady, spell-bound, not only " in stony fetters fixed, and motionless," but asleep or in a trance, is seated in the marble chair. Sabrina and her attendant nymphs are hovering round her. One nymph presents in a shell the water " from the fountain pure." Sabrina, bending over the lady, is about to sprinkle her and to pronounce the " dissevering charm." In front stand the two brothers and the attendant spirit. In the spandrils, two of the deformed " rabble rout" look down in affright.

VII.—EDWIN LANDSEER, R.A.

" —— Their human countenance,
" Th' express resemblance of the gods, is changed
" Into some brutish form of wolf or bear,
" Or ounce or tiger, hog or bearded goat."
Comus, v. 68—71.

The same subject as No. IV., very differently treated. Comus, surrounded by his crew, is terrified by the approach of the brothers, who appear behind in the act of rushing upon them. A bacchante, with a beautiful female form, and the head of a hound, has thrown herself in affright upon the arm of Comus. Other monsters, half brute, half human, in various attitudes of mad revelry—grovelling, bestial insensibility—confusion and terror—are seen around him; the pathetic, the poetical, the horrible, the grotesque, all wildly strangely mingled. In the spandrils are two heads—a grinning ape, and a bear drinking.

VIII—W. DYCE, A.R.A.

" Noble lord and lady bright,
" I have brought ye new delight,
" Here behold so goodly grown,
" Three fair branches of your own."
Comus, v. 968—975.

The attendant spirit, kneeling, presents the liberated lady and her two brothers to their noble parents, who come forth from their " state" to receive their princely progeny. In the spandrils, two guardian angels present crowns of white roses and myrtle.

We shall not at present enter into any minute criticism of these works of art. We can only afford to be general. It may, therefore, suffice to say that hardly one of the artists has " come up" to the design of the poet. The various figures of Comus are good;—that of Mr. Leslie, we deem, the best ideal of the character. " The Lady" is made very little of—a sad burlesque, in most instances, on the high-souled, virtuous, dignified, creation of Milton. Sir William Ross makes her a young lady of " modern accomplishments"—pale and sentimental—whilst Mr. Leslie represents her as an innocent girl, hardly arrived at the age of puberty. With Mr. Eastlake she is a Madonna, and rather stupid looking into the bargain. Perhaps, Mr. Uwins has given the best impersonation of this sublime and noble character. Mr. Maclise's design is that of a very beautiful woman, but freezingly-cold and marble-like, far more so than the subject demands. Mr. Landseer's fresco is inimitable; and, to our taste and judgment, superior to all the rest. He is quite *chez lui*, of course, in the depiction of his various " brutish forms," but there is, independently of this, a mind—a creative genius—in the piece. Their heads are truly unique, and the " upright bruin" is enough to shake one's sides with mirth.

Beneath the lunettes are panels adorned with arabesques, in harmony with the main subjects. Over each door are winged panthers, in stucco, with a head of Comus, ivy-crowned, between them. The ivy and the vine predominate amid the wreaths of many-coloured flowers and fruits the masks and grotesques, which adorn the panels and friezes. Beneath each window is the cipher of her Majesty and Prince Albert, encircled with flowers. The medallions, in bas-relief, on the pilasters, contain figures and groups from a variety of Milton's poems.

A richly-carved and gilt door opens from the central apartment into the room on the left, which has been decorated in what may be called the romantic style. The subjects are all taken from the novels and poems of Sir Walter Scott. The walls of this room, to the height of 12 feet, are painted in imitation of grey marble, with such taste and fidelity as to deceive the most practised eye. Above this wainscotting, which has a very chaste and cool effect, runs a decorated frieze, in 12 compartments, three on each side; of these, the central compartment is formed of a bas-relief, in white stucco, on a dark-blue ground; and to the right and left are festoons of flowers, richly coloured. and surrounding small landscapes, in frames, illustrative of the scenery of the novels.

The ceiling is coved, at the summit of which is a square opening representing sky. Small statues of children sustain the spandrils, and stand on brackets decorated with the thistle, which is also introduced in the border of the pavement.

The room on the right of the octagon room is decorated in the Pompeian style; all the ornaments, friezes, and panels being suggested by, or accurately copied from, existing remains, except the coved ceiling, which is entirely inented by A. Aglio. It is considered a very perfect and genuine example of classical domestic decoration, such as is found in the buildings of Pompeii —a style totally distinct from that of the baths of Titus, which suggested to Raphael, and his school, the rich arabesque and ornaments in painting and in relief, which prevailed in the 16th century, and which have been chiefly followed in the other two rooms.

We quitted the Pavilion with mingled feelings of pleasure and agreeable surprise, rejoiced to witness so gratifying a testimony to the taste of the exalted personages by whose daily visits it will be honoured, and astonished to view the triumph (for so we may call it) which has been already achieved by our fellow-countrymen in this novel and almost untried branch of the fine arts.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

June 23.—W. Tite, Esq., V.P., in the Chair.

A paper was read by C. Parker, "*On the Proportions of the Beams used by Ancient and Modern Architects.*" The paper commenced by comparing the strength of the square and the strongest beam that could be cut out of a round tree, and contrasting the proportions with the usual forms which ancient and modern architects adopt in beams, the former making the breadth, and the latter the depth, the element of strength. It then traced the views that different nations have held and practised in their constructive operations. It stated that the Egyptians preferred the square form of bearing beam, which proportion was used in Solomon's palace, and that the Greeks and Romans used the rectangle placed horizontally. It then remarked that in all the timber buildings erected before and after the Norman conquest, the breadth of a beam was placed to resist an opposing force, and so continued to be used in the rebuilding of London after the fire in 1666. Prior to this date, the system of double framing was introduced on the Continent, and changing the proportion of timbers, made the depth preferred to the breadth, which view is now thought correct. The diversity of opinions thus shown, induced the following experiments, which were made with iron, from the difficulty of obtaining specimens in wood of equal strength. The object was to ascertain the effect of increasing two, three, or more times the breadth of a beam—also of increasing the like number of times the depth of a beam, and the comparative strength of two separate and one compact beam of equal weights. The result showed that every addition made to the breadth, was attended by a decrease of the bearing power in the ratio of $\frac{1}{7}$ to $\frac{2}{7}$ as the case might be, whilst a contrary effect attended the enlargement of the depth; also that two separate beams were much weaker than one compact beam.

A paper was likewise read descriptive of "*A Series of drawings of Buildings in Southern India,*" made some time since under the direction of General Monteith. The drawings comprised some elaborate views of the Pagodas, and the Palace and Choultry of Tremail-Raig at Madura, a city on the Coromandel coast, and erected about the year 1623; likewise of the Great Temple of Shivven, on the sacred Island of Ramisseram, between the Coromandel coast and the island of Ceylon, and but little known to Europeans. This temple and its appurtenances almost entirely covers an area of 830 feet by 625 feet. The building is of different periods, a small shrine or temple having existed on the island from a remote period, but the chief additions were made by the Rajah of Ramnad, about 150 years since.

July 7.—W. F. Pocock, Esq., in the Chair.

Mr. E. I'Anson read a paper "*On the Mosaic Pavement in the Cathedral of Sienna.*" Mr. I'Anson, Jun., prefaced his communication by tracing the general history of decoration in mosaic, up to the period of the revival of the arts—he then called attention to the mosaic pavement at Sienna, which represents the ages of man in seven different stages, as follows:—

1. Infantia—a child playing in a garden of roses.
2. Pueritia—a stripling holding a quoit in his hand.
3. Adolescentia—(the figure almost totally obliterated).
4. Juventus—a figure holding a falcon on the left hand and a bent bow in the right hand.
5. Virilitas—a figure with a pondering mien, holding a closed book.
6. Senectus—a slim figure, robed, supported by a staff, and holding a rosary in the left hand.
7. Decrepitus—an old man leaning on crutches and tottering over an open grave.

Mr. I'Anson then alluded to Shakspeare's description of the seven ages, and observed that it was evident that the same feeling influenced the artist of this mosaic and our bard. This work was attributed to Beccafumi, who flourished at the beginning of the sixteenth century (having been born in 1484, and died 1549)—an epoch prior to that of Shakspeare. It is, therefore, probable that the idea was current at that time, and however much Shakspeare may to us have made the thought his own by the manner in which he has treated it, it is clearly not an original thought with him. The paper closed with a description of some mosaic fragments of Roman work, found about sixteen feet below the surface, in excavating for the new buildings at Freeman's-place, Cornhill, a specimen of which was shown.

"*On the Setting up of Stones, Pillars, &c., as Memorials to commemorate events,*" by Mr. Scoles, Fellow.—The practice of setting up single stones for the purpose of recording events, has prevailed in most countries from the earliest periods on record, as we learn both from sacred and profane authors. Numerous instances of the application of rude stones, either as memorials of events, or as sepulcral monuments, having been adduced, Mr. Scoles proceeded to comment on the use of isolated columns of any of the orders of architecture for such purposes. He mentioned that the Romans, who were, perhaps, the first people to erect columns to record their triumphs or commemorate events, had, in all probability, borrowed the *idea* from the Egyptian obelisks. The refined taste of the Greeks, however, would not allow them to perpetrate the absurdity of applying so important a feature in construction as the column for such a purpose. The column, when used and proportioned to support a superincumbent weight, becomes an object of decorated construction, but when enlarged to colossal proportions, and standing isolated, rather looks like the remains of some gigantic temple. The column known as Pompey's pillar, proves that the Romans did not confine this absurd application to their own country. With respect to this monument, it has been discovered that its shaft was originally an obelisk, thus transformed by the addition of a white marble capital and base, and by being placed on a pedestal. Mr. Scoles, in conclusion, expressed a hope that we should see the day, when those, to whom the control, as respects the erection of public testimonials, may be intrusted, will cease to prescribe the ever-recurring idea of a column as the subject to which the competing architects are to confine their designs.

July 21.—J. B. Papworth, Esq., V. P., in the Chair.

The Duke of Serradifalco, who was present for the first time since his election as an honorary and corresponding member, was introduced by Prof. Donaldson, and admitted by the chairman.

The prizes awarded by the Institute during the session were presented as follows:—To Mr. S. I. Nicholl, student, the medal of the Institute, for his essay "On the Nature and Uses of Slate as a Building Material;" to Mr. W. W. Deane, student, for an architectural design, "Wilkins's Vitruvius;" to Mr. G. Judge, student, for the best sketches on subjects given monthly by the council, "Britton's Public Buildings of London," to Mr. Judge was also awarded the prize for the best notes of the proceedings of the Institute during the session.

A paper was read "*On an antique Portico at Damascus,*" communicated by W. R. Hamilton, Esq. This monument was first discovered by Mr. Hamilton in 1802. From the circumstances under which it was seen, his notice of it was necessarily very scanty, but Sir Gardiner Wilkinson has lately been able to survey it more efficiently, and to supply the measurements from which this paper and the drawings which accompanied it were compiled. The portico consists of six Corinthian columns, about forty-two feet in height. The external columns are complicated with a double pilaster, and the middle intercolumniation is broken into an arch, the entablature, which is highly enriched, going over as an archivolt. This monument is evidently of the same class and period as those of Baalbec and Palmyra.

A paper was read descriptive of the *Temples of Agrigentum*, by S. Angell, Esq., in the course of which he took the opportunity of paying a just compliment to the Duke of Serradifalco, for the interest he had taken in the antiquities of Sicily, and the knowledge and munificence he had displayed in his great work on that subject, the fifth and concluding volume of which he had that evening presented to the Institute.

This evening's meeting closed the session.

REGISTER OF NEW PATENTS.

(Under this head we propose giving abstracts of the specifications of all the most important patents as they are enrolled. If any additional information be required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

IMPROVEMENTS IN THE FORM OF TILES FOR DRAINING, &c.

James Smith, late of Deanston, now of Queen-square, London, Civil Engineer, and William Gardiner Jolly, of Drymen, county of Stirling, Scotland, for "*Certain Improvements in the Form of Tiles for Draining, in Implements for Manufacturing thereof, and in the Modes of Manufacture.*—Granted August 29, 1844; Enrolled Feb. 1845.

This invention consists, Firstly, for constructing drain tiles with in dented ends, so that they will interlock, and give support to each other, and be prevented from getting out of one continuous line. Secondly, improvements in machinery for makng tiles for draining. Thirdly, for giving to machinery, for making tiles for draining, a locomotive progression, by the act of working the machinery itself; so that the workman, standing by the machine, may deliver the tiles, as they are made, on shelves, racks, or surfaces, to dry. Fourthly, improvements in machinery for making tiles for draining, by pressing the material through dies or orifices. Fifthly, for making tubular tiles for draining, one within the other; and, sixthly, in manufacturing tiles for draining, by pressing peat into suitable forms, in or upon moulds, or through moulding orifices.

RAILWAY WHEELS AND CARRIAGE SPRINGS.

John Bower Brown, of Sheffield, merchant and manufacturer, for "*Improvements in combining cast steel with iron, and in the construction of carriage springs.*"—Granted Oct. 10, 1844; Enrolled April 1845.

This invention relates first to improvements in combining cast steel with iron for railway tyre, and secondly to the construction of carriage springs. The first improvement is for combining cast steel with iron for bars of railway wheels, for this purpose the inventor takes a block of iron of such weight together with the steel as will make the tire of a wheel—the iron is heated to nearly the point of fusion and then placed in a cast-iron mould of sufficient depth to receive the iron and steel combined, immediately the iron has been put into the mould it is clamped and then the steel already melted in crucibles is poured in, by this process the steel and iron is combined in one mass, it is then drawn out into a bar and afterwards passed between grooved rollers of the form of the tyre; by this combination the inventor says that railway tyre will be of a superior character to the tyre made by welding steel to iron.

The second part of the invention relates to springs for carriages made up of a series of plates moving or sliding on each other. The improvements consists in forming channels, grooves or recesses in the surfaces of the plates to contain grease or other lubricating matter, which will gradually work out from these grooves as the springs are used by the sliding action of the plates. These grooves or recesses are formed in the plates when they are rolled, and when they are put together to form a spring the lubricating material is placed in the grooves or recess. Another part of the invention is for forming carriage springs of two widths of plates, instead of having all the plates of one width—for railway purposes, supposing the spring is to consist of plates 3 inches wide, the inventor uses other and narrower plates of 2 inches wide, and in making up a spring he introduces a narrow plate between each two wide plates, hence the spring will not have so much extent of rubbing surfaces between the plates as when all are of one width. The claims are—first for the mode of combining cast steel with iron when manufacturing railway tyre; secondly for constructing carriage springs by forming grooves or recesses in the plates as herein described, and also by combining plates of different widths.

ALLOYS OF METALS.

Alexander Parkes, of Birmingham, Artist, for "*Improvements in the manufacture of certain alloys or combinations of metals, and in depositing certain metals,*—Granted October 29, 1845; Enrolled April, 1844.

These improvements relate, first, to five different combinations or alloys of metals, to produce white or pale-coloured alloy.

The first alloy consists of foreign zinc, tin, iron and copper. For 100 lbs. take 33½ lb. "foreign zinc," 64 lbs. tin, 1¼ lb. iron, and 2¼ lbs. copper; or 50 lbs. foreiga zinc, 48 lbs. tin, 1 lb. iron, and 3 lbs. copper, or any intermediate proportion of zinc and copper. To combine these metals, the iron and copper are first melted together in a crucible, in a casting furnace; and while in a fused state, the tin is added in such quantities at one time, that the iron and copper shall not become solid; the zinc is then added, and the whole combined by stirring them together. The flux recommended is 1 part lime, 1 part of Cumberland ore, and 3 parts of sal ammoniac by weight. The alloy may be cast in sand or ingots for rolling.

The second alloy consists of "foreign zinc," tin, and antimony, either with or without arsenic. For 100 lbs. take 66 lbs. zinc, 32¼ lbs. tin, 3¼ lbs. antimony; or, 79¾ lbs. zinc, 19½ lbs. tin, and 2¾ lbs. antimony, or any intermediate proportion. The metals are melted in an iron or clay vessel, with the ordinary black flux; and when well combined, the alloy is cast into an ingot or mould, when for sheets it is rolled cold. For sheathing of ships or vessels, to the above quantities, from 8 to 16 ozs. of metal arsenic is added to the 100 lbs. of alloy.

The third alloy consists of forign zinc, copper, iron, and nickel, so proportioned to produce a white metal as a substitute for German silver, which is effected by first combining the iron and nickel in certain proportions, equal quantities are preferred; but it is essential that these two metals be first combined, and then the copper; and then the zinc added, or the combination of copper and zinc may be added. For 100 lb. take 45½ of alloy nickel and iron in equal proportions, 45½ lb. of copper, and 10½ lbs. of zinc; or 30¾ lbs. alloy of nickel and iron in equal proportions, 46 lbs. copper, and 261¼ lbs. zinc, or any intermediate proportion of the copper and zinc.

The fourth alloy consists of nickel, silver, and copper, either alone or in combination with zinc or other metals. The proportions will depend for what the alloy is required; either of the two following are useful, and little oxidized by the atmosphere—60 lb. copper, 60 lb. nickel, and 20 lb. silver; or 60 lbs. copper, 10 lb. copper, 10 lb. silver, and 20 lb. zinc. The copper and nickel are first melted together, with or without flux, a flux is preferred. When the two metals are melted, the other are added together or separately. The alloy may be poured into ingots for rolling, or cast into sand.

The fifth alloy consists of nickel, iron, and copper. For 100 lb. take 25 lbs. nickel, 25 lb. iron, 50 lb. copper; or 15 lb. nickel, 25 lb. iron, and 60 lb. copper. The iron and nickel is preferred to be melted together, first with either of the fluxes before described, and then the copper added. This alloy is stated to be a new conductor of heat.

The other improvements relate to the depositing of metals, by employing salts, or compound salts, of the metal rendered liquid by heat or fusion, together or in connexion with electric currents. The salts found most advantageous are iodides, chlorides, and phosphates, and generally those capable of holding metals when in a fused state, and also salts in combination with other salts, avoiding the use of those salts which will decompose the salts of the metals employed, as for example; iodides of gold and silver may be used alone, or combined with iodide of potassium or sodium, or with hyposulphites. The process found most preferable for silvering is the following: 6 lbs. of the chloride of silver is fused in a vessel; when fluid, a plate of silver is suspended in it, in connexion with the negative pole of an electrical apparatus, and the article to be silvered to the positive pole, where it will soon become coated with silver, or 6 lbs, of the iodide of silver is fused as above. If to this compound of silver it be desired to add other salts, the iodide of potassium is preferred, in the proportion of 3 lb, to 10 lbs. thereof to 6 lb. of the iodide of silver, and sometimes one to two pounds of the iodide of mercury or copper to 6 lbs. of the iodide of silver. For gilding take 20 oz. of iodide of gold, and 80 ozs. of either the iodide of potassium or sodium, and adopt the same process as described for silvering. The process applied to other metals is the same as for silvering, with the exception of the salts to be employed, and is applicable, with the salts of platinum, copper, or zinc. The claim for this part of the invention is "for the deposition of metals, by electric currents from their salts when in a state of fusion, and whether used separately or combined with other salts."

CORRUGATED IRON ROOFS.

John Spencer, Agent of the Phœnix Iron Works, West Bromwich, Staffordshire, for "*Improvements in manufacturing or preparing plates of iron or other metal for roofing and other purposes to which the same may be applicable.*"—Granted 23rd Nov., 1844: Enrolled May, 1845.—*(See Plate XX.)*

The improvements relate to the manufacturing corrugated sheets or plates of metal with greater facility, and at less cost than the present processes, by passing the plates either warm or cold, between fluted rollers, as shewn in fig. 1, which is a section of a pair of fluted rollers; and for the purpose of giving the plates an arched form, they are passed between rollers, as shown in fig. 2. *a, a*, are two plain rollers, and, *b*, a grooved roller; these rollers can be adjusted in the frame, *c*, and the groove in the roller, *b*, are made to correspond with the corrugations in the plate.

DISTILLATION OF TURPENTINE AND TAR.

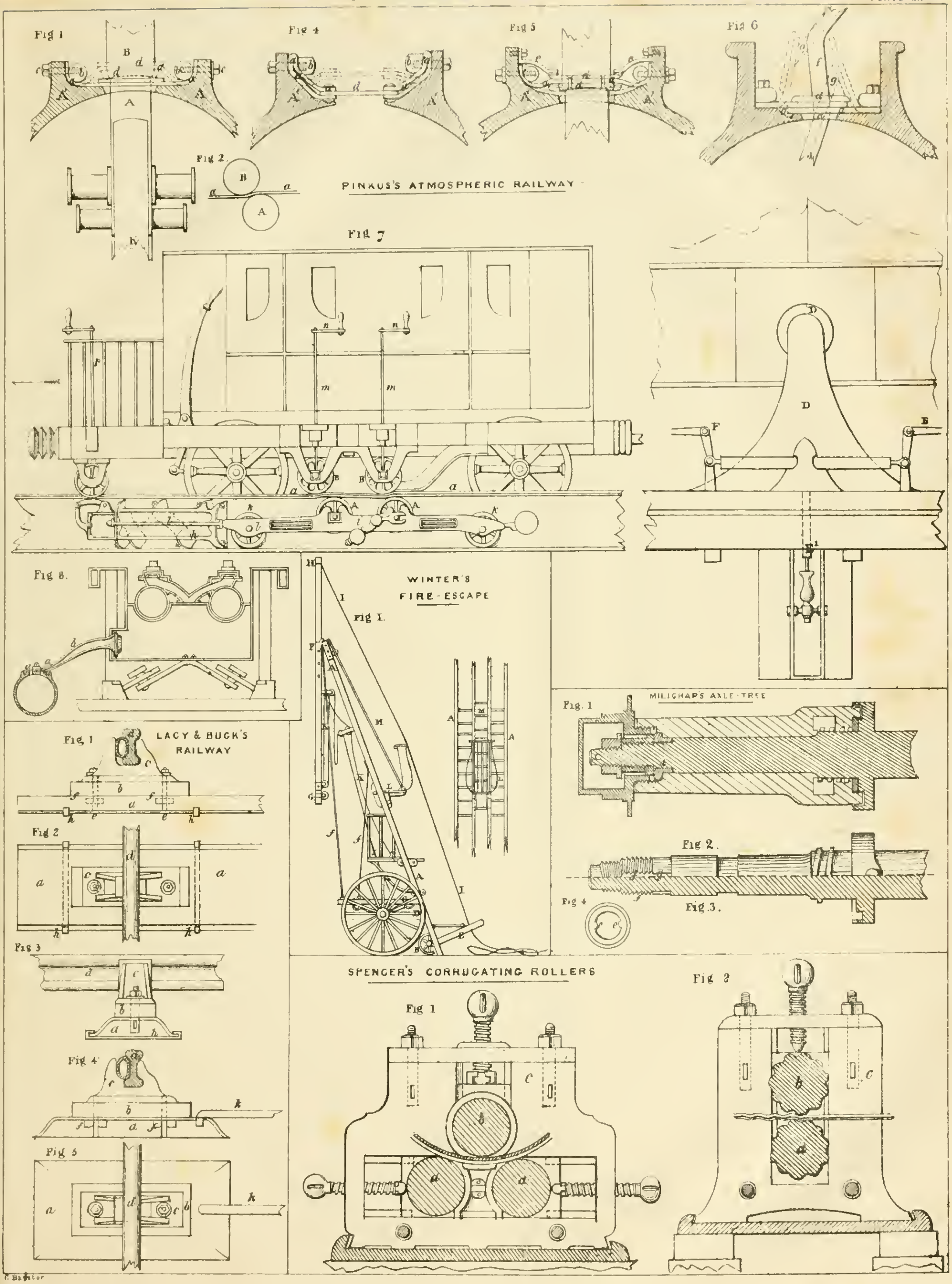
William Oxley English, of Hull, distiller, for "*Improvements in the distilling of turpentine and tar and rectifying volatile spirits and oils.*"—Granted Nov. 25, 1844; Enrolled May, 1845.

This invention consists in distilling turpentine and tar and rectifying the spirits from turpentine and tar and other volatile spirits and essential oils at a low temperature, by withdrawing the atmospheric pressure by an air pump applied to the top of the retort, worm, or receiver. By this application the spirit will flow over at a lower temperature than when distilled by the ordinary plan.

AXLE-TREES.

George Milichap, of Birmingham, in the county of Warwick, for "*Improvements in the construction of axle-trees.*"—Granted November 25, 1844; Enrolled May 1845.—*(See Plate XX.)*

The object of the invention is for the obtaining greater security in preventing wheels coming off axle-trees, and consists in so applying screws to axle-


PINKUS'S ATMOSPHERIC RAILWAY
Fig 1
Fig 2
Fig 4
Fig 5
Fig 6
Fig 7
Fig 8
WINTER'S FIRE-ESCAPE
Fig I
MILICHAP'S AXLE-TREE
Fig. 1
Fig 2.
Fig.3.
Fig 4
LACY & BUCK'S RAILWAY
Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
SPENCER'S CORRUGATING ROLLERS
Fig 1
Fig 2

trees, that in the event of the ordinary securities failing the wheels cannot come off, so long as the carriage is moving onwards, the screws being so applied and arranged in respect to corresponding ones in the axle-tree boxes, that the wheels can only be removed from their axle-trees by turning the wheels back. And it also relates, in applying an improved form of collet.

In the engraving, fig. 1 shows a section of the axle-tree and box complete, with the improvements. Fig. 2, the axle-trees separately; and fig. 3, a section of the axle-tree; and is arranged, so long as the other means of security remain efficient, the screw will not in any way come into action, and is only called into use when the other means of securing the axle-tree in its box have failed, and then the act of the wheel revolving in its onward direction tends to screw the axle-tree box on to the axle-tree. *d*, shows the novel construction of a collet, on the interior of which are formed two projecting ridges, *e*, *c*, and in place of one side of the screw at the end of an axle-tree being made flat on one side to correspond with the flat portion of the interior of the collet, has heretofore made, the screw has a groove, *f*, on either side, so that the collet can pass over the screw, and the projections, *c*, of the collet be allowed to enter into the grooves, *g*, of the bearing of the collet on the axle-tree.

ATMOSPHERIC RAILWAYS.

Henry Pinkus, of Great Marlborough Street, Esq., for "*Improvements in obtaining and applying motive power to impelling machinery.*"—Granted Dec. 27, 1844; Enrolled June, 1845.—*(With Engravings, Plate XX.)*

In order to have a correct idea of the novelties of this invention, it would be necessary to enter into a description of Mr. Pinkus's previous specifications of 1834, 1835, 1839 and 1840, some of which inventions, particularly those of 1834 and 1835, the inventor states have been carried into practical operation and into public use on the Dublin and Dalkey railway, in Ireland. The present specification, which frequently refers the reader to the specifications above named, contains no less than 369 folios accompanied with 35 sheets of drawings. The present improvements consist—*firstly*, in the constructing lines of pneumatic or atmospheric railways with varied modifications in mechanical construction and arrangement; *secondly*, in the methods of applying thereto the motive power, and in the methods of working such railways with greater safety and economy; *thirdly*, in the methods of applying or using the elementary principles combined therewith under varied conditions for better economy. The following is a description of some of the principal features of Mr. Pinkus's specification; one in particular consists in a mode of transmitting the power from the travelling piston to the carriage by means of rollers in place of a connecting arm as heretofore, in the following manner:—

Fig. 1 shows a transverse section of a traction pipe having the longitudinal slit or opening in the pipe covered with a flexible material as follows:—*a a* is a piece of leather or other flexible material firmly attached at each edge, and throughout the whole length of the line, by means of rods of iron *b b*, and set screws *c c*, passing through projections cast on the traction pipe; *d d* are plates of iron rivetted on the upper and under side of the flexible material *a a*, for the purpose of strengthening the same. A, fig. 2, is a roller attached to the travelling piston within the traction pipe, this roller is of such diameter as to raise the flexible covering of the pipe into the position shown in dotted lines; B is a roller attached to the leading carriage of the train, and in advance of the roller A, the periphery of the roller B is from one to one and a half inches below that of the roller A, so that as the latter is forced along the traction pipe the flexible covering is raised as above described and pressed against the roller B, so that it acts as a continuous inclined plane, thereby causing the train of carriages to be propelled forward; in fig. 2 we have given a side elevation, showing more clearly the action of the rollers: similar letters denote corresponding parts in all the figures. Fig. 4 shows a modification of the flexible covering; A′ A′ shows a transverse section of a portion of the traction pipe, *a a a* are two pieces of leather or other flexible material firmly fixed along each side of the opening in the pipe by means of rods *b*, and screws *c*, as above described; *d* is a steel plate about 4 inches wide and ⅛ inch thickness, this plate is firmly held between the edges of the leather *a a* by means of rivets, the dotted lines show the position of the flexible covering when raised by means of the rollers, which according to the drawings is one inch. It will be observed, that as the piston travels along the plate *d* will be bent in a direction of its length, as shown with regard to fig. 2. Fig. 5 shows another modification of the flexible valve or covering for the longitudinal slit, and consists of a piece of leather *a a* strengthened with narrow metal plates *d d*, which are about 4 inches by 2½ and attached to the leather by means of rivets; *e e* are also wrought iron plates firmly fixed to the pipe and of the form shown in the drawing, the object of these plates is to prevent the flexible material from stretching, and in order to accomplish this the outer edge of the plates *e e*, and on the underside thereof is made with a number of indentations or teeth which receive similar indentations, or rather projections, formed along each edge of the plates *d′* as the same is raised by the roller aforesaid, thereby preventing the flexible material from being elongated. Fig. 6 shows a transverse section of a duplex valve, *a a* are pieces of leather strengthened with metal plates *d d*; *f* is the piston rod or arm which connects the piston with the carriage, this arm supports two bevel wheels *g g*, a portion of which is shown in dotted lines, the object of the wheels *g g* is to open or raise the valves in the position shown in dotted lines as the arm travels along; it will be clearly seen that one valve is made to overlap the other.

Having thus briefly noticed some of Mr. Pinkus's valves, or mode of closing the longitudinal slit or opening, we will next describe the methods of working atmospheric railways according to the present invention. Fig. 7 shows a vertical section of a carriage supposed to be descending an inclined plane *h h* is the travelling piston, which is made to turn round or revolve upon the rod *i*, the object of which we did not notice; the rod *i* is supported by two carrying wheels *k k*, situated in the vertical plane, and is also provided with guiding wheels *l l* situate in the horizontal plane; A A are the two wheels, supported by the rod *i i*, for raising the flexible covering *a a* and forcing the same against the wheels B B for propelling the train of carriages, these latter wheels are, as will be observed, attached to the under part of the carriage, and we presume are capable of being raised or depressed by means of the rods *m* and handles *n*; *o* is a pressure roller, which can be raised or lowered by means of a rod *p*, and handle *q*; *r* is a lever which is always in contact with the underside of the flexible valve or covering, the outer end of this lever is connected with a valve at *s*, so that by depressing the pressure roller *o* by means of the handle *q* the valve *s* can be opened so as to allow the air to pass for the purpose of retarding the motion of the carriage; D is a branch pipe communicating with the traction pipe on each side of the transverse valve E^1, the outer end of this pipe, as at D^2, communicates with a huge hemispherical vessel or vacuum chamber. Now we have stated that the carriage or train is supposed to be descending an incline, the vacuum chamber being at the top of such gradient, at the bottom of the gradient there is another vessel intended for compressed air. Suppose, therefore, a train of carriages to have arrived at the top of the incline and are proceeding down the opposite incline in a direction of the arrow, the first carriage of the train will close the valve E, so as to shut off the communication between the vacuum vessel and that section of the pipe and will open the valve F, and the consequence will be that as the train descends by its own gravity a partial vacuum will be formed in the vessel, and moreover the air contained in the traction pipe and in front of the piston will be forced into the receiver or vessel for compressed air, and will act as a cushion to retard the progress of the train; so that the power thus generated by the descent of the train may be beneficially employed in resisting the next train up the incline.

This is no doubt what is intended, but we very much question it since there is no rigid connection between the piston and the carriage whether the latter would not run away and leave the piston either to go back again or remain motionless. By way of conclusion to this mode of propelling a train of carriages, we will suppose that a train weighing from 30 to 50 tons was about to be started; we will also suppose that in front of the piston there is a transverse slide or stop, and that in front of this stop the air has been exhausted, or partially so, so as to form a vacuum of from 5 lb. to 10 lb. on the square inch; the train being now ready for starting the transverse slide is withdrawn and the above pressure suddenly transmitted to the piston, the effect of which would be that instead of setting the train in motion, the first carriage, by reason of the sudden impulse given to the piston, will be raised from the rails and the piston liberated, which would dart off like an arrow leaving the train of carriages behind. This certainly might in some measure be obviated, either by loading the first carriage to an enormous extent, or by the application of wheels fixed to the carriage and working under lateral projections cast on each side of the traction pipe so as to prevent the first carriage being raised and thereby liberating the piston.

Another mode of propelling according to this invention is by constructing a double line of rails, between each line there is a traction pipe, and between the two lines there is a pipe for compressed air. At suitable distances along the line there are valve boxes which are connected together by another line of pipes, (in all making four), termed transfer pipes, the valve boxes are provided with suitable valves and apparatus for opening and closing the same, the object of this arrangement being to propel the piston by means of compressed air on one side and a partial vacuum on the other. The apparatus or levers for opening and closing the valves are attached to the first carriage of the train, so as to open a communication between the reservoir containing compressed air and the propelling main, that is to say behind the piston, the transfer pipes before spoken of form a medium through which a vacuum is created in advance of the piston.

The specification also describes a mode of propelling a double line with a single line of pipes. In order to effect this purpose the inventor proposes to lay down on one line a length of pipes, say one mile, at or near the termination of this length the pipe branches off to the next line of rails, and is continued for another mile, near the termination of which length there is a second branch pipe, so that the propelling main, in place of being in a continuous length along the line, is in lengths of a mile each, more or less. The object of this arrangement is to propel the train of carriages for the first mile by atmospheric pressure, the second mile being travelled by the momentum acquired in travelling the first mile,—so that the train travels one mile by atmospheric pressure and the next by momentum. In order to facilitate the ingress of the piston into the termini of each length of pipes the same are made with trumpet mouths. It is almost needless to add that the weight of the train under these circumstances must be limited according to the distance between each length of pipes.

Another mode of propelling a double line is shown at fig. 8, which shows a section of a propelling main having two longitudinal openings covered by a valve *a a*; *b* is a hollow arm flattened at the inner end so as to pass underneath the valve *a*, the outer end of this hollow arm terminates in a ball and socket joint attached to a vessel carried by a locomotive engine of the ordinary construction: the operation is as follows—the air in the traction pipe being exhausted a partial vacuum will be formed in the aforesaid vessel and the engines of the locomotive will be worked by the pressure of atmosphere in the same manner as the present application of steam.

We will just state in conclusion that the specification shows the application of some of the principles hereinbefore described to propelling boats on canals, also a mode of propelling a train by the application of a series of endless ropes, together with the application of rotary engines for the purposes above described. The sum and substance of the claims are for the arrangement and combination of machinery or apparatus as described with respect to the several figures or drawings and their application to the purposes hereinbefore described.

RAILWAY CHAIR AND SLEEPER.

Henry Charles Lacy, of Kenyon House, near Manchester, and George Watson Buck, of Manchester, for "*a New manufacture for and method of sustaining the rails of railways.*"—Granted Nov. 29, 1844; Enrolled May 29, 1845. *(With Engravings, Plate XX.)*

The patentees state that the stone blocks and wooden sleepers now in use for sustaining the rails of railways are subject to certain objections in practice which this invention is intended to obviate. The stone blocks, by reason of their weight and unyielding nature, are subject to sink in the ballast more than a lighter substance would do with the same bearing surface, and therefore constantly require to be raised, which is attended with great expense and difficulty. The objection to wooden sleepers is that they are liable to decay, and also to be knocked in pieces by the constant packing, and moreover when the pins are driven in the sleeper is liable to crack and split. The inventors in order to obviate these defects employ sleepers of wrought or malleable iron, which forms the subject of this patent.

Fig. 1 is a side elevation, and fig. 2 a plan of one of these improved sleepers fig. 3 shows a transverse section thereof taken parallel with the line of rail, In figs. 1, 2, 3, *a a* is the cross sleeper, the peculiar form of which is shewn in section at fig. 3, *b b* are blocks of wood, *c c* are chairs, *d d* the rail, *e e* the bolts or pins as shown by dotted lines in figs. 1 and 3, these bolts, which have a cotter *f* at one end and a nut *g* at the other, pass through the chair and wood block and fix the same to the cross sleeper, *h h* are ties of iron placed across the under side of the sleeper and turned over the edge thereof for the purpose of stiffening it (see fig. 3).

Fig. 4 represents a section taken transversely, or across a railway constructed with short or half sleepers, the form of which are something like an inverted tray, having the wooden blocks, chairs, and bolts with nuts and cotters as before; the two sleepers which are opposite to each other on the line of railway are secured together by a wrought iron bar *k*, bent at each end at right angles so as to pass through holes made in the sleeper. The specification concludes that "we would have it understood that we do not claim as our invention the exclusive use of the several parts of a railway, such as the rails, chairs, and modes of fastening shown in the drawing, except when the same are employed in connection with our invention, which consists in the manufacture of a sleeper or bearer of malleable or wrought iron, and its application to sustaining the rails of railways as above described."

James Winter, Sen., of Wardour Street, Soho, Middlesex, J. Winter, Jun., of the same place, and William Lane, of Bedford Place, Russell Square, in the said county, for "*an Improved scaffold or mode of scaffolding, applicable also as a fire escape for life and property.*"—Granted Dec. 2, 1844; Enrolled June 2, 1845. *(With Engravings, Plate XX.)*

Fig. 1 shows an edge view or side elevation of this apparatus, which consists of a double ladder A A, the lower extremity of which is made to run upon iron wheels B; C is a frame or carriage supported on travelling wheels D, mounted on springs in the usual way; E is a handle or frame for moving the apparatus from place to place; to the upper part of the ladder A A is attached, by means of a pin joint, a ladder F G, the two sides of this ladder are continued from F to H, the staves of this part being dispensed with, such part forming as it were a lever; at H is attached a wire rope I I, by pulling at which the end G, of the ladder F G, will be raised so as to form a continuous ladder with A A, as shown in dotted lines; J is a movable gallery or platform capable of being raised to any required height by means of ropes or chains K K; L is another movable stage supporting a ladder M, which may be of lighter construction than the others, this ladder, which is attached at its lower end to the gallery L, by means of a pin joint, is provided at its upper end with two rollers, the object of which is to facilitate its movement when passing over the ladder F G, or when against the wall of a house. The gallery L, and ladder M, and also the gallery J, may be raised by means of ropes passing round a pulley and working upon the axle of the carriage wheels D, motion being given to such pulleys by means of a winch or handle; *f f* are wrought iron rods for supporting the ladder A A.

Fig. 2 shows a front view of a portion of the apparatus described, in which similar letters denote corresponding parts. There are other modifications of the apparatus above described, one of which is so constructed that the whole machine can be brought in a horizontal position so as to be more readily moved from place to place; it is also constructed stronger and better adapted for scaffolding. The claim is for the mode of arrangement and combination of parts, together with the principles of construction upon and according to which such modes of arrangement and such combination of parts are made, and by which the same are carried into practical effect, and that in the manner as we have before specified, described and set forth in this our specification and drawings thereof.

RAILWAY SPECULATIONS.

The following letter, on account of its interest and importance, we have extracted from *The Times*. It exposes the present system of Railway jobbing with great force and accuracy. Though we for the most part abstain from discussing what may be termed Railway politics, and confine ourselves to scientific information respecting railways, still the evil alluded to in the following letter, has now arrived at such a height that we should consider it a neglect of duty to abstain from all notice of the subject.

Sir,—The subject of this title is, at the present moment, of the greatest importance. The money-market is crowded with schemes; most of these are railway projects. Many of them have for their object the construction of railways in foreign parts. Whether the transmission of capital for the benefit of other countries is politic or not, or whether it should be encouraged or repressed, is not intended to be discussed in these observations. What more immediately demands attention is the legal rights of those who invest in railway shares. Let us first take railways which are proposed to be established in Great Britain and Ireland.

A railway scheme is advertised. Persons desirous of having shares are requested to apply for them by letter in a particular form. Under this letter the person applying agrees to sign the requisite deeds when they shall have been prepared. These deeds are, the one called a "Parliamentary contract," and the other a "subscriber's agreement." The former is a contract authorizing the directors therein mentioned to take necessary steps for obtaining an act of Parliament, and pledging the shareholders who sign it to the payment of "calls," as may be directed by the act of Parliament when obtained. The latter is a contract by which the shareholders engage to conform to certain rules and regulations therein contained, pending the acquisition of Parliamentary authority. These stipulations apply to the appointment of directors and officers, the powers to be exercised and duties performed by them, the amount of capital to be raised, &c.

Under the recent statute, 7 and 8 Victoria, c. 110, these companies must be registered. The registration is of two sorts—"provisional" and "complete." It is not necessary to consider what is to be done in order to obtain either "provisional" or "complete" registration. But, when procured, the "provisional" certificate insures for a year, and may be renewed for another year, but not longer. The powers conferred by it are particularly stated. The company may assume their "name," open subscription lists, allot shares, and receive deposits not exceeding 10s. per cent. beyond the amount required to be deposited by the standing orders of Parliament. They may also take steps to obtain their act; but they are prohibited from making calls. Nor can they purchase lands, or enter into contracts for works, except conditionally upon obtaining their act. Contracts for surveys, and other things to be done in order to get to and through Parliament, may, however, be entered into. Penalties are inflicted if deposits are taken, allotments made, or scrip issued, before "provisional" registration has taken place.

The certificate of "complete registration" ceases to have effect from the moment the act of Parliament has been passed. The powers conferred by the certificate are—the liberty to use a common seal with their name upon it, the privilege of suing and being sued in their registered name, the right to issue certificates of shares, and, conditionally upon obtaining their act, they may enter into contracts for works, &c. But the same prohibition exists as under "provisional" registration as to the purchase of lands, making of calls, and otherwise; but they may hold "general" and "extraordinary" meetings from time to time. Their powers extend no further.

To the uninitiated public this sketch may be useful. It will show them what powers may be exercised by a railway company from the time of their announcement to that of their completion by legislative sanction. But it is of more importance to them to understand what is the condition of those who ask for shares, and those who obtain them whether mediately or immediately, from the original holders.

The person who writes for letters undertakes to sign the necessary deeds, already described. The moment he receives his scrip or shares a contract has been made between himself and the directors to execute a particular instrument. This contract may be enforced, either by action at law for damages, or bill in equity for specific performance. He cannot escape from it. He may think to relieve himself from this responsibility by selling his "scrip" in the market. No such result will follow. The company may still hold him to his bargain. They cannot be compelled to receive his assignee as their shareholder or partner in the undertaking. It has been stated that under "provisional" registration shares may be "allotted," and under "complete" registration "certificates of shares" may be issued. The remarks just made will apply to both.

So much for the position of the first holder. How does the second or subsequent holder stand? He pays his money, probably including a premium, for a given quantity of "scrip." The scheme is a prosperous one; and when the act of Parliament is obtained, he expects to be registered as a shareholder. No such thing. He presents his "scrip" at the office, desires to have them exchanged for "shares," pursuant to the act of Parliament, and is ready to sign the "register of shareholders," but may be refused! He has no remedy against the company. He has bought a nothing. He may probably resort to his immediate predecessor, endeavour to compel him to refund on the ground of failure of consideration; but where is he?

These are the respective conditions of the first and the last holders, between the inception and completion of a railway company. Are the public aware of this state of things? But what are "scrip," what are "shares?"

A "share" is a certain part, or definite amount of interest in a particular company. That company must be established before any share can be said to exist. Where, therefore, "scrip" are issued between the time of its announcement, and that of obtaining the act of Parliament, they are not "shares," because they cannot legally be transferred; they are merely instruments which will entitle the persons who may have subscribed the deeds beforementioned at the time of obtaining them to have "shares" given to them by the company after the act of Parliament has been procurred—in other words, when the company have been established. But they convey no property by assignment. The act alone constitutes "shares," and makes them transferable. The certificates are evidence merely of the right of the first holders to obtain "shares," and sometimes, to distinguish them from the real title to shares, or shares, are called "scrip certificates." If the public doubt whether this is so, let them consult the judgment of Lord Langdale in "Jackson v. Cocker" (a name quite 'apropos') in the 4th vol. of 'Beavan's Reports,' p. 59.

Inner Temple, June 2. C. W.

ON THE HISTORY AND PRACTICE OF SCULPTURE.

A series of Lectures delivered at the Royal Institute, by Mr. Westmacott, A.R.A.

LECTURE III.—(From the Athenæum.)

Mr. Westmacott's third lecture, delivered on the 22d ult., concluded the History of Sculpture in Greece, and reviewed the condition of the art in Rome, to its decline there in the seventh century.

It was observed that the schools of Phidias, Praxiteles, and Lysippus had carried Sculpture to its perfection. And it was the opinion of Winckelmann that, after that nothing was left in Sculpture but what was produced by a class of mere imitators. Mr. Westmacott admitted this might be true to a certain extent, but the names of many eminent men are handed down to us who continued to produce works quite in spirit of the great masters. If artists, originating ideas, and giving form to their own fancies, adopt the most approved principles of Art for effecting this object, they surely merit high praise for carrying on the established excellence of a school. They may justly be reflected upon as mere copyists, who, not drawing upon their own feelings for subjects, servilely steal the ideas of others, and then produce cold, passionless resemblances, which only serve to remind the spectator how unsatisfactory the best copy of form may be, if it be wanting in the life and interest of invention.

At the dismemberment of the Macedonian empire, the Seleucidæ, who reigned in Syria, endeavoured for a time to uphold the arts; and Hermocles, a sculptor, is especially mentioned as having been extensively employed. Pergamus received Attalus for its ruler, and several sculptors of eminence are recorded who were employed to illustrate his and his son's victories over the Gauls. Ptolemy, and his immediate successors in Egypt, also showed a disposition to encourage Sculpture. The assertion, therefore, of Pliny, that from the 120th to the 155th Olympiad Art was almost extinct, is not quite borne out by facts.

The mention of Chares as the author of the celebrated Colossus of Rhodes, suggested the propriety of referring to the sculptors of that island. Some very fine specimens of the art were produced in its school. The authors of the celebrated group of the Laocoon, Agesander, Polydorus and Athenodorus, were Rhodians; as were Appollonius and Tauriscus, the sculptors of the enormous marble group of Zethus and Amphion tying Dirce to the horns of a wild bull. It is at Naples, and is known as the Toro Farnese. It is almost incredible, that from this small island the Romans brought away as many as three thousand statues.

In speaking of the Sculpture of Sicily, the lecturer observed, the art never was practised there in a way that gives it a claim to be considered as a school. He particularly recommended an examination of some of the coins of Syracuse to the attention of those who desired to see examples of a rich and free style of form, united with exquisite execution. Some of the medals are among the finest specimens of art. It was observed that some of the most admired productions in Sculpture have been attributed to artists who lived as late as 150 B.C. Among these are the fine fragments called the Torso of the Belvedere, at Rome; the Farnese Hercules; the statue of the Fighting Gladiator; or, more properly, of a warrior. These works have the sculptors' names on them. The statue of the Hermaphrodite, at Paris, is also attributed to this age; and some antiquaries have added the above-mentioned group of the Toro Farnese, and even that of Laocoon and his Sons.

The fatal blow to the Arts in Greece was given by the conquest of the Romans. In 86 B.C. Athens fell, never to rise again. The history of Greek Sculpture may be considered to close at this time.

Style, Manner, Ideal Beauty.

STYLE, it was said, had been applied, first, comprehensively—to the whole or pervading character of Art—as in the production of a school or class. It involves completeness; or an entireness of conception and expression. Thus, the Etruscan school is whole, and entire as a class, and has its style. The Elgin Marbles equally are examples of style, as marking a school of Art. Secondly, it is applied to a quality exhibited in individual works, which do not necessarily belong to a particular time or school. To illustrate this by reference to the works of the great masters spoken of in a former lecture, Mr. Westmacott said, the schools of Phidias and Praxiteles are thought to have combined all the great qualities of imitative art. They discovered and represented the finest combinations of forms; uniting the parts, in themselves perfect, so harmoniously in a whole, that it, also, was perfect and complete. As every part was fitted to advance the end, each having its due place, proportion, and importance, the result has been a sum, or total, which all the best judges of all periods have agreed to consider a canon of Art. And thus a work is said to have style, or to be deficient in style, as it comprises more or less of the qualities which these schools more than any others exhibit. In a work in which there is a fine style, nothing small, or meschino, as the Italian critics call it, will occupy the attention. Largeness and breadth of effect are essential to style. Where small details would disturb these qualities of largeness and breadth of effect, they are skilfully absorbed and generalized, and are thus represented in masses.

MANNER was said to be applicable to the particular and individual. It is indicated by the attention that is paid to parts. Peculiarities that can be defined mark or exhibit manner, while style is stamped upon a work in which the particular and individual are absorbed into the whole. The force of both terms was then exemplified by a reference to Etruscan art. The ancient Etruscan sculpture is marked by its style; but it also is eminently remarkable for manner; as in the peculiarity of lengthened turned-up fingers, and the stiff, straight, zigzag-ism of the draperies. In the works of individual artists, that peculiarity by which the work of one hand is always and immediately recognized constitutes that artist's manner.

Ideal Beauty.

With respect to another difficult subject for definition, Ideal Beauty, it was observed that scarcely any object in nature, however generally pleasing, is found so perfect in all its parts that some one or other of those parts may not be discovered in greater perfection in some other object. Every object that nature presents to us has what are termed accidents. These accidents are varieties of, or, more correctly speaking, departures from the perfect canon or standard of form of that object. Ideal beauty consists in the selection and combination of all the most perfect parts in one complete whole. No portion of this can be invented or originated by the artist; for nature being his only model, any independent conception of his own respecting form could only result in absurdity and deformity. The supposition, therefore, that Ideal beauty is ever intended to mean imagined beauty, and not beauty that does exist and may be found, is based on a mistaken apprehension of the term. It is the province of the artist to reject the accident, and to restore the absent perfection. By doing this skilfully throughout his work, he produces perfect beauty, or what in technical language has been called "Ideal Beauty." It is obvious that ideal beauty cannot be comprehended at once and intuitively. It must be the result of great observation, study, and considerable knowledge of form; and, applied to the human figure, requires an intimate acquaintance with its capability of action, and the character forms assume under particular circumstances. The ideal beauty of one class is not the beauty of all classes. Thus, beauty exists in the Apollo; in the Theseus and the Ilyssus; in the Venus of Melos, and the Venus de Medicis; but in all these, and other well known examples, it is only ideal beauty as it illustrates in perfection the class of subject to which it is applied. Mr. Westmacott then examined the question of fitness and propriety, in their relations to beauty. In conclusion, he said that the best school in which true beauty of form could be learnt, and its principles studied, was fine Greek sculpture—not because Art is superior to Nature, but because the Greek sculptors have selected, copied, and applied all the best forms in nature; and therefore their works illustrate, and so far facilitate our becoming acquainted with, the laws of beauty. They have, as it were, provided the best books for our learning a difficult language.

Roman Sculpture.

It was not till after the conquest of Greece, and the arrival of the enormous collection of works of Art brought as plunder and spoil to grace the triumph of the conquerors on their return to Rome, that Sculpture began to attract any marked attention there. Syracuse yielded up its treasures of art after the conquests of Marcellus; Corinth had been stripped of its wealth in art by Mummius; and Athens also had largely contributed her share of exquisite works in sculpture, to enrich the Roman capital. It became a fashion to form collections; and to this caprice modern times are indebted for the preservation of some of the finest productions of Greek art. Verres has been handed down to posterity as one of the most ardent, and, it must be added, least scrupulous of collectors; but his anxiety to obtain possession of the most exquisite works of the great masters, doubtless occasioned many to be carefully preserved which otherwise would have been neglected or destroyed. In the century preceding the birth of Christ, several sculptors of eminence, all having Greek names, were practising in Rome. Both Julius Cæsar and Augustus appear to have made efforts to preserve fine ancient works, and so far gave opportunity to the Romans to acquire a taste for Art. Augustus, especially, formed collections of statues and other objects of taste, and set an example in this respect that was followed by many of the rich and influential. During the reign of this Emperor are found the names of some of the most eminent artists of antiquity; Posidonius, the architect Vitruvius, and Dioscorides. The gems of the latter are among the finest specimens of the art. Nero had statues imported from Greece, and it is astonishing that, notwithstanding the extent to which the country had already been plundered, it is recorded that no fewer than 500 bronze statues were procured from the Temple of Apollo at Delphi.

Apollo Belvedere.

The celebrated statue of the Apollo of the Belvedere was discovered among the ruins of a palace of Nero, at Antium. It has been conjectured that it may have formed one of the statues from the temple of the god. It is the opinion of some of the best practical judges of sculpture that this statue is a copy from a bronze; and the fact of its being in a marble resembling in all respects that of Luna, has led to the supposition that it is in what we call Carrara marble. This, of course, would give it a comparatively late date; these quarries not having been discovered till the time of Cæsar. Some have attributed the statue to the Augustan period. The question is still undetermined; but even supposing the marble statue of the Belvedere to be a copy, the original may possibly have been, as Winckelmann conjectures, one of the Delphian statues. Mr. Westmacott explained some of the reasons for this work being considered a repetition of a bronze, referring particularly to the treatment of the hair and drapery, as indicative of a style more appropriate to metal than marble.

Roman taste in Sculpture.

In his remarks on the condition of Sculpture, at this time, the lecturer said that generally speaking, in Rome it was a pseudo taste—got up as a fashion or caprice; and, consequently, there was no fixed principle which was calculated to establish a good school, or even to preserve a continuity of style. Sculpture, after this temporary revival, rapidly declined, although occasionally exception may be made in the case of busts.

The establishment of the seat of empire at Constantinople was a fatal blow to the grandeur of Rome; but Constantine endeavoured to restore the Arts in his Eastern dominions. He collected statues, instituted schools, rewarded students, built galleries—but all in vain. The spirit was lost; and all these inducements offered by the Emperor from his individual hope to re-establish Art, were powerless to effect his object. Many of the finest productions of ancient Sculpture existed in Constantinople till nearly the end of the fifth century of our era; when a fire, in 479 A.D., consumed the palace of the Lausi, and destroyed an immense collection of statues that had been accumulated there.

Mr. Westmacott said that the history of ancient Sculpture might be considered to end at this time. He observed that the monuments of the Romans are very numerous, and have been exceedingly useful in illustrating the manners and customs of that people; but Roman sculpture has not the same claims upon our attention as that of the Greeks. The best works they had were of the Greek school, and usually were by Greek artists. Their own original attempts are characterized,—if it can be called character—by poverty of invention, meanness of design, and, usually, most unskilful execution. The art was sometimes patronized; but it does not appear that the patrons at any time understood, felt, or appreciated Sculpture, further than as a means to furnish their palaces, or to flatter their personal vanity. Consequently it never rose—and never could rise—to that excellence which it attained in Greece, where it was made the means of embodying grand conceptions, by the union of expression and sentiment with the most beautiful forms.

THE LIGHTHOUSE ON THE GOODWIN.—We understand that this extraordinary undertaking remains still without the promised light, in consequence of Mr. Bush, the spirited projector, having been unable, up to the present time, to come to any understanding with the Trinity Board, which has the exclusive privilege of managing the lighthouses on the English coast. Permission having been granted, however, by the Government for the erection of the building to contain the "Light for all Nations," it is the intention of Mr. Bush to take up his residence, with his wife and family, in the lighthouse, and to have the highest chamber illuminated with a pale blue light for his own use. Of course this, however, will at the same time have the effect of warning ships, and a telegraph is erected to signalize vessels at the back of the Goodwin. As the lighthouse stands 36 feet above high water mark, it is Mr. Bush's intention, in order to protect his new residence, to discharge rockets in dark nights, or sound a gong in foggy weather. It is sincerely to be hoped that something will be done to accommodate matters between Mr. Bush and the Trinity Board, as the undertaking is of national importance, and the inventor has incurred both personal and pecuniary risk. On landing at Deal, after sleeping three nights in the lighthouse, Mr. Bush was warmly congratulated on his "safe arrival."—'Observer'

Blowing-up of Shoal in the Thames.—*July 5th.*—During last month, the operations for removing the shoal off Limehouse-reach, which of late years has proved so dangerous to the shipping passing up and down the river, have been highly successful. The shoal was upwards of a mile in length, and was an accumulation of gravel mixed with stone, consolidated in greater or less degress by what was conjectured to be the action of numerous petrifying springs. It was of so hard a character, that it defied all efforts to remove it by dredging machines; consequently, it was determined to attempt its removal by a series of submarine explosions, effected by placing mines in cavities bored in the shoal, and fired by galvanic power. Captain Fisher, the harbour-master, has superintended the operations.—*Globe.*

Ships Propelled by the Screw.—Four iron vessels, of various dimensions, with screw propellers, are now building at Liverpool, under the directions of Mr. Grantham, consulting engineer. These vessels vary from about 300 to 1000 tons, with engines of from 50 to 150 horse power. They will be fully rigged, and are all intended for the highest rate of sailing. On account of the greatly increased capacity for stowage in iron ships, the amount of cargo, independent of the space for the engines and coals, will be equal to that carried by timber built vessels of the same external dimensions. The propellers in the cases here referred to are to be worked on a different principle to those hitherto constructed—the engines will be connected direct to the propelled shaft, causing the engine and screw to make an equal number of revolutions; by these means all spur wheels or bands are avoided, the machinery is much simplified, and kept nearer to the bottom of the vessel, an object of great importance in sailing vessels. Mr. Grantham obtained a patent, about three years ago, for this mode of working the screw propeller, at which time he applied it to a small vessel. Mr. Peter Cato, and Messrs. James Hodgson and Co., have contracted for the vessels, some of which are in frame, and Messrs. Fawcett, Preston and Co. and Messrs. Bury, Curtis and Kennedy, are to construct the engines.

The *Terrible* steam-vessel is in the inner basin of Woolwich Dockyard, fitting with her engines and paddle wheels. This powerful vessel begins to assume a formidable appearance, owing to the great strength of her timbers and the dimensions of her paddle-boxes. She will have four funnels, two of which are already put up, and the other two in progress, and everything connected with her appears to be on a gigantic scale, her engines being of 800 horse-power.

Tubular Boilers.—The *Moniteur* lately published a circular letter, addressed by the Minister of Marine to the Maritime Prefects, informing them that, in consequence of the superiority of the tubular boilers over the boilers now in use on board the steamers of the Royal navy, the Government had resolved to dispense with the latter altogether, and to replace them, as they became unfit for service, by those on the new system, until some other mode still more advantageous than the latter should have been found. The Minister observes, that the tubes in question are almost exclusively manufactured abroad, and he recommends the maritime prefects to direct the attention of the ironmasters to the construction of boilers on the new principle.

St. George's Channel, Bermuda.—The long contemplated and highly useful undertaking of deepening the Channel leading into the harbour of St. George, which had undergone a few preparatory experiments performed by Corporal Harris, of the Royal Sappers and Miners lately. This work has assumed a very decided character—a general blasting has commenced, and continued daily to Saturday, when their Excellencies, the Governor and the naval Commander-in-Chief, with some ladies, and a number of naval and military officers and civilians, came to visit the works in a steamer, and by a very satisfactory examination of the bottom, and of the quantity of rock impediments already removed, all were astonished, but highly pleased by the certainty of eventual success in the removal of every obstacle forming the obstructions hitherto complained of.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JUNE 26, TO JULY 25, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Isham Baggs, of Great Percy street, Claremont-square, engineer, for "Improvements in obtaining motive power by air."—Sealed June 26.

Alexander Angus Croll, of Bow-common, Middlesex, chemist, for "Improvements in manufacturing, measuring, and transmitting gas, and in obtaining ammoniacal and other products from the refuse matters of such manufacture."—June 26.

Bower St. Clair, of Manchester-street, Manchester-square, gent., for "Improvements in the manufacture of sugar." (Being a communication.)—June 26.

Dominic Frick Albert, of Manchester, operative chemist, LL.D., for "an Improved application of materials to the manufacture of soap."—June 28.

James Hall Nalder, of Alvescott, Oxford, gent., for "Improvements in drills for drilling corn, grain, and manure."—June 28.

Alphonse Le Mire de Normandy, of Dalston, Middlesex, for "Improvements in the manufacture of thimbles and finger shields."—June 28.

Simon Snyder, of Dayton, United States of America, mechanic, for "Improvements in tanning hides and skins."—June 28.

Charles Goodwin, of Bow-lane, Middlesex, ship-surveyor, for "certain Improvements masts and spars."—June 30.

Philippe Poirier de Saint Charles, of Norfolk-street, Strand, Middlesex, civil engineer, for "certain Improvements in the production of type for printing, and in the machinery employed for the same."—July 1.

Stephen Hutchinson, of the London gas works, Vauxhall, engineer, for "certain Improvements in gas meters."—July 2.

Francois Marie Agathe Dez Maurel, of Marlborough-terrace, Old Kent-road, gent., for "Improvements in the manufacture of soap."—July 3.

John Hopkins, of Rector-place, Woolwich, gent., for "certain Improvements in rails and trams for rail-roads and ironways."—July 3.

Thomas Walker, of Euston-square, mechanic, and George Mills, of Dover, coal merchant, for "certain Improvements in springs and elastic power, as applicable to railway carriages and other vehicles, and to other articles and purposes in which springs or elastic power is now used."—July 3.

William Simmons, of Oldham, in the county of Lancaster, hat manufacturer, for "certain Improvements applicable to hats, caps, and bonnets."—July 3.

William Mather and Colin Mather, of Salford, Lancaster, engineers, for "certain Improvements in boring earth, stone, and subterraneous matter, and in the machinery, tools, or apparatus, applicable to the same."—July 3.

William Newton, of Chancery-lane, civil engineer, for "certain Improvements in railways, and in the means of propelling carriages." (Being a communication.)—July 3.

Lemuel Goddard, of Crescent, America-square, merchant, for "Improvements in the manufacture of candles, and in the means of preventing them from guttering whilst burning." (Being a communication.)—July 3.

William Symes, of Victoria-road, Pimlico, grocer, for "certain apparatus for dividing lump sugar."—July 3.

George Myers, of Laurie-terrace, Westminster-road, Lambeth, builder, for "Improvements in cutting or carving wood, stone, and other materials."—July 8.

Jacob Brett, of Hanover-square, Middlesex, Esq., for "Improvements in propelling carriages on railways, and other roads and ways." (Being a communication.)—July 8.

John Greenwood, of Church, Lancaster, manufacturing chemist, John Mercer, of Oakenshaw, Lancashire, chemist and calico-printer, and John Barnes, of Church, in the same county, chemist, for "certain Improvements in the manufacture of certain chemical agents used in dyeing and printing of cottons, woollens, and other fabrics."—July 8.

John Leifchild, of the Minories, blue manufacturer, for "Improvements in the manufacture of blue to be used as a substitute for stone blue."—July 8.

Antoine Bossy, of Paris, merchant, for "Improvements in manufacturing waterproof paper."—July 10.

John Samuel Templeton, of Sussex-place, Kensington, artist, for "Improvements in propelling carriages on railways."—July 12.

Hugh Cogan, merchant and manufacturer, of West George-street, Glasgow, for "An improved method or methods for weaving in patterns, or various colours, or fabrics."—July 12.

Edmund Ratcliff, of Birmingham, manufacturer, for "a certain Improvement, or certain improvements in the furniture of door-locks and latches."—July 12.

William Chantrell, of Leeds, gentleman, for "certain Improvements in weaving machinery."—July 12.

Joseph Fulton Meade, of Dublin, gentleman, for "certain Improvements in steam-engines and boilers."—July 12.

Samuel Tretheway, of Water-grove Mine, near Stoney Middleton, Derby, civil engineer, and Joseph Quick, of Summer-street, Southwark, engineer, for "an Improved combined expansive steam and atmospheric engine."—July 12.

Horatio Sydney Sheaf, of Waterloo place, Old Kent-road, artist, for "certain Improvements in obtaining and employing motive power."—July 12.

Thomas Russell Crampton, of Southwark-square, engineer, for "Improvements in match boxes, or articles to be used in the production of instantaneous light, and in the machinery for manufacturing the same."—July 12.

Richard Simpson, of the Strand, London, gent. for "certain Improvements in bleaching yarns and fabrics." (Being a communication.)—July 12.

Joseph Malcomson, of Portlaw, Ireland, for "Improvements in apparatus used for propelling carriages on roads, and vessels on inland waters when employing atmospheric pressure."—July 12.

John Shaw, of Broughton-in-Furness, Lancaster, chemist and druggist, for "a hydro-pneumatic engine."—July 12.

Patrick Sandeman, of Greenside street, Edinburgh, upholsterer, for "Improvements on coffins."—July 21.

John James Sinclair, of Helmet-row, Middlesex, hot-presser, for "certain Improvements in producing glossy surfaces on paper and similar materials."—July 21.

Thomas Robinson Williams, of Love-lane, Aldermanbury, gentleman, for "an Improved process and machinery for rendering paper and wrappers waterproof."—July 21.

Julius Adolph Detmold, of the City of London, merchant, for "Improvements in the means of applying steam as a motive power." (Being a communication.)—July 21.

William Broughton, of New Basinghall-street, London, millwright, for "Improvements in machinery or apparatus for grinding grain, drugs, colours, or other substance."—July 21.

Thomas William Gilbert, of Limehouse, Middlesex, sail-maker, for "Improvements in the construction of sails for ships and other vessels."—July 21.

Angier March Perkins, of Francis-street, Regent-square, of an extension for the term of five years of an invention for "certain Improvements in the apparatus or method of heating the air in buildings, heating and evaporating fluids, and heating metals."—July 21.

Jacob Brett, of Hanover-square, Middlesex, gentleman, for "Improvements in atmospheric propulsion, and in the manufacture of tubes for atmospheric railways and other purposes." (Being a communication.)—July 21.

Michael Perrier, of Lymington, gentleman, for "Improvements in spinning and twisting cotton, flax, silk, and other fibrous materials." (Being a communication.)—July 21.

John Lings, of Spur-street, Leicester-square, cheesemonger, for "Improvements in apparatus for the preservation of provisions."—July 21.

Charles de Bergue, of Arthur-street West, London, merchant, for "certain Improvements in rollers and other machinery or apparatus to be employed in flattening, preparing, and polishing wire for the construction or manufacture of reeds for weaving the rollers, being applicable to other like purposes."—July 24.

James Stokoe, of Newton, Northumberland, mill-wright, for "certain Improvements in purifying the vapours arising from smelting and other furnaces, and in recovering therefrom any useful matters which may be intermixed therewith."—July 25.

William Henry James, of Clement's-lane, London, civil engineer, for "certain Improvements in the manufacture of plates and vessels of metal, and other substances suitable for heating purposes, and in the means of heating the same."—July 25.

Richard Archibald Brooman, of the Patent Office, 166, Fleet-street, London, gentleman, for "certain Improvements in dyeing." (Being a communication.)—July 25.

TO CORRESPONDENTS.

"A Constant Correspondent" (Brecon, South Wales) asks us to insert an account of the failure of the arches of Ashton-under-Line Viaduct. We would most gladly comply with his wish, but we can get only general, and, therefore, unsatisfactory information. The difficulty of getting the most valuable of all intelligence—local intelligece—is immense. Notwithstanding every effort, we have the utmost trouble in obtaining accounts of important circumstances connected with architecture and engineering from localities from London. If a person will only tell us what is going on with reference to architecture or engineering in his own neighbourhood, no matter how modestly he estimates his powers of authorship, he sends a valuable letter. The most acceptable information we can have is that which is LOCAL.

"A Subscriber" (New York). The stone lanthorn on the top of St. Paul's is supported by a brick cone, which is concealed between the inner and outer domes. The outer dome is of timber covered with lead. The lowest course of the cone is held from bursting outwards by an iron chain. An answer to the second question in our next. We owe our correspondent an apology for not answering him before; will he return good for evil by taking a hint from the answer to our Brecon correspondent?

"A Manufacturer."—Dr. Playfair, at the late meeting of the British Association, said that he had determined, experimentally, that in the hot blast furnaces 91 per cent. of the heating power of the fuel were lost.

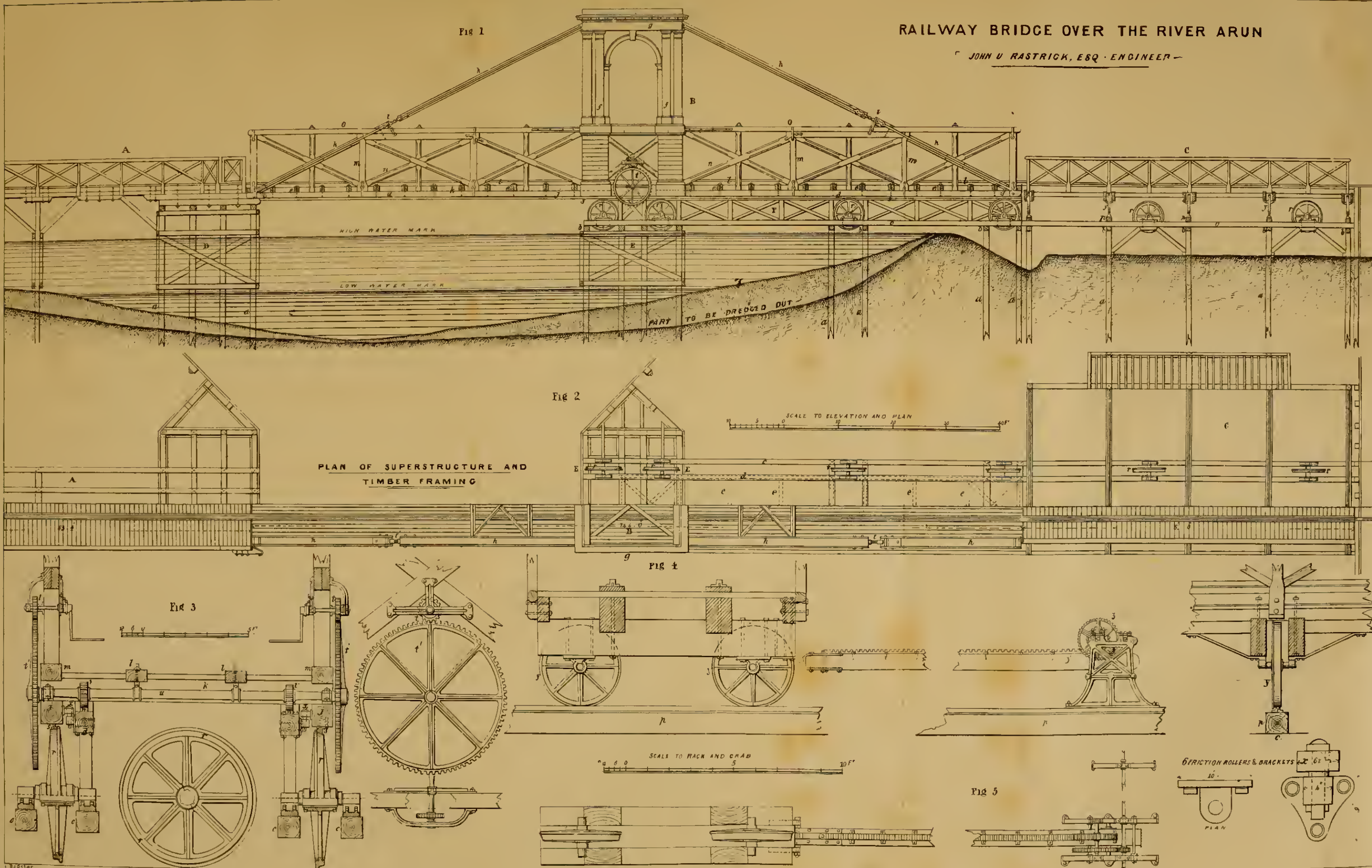
The letter of "W. B.," on Atmospheric Traction, came too late for insertion. It shall appear next month if he wish it, but the principles are erroneous throughout.

To a "Working Mechanic" (Newcastle-on-Tyne) the same answer. These correspondents should not attempt to eke out defective arguments by strong assertions.

ERRATUM.—In the review of Prof. Ansted's work, p. 237, the title is misprinted, it should be "Geologist's Text Book."

RAILWAY BRIDGE OVER THE RIVER ARUN

JOHN U RASTRICK, ESQ · ENGINEER



THE DRAWBRIDGE OVER THE ARUN,

ON THE BRIGHTON AND CHICHESTER RAILWAY.

(With an Engraving, Plate XXI.)

The distinguishing characteristic of modern engineering is that it never works by general methods. New demands on its powers are being constantly made; new means of developing them are therefore required; new classes of operations arise, and these call for new methods of effecting them. The problem of engineering is an infinite one, and each of its cases requires a particular solution. Experience may, and indeed does, furnish some general ideas for the guidance of the engineer, and theoretical science will warn him from attempting physical impossibilities, but the difficulties of each particular case with which he has to deal must be for the most part overcome by particular contrivances adapted to it alone. At present it seems quite impossible to compile a general *grammar* of engineering. It is only by recording each new case as it occurs, and by observing the degree of its success that we can hope to hereafter render engineering a systematic and classified science.

The case which forms the subject of this paper is one of those instances in which previous rules of engineering were inapplicable, and it possesses great interest, not only from its absolute novelty and extraordinary boldness, but also from the ingenious and perfectly satisfactory manner in which the difficulties have been grappled with and overcome.

The line at that part where this bridge is constructed, is intersected by the navigable river Arun. It was requisite in the construction of the railway to provide for the uninterrupted navigation of this river, which connects the important town of Arundel with the sea; and, as it would have been impracticable to construct the railway bridge so high as to allow the passage of masted vessels underneath it, it was necessary to make provision for its removal when requisite.

The means by which this object is attained may be in general terms stated thus—the rails passing over the river, and a portion of those on the banks are laid on a moveable platform, which, when the trains are passing, is supported on piles; but when vessels are about to pass, this platform and the rails, &c. upon it are rolled back along the line. In order to make room for this platform when so rolled back a part of the rails of sufficient length is moved aside, so that the platform may occupy the space thus provided for it. It will be seen then that altogether there are two moveable portions of the structure, one over the river capable of being rolled back in the *direction of its length*, the other on the ground capable of being moved *laterally* to allow the former portion to be rolled back. These two portions are respectively marked in the engraving C and B.

A is the fixed portion of the bridge 68 feet long, extending over part of the river from the embankment to the opening; and is supported on piles which carry four longitudinal bearers of timbers 12 in. square, on the two centres of which the rails are laid: the two outer carry a hand railing.

The moveable part of the bridge from the end of A to the platform C, when in use is supported on piers D and E, and on piles from E to C. The piers D and E are each 28 feet wide by 18 feet, and consist of piles 14 inches square with cross beams 14 in. by 12 in. Supported by the pier E and the piles *a* is framing F, carrying transverse bearers *b* 14 in. square, on which are laid four longitudinal bearers *c*, 12 in. square; the two centres of which support by a framing of two other longitudinal bearers *d* of timber 12 in. by 10 in. which receive the iron racks which we will explain presently. The bearers *d* are tied by the cross framing *e*, of timber 6 inches square. The moveable part of the bridge B is 124 feet in length by 14 feet in width. In the centre of this structure is a suspension tower. This tower consists of eight vertical posts of 14 inches, two at each angle *f*, with a plate *g*, at the top of them. The timbers are cased and present the form of pilasters, entablature and archway suspended from the top of the tower are four inclined ties *h*, each of these ties are made of timber 12 inches square, in two lengths, and strenghtened by wrought iron straps 3 inches by 1 inch. The two lengths are connected by right and left handed screws at *i*, the purpose of which is to keep the whole in a state of tension. The horizontal platform of the bridge is supported by these ties, and consists of two longitudinal bearers *j*, on which are laid transverse girders *k*, 12 inches square, these support the longitudinal sleepers *l*, 14 inches by 7 inches, which carry the rails. The hand railing is queen post trussed; the queens *m*, being 12 inches by 9 inches, and the diagonal struts *n*, and horizontal plate at top *o*, being of timber 12 inches square.

C is the moveable platform which is displaced to make way for B, when rolled back; C is 63 feet long by 11 feet wide.

Here again we have a substructure of piles *a*, with cross bearer *b*, and longitudinal plates *c*, as before. Transverse rails are laid on transverse sleepers *p*, and on these rails run the wheels of the platform when it is being moved aside. The platform consists of longitudinal bearers 14 inches square, which carry the sleepers of the railway.

Mechanism for moving the bridge and platform.

1st. With respect to the motion of the part B. The mechanism is shewn in fig. 3. Six pairs of flanged wheels *r*, 6 feet in diameter, perform the office of rollers; their axles revolve in boxes fixed to the timbers *c*. An inverted rail *s* is fixed to the under side of the bearer *j*, and runs on these wheels. Motion is communicated to the platform by two men who work two crab engines at the central tower, one on each side of it. These engines consist of pinions *t*, 14 inches diameter, working into spur-wheels *t'*, 7 feet diameter, keyed to their common axle *u*, 5 inches diameter, which carries also pinions *v*, 12 inches diameter, taking into a longitudinal rack *w*, which extends the whole length of the framing *d* before described. It will be seen that by this arrangement the men move the bridge with its tower, &c., and consequently are themselves carried with it to the part C. The platform in its motion is guided by six friction rollers *x*, with vertical axes fixed on the side of the framing *d*.

2nd. With respect to the lateral motion of the platform C. The mechanism is shewn in figs. 5 and 5. Five pairs of flanged wheels *y*, 4 feet diameter, support the platform, and run on the transverse rails *p*. The motion is effected by two fixed crab-engines *z* with common axle at each end of which is a pinion 6 inches in diameter, taking into a spur-wheel, 2 feet diameter, with pinion 1 feet diameter taking into racks *z'*. These racks, fixed as timber shafts, 9 inches square and 18 feet 9 inches long, rest at one end on a roller fixed to the crab-engine, and are bolted at the other end to the framing of the platform. By this arrangement it will be seen that the crab-engine communicates a lateral motion to the platform.

Reference to Engravings.

Fig. 1. Elevation.
Fig. 2. Plan with boarding removed from one-half to show substructure.
Fig. 3. Tranverse section of moveable part of the bridge showing the mechanism.
Fig. 4. Transverse section of moveable platform showing the mechanism
Fig. 5. Plan of the rack and crab.

The Brighton and Chichester Railway is a continuation of the Shoreham Branch of the London and Brighton Railway, and is now in course of construction. The new railway will be rented by the Brighton Company: it is a single line, and at the point where the drawbridge is constructed, runs about midway between Arundel and the sea.

STUDIES OF PLAN.—No. I.

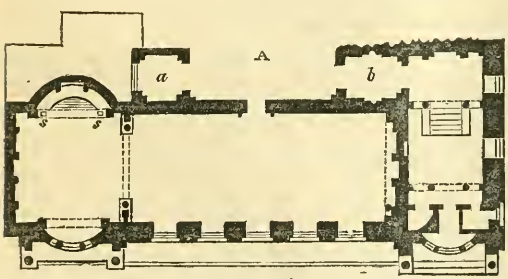
After so very long an interval, instead of returning to the subject under the first title, "Episodes of Plan," we take it up again under the simpler and more usual designation of "Studies," which we may continue from time to time, after the fashion of what the Germans call "*Zwanglosen Hefte*," just as opportunity may offer.

In buildings of a superior kind we have a right to expect something of artistic and æsthetic effect arising out of disposition and conformation, out of plan and section,—well managed arrangements and combinations that *tell* powerfully, even before decoration begins to be applied; and which with even a moderate degree of decoration will be more captivating than mere costly decoration without architectural effect as a groundwork for it. Be it ever so vulgar or common-place, any large room may be bedizened out any day, and in the most approved *fashion* of the day—in all its extravagance, by the decorator and the upholsterer; yet let them be ever so skilful and tasteful in their own way, the work of those artists is only skin deep; they can only clothe, fill up and dress up what the architect has left naked and blank. If the work of the latter be awkward and dowdy, the one may help it somewhat by his professional cosmetics, and the other by the rich attirings in which he deals: more than this they cannot accomplish. Without at all underrating their skill, or rejecting their aid, we may yet not unreasonably require something more to charm us, dressing-up will do much—we may say, a very great deal—for rooms as well as for women, but as it can not bestow on the latter beauty of face and of figure, nor any of the nameless graces of expression; so neither can it supply in the former the charm of architectural physiognomy and the witchery of architectural effect. Well, what does it matter after a l, many will say, whether there be effect of that kind or not:—that it must be admitted is taking a very philosophical view of the matter, but it is also laying the axe to the tree and cutting it down both root and branches, since what is decoration itself for save effect, and effect merely? We grant that effect of the latter is more generally felt and more easily appreciated than the other; yes, and so is costly furniture than pictures and other works of art.*

Still though piquant effects arising out of plan and section seldom fail to make an impression even upon the ordinary spectator, the system usually pursued would seem to be intended to avoid them, the chief aim being to obtain as many and as spacious rooms as possible out of a given area without any loss of space. Of course in moderate-sized houses, where every square foot must be economized, beauty of form and effect must give way to utility and convenience; but where there is sufficient space, such of it as is given up to the purpose of producing effect, and of creating variety in the forms of adjoining rooms, is, most assuredly, not sacrificed, any more than is the *useless* space overhead which serves only to give proportionate loftiness to spacious apartments. These remarks partake, we confess, too much of prosing, because what they are intended to urge ought to be sufficiently evident of itself; whereas there is unfortunately too much occasion for forcing them upon the consideration of architects and their employers. Unless some particular difficulty or accident happen to suggest some peculiar and *pro re nata* treatment for part of a plan, there is very rarely any sort of effect as regards *plan*. Even accidents are seldom turned to the account they might be, and supposing they were always made the most of, an architect ought not to depend upon mere chances of the kind, but where he has the opportunity of doing so ought to study combinations that will tell, and to plan purposely *for* effect. Like other artists he ought to be able to foresee and prejudge results, and he ought to be inspired by the ambition of putting something entirely of his own into his work. This we are sorry to say is so far from being the case that one may turn over hundreds of plans without finding a single fresh idea in them, or a single point of any value. Anything above the ordinary prose of everyday routine in plan is quite a prize, and to be treasured up accordingly. An example of the kind was lately given in this Journal, viz., Messrs. Williams and Sowerby's new room, which, though exception may be taken to other parts of the design, especially to the entablature of the order, offers a valuable study of ingenious plan and able contrivance.

The "Glyptotheca" presents an arrangement of plan that is altogether unique, and which for charm of effect far surpasses any thing to be met with in any of our royal palaces, however short it may fall of it, in regard to mere size, or splendour and sumptuousness. But we mention the Colosseum now merely *en passant* and because it happens to come into our mind; for we are not at present prepared to take up that Gallery as a study in the manner which it deserves. Our first subject shall be the

Morning Room of the Conservative Club-House.



In regard to which we have taken the liberty of substituting a somewhat altered plan for the actual one, in order to render more evident than by merely explaining our idea in words, what we conceive would have been a decided and very material improvement, one that would have given striking character and effect, and increased importance to that further compartment of the room in which the bay-window is placed, without at all disturbing any other part than the side facing the bay. As it is now built, architectural character is kept up on that side merely by two pilasters answering to those on the other sides of that division of the room. Hence there is nothing whatever striking in plan,—no other than the ordinary effect of a spacious bay on one *side*, without a corresponding recess of any kind on the opposite one, or any architectural feature at all that might serve to keep up some sort of balance. Even a sham folding-door opposite the bay would, in our opinion, have been better than nothing,—a very allowable expedient, because it would have done away with the blankness which is now so disagreeable; an ornamental doorway would have produced a central feature on that wall, and by the door frame being entirely filled in with looking-glass, the room might have been reflected in such a manner as to produce a striking vista from the bay, to another bay seen in the distance, and the effect would have been all the more piquant, because after the early part of the day, the sun strikes upon the houses on the opposite side of the street. For our part we should greatly prefer a single large mirror facing the bay, to there being as at present one over the chimney piece at each end of the room; because in the first place the room is so long in itself (92 ft. by 26½ feet) as not to require any appearance of increased extent in that direction; and in the next, there is too much repetition of the effect —to say the truth rather a hackneyed one—attending mirrors placed opposite to each other, for we here find them so disposed both in the upper and the lower hall, or Staircase Saloon, and also again in the Drawing-rooms.

Supposing nothing further could have been done, the expedient just pointed out would have both produced effect and given an air of completeness to that compartment of the room by providing a feature on what is now a blank side of it. But it was possible—or rather, very easy to accomplish a great deal more, there being nothing to hinder the forming a recess there, corresponding with the window-bay, as there was only to build it out a few feet into what is a back court, with no other widows towards it than those of a back staircase and water closets. Accordingly we have so represented the plan in our altered version of it. By this management something is gained as to mere space, not that that is any advantage worth mentioning, there being already quite as much actual space as need be. It is more to the purpose to say that symmetry of plan would be established, and not only symmetry but some novelty of arrangement also;—that in other respects there would be considerable effect where now there is none, and that effect would also be of an unusual kind;—and lastly, that the improvement would not be confined to that further or south compartment of the room, but extend itself to the rest. As regards the general plan there would be *contrast*, since that end division of it would be a distinct one placed *transversely* to the other with an expansion of from 26 ft. 6 in. to 40 feet, that is, the main division of the room would be 65 × 26·6′, the other 26·6′ × 40, whereas at present it is only enlarged on one side by the additional space of the bay, which, whatever, may therefore be gained in regard to mere convenience, is by no means a particular architectural beauty, the result being an unlucky *lobsided* look. In addition to that of plan considerable effect might have been obtained by increased light, because as there would be nothing above on the upper floor, a recess on the west side might be covered by the portion of a dome, rising higher than the general ceiling, and might have either coffers or long panels radiating to its centre, filled in with coloured glass, either of uniform tint *à la* Soane, or of different colours and of ornamental pattern. Coloured or even colourless light thrown down in that manner would give more than usual vivacity to a part of the room which now looks not only blank, but somewhat sullen also. A large mirror set within a doorway ornamented with columns like the door from the Hall, and having its reveals panelled (that is with half panels whose reflection in the mirror would produce whole ones), would produce the effect which we have already pointed out. Or else a very different one might be obtained by having three mirrors—a wide and two narrower ones, so disposed as to correspond in every respect with the openings of the opposite window (the mirrors being of course planes though fixed into a curved wall). The mirrors being at different angles would repeat objects in different directions, and perfect correspondence of design with the windows might be kept up by similar draperies and

* We know of an instance where a little oversight in regard to the position of two doors caused prodigious vexation and annoyance: the room was a dining room, and the sideboard was intended to be placed on the side opposite the fire-place, there being in fact no other situation for it, there being a large Venetian window at one end and folding doors at the other. All was pronounced quite satisfactory until the furniture was brought in, and then, oh sad discovery!—then it was found out that the sideboard could not be fixed directly facing the chimney-piece, without making most awkwardly manifest that of two doors on that side of the room where it was to stand, one was two feet further from the angle of the room than the other. It would have been just the same with any other marked object requiring a central situation on that side of the room, a large mirror or picture for instance, or such a piece of furniture as either a cabinet or sofa. There was indeed sufficient reason for one of the doors being put just where it was, but then either the other should have been placed so as to correspond, or some expedient have been resorted to for securing perfect symmetry in that elevation of the room which was opposite the fire-place. In mere ordinary houses such bungling as was here shown may be put up with, but where there has been no restriction as to cost, it becomes quite intolerable,—a deformity for which the most splendid furniture cannot atone.

drapery cornice;* the only objection being that a recess so fitted up would be more in character for a drawing-room or boudoir than for the Morning-Room of a Club-House; so we will dismiss that idea, and abide by the one shown in our plan, viz., a single mirror, and that the only one in the room,—for we would not have those over the chimney pieces, where a panel with sculpture in bold relievo would show so much better, and better suit the general character of the room.

There are other reforms besides those of plan which we could wish to make in this room of the "Conservative," since, to say the truth, there are many things about it that are quite irreconcilable with any principles of taste, and which might just as well have been otherwise, they being entirely matters of choice and not of necessity. What strikes us as a disagreeable inconsistency and a departure from the costume of the style is the mixture of colours and materials in the parts composing the order. Scagliola columns are placed on a wainscot stylobate; thus what if not marble, looks like marble, rests upon a less solid material. The small order that decorates the door (engaged columns grouped with half pilasters on each side of them), differs from the larger order in having its entablature of oak as well as the pedestals; nor is there any distinction of colour between the door itself and the entablature over it,—which we take to be a fault, inasmuch as now treated, the uniformity of colour which seems to have been intended for the whole of the composition, is disturbed by that of the columns. These last, again, though of the same order, viz., (an Italian Ionic), as the larger ones in the room do not agree with them, for whereas the latter are in imitation of Sienna marble, with white bases and capitals, those of the door are of porphyry with bronze capitals and bases. Considered by themselves, they present something singularly pleasing—a chaste and harmonious combination of colours, the bronze being of a uniform clear hue, inclining to a mellow golden tint; but then as regards the room those columns are mere patches in it, both colours requiring to be extended to some other parts; nor is the matter mended by the door being so placed as not to be distinctly marked out by its situation as a feature to be treated as *prononcé* as possible—which would have been the case had it been at the end of the room (in the centre, of course,) instead of being on one *side* of it. It is, further, a question with us whether it would not have been adviseable to bronze the door itself of the same hue as the bronzing of the capitals, so as to obtain some mass of that colour. Whether that were done or not, there was an excellent opportunity for carrying out the porphyry and bronze, by making the two chimney-pieces to accord with the columns of the door—of porphyry colour with bronze mouldings and ornaments, the stoves, &c. being also of bronze. Had that been done, a balance as to colouring would have been produced, and the present disagreeable spottiness avoided. Instead of which the chimney-pieces are either of black or very dark marble—in our opinion the very worst colour imaginable for such a purpose, we having as great an aversion to a black chimney-piece as Goethe had to a white door. When such is its colour, a chimney-piece cannot possibly contribute any thing to the cheerfulness or decoration of a room. Black is not the colour for any sort of ornamental dressings to an aperture, no more for those of a fireplace than for those of a window, or the cornice of a room. Accordingly, the chimney-pieces show not only as two spots quite distinct in colour from everything else in the room, but as two very dismal ones—sombre, triste, and almost funereal. There is a good deal for criticism in the other apartments of the Conservative,—such as pillars with *black marble bases*, chimney-pieces of most ugly colour and design in themselves, and quite out of character with the style of the room where they are introduced (viz. the Library). But we confine our remarks to that portion of the plan which is shown in our engraving, where it will be seen that the entrance loggia is somewhat altered, it being thrown into the form of a curve in order so far, to correspond with the window in the other end-compartment of the front, on the ground floor. Another variation is suggested at *a*, by which, instead of being shut up from the central Hall A, as a small waiting room, it would be an open recess corresponding with the open lobby *b*, between the entrance hall and the inner one. In order to exclude the back court from sight, the window in *a* is supposed to be entirely of painted glass, and would accordingly, in that situation, produce a brilliant effect as soon as the door between the outer hall and lobby was opened; to say nothing of the greater extent of vista in that direction, so obtained.

* Though, as far as we are aware, it has never been done, we think that when there are large mirrors on the side of a room opposite to the windows they might have draperies like those of the windows, for, if of showy material and colours, draperies along one side of a room are attended with an awkward effect, especially if there are many windows or the room be a long one, in which case it is usual to consider the appearance it makes when looked at from one end,—wherefore it is desirable that one side should balance the other as nearly as possible.

DREDGE'S SUSPENSION BRIDGE.

Sir—I was very much surprised when the August number of your Journal was put into my hands, by reading the "*Remarks on the Mathematical Principles of Mr. Dredge's Suspension Bridge, by F. Bashforth, B.A., Fellow of St. John's College, Cambridge, and Member of the Cambridge Philosophical Society.*" I read it a second and a third time, before I could believe a Cambridge man had so committed himself, and now sit down to reply. The principal part of these remarks tends to "*expose*" a treatise written by Mr. W. Turnbull, which was first published by Mr. Weale, in 1841. Now with this demonstration whether it be good, or bad, *I had nothing whatever to do*, nor did I see the treatise until after it was published excepting for a few minutes in the author's hands when he called to ask me to give him a drawing and specification of some bridge, I had erected, or was erecting, which I did, and it was published with his demonstration, but because it was, I do not feel bound to support my position by the style of reasoning adopted by Mr. Turnbull, but even if I were, and the treatise so bad as Mr. Bashforth represents, (though I will shew presently it is not so), his college learning should have taught him that an erroneous argument proves nothing but the inability of the disputant, and that it is by correct reasoning alone we can point out the truth, or demonstrate the fallacy of the subject which provokes the inquiry. But to exonerate myself from all responsibility of Turnbull's treatise, here is part of his preface.

"The circumstances which led to the composition of the following pages may be briefly stated thus. Early in the spring of the present year (1841), John Macneil, Esq., an engineer of high professional standing, proposed to me, by way of a problem: to trace the principle which induced Mr. Dredge to adopt the tapering chain and oblique rods, and to prove mathematically that the principle thus adopted is strictly in accordance with the maxims of accurate mechanics."

"The MS. thus completed was laid before Mr. Weale, of the Architectural Library, High Holborn, who expressed a wish to purchase it forthwith, provided Mr. Dredge, who was then in London, would undertake to furnish a drawing and example, illustrative of some bridge either erected, or in course of erection."

"*I accordingly waited on Mr. Dredge*, who accompanied me to the publisher, and generously offered to supply whatever might be required either in the shape of *drawings, specifications*, or *estimates*, and in accordance with this offer, the contract, specification of material used, and an isometric drawing of the bridge across the river Leven, at Balloch Ferry, in Dumbartonshire, which are appended to this Essay have been supplied."

W. T.

I do not know, nor do I wish to inquire the reason Mr. Bashforth has for taking short sentences, and even parts of sentences from detached papers, placing them in juxtaposition, and thereby showing a very different meaning from that which when the context comes to be considered, they were intended to convey, here is a specimen—"It is to me a matter of surprise that there has been no exposure of what Mr. Dredge calls his 'system mathematically demonstrated, shewing by the most searching investigation the true principles of the novel and economical invention!!"

Now this quotation puts the authorship, or at least the responsibility of the essay upon myself; but when the whole sentence is read, which is merely a foot note to some detached papers, it will show a different meaning. It should have been "*Mr. Weale is about publishing* Mr. Dredge's system, mathematically demonstrated, showing, by the most searching investigation the true principle of novel, and economical invention." And *this was printed when I first heard of the treatise being written.* "I have merely compared quotation and leave the world to judge."

I will now, even at the risk of some mathematical censure, say a few words in support of Turnbull's demonstration. The principle objection taken by Mr. Bashforth is that of assuming "that we may attach one end of a supporting rod to the platform, and the other end to some convenient point just above, quite independently of the main chain," or in short, that the author really imagined that the chains of my bridge would maintain a straight line, even when the subsidiary forces were attached, was there ever anything so absurd, no person with the least knowledge of mechanics could make such a blunder, nor did Mr. Turnbull. For in page IV. we have

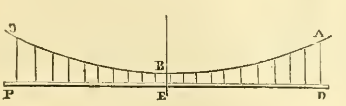
"If this individual bar be considered as a straight inflexible line, the principles of calculation are identical with those of a lever when sustained in equilibro by a single force applied at the remote extremity, and acting in the direction of the sustaining bar. But when the bar is *curved*, or *polygonal, as it necessary must be in the case of a chain employed in the actual construction of a bridge*, the process becomes a little more complicated, since it requires all the composant forces to be referred to, the several portions of the chain as resultants, we mean such portions as are comprehended between any two contiguous bars. In every other respect the principles which regulate the calculations are the same, and for this reason it will be sufficient to establish the theory in reference to the straight line only, since the reader, who is familiar with the *composition and resolution of forces*, will find no difficulty in extending the process to a *curve*, and he who is not, will derive but little benefit from a perusal of the subject which is now laid before him." And now with regard to the investigation, without questioning whether the author was capable or incapable of fully satisfying the conditions of the problem proposed by Sir John Macneil, yet considering the slender data it was possible for him to obtain in 1841, and the simple mathematics he used, the work was satisfactory, even though at the end he jumps at conclusions rather than deduces them from previous reasoning. I do not wish to uphold it as a specimen, but I do say that if he did not succeed in a complete solution of the problem, he deserves credit for what he did, for he was the first who attempted it.

Mr. Bashforth next, after alluding to much that has been written, says, "but most unfortunately not one of the writers even *professes* to have a knowledge of mathematics, and consequently all their opinions are worthless!!!" Practical men will thank mathematicians very little for such compliments as these. What, Sir, are plain common sense statements "worthless?" Are experiments "worthless?" Is practical experience "worthless?" Is the successful completion of twenty bridges in four years "worthless?" Is the adoption of the plan in foreign parts "worthless?" Is the increasing reputation it has always obtained "worthless?" I could continue, but then it would be "worthless," compared with a mathematical investigation, well, let it be so, and I will yet meet Mr. Bashforth on his own ground, for *I am a mathematician*, and every thing that bears my signature is the result of rigid investigation. Although I do not wish to make a parade of what little learning I may possess, yet I fear no attack on this point, even from a Fellow of St. John's; and since Mr. Bashforth has commenced, it may not be presumptuous in me to express a wish to try his strength as an analyst on this subject, if you, Sir, will kindly allow us the use of your pages for that purpose.

In reference to the weight of the chains of the Menai Bridge, the statement of 1935 tons is taken from a small pamphlet, an abstract of Mr. Provis work, (I purchased at Bangor); I have it somewhere amongst my papers, but cannot at this moment find it. Mr. Bashforth speaks of 774 tons, but this refers to the weight between the points of suspension only, whilst the 1935 tons includes the whole of the chains outside the towers, and the immense masses of iron work attached to the chains in the retaining tunnels. I have always been very careful to put forward nothing but what I could substantiate, and if this be an error, it is an error of the pamphlet from which I copied it. Lord Western also makes a similar statement in his letter, which his Lordship copied from the book I lent him. The weight of iron required in the chains of a bridge, such as the Menai, on my plan, would be about 70 tons instead of 1935.

Mr. Bashforth next remarks, "Again we are informed that the tension of the chain must be nearly 3750 tons, half acting in each direction." This, I *believe*, is only part of a sentence, the context of which would shew the meaning; but as it here appears, it requires some

Fig. 1.



explanation. Therefore let A B C, fig. 1, be the chains of the Menai Bridge, D E F the roadway. Suppose a section B E of the chains, and platform when made, then each half A B E D, and C B E F would exert a horizontal force of 1875 tons,* which, when the chains are connected at the point B, would counteract each other. Now since each half of the bridge causes 1875 tons of horizontal force, the whole bridge must cause double that, one-half of which is reached by the other.

To put it in another light, let A B, fig. 2, be a cord passing freely round the pulley C, and suppose at each end A and B, animal force were applied in the direction of the arrows equal to 1875 tons, now it is evident that if each excited a force of 1875 tons, the amount of work done by both would be = 3750 tons, but because one counteracts the other, the strain in the cord is only 1875 tons. These examples will illustrate my meaning.

Fig. 2.

I think I have now said enough to shew that the principle is not so wrong, nor my statements so conflicting as the author of the "Remarks" would make it appear, and having reconciled those which *he* made somewhat contradictory, "I leave it for the world to judge, and Mr. Bashforth to reply.

There is no occasion, Sir, for searching the Phil. Trans. in 1826 for what was known long prior to that period, for the tapering of the chain for a catenary bridge is fully exemplified in the "principle of the polygon of pressures," but then it is so *small* as not only to be unworthy of notice, but *impossible* to be carried out in practice, and I must repeat to Mr. Bashforth the same I told Mr. Mosely, when he committed a similar error, *that my plan bears no analogy to the catenary*. As we have been talking about the Menai bridge, I will take that structure to exemplify this by comparison. Drewry, page 167, states, "The chains of the Menai bridge contain 260 square inches of iron, if therefore they were proportioned throughout to their tension, they should contain at the middle about 251 square inches." Now in the chains of a similar bridge, on my plan, there need *not be any section of iron ah the centre*, because there is *no tension existing there.* I will make one more remark and then have done.

In the conclusion of the paper, Mr. Bashforth says, "In the general case the data are insufficient for a mathematical solution," &c.! And yet he has "*undermined the foundation*," shewn "*the principle to be built on a fallacious assumption*," and proved "*it to be wrong*," anathematizing the whole as though he rigidly investigated it and almost with *acknowledged insufficiency of data*." I therefore return Mr. Bashforth his compliment, viz., (that if the opinions of men who are not mathematicians are "worthless," the opinion of a mathematician without data is equally "worthless," ergo) his remarks are "*worthless*," and mathematicians, I am sorry to say, have in a great measure to thank themselves "for the distrust with which practical men regard theories."

I must apologize, Sir, for writing to such a length, but could hardly, with courtesy, to Mr. Bashforth, have replied in less.

I remain, Sir, your obedient servant,

James Dredge.

Bath, August 6, 1845.

₊ Mr. Dredge disavows Mr. Turnbull's papers, he is therefore not responsible for the errors in it; but as he says that he himself is a mathematician, does he not suffer his zeal to exceed his knowledge when he defends a paper which he confesses "jumps at conclusions rather than deduces them from previous reasoning," and in which it seems that the writer assumes that if three forces keep a point in equibrio, one of them may be greater than the sum of the other two? Such nonsence could never by any possible contingency have been written by a mathematician, and is so obviously beyond all defence, as to be scarce worth attacking. But it must be allowed in justice to Mr. Dredge that "erruneous argument proves nothing but the inability of the disputant," and therefore does *not* prove Mr. Dredge's invention to be either valuable or valueless. The *real* question, the only question in which the public have any interest is—whether, weight for weight, Mr. Dredge's bridges are stronger than those or ordinary construction. Of Mr. Turnbull's paper quite enough has been said—if the discussion be continued, it ought to refer *exclusively* to the real merits of the question.—Ed.

Oxygen and Litharge.—At a sitting of the *Academie des Sciences* M Millon gave an account of some experiments as to the influence exercised by very smal quantities of foreign substances, in the decomposition of water by metals. M. Barreswil now explains this influence in the following manner:—"We may admit," says he, "that it zinc, tin, and lead, are attacked by hydrochloric acid with greater energy under the influence of only a few drops of a solution of the salt of platina, then without this influence, it is because the precipitated metal (platina), in contact with the precipitating metal, constitutes a true voltaic element. In fact, if instead of a solution of platina we make use of a piece of platina wire, and touch with it the metal to be dissolved, we obtain the same result. If arsenic accelerates, as we all know it does, the decomposition of water by zinc (a phenomenon analogous to the presence of platina), whilst it checks the action of acids upon iron, this apparent anomaly arises from the fact of the deposit formed upon the zinc being porous, whilst that which covers the iron is impenetrable, like gilding. The proof of this is, that if we scrape a surface of iron thus arsenicated, and replace it in the same liquid, the re-action becomes stronger than upon the same iron when entirely cleaned for the process. This protecting envelope is not necessarily metallic; it suffices for it to be impenetrable to liquid, adherent, and insoluble in the bath. Thus marble is not dissolved in concentrated nitric acid, because it covers itself with an insoluble coating of nitrate of lime.

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* "Suppose the whole suspended weight of the Menai Bridge, with its fair load, to be 1000 tons, then the tension at the middle would be 1878 tons.—Drewry, page 167.

NOTES
ON THE PHILOSOPHY OF ENGINEERING.
I.
On the Lead of the Slide.

The series of notes on the philosophy of engineering which I propose to continue from time to time in this Journal will be commenced with a somewhat bold design—which is no less than to call into question certain of the views of the Comte de Pambour on the theory of the steam engine. The extraordinary perspicuity of his investigations, the admirable arrangement of his experiments, and the beautiful simplicity of his physical conceptions, have procured for him so just a reputation amongst those whose applause is really worth having, that I almost despair of being able to overcome the prejudice which will exist against any attack upon his doctrines. Nevertheless, the following tenets respecting the lead of the slide, appear to me, after careful consideration, so essentially erroneous, that I think that he himself, on reconsideration, would hardly be prepared to defend them.

"We have already mentioned the advantages arising from the lead of the slide, with regard to the play and conservation of the engine; but there is another advantage no less important, resulting from this disposition, namely, that of obtaining a greater velocity, and consequently a greater useful effect of the engine with a given load.

"This effect is easy to comprehend; for if the suppression of the steam from the boiler, instead of being made precisely at the end of the stroke of the piston, takes place, for instance, at the moment when the piston is yet an inch from the bottom of the cylinder, from that moment steam ceases to flow into the cylinder. Thus, with regard to the quantity of steam admitted into cylinder or expended at each stroke of the piston, the length of the stroke is really diminished an inch. Now it is the quantity of steam produced by the boiler which regulates and limits the velocity of the engine. Suppose that such production furnished m cylinders-full of steam per minute, when the total length l of the stroke was filled with steam: now no more than the length $l - a$ is filled with steam; the same production then will fill per minute a number of cylinders expressed by $m \times \frac{l}{l-a}$. Hence, in fine, the velocity of the engine will be increased in the inverse ratio of the lengths of the cylinder which are filled with steam."

Treatise on Locomotive Engines, Chap. 16, *sec.* 2.

The error in this passage appears to me to be this, that M. de Pambour in comparing the two cases, supposes that the density of the steam in the cylinder is the same in either instance. Now were this so, we should arrive at this strange conclusion—that if the same motive force, which in the first instance acted through a distance l, be made to act through a shorter distance $l-a$, it will move its load with *greater* velocity. This appears to me perfectly inadmissible, and I shall show that the motive force is in the second case so altered that though it act through a shorter distance, it does the same work that the original motive force does in acting through the whole length of the cylinder.

It need scarcely be said that I here assume the truth of Boyle or Mariotte's law; it is ascertained from M. de Pambour's experiments that this law is really true for the steam in high pressure engines, when the densities are not greatly varied.

It is also presupposed that the reader is aware that when an engine is in motion, the density of steam in the cylinder may vary considerably from that in the boiler. For if the boiler generate such and such a number of cubic feet of steam per minute of a given pressure, and if that steam have, owing to the rapidity of the stroke, to occupy twice as many cubic feet in the cylinder, by Mariotte's law the cylinder-pressure would be only half the boiler-pressure.

Before however examining *what* the cylinder-pressure must be, that as much work may be done where there is, as where there is not, a lead of the slide, I must draw attention to another passage from M. de Pambour's treatise.

"At the moment when the piston reaches the point which corresponds to the *lead of the slide for the suppression of the steam, the motive force is suppressed*; and *when the piston, continuing its stroke in virtue of its acquired velocity*, arrives at the point which corresponds to the lead for the admission of the steam, it not only receives no further impulse in the direction of the motion, but suffers an opposition from the motive force itself, then let in against it."

The passages which I have marked by italics, I may unhesitatingly affirm to be erroneous. The motive force is *not* suppressed when the steam is cut off, for it continues to act expansively; the piston does *not* continue its motion in virtue of its required velocity merely, but does receive "further impulse in the direction of the motion."

The last clause of the quotation refers to the *lead of admission*, but I shall in the following investigation consider the effects of the lead of suppression alone, as being the most important, and because I do not wish to complicate the question with effects which are of such a nature that they may be considered separately.

In estimating the work done by steam of a given pressure Π in a cylinder of given length a for a given lead of the slide, I will take the usual measure of the "travail" or "work done," namely, the pressure multiplied by the space through which it is exerted.

Suppose the piston has risen to a height h in the cylinder at the moment when the steam is cut off, then up to that moment the full pressure Π has been exerted through a distance h, or the work done $= \Pi h$.

Let x be a point to which the piston has risen after the suppression of the steam, the pressure is now decreased in the inverse proportion of the spaces occupied, or of $x : h$, and if we suppose this pressure constant for a distance dx, the work done at this point is

$$\frac{h}{x} \Pi \, dx.$$

And the whole work done after the steam is cut off is determined by integrating this expression between the limits h, the point of suppression, and a the height of the cylinder. Effecting this integration and adding the work done before suppression, we have for the whole amount of work done,

$$\Pi h + \Pi h \log_\epsilon a - \Pi h \log_\epsilon h \qquad \text{(A.)}$$

I will just pause here for a moment to observe that the expression which I have marked (A) vanishes (as it ought) when h is put $= 0$, or when the steam is wholly suppressed. The first two members of (A) obviously vanish when h is zero: the last one however becomes $\Pi \, 0 \log 0$, which is an illusive expression; but if for $\log h$ we use its expansion

$$(h-1) - \tfrac{1}{2}(h-1)^2 + \tfrac{1}{3}(h-1)^3 - \ldots\ldots$$

and multiply this by h, it is seen the whole vanishes when $h = 0$.

Suppose that when the engine is working at uniform velocity, that is, is at its normal state of motion, the resistance offered to the piston by the work to be done is p lb. to the square inch, then of course the work to be done in each stroke $= p\,a$, if a be the height of the cylinder; and if steam be admitted during the whole stroke it is clear that the pressure of steam in the cylinder also must be p lb. to the square inch. If however steam be admitted during part only of the stroke, the pressure must be so much increased that the work done by the steam may still be the same. We have then to equate our expression, obtained above, with $p\,a$. Hence

$$p\,a = \Pi h (1 + \log a - \log h).$$

Here then nothing is more easy than to compare the pressures in the two cases where there is, and where there is not, a lead of the slide; for the equation gives at once

$$\Pi = p \frac{a}{h(1 + \log a - \log h)} \qquad \text{(B.)}$$

This then must be the pressure of the steam supplied to the cylinder in order that when cut off at a height h, it may do the same work that steam of pressure p would if acting through the whole length of the cylinder. By examining equation B it will be seen than when $h = 0$, or the steam is totally suppressed, the expression for the corresponding pressure becomes $= \infty$, as it ought. But it is carefully to be noted that the real limit to the value of this pressure arises from the consideration that it can never be greater than in the boiler. We must therefore never give a value which would make the value of Π greater than the boiler-pressure. If we did the engine would no longer be able to do the work we have assigned to it.

I will now resume the expression (A) and employ it for the purpose of comparing a steam engine which has, with a steam engine which has not, a lead of the slide. I think the following will be a very convenient way of instituting this comparison. There are four principal conditions under which the problem of the steam engine is varied.

I. The degree of pressure in the boiler.

II. The rapidity of evaporation.

III. The load moved.

IV. The velocity with which the load is moved.

The reader will see that of these conditions the first two are of the nature of causes, the last two are effects. Now the way in which I propose to examine the result of introducing a lead of the slide into an engine which was before worked at full pressure is this; to see what change it would produce in *each* of the above two effects, supposing the other three conditions to remain unaltered. That is, to see

1st. How the velocity must be changed if I, II, and III remain unchanged.

2d. How the load must be changed if I. II. and IV. remain unchanged.

I do not mean to say that the lead of the slide might not be made to produce changes in both effects at once, but the subject will be exhibited most clearly by the plan suggested of considering each change separately.

On the alteration of the velocity produced by a lead of the slide.

1. To examine the alteration in the velocity produced by a lead of the slide, the rapidity of evaporation being the same, and the load of resistance remaining unchanged. Suppose the evaporation such that it would produce per minute m cylinders-full of steam of the pressure p: then it would produce $2m$ cylinders-full of the pressure $\frac{1}{2}p$, $3m$ cylinders-full of the density $\frac{1}{3}p$, and, for the same reason, $\frac{h}{a}(1+\log a-\log h)\,m$ cylinders-full of pressure $\frac{a}{h(1+\log a-\log h)\,p}$.

If however the steam be cut off when it has filled the cylinder to a height h instead of a, the number of times the cylinder is filled per minute will be increased in the proportion $a:h$. Hence finally the number of cylinders-full of steam, and therefore the number of strokes per minute are defined in reference to (B) by the expression

$$\frac{a}{h}\,\frac{h}{a}\,(1+\log a-\log h)\,m$$

or the velocity will be increased in the ratio

$$1 : 1+\log a-\log h \qquad \text{(C.)}$$

Hence the smaller the value of h, the greater the velocity, subject only to this limit that the value of h must never be such as would suppose a higher pressure in the cylinder than that in the boiler. We obtain therefore the following practical rules.

The highest velocity for a given load and given evaporation is obtained by cutting off the steam at such a point that the steam in the cylinder shall, during admission, have the same pressure as the steam in the boiler.

The velocity will be increased by increasing the boiler-pressure and the lead of the slide conjointly.

The rules which are here demonstrated are of the highest importance, and I confess that it is with no little satisfaction that I arrive at results which I did not foresee till the very moment of interpreting the analytical formula which I have here exhibited. These rules, even when viewed apart from the analysis which has led to them, bear the highest marks of probability; and they have this advantage that they are not merely theoretically true, but correspond to the actual working condition of steam engines, and require no practical modifications arising from friction of machinery and other unknown resistances.

Before quitting the subject it will be well to see what is the value of the lead of the slide which gives the cylinder-pressure equal to the boiler-pressure, and therefore, as we have shown, produces the greatest velocity.

Let the effective pressure in the boiler be P lb. to the square inch, and, as before, let the load offer a resistance of p lb. on each square inch of the piston. Then we have from equation (B) for the maximum value of h

$$\frac{p}{\mathrm{P}}=\frac{h}{a}\left(1+\log_\epsilon\frac{a}{h}\right)$$

From this equation we can easily find what relation to the load and the boiler-pressure the lead the slide should have for a maximum velocity. For instance let us suppose the resistance to the piston 48 lb. per inch, and the boiler-pressure 50 lb. per inch. In this case it will be found on trial that the equation is nearly satisfied by putting $h=\frac{3}{4}a$, for we have

$$\frac{p}{\mathrm{P}}=\tfrac{3}{4}\left(1+\log_\epsilon\tfrac{4}{3}\right)$$

$$=\tfrac{3}{4}\,(1+.2876)=.96 \text{ nearly.}$$

This would give the relation of p to P equal to 48 : 50, or conversely if the effective boiler-pressure were 50 lb. per inch and the resistance 48 lb., the maximum velocity for a given evaporation (and therefore for a given amount of fuel) would be obtained by cutting off the steam at ¾ ths the stroke.

"Suppose, in effect, that a load of 50 tons gross, tender included, be drawn up a plane inclined $\frac{1}{500}$, by an engine with 2 cylinders 11 inches in diameter, stroke of the piston 16 inches, wheels 6 feet, friction 103 lb., total pressure of the steam in the boiler 65 lb., or effective pressure 50 lb. per square inch."

"We have already found above that the total resistance opposed by that load to the motion of the piston, in the case of this engine, is 48 lb. per square inch."

I have taken this extract from M. de Pambour's account of his admirably conducted experiments, to show that the case I have supposed accords with practice. It appears that in this case, with an evaporation of one cubic foot of water per minute, the engine would move the train at the rate of 20·7 miles per hour, there being no lead of the slide. The lead being ¼th, we find from (C) that the velocity (for the same evaporation) would be increased in the ratio

$$1 : 1+\log\tfrac{4}{3}, \text{ or } 1 : 1{\cdot}2876$$

or the velocity would be increased from 20·7 to 26·61 miles an hour—no trifling advantage certainly. It is necessary, however, to refer the reader to another extract from M. de Pambour's work, because the considerations which it offer apply to the investigation here made, and are essential to its accuracy.

"It is necessary here to remark, that as this lead offers a resistance precisely equal to the pressure of the steam in the boiler, and as we have seen that at the moment of starting of every engine, the power must necessarily exert an effort greater than the resistance, it would be impossible for the engine to set itself in motion with the load. If then we would make the engine work with this load, it is understood that the aid of another engine would be requisite to start it; or else the engine-man must for a few minutes close the safety-valve, to create in the boiler a sufficient excess of pressure, till the uniform motion be attained. Then the momentary excess of pressure may be withdrawn and the engine will continue its motion without any external aid.

"However, as on railways there continually occur little inequalities or accidental imperfections in the road, and as the engine ought to be capable of overcoming them, it is not to be expected that it can be made to perform an entire trip, working precisely at its maximum of useful effect, or with its maximum load. The preceding determination therefore is to be considered only as showing what the engine may perform on arriving with a velocity already acquired, at an inclined plane situated at a certain point of the line, or as indicating the point towards which our aim should tend as much as possible, in order to accomplish producing the maximum of useful effect, but without reckoning on obtaining it completely in practice.

"We here neglect the little necessary difference between the pressures in the cylinder and in the boiler, from the flowing of the steam from the one vessel to the other. It plainly tends somewhat to reduce the load of the engine, increasing in a corresponding manner the velocity of maximum useful effect.

I ought, perhaps, to add that by improvements which have been (I believe) invented since M. de Pambour wrote, the expansion gearing is placed under the control of the engine-driver, so that he can regulate the lead of the slide while the engine is in motion. The slide need not, therefore, have any lead till the engine has attained its full velocity.

On the alteration in the load produced by a lead of the slide.

2. I come now to consider what alteration must be made in the load or resistance for a lead of the slide, supposing the evaporation and the velocity to remain unchanged. It will be clear that as far as concerns locomotive engines this second enquiry principally affects luggage trains, while the former enquiry as to the means of increasing velocity most affects passenger trains.

Suppose, as before, that when there is no lead of slide the boiler supplies m cylinders full of steam of the pressure p. If now we suppose the velocity unchanged, there will still be the same number of strokes per minute, and the quantity of steam supplied for each stroke will also be the same as before, only it will fill the cylinder to a height h instead of a, its pressure will therefore be increased in the proportion $a : h$. Now by the principles already laid down the work done by steam of this pressure $\frac{a}{h}p$ used expansively is

$$\frac{a}{h}p.\;h\,(1+\log_\epsilon a-\log_\epsilon h) \text{ or } a\,p\,(1+\log_\epsilon a-\log h)$$

When, however, the steam was used without expansion the total work done in each stroke was $a\,p$. We have, therefore to multiply by the quantity within the bracket to get the increased effect for expansion. It is clear also that the increased load or resistance, since it acts through a distance a, is found by dividing by a, that is, the increased load, which we will call p', is expressed by the equation

$$p'=p\,(1+\log a-\log a)$$

or the load for a given amount of fuel and a given velocity is increased by the lead of the slide, in the proportion

$$1 : 1+\log a-\log h \qquad \text{(D.)}$$

The greater then will be the load which can be moved, as the value of h becomes smaller; subject only to a limit similar to that in the first question. Since the pressure in the cylinder can never be greater than that in the boiler the maximum effect will be produced by giving h such a value that

$$\frac{a}{h}p = \mathrm{P}$$

Hence we have for the greatest useful value of h

$$h = \frac{p}{\mathrm{P}}a$$

where the evaporation is equivalent to m cylinders-full of steam of the pressure p per minute. Here p is an unknown quantity, but m is known, because the velocity of the engine is supposed to be known. By ascertaining, therefore, the cubical content of the cylinder and referring to M. de Pambour's tables, for the relation of the volume of steam of any pressure to the water from which it is generated we shall be able to ascertain p.

To take an instance, let us suppose the evaporation of an engine such as that which M. de Pambour takes as the average, namely that $\frac{3}{4}$ cubic foot of water is tranferred to the cylinder in steam each minute. Also let the number of revolutions of the wheel per minute be 116. (This corresponds nearly to a speed of 20 miles an hour, the driving wheel being 6 ft. over.) The engine fills each of its cylinders twice in each revolution: the number of cylinders-full of steam per minute will therefore be 464. Suppose the capacity of each cylinder $\frac{9}{10}$ cubic foot. Then "m cylinders-full of steam of pressure p" become equivalent to 417·6 cubic feet of steam of pressure p. But this steam is supplied by $\frac{3}{4}$ cubic foot of water. The steam would have, therefore, 556 times the volume of the water which produced it; and by the tables it appears that this relative volume corresponds to a pressure of 50 lb. per inch, or 35 lb. effective pressure, which is therefore the value of p. Hence, if the effective boiler pressure be 50 lb. per inch the formula

$$h = \frac{p}{\mathrm{P}}a \text{ becomes } h = \frac{35}{50}a$$

or the greatest useful lead of the slide is in this case given by cutting off the steam at $\frac{7}{10}$ths of the stroke.

It will be seen from (D.) that the load would in this case be increased in the proportion

$$1 : 1 + \log\tfrac{7}{10} \text{ or } 1 . 1{\cdot}356$$

or for the same amount of fuel and the same velocity the load may be increased about $\frac{7}{20}$ths by the lead of the slide.

I believe that I have now considered all the principal cases of the question of the lead of the slide, though for brevity some points are omitted to which I shall recur hereafter. As far as I am aware the question, notwithstanding its importance, has never been accurately discussed. This may appear a strange assertion, but the reader will not deem it incredible, if he agree with me in considering M. de Pambour the great authority in matters relating to the theory of the steam engine, and also agree with me that in the present instance M. de Pambour is in error. Tredgold, I believe, discusses the question without reference to the rate of evaporation in the boiler: if so, I need scarcely say, after the laws laid down above, that I consider his reasoning totally flagitious. I confess that the errors which abound in his works have long since led me to estimate his physical theories very lowly. The problem of the steam engine is one which for its importance to the welfare of mankind, for its interest, and above all for the *exactitude* of which it is susceptible, deserves the energies of the profoundest mathematicians, but they have strangely neglected it, and it has consequently been approached by the veriest sciolists, whose erroneous reasonings have only widened the breach between the engineer and the philosopher. To this remark De Pambour is indeed an illustrious exception; but where are his fellow labourers? The investigation which I have just made, for example, ought to have devolved into far other hands than mine. I have striven to render it at least not inaccurate, but it ought to have been undertaken by those who could have given it a value much higher than this negative qualification.

H. C.

REVIEWS.

Letters on the Unhealthy Condition of the Lower Class of Dwellings, with an Appendix, containing Plans and Tables. By the Rev. CHARLES GIRDLESTONE, A.M., Rector of Alderley Cheshire.—Longman, 1845, 8vo. pp. 92.

The sanatory condition of our large towns has for some time past occupied a large share of public attention, and deserves to occupy a much greater. The abstract of the second report of the Health of Towns' Commission, which we gave in our last number, presents a lamentable and alarming picture of the degradation of the lower classes in manufacturing towns. While we are hugging ourselves with the pleasant conceit that the schoolmaster is abroad, that science is rapidly advancing, and that railways and electric telegraphs are fast bringing us to a species of intellectual millenium we seem to forget that for the present, at least, all our improvements principally affect the upper and middle classes of society. The vice and squalid debasement of the manufacturing population, as exhibited in the Commissioners' Report, can scarcely have been paralleled, and, we are bold to say, has never been exceeded at any period of our social history. It is a positive fact that in many places education has rapidly retrograded, instead of advancing. It appears from the Report of the Registrar-General, that out of every hundred couples married in Lancashire, during the last few years, "only 12 men and 8 women were able to sign their names," whereas Mr. Coulthart has shown that eighty years ago 54 men and 17 women out of a similar number wrote their names. Such statistics as these furnish a far more forcible picture of the deplorable condition of the poor in populous districts than the most eloquent rhetoric could supply. The inseparable companions of general ignorance are these—Poverty—Squalor—Disease—Crime. If the reader will examine the official report, or still better, obtain information by his own personal inspection, he will be able to trace each of these four consequences of ignorance, with terrible distinctness, in the social condition of the lower class of labourers and artizans. The latter of these consequences is a subject too distasteful to be insisted upon in more than general terms; be it enough to explain that it is but too certain that the promiscuous herding of the poor in crowded tenements, is a most fruitful cause of vice, which violates the purest ties of nature. These violations of the laws of humanity, it seems to be now ascertained, are vastly more numerous than the reports of the assizes would lead the public to suppose, and are almost inseparable from the present arrangement of the tenements of the poor in populous places.

The sanatory condition of the poor is however the more immediate subject of the excellent and most philanthropic pamphlet before us. The writer has chosen for his motto the following forcible passage from the writings of one whose affectations of language cannot wholly obscure the beauty of his thoughts—Carlyle.

Health is a great matter, both to the possessor of it and to others. On the whole, that humorist in the Moral Essay was not so far out, who determined on honouring health only; and so, instead of humbling himself to the high-born, to the rich and well-dressed, insisted on doffing hat to the healthy: coronetted carriages, with pale faces in them, passed by as failures, miserable and lamentable; trucks with ruddy-cheeked strength dragging at them, were greeted as successful and venerable. For does not health mean harmony, the synonym of all that is true, justly ordered, good? is it not, in some sense, the net total, as shewn by experiment, of whatever worth is in us? The healthy man is a most meritorious product of nature, so far as he goes. A healthy body is good; but a soul in right health, it is the thing beyond all others to be prayed for; the blessedest thing this earth receives of heaven."

Mr. Girdlestone's pamphlet is professedly founded on the first Report of the Health of Towns' Commission. He first of all brings proofs of the accuracy of the inquiry, by explaining the manner in which it has been conducted, and then enters upon the several subjects of unhealthy influences, defective drainage, insufficient supply of water, &c., but as we have already devoted much space to the subject, we can only avail ourselves very partially of the valuable information which he has collected. We have selected the following passages from the chapters on Drainage and Ventilation.

We are daily bringing into our streets and our abodes both water from springs, and wells, and rivers, and also various other matters, liquid and solid, for food and for many other uses; of which matters, a very large amount, and ultimately the whole, or nearly so, becomes refuse, and must somehow be got rid of. Now a perfect system of sewers is adapted for the disposal of all such refuse matters, whether liquid or solid; the one helping to float away the other, and the rain as it falls washing all out clean. And such a system, to be perfect, must clear off every kind of refuse out of the precincts of the house and of the town, before it has begun to decompose and putrify; and then the town atmosphere would not only be as dry as that of the country, but as free from everything that is offensive and injurious, as far at least as this refuse matter is concerned. But if there be no efficient public sewers, if the refuse be merely put out of sight in cesspools and dust bins, or in sewers, which, for want of a proper fall, are full of stagnant filth, and act as extended cesspools; if there be no drains from each house into the public sewers, and no traps or valves, or flaps, at each opening of sewer and of drain; if there be no paved pavement, nor any well formed roadway impervious to moisture; in such a case, and in proportion as these several points have in any case been neglected, there, not only the rain, but all the water sed for washing, cooking, and manufacturing, however filthy it may have become, and all the refuse and excremental matter of every kind, accumulating hour by hour, and day by day, and year by year, except so far as it may be partially removed by the offensive and degrading process of manual labour, must be left to rot on the surface, and to sink into the soil, liable to be stirred up anew by each shower that falls, and ready to yield to the sun as it shines, and to the wind as it blows, vapour charged and tainted with disease and death.

We find an intelligent physician giving it as his opinion, and proving it by a very remarkable Table of Mortality, that the true cause of the periodical cholera, so generally ascribed to the abundance of fruit, is to be found in "the miasmata evolved from stagnant water, or impure drains, by the heat of summer."

As to the wasteful expense incurred by conferring monopolies on water companies, it is shewn, that in Liverpool the public are paying six times the cost incurred by the company. And as to the supply thus exorbitantly paid for, "In the poorer neighbourhoods there is usually a cock in each court, and the inhabitants carry it and store it in jugs or wooden vessels, from day to day. But compared with the dense population the supply is totally inadequate.

We regret that we are obliged to pass over much that is interesting, but the following passages recapitulating the miscellaneous unhealthy influences are so forcible that we cannot venture to omit them.

From the employments of peace let us turn for a moment to the scenes of warfare. If ever a town is to the utmost degree unhealthy, it is a town in a state of siege, or of blockade; its homes doubly crowded by its defenders and their retinue, and the wounds which man purposely inflicts on man added to the ills which by negligence he entails upon himself. But not only besieged towns and fortresses, camps also in the open country, and barracks in the healthy suburbs of a town, have often given deadly proof of the injury to health sure to arise, however sound men may be in constitution, however well clothed and well fed, if they abide in a site which wants drainage, or where their refuse is not duly removed, or where there is no adequate supply of fresh air. Not to go back to ages when these matters were never so much as thought of, the records of the last great European war would prove, if they were examined with a view to this point, that however many lives were lost in battle, many more were sacrified in swamps and in crowded hospitals, beneath suffocating tents, or between the decks of heavy laden transports. A case is mentioned incidentally, in the evidence, of "2,000 British seamen dying in one fleet from fever and want of ventilation." The state of things, till of late, universal on board of ship, is indeed one of the most striking proofs of how much health depends on due attention to the supply of pure water and fresh air. However exhilirating the atmosphere on deck, the amount of sickness, often very great indeed, always bears proportion to the closeness and the filthiness below. And they who are borne round the world by winds upon the ocean become victims of "ship fever," as it is called, because in the interior of the vessel, where they eat, and rest, and sleep, they stint themselves in fresh air to breathe, and in clean water to wash with, whilst they have an unlimited supply of both close at hand.

Even when the individuals who generate the poison remain free from its effects, they may communicate the fever to others, as was the case in what is known, from that circumstance, as the Black Assize at Oxford in 1477, where the Lord Chief Baron, the sheriff, and about 300 more, (all who were present in the court,) were infected by the prisoners, and died within forty hours; and also in the famous Old Bailey session of May, 1750, in which most of those present who occupied one side of the court, (including the Lord Mayor, two of the judges, and one of the aldermen on the bench,) so as to receive the emanatious from the prisoners' bodies, contracted fatal typhus.

On the repulsive subject to which we have alluded concerning the effects of crowding large numbers of the poor into confined places, the writer has most pertinent remarks. The picture which he presents is a melancholy one indeed, but there is no room for hoping that it is overcharged. The facts presented are decisive as to the extent of the evil—the records of demoralisation in this pamphlet, it is not necessary for us to repeat; it is enough that they have been published once. We prefer rather to give in Mr. Girdlestone's own words, a general statement, fully authorized by the evidence before him.

We are thus brought to the lowest point of moral degradation, the corruption and decay of natural affection; that havoc of the conjugal and parental ties which severs the first bonds of all human society. Henceforth there is no foundation left for the true principle of social and political morality, namely, the love of each man for his neighbour as a fellow member of the body politic. Nor is it possible that this state of things can extend widely, or last long, in one class of the community, without in some measure infecting all the rest. Repulsiveness begets repulsion; hate, hatred; and jealousy, suspicion. In the lack of all neighbourly communion between the employed and their employers, there is room for a state of feeling which is described by one of the witnesses as common among men "not necessarily hardhearted." "They form a low estimate of the value of life and health. A man dies, and another replaces him without cost to his employer: but if it were a horse or a dog, the owner would have to pay for a new one. This makes all the difference." And as to the neighbourly visitation of the poor by the wealthy, the surrounding circumstances of indecency often absolutely preclude the gentle and soothing agency of such kindness on the part of female neighbours. Independently indeed of this hindrance, the general unhealthiness of the atmosphere of towns has a most injurious effect on the relations of society, by inducing all who can afford it, including in some cases even the clergy and the medical practitioners, to remove into the suburbs. And yet the actual presence, and the familiarly known habits of a Christian family, the sanctifying influences of a Christian home, as an accessible centre of the charities of life, and an energetic source of their diffusion, these are amongst the chief means of doing good to our fellow creatures, whatever be our rank or calling; for these no subscriptions to societies, no attendance at committee meetings, can avail as substitutes; these tell better even than visiting in private, or than preaching in public.

The tables at the end of the pamphlet exhibit, by direct calculation, the effects of drainage and ventilation on health in large towns. Different schemes for ventilation, and methods of improved sewerage are also exhibited, but these have for the most part been already laid before our readers. We must therefore refer those who are desirous for further information, and are unwilling to examine the voluminous Official Reports, to the excellent abstract contained in the present pamphlet. The following eloquent reflections with which it concludes shall be our last extract.

There was indeed a country once, in which every man dwelt under his own vine, and under his own fig tree; there was a law by which no man's portion of land could be permanently alienated; and there was a woe denounced against those who "*join house to house, and lay field to field, till there be no place, that they may dwell alone in the midst of the earth.*" I need not say what commonwealth that was, nor whence that civil polity was derived, nor how differently our own is constituted, nor how much we lose by wholly overlooking those divinely revealed principles of society, which, with due accommodation to varying circumstances, must ever be of value to all mankind. Enough that we bear in mind this consequence of our own system of things, namely, that with few exceptions, the working man cannot ever have the interest of owner, or even of leaseholder, in the place of his abode; and hence has no voice in settling its original construction, nor any power to alter it, or to adapt it to his wants. So much the more obviously is it the duty of the landlord to study, not simply his own gain, but the health, the convenience, and the decent habits of his tenantry. And so much the more is it incumbent on the higher classes of society, generally, to devise and to promote the means of bringing it to pass, that if a man be diligent, frugal, sober, honest, and desirous of living in a healthy and decent home, he shall at least have the option of procuring one. This is at present a sheer impossibility, to many of those who dwell in towns, and to not a few dwellers in the country; a fact which ought to be well weighed by those whom it must deeply concerns, the great proprietors of the soil. And to those who are merely occupiers, and who would fain have better dwellings to occupy, I would say, This is a point much better worth your striving after earnestly, than those various questionable objects, to which your attention is apt to be turned by your deluded or designing leaders. Be assured, that your best way to emerge from the hardships of your present condition, is, first, to practise, under any circumstances, honesty, sobriety, frugality, and diligence; and next to direct your energies to objects, in which all classes, and all parties, must admit the reasonableness and justice of your claims. Such must be your contribution to a cause, to which I hope that all will contribute something. For my own part, if I can do little more than write in your behalf, I feel thankful to have been led to do thus much. I know not how I could have better spent the time, than in digesting these letters from the voluminous Report on the unhealthy condition of your dwellings. Nor could I by any other means have satisfied myself, after evidence so clear of evils so painful to contemplate, except by doing the best I could towards promoting their redress.

It is clear that the subject of these pages must occupy far more attention and more active exertion than have hitherto been devoted to it. The inadequacy of private benevolence to remove the evil is evident, and it is intolerable that any dissension should occur to delay the enactment of suitable legislative provisions. Whatever may be the heat of political discussion, the health—the morality—the existence of the people is a question in which there can be but one party—the nation.

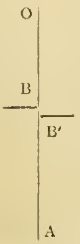
The Farmer's Boy and other Rural Tales. By Bloomfield. With Illustrations by Cooper, Taylor, and Webster. London: Van Voorst, 1, Paternoster Row. 18mo.

The above work has been sent to us from the publisher, but the subject does not come within the province of this journal; the book is, moreover, a reprint of the known works of Bloomfield. We can, however, bear testimony to the great beauty of the vignette woodcuts with which these poems are adorned. They absolutely rival the sharpness and delicacy of steel engravings. The typographical elegance, also, of this work is in no way inferior to that which characterizes the other books of the same publisher.

ON THE PROPER DEPTHS BELOW WATER MARK OF CILLS USED FOR DRAINAGE.

By F. Bashforth, B.A., *Fellow of St. John's College, Cambridge.*

Engineers are divided in their opinions respecting the proper depths below low water mark at which the cills of sluices, employed in draining low land, ought to be placed. It appears to me that a few simple mathematical considerations will set the matter at rest. The difference between the densities of fresh and salt water is well known; and from the acknowledged fact that the tides flow up the bottom of rivers, elevating the fresh water in their progress, and that large rivers, such as the Oronoco, at their mouths, form immense bays of *fresh* water, the fresh water swimming on the surface—we learn that the difference of those densities is such as cannot be neglected.



Let the figure represent a section of the water-gate O A, capable of turning about O. Let the surfaces of the fresh and salt water be at B and B' respectively, when the momenta of the two pressures tending to turn the gate equal

$$\left.\begin{array}{l}A\,B = x\\ A\,B' = x'\end{array}\right\}\qquad O\,A = h$$

$\left.\begin{array}{l}\rho\\ \rho'\end{array}\right\}$ the density of the $\left\{\begin{array}{c}\text{fresh}\\ \text{sea}\end{array}\right\}$ water.

l = width of the sluice.

$$\text{Pressure of the fresh water on } A\,B = s\,\rho\,(l\,A\,B)\,\frac{A\,B}{2} = s\,\rho\,\frac{l\,x^2}{2}$$

Distance of cent. of press. below B = $\frac{2}{3}$ B A = $\frac{2}{3}\,x$.

∴ Moment of the pressure of the fresh water tending to turn the gate about O $= \frac{s\,\rho\,l\,x^2}{2}\,(h - \frac{x}{3})$.

Similarly, moment of the pressure of the sea tending to turn the gate in the opposite direction $= \frac{s\,\rho'\,l}{2}\,x'^2\,(h - \frac{x'}{3})$.

These are supposed equal ∴ $\frac{s\,\rho\,l\,x^2}{2}\,(h - \frac{x}{3}) = \frac{s\,\rho\,l\,x'^2}{2}\,(h - \frac{x'}{3})$

$$\text{or } \rho\,x^2\,(h - \frac{x}{3}) = \rho'\,x'^2\,(h - \frac{x'}{3})$$

$$\text{or } x^3 - 3\,h\,x^2 = \frac{\rho'}{\rho}\,(x'^3 - 3\,h\,x') \qquad (1.)$$

First, suppose that the cill is 6 feet below, and that O is 14 feet above low water mark—

$$x' = 6,\ h = 20 \text{ and } \frac{\rho'}{\rho} = \frac{103}{100} = 1{\cdot}03$$

$$x^3 - 3 \times 20\,x^2 = 1{\cdot}03 \times 36\,\{6 - 60\}$$

$$\text{or } x^3 - 60\,a^2 = 2002{\cdot}32$$

It will be found on trial that $x = 6{\cdot}1$ feet very nearly satisfies this equation. Hence we see that the fresh water must be about $\frac{1}{10}$ of a foot higher than the sea water, when the tendency of the gate to turn in either direction is zero. Although this point would frequently be found worthy of consideration, it is not the most important.

Let P, P′ denote the pressures of the fresh and salt waters at points in the horizontal plane passing through A. Then we have

$$\frac{P}{P'} = \frac{\rho\,x}{\rho'\,x'} = \frac{100 \times 6{\cdot}1}{103 \times 6} = \frac{610}{618}$$

Hence we see that if the gate were opened in the present state of the case, instead of the fresh water rushing out the salt water would actually flow through the whole length of the cill. If the fresh water become elevated $2\frac{1}{4}$ inches above the surface of the sea then all along the cill (the widest part of the opening) the pressures of the two would be equal.

Secondly, we will now suppose that the cill is placed one foot below low water mark—the point O being, as before, 14 feet above the surface.

$$\left.\begin{array}{l}x' = 1 \text{ foot}\\ h = 15 \text{ feet}\end{array}\right\}$$

∴ substituting in = (1) we get

$$\begin{aligned}x^3 - 3 \times 15\,x^2 &= 1{\cdot}03\{1 - 45\}\\ &= -1{\cdot}03 \times 44\\ &= -45{\cdot}32\end{aligned}$$

$$x = 1{\cdot}02 \text{ ft. nearly}$$

$$\therefore x - x' = 1{\cdot}02 - 1{\cdot}00 = {\cdot}02 \text{ ft.} = \tfrac{1}{50} \text{ foot.}$$

In the first case we get

$$x - x' = 6{\cdot}1 - 6 \text{ ft.} = \tfrac{1}{10} \text{ foot.}$$

These examples are not supposed to belong to any particular case, but it was necessary to make numerical applications of equation (1.) to show clearly the result of calculation. We thus see that it is possible that the moment of the water tending to open the gates may be greater than that tending to keep them closed, but that when the gate *just opens* the pressure of the salt water in the same horizontal plane with the cill must be greater than that of the fresh water in that plane; and consequently, at every orifice, below some point C, the salt will flow into the fresh water, and above that point the fresh water will flow into the sea. In no case can B be less than about $\frac{1}{10}$ foot higher than B′, for in that case the moment of the pressure of the fresh water would be less than that of the sea, and consequently the gate would be closed.

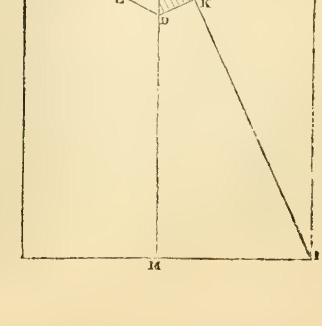
When there is a fall in a river of three or four inches per mile, it becomes of the greatest possible importance that not even one inch should be thrown away by an erroneously constructed sluice. It is to such cases that this investigation is intended to apply. If the densities of the two waters had been the same, the lower the cill the more water would be discharged.

OBLIQUE ELLIPTIC ARCHES.

Sir—In the essay on Oblique Bridges by G. W. Buck, Esq., he considers it not imperative on the engineer to erect oblique elliptical arches, as they may generally be made segmental, and for that reason has not considered the subject; as they sometimes are erected I send you the following elucidation descriptive of a bridge of that form, of similiar dimensions to those over the line on the Edinburgh and Glasgow Railway, showing how it may be constructed according with his scientific principles by converting the ellipse into circular arcs. If you consider it worth the attention of your readers I will be obliged by its insertion in your valuable Journal.

Fig. 1. Development of elliptical arch crossing at an angle of 60° 50′. A C D D′ represents the skew of the bridge, and C F G D its development; the line C K, to which the courses of the arch must be parallel, should be theoretically at right angles to C F, but when it does not suit the division of the courses it requires to be adjusted to the nearer course, in this case it is made to join the seventh; the checks on the impost are at right angles to C D.

Fig. 1.



Dimensions and Calculations.

A B width of arch on the square	28 feet
O E height of arch	6
A A′ depth of arch at springing	1·25
E T ditto at crown	1

B F or A E B = $\sqrt{\frac{1}{2}}\ \frac{AB^2\, 28^2 + 2\,OE\, 12^2}{2} + \frac{AB\, 28 + 2\,OE\, 12}{4} \times \frac{3\cdot1416}{2}$ = 32·626

A C width of arch on the skew = sin obl. 60° 50′ : R :: A B 28 : A C = 32·065

B C = R : cosin obl. 60° 50′ :: A C 32·065 : B C = 15·627

C L external width of bridge including projection of arch-stones 1½ in. .. .. 17·25

Angle B F C = B F 32·626 : B C 15·627 :: R : tan B F C .. 25° 35′ 35″

C F = sin B F C 25° 35′ 35″ : R :: B C 15·627 : C F .. 36·175

Convenient number of voussoirs, 31

Thickness of ditto $\frac{CF\ 36\cdot175}{31}$ = 1·167

C D from face to face of springer = R : cosin obl. 60° 50″ :: C L 17·25 : C D = 19·755

D K = 7 courses × the thickness 1·167 = 8·169

Angle D C K adjusted = C D 19·755 : D K 8·169 :: R : sin D C K 24° 25′ 14″

C M axial length = R : cot D C K 24° 25′ 14″ :: B F or M I 32·626 : C M .. .. 71·85

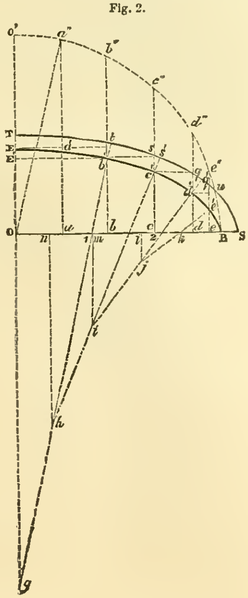
Development of half the Arch C, *l, m, n, o, p, q, to obtain the bevels for Heads of Arch-stones.*

Divide B E into a convenient number of parts and lay them on B *f*, draw lines parallel to B C and the ordinates will be found by similar triangles, as A B : B C : : A *b′* : *b′ m′* and F B : B C : : F *b* : *b m*. Then *b′ m′* − *b h* = *h m*.

Divisions on B E *or* B *f*.	*Ordinates calculated on* C *q*.
B *a* = 1·80	*g* *l* = ·561
a *b* = 1·81	*h* *m* = ·736
b *c* = 3·22	*i* *n* = ·689
c *d* = 3·20	*j* *o* = ·478
d *e* = 3·15	*k* *p* = ·238
e *f* = 3·14	

Fig. 2. Elliptical arch on the square divided into circular arcs. B S = 1·25, second arc = 1·13, third = 1·05, fourth &c. = 1·0.

Fig. 2.



Distances of Ordinates. On B O.	*Ordinates of Circle.*	
	Radius	14
B *e* = ·55	*a a″* = R^2 or O a^2 − O a^2 = *a* a^2 ✓	= 13·645
e *d* = 1·23	*b b″* = R^2 − O b^2 = *b* b''^2 ✓	= 12·527
d *c* = 2·87	*c c″* = R^2 − O c^2 = *c* c''^2 ✓	= 10·42
c *b* = 3·1	*d d″* = R^2 − O d^2 = *d* d''^2 ✓	= 6·831
b *a* = 3·12	*e e″* = R^2 − O e^2 = *e* e''^2 ✓	= 3·885
a *o* = 3·13		

Ordinates of Ellipse.

The one semi-axis is to the other as the circle to the ellipse,—

or B O : O E :: *a a″* : *a a′* (14 : 6 :: 13·645 : 5·848) = 5·848
b b′ (14 : 6 :: 12·527 : 5·368) = 5·368
c c′ (14 : 6 :: 10·42 : 4·465) = 4·465
d d′ (14 : 6 :: 6·831 : 2·892) = 2·892
e e′ (14 : 6 :: 3·885 : 1·665) = 1·665

To find the Angles.

1st. E′ E *b* or *g b′* E. E′ *b* 6·25 : E E′ (6 − 5·368) ·632 : : R : tan E *b′* E′ 5° 46′ 27″ and 90° − E *b′* E′ 5° 46′ 27″ = E′ E *b′* or *g b′* E = 84° 13′ 33″.

2nd. *h b′ c′* or *h c′ b′*. *b′ s* 3·1 : *s c′* ·903 : : R : tan *s b′ c′* 16° 14′ 25″ and 180° − (*g b′* E 84° 13′ 33″ + E *b′ b″* 84° 13′ 33″) = *b″ b′ t* 11° 32′ 54″ and 90° − *b″ b′ t* 11° 32′ 54″ = *t b′ s* 78° 27 6″, then 180° − (*t b′ s* 78° 27′ 6″ + *s b′ c′* 16° 14′ 25″) = *h b′ c′* or *h c′ b′* = 85° 18′ 29″.

3rd. *k* B *e′*. B *e* ·55 : *e e′* 1·665 : : R : tan *e* B *e′* = 71° 43′ 12″.

To find the Radii.

1st Rad. *g b′*. 180° − 2 *g* E *b′* 84° 13″ 33″ = E *g b′* 11° 32′ 54″ and sin E′ E *b′* 84° 13′ 33″ : R : : E′ *b′* 6·25 : E *b′* 6·281. Sin E *g b′* 11° 32′ 54″ : sin *g* E *b′* 84° 13′ 33″ : : E *b′* 6·281 : *g b′* = 31·219.

To find the lines drawn from the centres of the several arcs perpendicular to the semi-axis O B.

1st. *j l* and B *l*. *j e′* 5·927 − *k e′* 2·795 = *j k* 3·132 and R : sin *j k l* or B *k e′* 36° 33′ 36″ : : *j k* 3·132 : *j l* = 1·865.

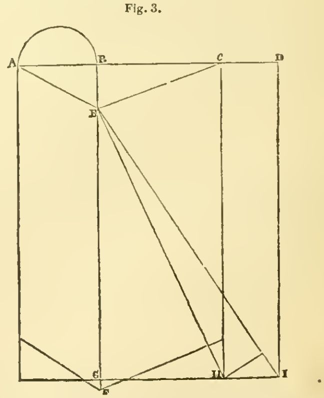
And R : cosin *j k l* 36° 33′ 36″ : : *j k* 3·132 : *k l* 2·564 and B *k* 2·795 + *k l* 2·564 = B *l* = 5·359.

2nd. *i m* and B *m*. 90° − *d d′* 2 or *q d q′* 36° 30′ 14″ = *d* 2 *d′* or *i* 2 *m* 53° 29′ 46″ and sin *d* 2 *d′* 53° 29′ 46″ : R : : *d d′* 2·892 : *d′* 2 3·597 and *i d* 12·067 − 2 *d′* 3·597 = 2 *i* 8·470 R : sin *i* 2 *m* 53° 29′ 46″ : : 2 *i* 8·470 : *i m* = 6·808.

And R : cosin *i* 2 *m* 53° 29′ 46″ : : 2 *i* 8·470 : 2 *m* 5·039 and R : sin 2 *d′ d* 36° 30′ 14″ : : 2 *d′* 3·597 : 2 *d* 2·14 and B *e* ·55 + *e d* 1·23 + 2 *d* 2·14 + 2 *m* 5·039 = B *m* = 8·959.

Fig. 3. Development for circular arcs.

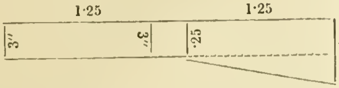
Fig. 3.



The angle D C K, fig. 1, or G E H is the angle of intrado, and G E I the angle of extrado, and the difference of these, or H E I, is the twist wrought on the beds of the arch-stones; a sectional view through the crown of the arch to show the radiation of the courses would exhibit the checks on the soffit to which the template for intrado applies, but the calculations generally will be sufficient for practical purposes.

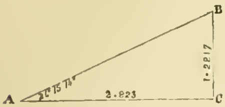
A B = Rad 2·795 × 2 = 5·59
B C = A B 5·59 × 3·1416 ÷ 2 = 8·781
A E = sin obl. 60° 50′ : R :: A B 5·59 : A E .. .. 6·401
B E = R : cotan obl. 60° 50′ :: A B 5·59 : B E .. .. 3·12
Angle B C E = B C 8·781 : B E 3·12 :: R : tan B C E .. 19° 38′ 38″
E C = sin B C E 19° 38′ 38″ : R :: B E 3·12 : E C .. 9.318
Angle G E H = D C K, fig. 1 .. .. .. 24° 25′ 14″
G E = R : cot G E H 24° 25′ 14″ :: G H or B C 8·781 : G E.. 19·337
B D = A B 5·59 + 2 B B′ 2·50 = diam of extrado 8·09 × 3·1416 ÷ 2 = B D 12.708
Angle H E I = G E 19·337 : G I or B D 12·708 :: R : tan G E I = 33° 18′ 44″, and G E I 33° 18′ 44″ − G E H 24° 25′ 14″ = H E I .. .. 8° 53′ 30″

Twisting Rules.

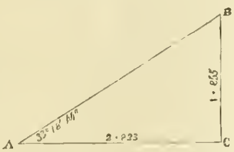


R : tan H E I 8° 53′ 30″ :: the length 1·25 : the diff. of width .. 0·19
Distance apart on the intrado .. .. 2·5
Ditto on the extrado in the ratio of H E to E I = 2·7
Templates A C = 2·823

Template for checks of intrado.



Template for checks of extrado.



Being one of the divisions on the impost the template placed thereon, on A B and scored along B C.

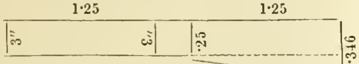
Point of eccentricity on the centre line for radiation of joints.

Rad. 2·795 cotan obl. 60° 50′ tan G E I 33° 18′ 44″ = 1·025 = *g s*, fig. 4.

The calculations to obtain the twist and eccentricity for the other arcs are performed in a similar manner.

2nd Rad. 5·927. Angle H E I = 4° 51′ 23″.

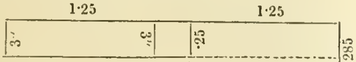
Twisting Rules.



Eccentricity = K *r*, fig. 4, 1·856.

3rd Rad. 12·067. Angle H E I = 1° 54′ 45″.

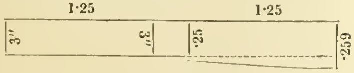
Twisting Rules.



Eccentricity = *b q*, fig. 4, 3·337.

4th Rad. 19·727. Angle H E I = 1° 5′ 8″.

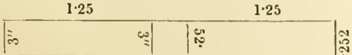
Twisting Rules.



Eccentricity = *m p*, fig. 4, 5·243.

5th Rad. 31·219. Angle H E I = 0° 40′ 11″.

Twisting Rules.

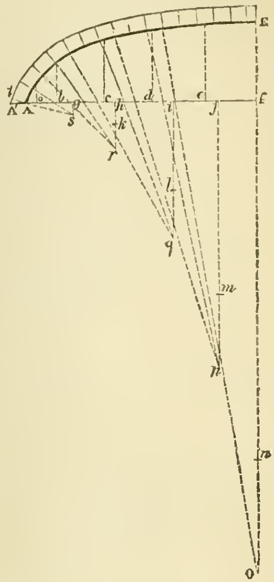


Eccentricity = *n o*, fig. 4, 8·166.

Fig. 4. Elliptical arch on the skew, showing the direction of the face joints.

A A′ = sin obl. 60° 50′ : R :: fig. 2 B S 1·25 : A A′ .. 1·431
A *a* = fig. 1 A C $\frac{32·065}{2}$ = A *f* 16·032 and fig. 2 B O 14 : A *f* 16·032 :: fig. 2 B *e* ·55 : A *a* .. .. .. ·63
A *b* = fig. 2 B O 14 : A *f* 16·032 :: fig. 2 B *d* 1·78 : A *b* .. 2·038
A *c* = fig. 2 B O 14 : A *f* 16·032 :: fig. 2 B *c* 4·65 : A *c* .. 5·325
A *d* = fig. 2 B O 14 : A *f* 16·032 :: fig. 2 B *b* 7·75 : A *d* .. 8·875
A *e* = fig. 2 B O 14 : A *f* 16·032 :: fig. 2 B *a* 10·87 : A *e* .. 12·447
A *f* = 16.032

Fig. 4.



The vertical heights from semi-axis to ellipse are the same as in fig 2.

A *g* = fig. 3 A E $\frac{6·401}{2}$ = A *g* .. .. .. 3·2
A *h* = fig. 2 B O 14 : A *f* 16·032 :: B *l* 5·352 : A *h* .. 6·136
A *i* = fig. 2 B O 14 : A *f* 16·032 :: B *m* 8·959 : A *i* .. 10·259
A *j* = fig. 2 B O 14 : A *f* 16·032 :: B *n* 11·698 : A *j* .. 13·395

The distances from the semi-axis to the several centres are the same as calculated for fig. 2.

Fig. 2 *b j* = *h k* 1·865
m i = *i l* 6·808
n h = *j m* 13·96
Rad 31·219 − O E 6 = *f n* 25·219

The points of eccentricity are as calculated fig. 3.

Rad 2·795 eccent. *g s* = 1·025
Rad 5·927 do. *k r* = 1·856
Rad 12·067 do. *l q* = 3·337
Rad 19·727 do. *m p* = 5·243
Rad 31·219 do. *n o* = 8·166

First joint on face A *l*. A *g* 3·2 : *g s* 1·025 :: A A′ 1·431 : A *l* ·458.

I am, Sir,
Your obedient servant,
JAMES MORICE.

Perth, Aug. 5, 1845.

CARLTON CLUB.—It appears that the members of the club are disposed to be very fickle respecting the selection of designs for the enlargement of their club. They first selected a few eminent architects to furnish designs, and awarded a premium of £200 to Mr. Salvin for what they considered the best design; and a second premium of £100 to Mr. Hopper, for the second best design. Not satisfied, however, with these designs, they determined to select some other architects to make a new design; and after a severe contest, it was decided by 220 votes, to employ Mr. Basevi and Mr. Sydney Smirke conjointly against 210 votes for Mr. Barry. The club appears still to be undecided, having by a late vote, we are informed, postponed the rebuilding for another year, when we suppose there will be another contest who shall be the architect.

ANALYSIS OF THE REPORT OF THE SELECT COMMITTEE ON ATMOSPHERIC RAILWAYS.

The following analysis of the Report of the Committee of the House of Commons on Atmospheric Railways has been collated in alphabetical arrangement for facility of reference. The original document is admirably drawn up, and the excellent copious index which accompanies it has materially assisted us in completing our abstract.

Accidents.—Reasons for considering that there would be more risk of accidents upon a single atmospheric line than upon a double locomotive line —(*Stephenson.*)

"I considered that question in the first instance, when the matter was brought before me very carefully, and I certainly came to the conclusion that the intersection of the lines would be attended with more risks on that system than on the locomotive system with two lines; I think the risk would be considerably more; I am aware that it has been proposed to make use of what are called fixed points in the crossings at the stations, but if the carriages are to run into a siding, or even to run past, which many of them must do at the rate of 30 or 40 or 50 miles an hour if this principle be adopted, I say that the danger is very great. The risk of getting off the line is principally confined to those points at crossings. On locomotive lines we have no accidents of any consequence away from those points leaving the stations, the accidents are almost always where the points and crossings are; those require to be attended to by manual labour. I prefer that a great deal to the system of fixing points as it is termed, that is, self-acting; self-acting machinery has been applied in many cases to these very things for 9 or 10 years. I have known them occasionly adapted to work by themselves; the engine going in or out of the siding opened or shut the points as the engineer wished; it is very easy to construct an apparatus of that kind, but it is practically useless, and it has been already abandoned. In the first instance I tried it myself on the Birmingham line, but in the winter time, from a fall of snow, and a severe frost after it, we found that the self-acting switches were always wrong, and they got fixed and would not act at all, and therefore anything like a self-acting apparatus I hold to be in all cases extremely dangerous; and the fact is that all railway companies that I am aware of have abandoned them.

Reasons for forming the opinion that the atmospheric system does not give greater safety than the locomotive; at the same time there is no reason for apprehending greater danger—(*Locke.*)

"It appears to me that the only reason why the atmospheric system could be supposed to give additional security consists in the connexion between the tube and the carriage, the tube tending to keep it in connexion with the line. Now, there must be, as it seems to me, such a play between the piston and the train, in order to allow for the inequalities of the surface, as to render any impediment upon the rail very likely to throw the train off quite as likely as upon the present system of locomotives.

"I think that the locomotive system has one great advantage, in point of security, which many persons may think a reason against it, and that is its weight; I consider that the weight of the locomotive is one great source of security, in all cases where it is carrying passengers. I will give one or two illustrations; I have known a very heavy rail, weighing about 70 lb. to the yard, which had been put across the railway maliciously, cut in two by the weight of the engine; I believe if it had been a lighter carriage, it would have inevitably thrown it off the line. That is one reason why I say that a locomotive is a source of security, rather than of danger. Again, I should say that in the case of most of the accidents that arose in the early part of the working of railways, the *vis inertiæ* of the engine and the tender had the chief part of the shock when the trains had got off the rails, and that saved the passengers from what I would consider destruction. So much was that considered to be essential, that the Government, the Board of Trade, ordered that an additional carriage, besides the tender and engine, should be placed in front to prevent the train being broken to piece. Now, I consider that the effect of the engine (which always takes the brunt of the accident,—the effect is broken, because the engine comes first) is not only to force away any obstacle, but to resist the effect of the impetus upon the carriages that are behind it; I believe that if the engine and tender were not there, the effect upon the first carriage would be as serious as it is now upon the engine, the momentum being considered.

"Do you suppose that the evenness of way could be as well maintained if you had the passage of locomotive, as it could be if you had simply the passage of passenger and luggage wagons?—No, I think not; but still I would give that answer with some limitation; it is very true that there would be more stress upon the blocks of the road by a heavy train than by light carriages; but I do not think the wear and tear depends upon the mere weight which has to be transported upon it, because the subsidence, after every shower of rain, and every frost, would be the same, whatever weight was carried over it; and my opinion is, that the inequalities of the road are produced more by the changes of the weather than by the effect of heavy weights passing upon it; and moreover there are frequently as many as eight tons carried on one carriage; and when you are carrying eight tons upon four wheels, my opinion is that it has nearly as much effect upon the rail as the locomotive, because in the locomotive the weight is more equal; there is not much more weight upon a locomotive with six wheels, than upon an ordinary luggage wagon with four."

Air-pump.—Objections to the expansive principle of the engines applied to the air-pump on the Dalkey line; variable resistance in the air-pump, —(*Robinson.*)

"In the details of the machinery, I conceive there are many objectionable points. Of course, as a mere theorist, I should speak with some hesitation respecting them; but two or three of them must be obvious to any person. In the first place, circumstances, as I understand, compelled the constructors of this line to place their engine at a considerable distance from the main. The connecting pipe, which connects the main with the engine, is about a fifth of the whole capacity of the main. If the apparatus, the connecting tube and the air-pump, had been, as they ought to have been, air tight, that would not have been material; for it would have been a store of vacuum, a store of power laid up for a subsequent emergency; but as it is, one-fifth of the total power expended in producing the vacuum is lost at every train, in consequence of this connecting pipe."

Arches.—The height of the arches on atmospheric lines may be reduced, as there will be no engine-funnel to pass under them.

Atmospheric Resistance.—The late arrival of trains on all railways has arisen more from wind than anything else—(*Stephenson.*)

Axles of Engines and Carriages.—In the event of a fracture of the axle of a carriage, it could be removed from the line in five minutes—(*Samuda.*)

During the seven years that the London and Birmingham line has been open, and 10,000,000 of miles have been traversed, there have been but two accidents from the breaking of the axles of engines.—There is no reason to believe that the amount of accident would be diminished by the atmospheric system, as far as regards the breakage of axles of carriages; the result would probably be the same, supposing there to be no engine—(*Stephenson.*)

Breaks.—Carriages stopped by using powerful breaks: it is necessary, from the high velocity required, to have a break with a guard to every second carriage, on the Dalkey line—(*Samuda.*)

Bridges.—The bridges over the South Devon line, which is an atmospheric line, are of a less height by 18 inches than on locomotive lines; and those under the railway are of less substance and strength than usual, as the weight and vibration of the engines will be removed, and all the bridges and viaducts, which are made of timber, are of a lighter construction than those on the Bristol and Exeter railway.

Coal.—Price of coal upon the London and Birmingham line; probable cost of coal if an atmospheric line were made from London to Birmingham —*Stephenson.*

"What is the price of coal upon the London and Birmingham line?—The coal is about 14*s.*, the same price as you buy coals at in the London market; but they get some coals upon the line, at Rugby, at about 9*s.* or 10*s.*; all the coal that they buy at this end of the line of course costs them the same as in the London market. If an atmospheric line were made from London to Birmingham, the probability is that about 11*s.* would be the cost of the coal; I think that it is delivered now from the Derbyshire colleries at Rugby at 11*s.* a ton, and I do not think it could be materially reduced."

Collisions.—On the atmospheric principle collisions could not possibly take place other than at the station; with good regulations there is no reason to apprehend danger at the stations—*Locke.*

Connecting Rod.—In the event of the connecting plate breaking, the piston would proceed to the station without the carriages; another carriage could then be sent, and a vacuum again created—*Samuda.* The connecting rod between the piston and the carriage does not rub against the side of the tube—*Gibbons.*

Contracts.—Witness's brother estimated the tubes at 4,000*l.* per mile; they can be supplied at about 3,800*l.*—*Samuda's Ev.*

Cost of Construction.—Relative expense of construction and maintenance of the two lines—*Vignoles.*

"In almost all cases I think the expense of the construction of a single atmospheric line will be less than that of a locomotive double line, when you add the cost of the locomotive power and all the fittings relating to the locomotive apparatus to the cost of the railway. I do not think I have any tables here; but the price of iron at this moment is so very high, that probably it would affect the question in some degree. If you take a double locomotive railway per mile, laid down complete with 75 lb. rails, which are now considered the best for locomotive lines, with the proportionate size of chairs, the expense will vary from 5,000*l.* to 6,000*l.* a mile, according to the price of iron.—Upon what lines have rails of that extreme weight been laid down?—On the Midland Counties 75 lb. rails, and some of them 78 lb., and there are cross sleepers. I was engineer for that railway. Is not the tendency to make the rails heavier every year?—Yes; I proposed to put down 70 lb. for the rails, but the directors said that they would take the advantage of iron being cheaper, and would have rails laid down at 75 lb., and some are 78 lb. The cost of the upper works of a single locomotive line (that is, after the railway is prepared to receive the bed of rails) will vary from 5,000*l.* to 6,000*l.* a mile. The London and Birmingham cost, I think, on the average, 6,500*l.* a mile; but then the price of iron was very high. I have laid down lines of railway that have only cost 4,500*l.* a mile for the double line; that was when iron had got very cheap. The expense of workshops and everything connected with that department is about 2,500*l.* a mile: it is much more likely to be 3,000*l.* than 2,000*l.* Upon the Dublin and Kingstown I found the cost full 5,000*l.*, perhaps 9,000*l.* a mile; but that was because the line was only six miles long, and they have a large establishment of workshops. On the North Union it is about 2,000*l.* a mile. I have given the variations in cost dependent upon the price of iron and the weight of the rails; then in order to make the comparison we must have the size of the pipes of the atmospheric railway; but, taking it on the average, I should say that you can do with a very much lighter rail altogether. If you take a single line of atmospheric railway, and say a 13 or 14-inch pipe, and engines at every three or four miles, with the necessary air-pumps, and so on, I should think that putting aside everything except the upper works, and in the one case of the stationary power, and in the other of the locomotive power, they would be about the same; perhaps the atmospheric would be 500*l.* a mile or more cheaper.—If you took a 14 inch tube, I should think it would be more. In a flat country, would a 12-inch tube be sufficient?—I should think quite sufficient, because it is the size of the tube which regulates the load, and therefore if a country be flat, you have a sufficient amount of power to pass over a level line, and you do not want an increased power to overcome the gravity of the planes. Does a rise or fall in the price of iron equally affect the tube and the rails?—It would bear hard upon the atmospheric, because there is a large amount of iron required; the weight of the tube is about one cwt. to the foot."

Observation as to Mr. Samuda's estimate of 1,300*l.* a mile, for workshops, tools, water tanks, and matters of this description, being excessive—*Stephenson.*

"Mr. Samuda has given an estimate of 1,300*l.* a mile for workshops, tools, water-tanks, and matters of that description; do you consider that excessive?—There is scarcely a line in the country that has anything like it except the Birmingham, and that is much beyond what is necessary, I think. I reckon upon other lines of railway something like 2,000*l.* for locomotive engines, carriages, workshops, and so on. I have here the cost of several lines of railway in this country, not first-class lines of railway, like the London and Birmingham, but second-class lines. The first is the Northern and Eastern, leading to Cambridge; the cost of the carrying establishment upon that is 1,700*l.* a mile altogether. Can you separate the engines from the other items?—No, but if you take one engine for two or three miles, it is amply sufficient; in fact, they have not that upon several lines that have considerable traffic. Does that include the water-tanks?—Yes, everything; upon the York and North Midland, which has a complicated traffic, and a large traffic, the cost is 2,582*l.* per mile. Upon the Birmingham and Derby, before the amalgamation took place with the Midland, the cost was 1,840*l.* a mile. I would observe, that this had reference to what I should call second-class railways in trunk lines of country. I assumed it in my report at 150,000*l.* for shops and apparatus at the various stations, when I was making the comparison between the atmospheric system upon any line and the locomotive system, and I am sure that that 150,000*l.* is more than is necessary. I assume that Mr. Samuda must have taken that as the criterion when he stated that 1,300*l.* a mile is necessary; whereas there is not another line in the kingdom that is anything like it, and I assumed 150,000*l.*, because I could not procure the exact sum from the office; but the probability is, that I took it 50,000*l.* more than it was. In judging of the expenses of a line of railway to be made now, we must not take the London and Birmingham as a fair test?—In the carrying establishment, I think not; I think it is a most extravagant carrying establishment, because I had there to consult the comfort and the caprice sometimes of the public. The carriages are exceedingly inferior to the carriages upon the other superior lines; take the Great Western line?—I do not think that they are inferior to the Great Western carriages. They are smaller?—Yes, but a large house may be very bad. You are very much cramped when you travel any long distance?—I never was."

Crossings of Lines.—The immense number of crossings, and the variable nature of them in their positions, that would be required for the working of the London and Birmingham railway, supposing it to have been a single line, and showing the meetings of the trains at different points—(*Stephenson.*)

"With a view of explaining the effect of intersections by a single tube, I will just read, if the Committee will allow me, a paragraph from my Report: 'Suppose, for example, a line of railway 112 miles length were divided into stages of $3\frac{1}{2}$ miles each' (that is, supposing the London and Birmingham line), 'as proposed by the inventors; if a train were dispatched from each end, every half hour, for 12 hours' (which was the assumption), 'and the speed of about 37 miles per hour, including the stoppages for traffic,'—which would really require a speed much beyond what has been attained under any circumstances at present with a moderate load,—'there would be a train in motion at every 10 miles of line, and each train in its journey would meet 11 other trains, with whose progress it would interfere: in short, *each train would of necessity be stopped* 11 *times, and delayed until the train occupying the section of tube had quitted it, and the tube had been again exhausted.* Such a series of stoppages would, it is plain, give rise to so great an amount of delay as would render the use of a double line of tube absolutely imperative. In the example just brought forward by way of illustration, the mean speed assumed is 37 miles per hour, the whole time of the journey would therefore be three hours,' supposing no stoppages to take place; 'but the 11 stoppages occupying at least 10 minutes each, which is very considerable below what practice would require, would, notwithstanding the great velocity assumed, extend the time to five hours;' that is, notwithstanding the high average rate of speed of 37 miles per hour assumed. 'But let it be remembered that these stoppages cause additional meeting of trains;' because the the allowance of time for stoppages increased the time from three hours to five hours. In those two additional hours there must be four more trains dispatched from the other end; therefore, instead of meeting 11 trains you would meet 15, in consequence of the stoppages. In fact, as the true mode of considering this question of working by a single tube, you must take this as an axiom, that whatever your intervals are you must meet a train every half interval; that is, if you take half-hour intervals you must meet a train every quarter of an hour; if you dispatch a train every quarter of an hour, you must meet a train upon the line every $7\frac{1}{2}$ minutes. I will take this case: I start from London to Birmingham at 12 o'clock, and I intend getting there at three; I must meet all the trains that are dispatched from Birmingham between 12 and three; but I must also meet those which were dispatched from Birmingham at nine o'clock, because they are all on the road too; and therefore, if you have to work with a single tube, and to run the distance in three hours, you must meet all the trains that are dispached in six hours. That applies, in a remarkable way, to the atmospheric and the locomotive systems, for all experience on railways at present leads to the concentration of trains, and not to the division of them, that may be said to be the effect of the locomotive system. Suppose we admit that for the sake of argument. On the other hand, the atmospheric system, in order to make it work with the greatest possible economy, requires the greatest possible division as regards the power; because as I have stated that when the vacuums were low, the velocity attained might be high, but with a high vacuum the velocity could not be high, therefore the atmospheric differs from the locomotive system in rather requiring a subdivision of traffic, whereas the locomotive requires a concentration of traffic. But then the very circumstance which the atmospheric requires to make it work economically is fatal to it practically, because, as you divide the trains and dispatch them every quarter of an hour, the intersections become so numerous, that you would not get to Birmingham in 10 hours, as shown in my Report, because twice the time would be employed in stoppages that you would be passing from place to place. This is not a theoretical view, but it is a matter of fact which every one may test."

Dalkey Line.—Number of trains run on the Dalkey line during the eleven months previously to 1st March, 1845; aggregate number of coaches; number of passengers; items of the expense of the Dalkey line during the above eleven months, with explanation of these items—(*Bergin.*)

"The sum paid for coals during the 12 months for the steam-engine was 467*l.* 4*s.* 3*d.*; the sum paid to the engine-men, the stokers, and others constantly employed in the engine-house, was 302*l.* 5*s.* 6*d.*; then the supplies of oil, tallow, waste, and things of that sort, amounted to 43*l.* 4*d.*; the wages of mechanics employed in repairs of those accidents of which I have already spoken, as well as the ordinary current repairs, amounted to 197*l.* 3*s.* 3*d.*; the cost of materials consumed by them was 112*l.* 17*s.* 2*d.*; and there were some little petty expenses, 2*l.* 8*d.*; making a total charge for the steam-engine and air-pump on the Dalkey line, 1,124*l.* 11*s.* 2*d.* The expense of the main, travelling, piston, and valve, including the wages of the valve men, and all, is 271*l.* 1*s.* 6*d.* for the eleven months. The result of all is, that the total cost of the locomotive power (haulage is the general term) and of the maintenance of way, have together amounted to $9\frac{9}{10}d.$ per train per mile. It may be well here to state some particulars as to the valve composition: I find, from the experience we have had, that it costs 1*s.* per pound as at present made. If the whole main and valve were cleared from composition, the quantity necessary to put it in proper working condition would be $\frac{8}{10}$ths of a pound per yard, or 1,408 lb. per mile, and the expense of laying it would be about 10*l.* to 12*l.* This, however, being done in the first instance does not, according to my experience, require any thorough renewal. Small bits do occasionally break off, and *each poli e or other man along the line has at all times a small supply with him for the purpose of repairing any such loss.* The entire quantity used in this way throughout the whole term of our working did not exceed 14 lb. per week: this is included in the sum I have already given."

The Dalkey line is $1\frac{3}{4}$ statute miles in length. Dalkey is $71\frac{1}{2}$ feet higher than Kingstown—(*Bergin.*)

Dalkey to Bray.—An atmospheric line is proposed from Dalkey to Bray, in continuation of the Kingstown and Dalkey railway—(*Samuda.*)

Electric Telegraph.—Though of very great assistance in working economically, it is by no means indispensable—(*Samuda.*)

"If either from the electric telegraph not acting well, or from any other cause, the men did not pay attention to the notice given by the telegraph, by the very nature of the power, the vacuum would accommodate itself to the load which it had to draw."

The atmospheric system cannot be applied without great difficulty, unless the electric telegraph be used—(*Bidder.*)

"Now, with an electric telegraph on a railway, whether with two lines or a single line, I do not believe that an accident could occur, except from, I might almost use the expression, malicious negligence, because, where the train is, and what it is doing, and all the circumstances connected with it, is always known at every part of the line, and it can only therefore be by absolutely running, with a full knowledge of the train coming into it, that an accident can happen upon a line worked upon either system. We have an electric telegraph on the Yarmouth and Norwich line; that line has been at work for nearly a twelvemonth, and with perfect safety. With respect to every train, as it starts from one station, before it starts, notice of its starting is sent throughout the line, and an answer is received from every station to say that everything is clear: till they have this answer, the train should not start, and as it comes in sight of every station, information is given of it: and if that train were to break down, there would be no uncertainty with respect to it. Suppose the train has started, and anything has broken down, they will know it immediately throughout the line, and, therefore, starting in the teeth of that, would amount, in my view of the case, to malicious negligence, and no accident could happen there but from that cause."

Embankments. See *Gradients*, II.

Engine Houses.—The engine houses on the Croydon line will have chimnies like gothic towers, and will consume their own smoke.

Engine-men and Stokers.—Number and wages of engine-men and stokers required according to the time during which trains may run.

Express Trains.—They would not be necessary on atmospheric lines working constant trains. On long lines with long intervals between the trains, express trains might be started between such trains—(*Cubitt.*)

Fares.—The reduction of the fares on the Dublin and Kingstown line has caused a great increase in the number of passengers—(*Bergin.*)

Foreign Railways.—Some of the German lines are single lines, as are nearly the whole of the Belgian; the French are all double lines—(*Locke.*)

Friction.—On the Dalkey line the inside of the tube is quite smooth; the the piston requires no tallow. When the piston comes out of the tube there is scarcely any perceptible heat—(*Gibbons.*)

M. Hallett estimated the friction of the piston carriage, and lifting up, and sealing the valve, at 35 lb. only. On the Dalkey line there is not much wear upon the piston, which has a good deal of play—(*Robinson.*)

Frost.—The frost has not affected the longitudinal valve on the Dalkey line; it only requires a composition to be applied to it—(*Gibbons.*)

Fuel.—The consumption of coal on the Blackwall Railway is at the rate of 5 lb. per horse power for every hour during which the engine is at work. If coke were used instead of coal the cost would not materially vary. On the Croydon line coke or anthracite coal will be used—(*Field.*)

Gauge.—The gauge of the South Devon line will be the same as that of the Great Western—(*Brunel.*)

Gradients:—I. *Generally.*—II. *Opinions as to the superiority of the atmospheric system over the locomotive in ascending steep gradients.* III. *Opinion that good gradients are more essential on the atmospheric plan.* IV. *Gradients on various lines.*—1. Dalkey line. 2. London and Croydon line. 3. South Devon line.

(I.) It is the intention of the Dublin and Kingstown Railway Company, in the event of getting their line from Kingstown to Bray (7 miles), to make the highest point at the centre. One engine at the summit is capable of drawing three and-a-half miles each way; the descent will be done by gravitation—(*Bergin.*)

(II.) "When the locomotive engine is drawing a load upon a level, the traction per ton is of course considerably less than when it is drawing it up a steep incline; but at the time of drawing it up a steep incline, the locomotive engine necessarily requires an additional power to overcome its own gravity, and is consequently not prepared to give the train even the same amount of power it had been able to afford it on the level, at the very time when the train requires a greater amount of power."

Superiority of the atmospheric principle in ascending steep gradients; disadvantages under which a locomotive engine labours in this respect exemplified—(*Samuda.*)

"There is no atmospheric railway but the Dalkey line in existence; some gradients upon the South Devon line will be 1 in 40. But that from Vienna to Schonbrunn, which is now in the course of construction, admits of a gradients of 1 in 30?—It is a parabola in section; after passing Schonbrunn and getting to the upper end, it finishes with a gradient of 1 in 30. No, they go from 1 to 100 and 1 in 80, and they get to the 1 in 30 at last; but on the railway that is now about to be laid down from Paris up to St. Germain's, I have recommended the adoption of the terrace at an inclined plane of 1 in 30; and I believe it will be adopted; I strongly recommended a 1 to 30 gradient for the last mile up to St. Germain's, with a lofty viaduct across the Seine.

(III.) *Good Gradients are more essential on the Atmospheric Plan.* Taking high velocities into account, good gradients are positively more essential upon the atmospheric than upon the locomotive principle—(*Stephenson.*)

"The moment you get into bad gradients you must have a high vacuum to overcome the resistanee, because the word "gradient" is merely an equivalent for "load." It is absolutely nothing else, because whether you have resistance by gravity or resistance by load upon a level, it is precisely the same thing. There has been a great deal of misunderstanding, I am persuaded, upon this point. We find that the atmospheric requires to work at a vacuum of 16 inches upon a level; the more it deviates from that vacuum, or rather, the more the gradients deviate from those which require that vacuum, the worse it is, and that becomes more and more sensible as you get up towards a perfect vacuum. For instance: if upon a locomotive line we increase from a level to a gradient of 1 in 100, the resistance is immediately doubled or trebled; therefore you have immediately to increase the vacuum from, say, 16 inches, which is 8 lb. per ton, to 22 or 24 inches, and even more; therefore, you must necessarily either reduce your speed or diminish your load, which is precisely the condition of the atmospheric. In fact, if it were not so, the atmospheric would possess some properties entirely at variance with every mechanical power that we know of. If the velocity were irrespective of the gradient, or in other words, irrespective of the load, it would be tantamount to gaining power without the expenditure of power; therefore that power must follow the same laws as all other mechanical powers. If you wish to gain velocity you must either increase your power or diminish the load; but the condition under which you increase the power is by increasing your vacuum, which is a more lavish expenditue of power.—If you were told that it was possible to increase the diameter of the tube in proportion to the resistance from the gradient, in that case you would no longer hold that objection to be valid?—I should, even more so than before. Will you explain your reason?—If I increase the size of the tube, I diminish the velocity immediately, with the same engine.—But you must increase the engine?—Then it is a greater expenditure of power."

In gradients exceeding 1 in 100 the locomotive power becomes extravagant; upon a gradient of 1 in 100, in certain states of the rail, the locomotive loses its bite; it slips; this slipping begins at about 1 in 176, or less than that sometimes—(*Stephenson.*)

IV. London and Croydon Line.—"Will you state the gradient upon that portion of the Croydon line which you are about to open?—The extreme gradients are 1 in 50. What is the gradient of the parallel locomotive line? —It is level at the same place. I will explain to the Committee how that is: in passing from the Dartmouth Arms, where we begin our first experiment to Croydon, the Dover and Brighton lines branch out; I was determined not to interfere with those lines; I took therefore, so to speak, a flying leap quite over them, so that you will very soon see, I hope, a locomotive line with an atmospheric line going over it, with a rise and a descent again of 1 in 50; that viaduct is nearly completed; it is rather a curious thing in the construction of railways.—What is the length of that gradient on each side?—The length would be 50 times 20 feet, or thereabouts; about 1,000 feet. What are your other gradients?—They are very flat; 1 in 300, and 1 in 400, and so on; we shall have one gradient of three miles long at 1 in 100; that will be the second essay, and will not be finished quite so soon as the first six miles in going from London; but upon the first atmospheric line now in construction we shall go three miles level, three miles up a gradient of 1 in 100, three miles nearly level, and then half-a-mile up and down 1 in 50, and then level again to Croydon."—(*Cubitt's Ev.*)

South Devon Line.—"There will be very severe gradients upon the South Devon line, but not upon that portion which will be opened in July; the portion which will be opened in July will be the first 20 miles out of Exeter, which will be very light, easy gradients. From that distance to Plymouth, the gradients will be very severe; we have rises of 1 in 50, and in one instance 1 in 42."—(*Samuda*).

Grand Junction Railway.—The cost of maintenance of way on the Grand Junction was contracted for, for seven years, at 250*l.* a mile, including guarantee and insurance from all accidents and liabilities—(*Locke.*)

Guildford Railway.—It would require more capital to work this line on the atmospheric than on the locomotive principle; it is a single line—(*Locke.*)

The Guildford branch, six miles in length, is about to be opened in the course of a week or two, and I have made a computation upon the number of trains which we are going to run; seven or eight trains a day, which is the number of trains which we are going to run upon that line, would make 100 miles a day; eight trains each way a day, a 1*s.* per mile, would be 1,500*l.* a year. Now, taking the cost of furnishing that line upon the atmospheric system (it is but a single line) at 4,000*l.* per mile, which I understand to be the estimate that has been given of the expense of these tubes, it would be 24,000*l.*; and two engines at 5,000*l.* would be 10,000*l.*, making altogether 34,000*l.*, from which I deduct the cost of two or three locomotives, though one would do the work; the trains are arranged that one shall do the work, and there can be no fear of collision: but deducting 4,000*l.* for the cost of those engines, leaves 30,000*l.* as the amount of capital for the atmospheric railway, and the interest upon that at five per cent. is exactly the cost of the locomotive power."

Haulage.—Comparative cost on the Atmospheric System on a Line of Railway 20 miles long, sending 6, 12, and 24 trains per day, each way respectively—(*Samuda.*)

6 trains per day, each way:

Coal—500 lb. per hour, each pair of engines while working; and as each engine is employed for 9 minutes per train, the quantity usefully burnt will be 75 lb., add for waste while standing and getting up steam, 60 per cent. or 45 lb.

	d.
$\frac{120 \text{ lb.} \times 6 \text{ engines}}{20 \text{ miles.}}$ = 36 lb. at 10s. per ton	= 1·93
Enginemen's wages at each station, 1 man at 6s. 0d., and one at 3s. 6d., in all 7 stations: to this add 1 extra set of men for relieving the others; $\frac{9\text{s. } 6\text{d.} \times 8 \text{ sets}}{12 \text{ trains} \times 20 \text{ miles}}$	= 3·80
Repairs to engines, oil, hemp, tallow, and depreciation (I consider 130*l.* per year per station ample, but have taken 200*l.*	
Piston leathers	= 052
Charcoal	= 0·12
Wear and tear of travelling piston car	= 0·10
Train conductors (or men to attend piston carriage) 2 men at 5s.	= 0·50
Per Train per Mile	8·79

	d.
Maintenance of Groove: 2 men for 3 miles = per mile	= 2
Composition 15*l.* per mile per year	= 0·83
Continuous valve, &c. 50*l.* per mile per year	2·75
Per Train per Mile	5·58

12 Trains per day each way:

Coal (as before) usefully burnt, 75 lb. per train, add for waste, 50 per cent., or 37 lb.		112 lb.
$\frac{112 \times 6 \text{ engines}}{20 \text{ miles}}$ = 33 $\frac{12}{100}$ lb. coal at 10s. per ton.		d. = 1·77
Enginemen's wages (as before): $\frac{9s.\ 6d. \times 8 \text{ sets}}{24 \text{ trains} \times 20 \text{ miles}}$		= 1·90
Repairs to engines (as before): say $\frac{200l. \times 7 \text{ stations}}{24 \text{ trains} \times 20 \text{ miles} \times 365 \text{ days}}$		= 1·04
Piston leathers		= 0·25
Charcoal		= 0·12
Wear and tear of travelling piston gear		= 0·10
Train conductors, 4 men at 5s. each: $\frac{20s.}{24 \text{ trains} \times 20 \text{ miles}}$		= 0·50
Per Train per Mile		5 68
Maintenance	d.	
Of groove, 1 man per mile $\frac{3s.}{24 \text{ trains}}$	1·50	
Composition, 15l. per year per mile $\frac{10d.}{24}$	= ·41	
Of continuous valve, &c. 50l. $\frac{2s.\ 9d. \text{ per day}}{24}$	= 1·37	
		3·28

24 Trains per day each way:

Coal (as before) usefully burnt, 75 lb. per train. add for waste, 40 per cent. 30 ,, — 105 lb.		
$\frac{105 \times 6 \text{ engines}}{20 \text{ miles}}$ = 31·5 lb. at 10s. per ton		= 1·68
Wages (as before): $\frac{9s.\ 6d. \times 8 \text{ sets}}{48 \text{ trains} \times 20 \text{ miles}}$		= 0·95
Repairs, &c. to engines (as before): $\frac{£200 \times 7 \text{ sets}}{48 \text{ trains} \times 20 \text{ miles}}$		= 0·52
Piston leathers		= 0·25
Charcoal		= 0·12
Wear and tear of travelling piston gear		= 0·10
Train conductors, 8 men, at 5s. each: $\frac{40s.}{48 \text{ trains} \times 20 \text{ miles}}$		= 0·50
Per train per mile		= 4·12
Maintenance of groove, 1 man per mile, $\frac{3s.}{48 \text{ trains}}$	= 0·75	
Composition, 15l. per mile per year = $\frac{10d. \text{ per day}}{48 \text{ trains}}$	= 0·20	
Continuous valve, &c. 50l. per year, $\frac{2s.\ 9d \text{ per day}}{48 \text{ trains}}$	= 0·68	
		= 0·63

Interruption of Traffic.—Worked with a stationary power, a single line will on the whole be liable to less interuptions than a double line worked with locomotives—*(Brunel.)*

Leakage.—I. *Generally.*—II. *Loss of Power on the Atmospheric System from Leakage.*—III. *Principle Causes of Leakage; how far, in the progress of Improvement, it is likely to be prevented.*

If the tube be properly cast. there will be no leakage whatever through the iron—*(Field.)* The increasing pressure of the atmosphere at a high vacuum closes the valve more firmly and prevents additional leakage—*Robinson.* The leakage increases with the vacuum. Calculations as to the amount of leakage on the atmospheric system; experiments made by witness at Dalkey—*(Stephenson.)*

"We may state that there are three kinds of power available for railway purposes; the first is that of stationary engines with robes, which may be applied either to hilly countries or flat countries, as it is done in the north; the second is the locomotive system; the third is the atmospheric. I believe in point of power, the cost of producing a certain amount of available power, I mean power practically available, is very much the same. In the case of a stationary engine, you have the whole of the power communicated to the train except that which is absorbed by the engine itself, or by the friction of the rope, which of coarse is power created for the purpose of moving the machine, and bringing the available power into action. In the case of the locomotive system you have an objection, arising from the engine itself, which is a ponderous machine; whenever you move from a level, the weight of the engine acts against you. You have also a disadvantage in the locomotive system, viz. that you cannot employ a condensing engine; that is, you cannot employ a vacuum, therefore you are obliged to employ an engine which has the resistance of the air to contend with, and in the other case you have a vacuum. That is a drawback which must inevitably be applied to the locomotive engine. The proportion of the gross power developed by the engine bears very nearly the same proportion to the gross power that the friction of the rope does to the engine; it is very approximate; in some case it will be more and in some less; for example, it is clear that the friction of the rope in the case of a stationary engine will depend upon the length of the plane worked by the engine or the rope; for instance, if you have an engine working a plane of one mile in length you have the friction of the rope lost, which is due to one mile; if you work it two miles you have twice the per-centage of loss in the gross quantity of power developed by the engines. Then with respect to the atmospheric, I have gone very carefully into that question; you have the leakage, you have no friction of the engine itself, which of course is just the same as in the case of common stationary engine; therefore the comparison between the atmospherice and the stationary engine is simply a comparison of the friction of the rope and the leakage. Now the leakage it is difficult to compare exactly with the friction of the rope, because the effect of the rope is constant, the quantity of the power lost being constant.

"The effect of the leakage is varying at every pressure. Suppose you worked the atmospheric engine constantly at 2 or 3 inches, the leakage would be very immaterial. In my experiments at Dalkey, it amounted to 250 feet per minute; the horse power necessary to pump those 250 feet per minute was the loss; then, as you go on, if you increase the load, requiring therefore a higher vacuum, that is, increase the height of barometer from 2 inches, say, to 10, that is in the proportion of 1 to 5, that loss of 250 feet is changed, because the pump itself can only pump its own contents out at each stroke; the vacuum existing in the pipe at the density of the atmosphere is expended so many times inversely in proportion to the height of the barometer, or rather, in proportion to the cold remaining, not in the proportion of 2 to 10, but in the proportion of 28 to 30. What I mean to say is shortly this: that, as you increase the load in the atmospheric, or as you increase the necessity of working with a higher vacuum, you make the atmospheric worse than the rope; but as you decrease the vacuum at which you work, you make it better than the rope. There is an intermediate point, and that appears to have been by pure accident, at the Euston station, where the friction of the rope, and the loss by that friction, is as nearly as possible equal to the loss by leakage at Dalkey, according to my experiments. It appears that a mile of double rope is equal to about a mile and a half of atmospheric pipe; there they appear to be as nearly as possible equal. I think it is an error to attribute the whole of the leakage to the intermediate pipe. The question was raised when I was in Dublin by the late Mr. Samuda, and I then considered the matter. The intermediate pipe between the valve pipe and the pump had been prepared carefully; he told me that it had been pitched and covered with tar. I am perfectly aware, from experience, that a very slight covering of that kind is capable of rendering a cast-iron pipe of that description perfectly air tight; and the comparison of the leakage between the valve pipe and the pump was rather in favour of the close pipe and pump; the valve pipe was almost the better of the two, involving this necessity, that the pipe without the valve was little better than the pipe with the valve. But the real fact was this, and it was an oversight in the printing of that part of my report where I distinguish between the leakage of the one and the leakage of the other. I say, 'the leakage of the valve-pipe and the leakage by the connecting pipe;' it ought to have been, 'the leakage in the pump;' for a very large proportion of the leakage, in my opinion, takes place, not in the connecting pipe, but in the pump itself. It is the place where it is most likely to arise; it is a place where there is a good deal of nice workmanship, and where a good deal of derangement or wear and tear goes on; it is therefore much more natural to attribute the leakage to that which is continually exposed to wear and tear than to that which is not so exposed. Therefore, to attribute the whole or any of the leakage to the connecting pipe is not, in my opinion, a correct represention of the fact."

The leakage diminishes as the train passes along, as a less surface is exposed; the velocity becomes more irregular as the train approaches the end of the pipe—*(Stephenson.)*

"When the train was coming close to the end of the pipe, the quantity of air remaining in the pipe bore so small a relation to the contents of the pump itself, that the velocity came to be irregular, and it gave the train, just as it was going from the pipe, a sort of kick, an acceleration; but so long as the quantity of air in the pipe bore a considerable proportion to the quantity of air which the pump was capable of extracting at one stroke, the velocity remained exceedingly uniform, and the barometer extremely steady. I made experiments at 23 and 24 inches, and there was a constant loss of power; as the *vacuum was increased and the load increased to correspond*, there was a diminution of velocity. It was very strikingly illustrated by those experiments. It has been broadly stated by some persons that the velocity has no relation to the load, or in other words, has no relation to the gradient. Now 'load' and 'gradient' are, as I stated before equivalent terms. A load of 24 tons obtained a maximum velocity of 36 miles an hour; and as we went on increasing, when we came to a load of 50 tons the maximum velocity was 21 miles, and the barometer stood at 22 inches; in the other case the mercury in the barometer stood at 13 inches. Leaving the 50 tons, and going on to 60 tons, the maximum velocity then was 18 miles an hour; when we got on to 64 tons it sunk to about 17 miles an hour, so that as you go on increasing the load you get a corresponding and constant diminution in the velocity; in fact, as the engine power was uniformly exerted, as might be expected, with a larger load you have a less velocity."

A slight leakage would produce a vacuum between the valve and the piston before the starting of the train, but this would be a very slight imperfection in practice—*(Field.)*

The power of the stationary engines has been calculated at a speed of eighty miles an hour, or sixty miles allowing for leakage—*(Brunel.)*

The leakage is found to be in proportion to the length of the tube, and not to vary with the power at which it is worked—*(Robinson.)*

The real loss of power is the leakage. This increases in effect as the vacuum becomes greater; and is the great deduction to be compared with the loss of power under the locomotive system—(*Stephenson.*)

The leakage on the Dalkey line between the piston and the valve must be caused by bad joints to the tube—(*Field.*) The amount of leakage on a section of three miles would not be greter than that on the whole Dalkey line, because the tube would be better made with elastic joints—(*Brunel.*)

On the Dalkey line the leakages of the air-pump and of the connecting tube are much greater than they need be. The leakage of the air-pump and connecting tube is greater than the laakage of the main—(*Robinson.*)

A very large proportion of the leakage takes place, not in the connecting pipe, but in the pump itself—(*Stephenson.*)

As the leakage on the Dalkey line arises from defective mechanical contrivances, it is possible, but not probable, that in the progress improvements this loss may be materially diminished—(*Stephenson.*)

(To be continued.)

HARBOURS OF REFUGE.

Abstract of the Report of the Commissioners.

The more immediate points for the consideration of the Commissioners appear to be the following:—

1st. Whether it be desirable that a Harbour of Refuge should be constructed in the Channel, reference being had, on the one hand, to the public advantages likely to result from the construction of such a work, and, on the other, to the expense to be incurred in its completion.

2ndly. What site would be the most eligible for such a harbour, on account of its combining in the greatest degree the following grounds of preference:—

1st. That it should be of easy access at all times of the tide to vessels requiring shelter from stress of weather.

2ndly. That it should be calculated for a station for armed vessels of war in the event of hostilities, both for the purposes of offence and defence; and,

3rdly. That it should possess facilities for ensuring its defence in the event of an attack by the enemy.

We invited the Chairman of Lloyd's and the Chairman of the Ship Owner's Society to meet us, or to delegate others, to state the opinions of those great mercantile bodies, with reference to the positions they consider best as ports for the shelter of the trade.

We have also had before us every class of persons who were thought capable of affording information, including several eminent engineers; and, in order to guard against the often misleading opinions of residents at the different ports, we have examined many others, practically acquainted with the various places, whom we believed to be unbiassed by local partialities.

Dover.

History affords proof of the importance attached to this place as a military and naval station.

As the advanced post of England on the south-east coast, the want of a harbour here of sufficient capacity for the reception of vessels of war, and for the convenience and protection of trade, has attracted the notice of sovereigns and ministers from the earliest times, and has led to a large expenditure of money for the improvement of the present tidal harbour.

In considering positions eligible for the construction of breakwaters, it should be borne in mind that an inner harbour is an indispensable requisite, and if there is no natural advantage of that sort in the position selected, there must be the double operation of building an inner as well as an outer harbour.

There are few places that in this respect possess greater advantages than Dover. It has a dry dock for repairs, and extensive quays, with storehouses. Besides the outer receiving harbour, there is a basin covering more than six acres (now being enlarged to double that size), and a third called the Pent, which the late Mr. Rennie, in his report to Mr. Pitt, in 1802, says, may of itself be made capable of receiving many sloops-of-war and gun-brigs, and which the Dover Commissioners are now considerably improving.

Mr. Pitt, when Lord Warden of the Cinque Ports, was earnestly intent on having Dover Bay enclosed, and it was this circumstance which led to our obtaining from the Master-General of the Ordnance the plan of a harbour in Dover Bay, by the late Major-General Ford, of the Royal Engineers.

There are two points, each of great importance, which have been suggested as objections to any proposal for converting Dover Bay into a harbour; one that the holding ground is not good, the other that it will have a tendency to silt up.

With respect to the quality of the anchoring ground, Her Majesty's steam-vessel, the *Blazer*, of 500 tons and 120 horse power, was ordered there to test its tenacity to the utmost. The nature of the experiments and the satisfactory result will be seen in Captain Washington's Report in the Appendix.

In reference to the question of silting up, the Commission directed samples of the water in Dover Bay to be taken up at different times of tide, in different depths, and under varying circumstances of weather, which have been transmitted to the Director of the Museum of Economic Geology for examination; the results, as reported by Mr. Phillips, will be found in the Appendix.

The Commission is of opinion that more extensive experiments are necessary in order to determine the quantities of matter borne in suspension by the tidal currents on this part of the coast and liable to deposit, and beg therefore to suggest to your Lordships the propriety of their being continued, under the direction of the Admiralty, for the space of a year, in all circumstances of weather.

Dover, situated at a distance of only four miles and a half from the Goodwin Sands, and standing out favourably to protect the navigation of the narrow seas, is naturally the situation for a squadron of ships of war. Its value in a military point of view is undoubted; but the construction of a Harbour of Refuge there, is, in our opinion, indispensable, to give to Dover that efficiency as a naval station which is necessary in order to provide for the security of this part of the coast, and the protection of trade.

Beachy Head, East Bourne, and Seaford.

We have now to draw your Lordships' attention to the bay on the east side of Beachy Head, and westward of Langley point, which the commission of 1840 proposed as a site for a breakwater.

On the west side of Beachy Head the anchorage is free from the dangers which render the east side less eligible as a place for constructing a harbour of refuge. The holding ground off Seaford is of the best quality, and is much resorted to in easterly gales.

The Commission are of opinion that there is no good position in the neighbourhood of Beachy Head, where a harbour is as necessary as in any part of the channel, (being about half way between Dover and Portsmouth,) except in Seaford Road.

The Commission are fully aware of the objections which may be made to the formation of a breakwater harbour on the west side of Beachy Head, considering the prevalence of the westerly wind; but the local disadvantages on the east side of the Head, induce them to give a decided preference to the west side, and the proximity of Newhaven has materially influenced their decision.

Portland and Weymouth.

Our last visit westward was to Portland, which, from its situation with reference to the Channel Islands, and as the boundary of the narrow part of the Channel in this direction, came naturally within the range of our investigation.

A squadron stationed at Portland will have under its protection, jointly with Dartmouth, all the intervening coast, and these places, with Plymouth, will complete the chain of communication and co-operation between Dover and Falmouth, a distance of 300 miles.

There is everything at Portland to render the construction of a breakwater easy, cheap, and expeditious. and the holding-ground in the road is particularly good. A large part of the island facing the bay is Crown property, and contains abundance of stone. It has numerous springs, and plenty of the best water may be led in any direction for the supply of ships.

Harwich Harbour.

We have now to submit to your Lordships a few observations respecting Harwich Harbour, which we consider one of very great importance to the trade of the country.

This harbour, formed by the junction of the rivers Stour and Orwell, is one of the finest, and may be rendered one of the most useful havens in the kingdom. It has a sufficient depth of water and good holding ground over an extent capable of containing many hundred ships.

But with the exception of a channel, of 18 feet in depth, too narrow for general purposes, the entrance to this port is not deep enough to admit ships of more than 12 feet draught of water at low-water spring tides; it is therefore at present a tidal harbour as regards ships of a larger class.

It is remarkably well situated for the convenience of a North Sea squadron, and for the protection of the mouth of the Thames.

It is the only safe harbour along this coast, and is in the direct line of traffic between the Thames and the northern ports of the kingdom, as well as of the trade from the north of Europe.

There is a dock-yard with building slips belonging to the Crown, and the property under the Ordnance department is extensive.

It appears in evidence that by the falling away of Beacon Cliff, on the west side of the entrance, and the lengthening out of Landguard Point, on the east side, the harbour has sustained great damage within the last 25 years.

The bottom at the entrance to the harbour, and the coast on each side, is composed of blue or London clay, in which are layers of "cement stone," in great demand both in England and on the Continent. Hundreds of hands are constantly engaged in collecting it, and the evidence shows that by excavating the cement stone in front of the Ordnance premises, near the foot of Beacon Cliff, the water has spread so as to be diverted from its natural course, and the tide rendered so comparatively feeble, that it no longer acts with its accustomed force on Landguard Point, which has consequently grown out 500 yards during the past 40 years, as shown by the plan. It has already nearly filled up the deep-water channel, and, by its further increase, threatens to destroy the entrance.

In the Appendix there are Reports to the Admiralty from the officer carrying on the surveying service in the neighbourhood of Harwich, to which we beg to refer for a full confirmation of our opinion of the necessity of taking immediate measures for the preservation and improvement of this harbour. If this be not done soon, it is impossible to calculate on the extent of mischief which may take place, for in every south-west gale the Beacon Cliff is in peril of being washed into the sea.

We therefore feel it to be our duty to submit to your Lordships the pressing necessity for carrying out a breakwater, or stone groyne, from the outside of the Beacon Cliff, so as to surround the foot of it, and to extend the same over the shoal-water, to the north part of the Cliff-foot rocks.

We also recommend deepening the channel to the harbour to 18 feet at low-water spring tides by removing the shoals called the "Altars," and the eastern part of another shoal called the "Glutton."

Proposed Breakwaters.

Having made such observations respecting the different ports as may be necessary to enable your Lordships to form a judgment on the proposals we have to submit, and having given to the subject referred to us all the attention which its importance demands, we recommend :—

First, that a harbour be constructed in Dover Bay according to plan No. 1, with an area of 520 acres up to low-water mark, or 380 acres without the two fathom edge; with an entrance 700 feet wide on the south front, and another of 150 feet at the east end.

Entertaining the strong opinion we have expressed of the necessity of providing without delay a sheltered anchorage in Dover Bay, we venture to urge upon your Lordships' attention the advantage of immediately beginning the work by carrying out that portion which is to commence at Cheesman's Head.

Whatever may be finally decided upon as to the form and extent of the works in Dover Bay, the pier from Cheesman's Head, run out into seven fathoms water, appears to be indispensable as a commencement, and it will afford both facility and shelter to the works to be subsequently carried on for their completion.

This will give sheltered access to the present harbour during south-west gales, and protect it from the entrance of shingle from the westward: it will afford time also for observation on the movement of the shingle within the bay, and for further inquiry as to the tendency which harbours of large area on this part of the coast may have to silt up.

These inquiries the Commission consider to be of essential importance, and the results will afford the means of determining on the greater or less width that should be given to the entrances of the proposed harbour.

Secondly, we propose that a breakwater be constructed in Seaford Road in a depth of about seven fathoms water, one mile in extent, and sheltering an area of 300 acres.

Thirdly, that a breakwater be constructed in Portland Bay, to extend a mile and a-quarter in a north-east direction, from near the northern point of the island, in about seven fathoms water, having an opening of 150 feet at a quarter of a mile from the shore, and sheltering an area of nearly 1200 acres.

If only one work is to be undertaken at a time, we give the preference to Dover; next to Portland; and, thirdly, Seaford.

Mode of Construction.

Various plans for constructing breakwaters have been laid before us by highly intelligent individuals, whose projects are noted in the Appendix, and fully explained in the evidence.

We are directed by your Lordships to report on the expense to be incurred by the completion of the works we may recommend; but as no approximate estimate of this can be made without determining the general principles and modes of construction, we have examined the engineers who have come before us, and other authorities, upon those important points.

Their various opinions have been considered by the Commission, who prefer, for the construction of breakwaters, and for the security of the works of defence upon them, the erection of walls of masonry.

The Commission do not offer any opinion as to the profile of degree of slope necessary to ensure to the structure the requisite stability. They consider that this will be best decided by the Government, under professional advice, when the works shall be finally determined on.

The cost of either mode of construction having been stated to be nearly the same, whether it be masonry, or a long slope of rough stone similar to that of Plymouth Breakwater, the Commission beg to lay before your Lordships an approximate estimate of the works at the several places, viz. :—

Dover	£2,500,000
Seaford	1,250,000
Portland	500,000
Harwich...........	50,000

Protest.

This report was signed by nine only of the Commissioners, Captain Sir W. Symonds entered a protest against it in the following terms :—

I dissent from this report, because I consider the mass of evidence to be in favour of Dungeness; and because I cannot recommend a large close harbour at Dover, where the pilots consider the holding-ground generally indifferent, and the engineers say it will silt up.

Evidence.

Sir John Rennie's evidence.—(Chairman). The Commissioners have before them a plan of yours for enclosing the small Downs. In the evidence you gave before the Committee on Shipwrecks, you stated in answer to question 5966, that it will be four miles and half in length, but in your Report to the Commissioners of Ramsgate Harbour, you say it will be five miles, will you have the goodness to explain how that is?—The fact is, that in any work constructed upon the Brake, the operation of accumulation, which I consider will be produced by the works if conducted in a judicious and proper manner, will be rather to raise and increase the shoal in a particular position; it may be a quarter of a mile, more or less, for it is difficult to state whether it will be five miles or four and a half, till I know specifically the whole extent of the operations intended to be carried on. It is not like constructing a mole out in the open sea, where the whole work must be done entirely artificially; but here the object is to endeavour to make nature operate with us in conjunction with art, so that it is a very difficult thing to say in the first outset what would be the whole quantity which would be required to be done. I have given, in the Report to the directors of Ramsgate Harbour, an outside estimate, comprehending everything; but, I believe, provided the work be carried on, only a portion of it will be required.

You have alluded to the difficulties of constructing a breakwater at Dover, are those engineering difficulties to which you allude?—The difficulties are both engineering and geological, the principal geological; the engineering difficulties may be removed by a sum of money. I do not mean to say a proper harbour may not be constructed at Dover, but before I give an opinion upon it, I should wish to have time to consider it, if the Commissioners wish me to turn my attention to it. In my Report I have alluded to the position of Dover as a good position. The fact is, I have begun to consider it, and have gone back to the early history of Dover Harbour. I have made a commencement in the time of Henry VIII., and have got some very curious documents from the Cottonian Manuscripts, with drawings of all the different changes connected with it; and the history is very curious. Originally, from the facts we have, there was little or no mud in Dover Harbour, it was simply a bay formed in the chalk strata, and a small river coming in there; the Dour discharged itself at times, when it could, into the Channel; but in consequence of the prevalence of southerly and westerly winds, and the beach driving from the westward, a shingle bank was formed in front of the mouth of the river, so that the river, before it could get to the sea, was obliged to expand itself into a large lake; when this lake got sufficiently full from the waters of the interior, and when the winds were not so strong without, it burst through its barrier, and forced itself into the sea. Thus the shutting and opening of this basin soon occasioned, on the one side by the winds and waves from without, and on the other by the antagonist force of the waters from within, and the basin formed what is called Dover Harbour. Strangers looking at a position of that kind supposed that nothing more was requisite than to open the channel, and to confine it by works of art to preserve a proper harbour, but in proportion as those works were constructed the beach was increased, and the mud accumulated inside, and from hence has been the advance and receding in Dover Harbour.

Extract from the Evidence of His Grace the Duke of Wellington, taken before the Select Committee on Shipwrecks.

"5264. Chairman.—The attention of the Committee has been directed to the subject of a harbour of safety between Portsmouth and the Thames; will your Grace have the goodness to state your opinion as to the necessity for the erection of a new harbour?"—'I have no doubt about it. I entertain no doubt that it is absolutely necessary. There is now no security between Portsmouth and the Downs. Dover Roads is a very secure place, in the period of a northerly or easterly wind; but there is no security at other times; but, on the contrary, it is a very dangerous place in a wind from the south-west. They can run for the Downs; but there is no great ease in the Downs; certainly, there is no security in Dover, except from warlike attempts. But I should say that, considering the want of protection from the weather, and from military attacks in the Channel, the trade of the port of London will be in a very precarious situation, and will be a very losing one, in a variety of ways, in time of war, if something is not done beforehand—if some precautions are not taken. Steam-power, in moving ships, has made such progress at present, as that it must have a most material effect in maritime warfare (I use the word maritime warfare in contradistinction to naval warfare) in all future times. If anybody will just consider the advantage the French coast enjoys over the coast of this country, in observation of what is passing at sea; that is, to the southward, they have the sun in their backs; they see everything quite clear; and it is possible, from the coast of France, to calculate to a moment at what period a vessel coming up Channel will arrive at particular points; and they may be in readiness to seize her, at any point which may happen to be unguarded, supposing the vessel to be without convoy, and supposing that there should be no naval means at that point to take care of her. I should say that the trade of the port of London would labour under a great disadvantage if it were found that every vessel coming up from Portsmouth was obliged to come up in a convoy; that she should be shut up unless there were a convoy; and there are no means of providing for that safety except by ports; not one only, but there ought to be, I should say, at least two between the Downs and Portsmouth. I should say one about Dungeness, and another, possibly, at Dover. I have given a good deal of reflection to it, and have thought of it a long while, and that is the conclusion to which I have come; and it is a rational conclusion, for it is founded on what the state of the commerce of this port (which is the great port of the country) will be, by-and-bye, if something is not done.'

THE OUSE BRIDGE, ON THE HULL AND SELBY RAILWAY.

By William Brayley Bray, M. Inst. C.E.

(From a paper read at the Institution of Civil Engineers, Session 1845.)

In the year 1836 an Act was obtained for making a line of railway from Hull to Selby, where the proposed line was to join the line from Selby to Leeds, which had been opened two years previously.

The Act contained a clause respecting the bridge, by which the railway was to cross the river Ouse, requiring an opening arch to be provided 44 feet in width, for the passage of steamers and vessels with fixed masts.

The river Ouse at Selby is about 196 feet wide, and 14 feet deep, at low water; the tide rises 4 feet at neap tides, and 9 feet at spring tides. The freshes are very rapid, and have occasionally risen 1 ft. 3 in. above the high-water mark of spring tides. At the times of the new and full moon, it is high-water at Selby about half-past 8 o'clock, 3½ hours later than at Hull.

The bed of the river consists of silt, resting on a thin bed of quicksand, beneath which is hard clay. The clay dips to the north about 10 feet in the width of the river, and the south bank is so liable to slips, that in one part of Selby, the road along the side of the river cannot be raised within 3 feet of high-water mark spring tides; and on the site of the bridge, the kidding or staithing, formerly done to preserve the bank, had slipped many yards into the river.

The erection of the bridge was let to Mr. Briggs, of Ferry-on-Trent, and to the Butterley Iron Company. The work was commenced in the autumn of 1837. The piled foundations of the Selby abutment, and the adjoining pier, were finished early in the month of February following.

During the dry spring of 1838, the piles for the other piers of the north abutment were driven, and were finished in June; but the rain during the succeeding autumn and winter, caused such a continuance of freshes, that the sheet piling round the centre pier and the capcills were not finished till May 1839. The fixing of the standards for the piers was commenced early in April, and was completed in June.

From that time no further progress was made till the end of September, as the castings for the superstructure did not arrive from Butterley until that time.

The opening arch was closed on the 11th of October 1839, and re-opened for the navigation on the 13th of February, 1840; during which period all the vessels were obliged to pass through the other opening, which now forms the fixed arch of the bridge.

The fixed arch, with the remainder of the ironwork, was completed by the end of March 1840.

Construction.

The weight of metal in the bridge is about 590 tons, viz.,

	Tons.	Cwts.
Cast iron	568	2
Wrought iron	20	15
Brass	—	8
Lead	—	10
	589	15

The weight of each leaf of the opening arch is 92¾ tons, viz.,

	Tons.	Cwts.
Ironwork	85	14
Oak planking	3	9
Permanent way	3	12
	92	15

The abutments are each founded on 58 piles, 18 feet long, on the Selby side of the river, and 28 feet long on the Barlby side; these piles were driven into the hard clay, and their heads were cut off level to receive the longitudinal sleepers, 10 inches wide by 5 inches deep, which were fixed at distances of 3 feet from centre to centre, and on them were placed, at intervals of 4 feet apart, transverse cills, also 10 inches wide by 5 inches deep, and the intermediate spaces were filled in with broken chalk stone, grouted with thin mortar. On this platform the abutment was built of brickwork, with stone quoins, string courses, and coping.

These abutments were subsequently tied by strong wrought-iron rods to heavy stone piers, built on the solid ground at a distance of about 40 yards. These tie rods completely counteracted the tendency, which the slipping of the river banks would otherwise have had, to thrust the abutments forward, and to narrow the opening arch.

The six timber piers are placed in pairs, by which means the tail end of the opening leaf is preserved from injury.

Each of the four land piers is founded on 20 piles 15 inches square, which were driven about 15 feet into the clay, cut off level, and then tenoned, to receive three cap-cills 16 inches wide by 12 inches thick, the tops of which are laid 15 inches above low-water mark of spring tides.

Upon these cap-cills six cast iron frames are strongly bolted, with cast iron braces fitted between the frames on each side of the pier. Two transverse girders resting on these frames tie the whole together, and furnish proper bearings for the superstructure. The ends of the piers are finished with cut-waters formed of cast iron plates 1 inch in thickness.

The centre piers are similar to the land piers, but are founded on piles from 33 feet to 36 feet long, which are further cased round with sheet piling 6 inches thick, spiked to the cap-cills.

The iron frames are covered with planking 3 inches in thickness, on the side next the 45 feet arches, to protect them from injury by vessels passing through the bridge.

These works entirely conceal from view the brace piles of the centre piers, which are very well contrived for security. The two brace piles are rounded for a portion of their length, so as to allow the cast iron sockets to descend and take a solid bearing on the square shoulders of the piles.

Before lowering these sockets, fir braces 12 inches square were fitted and bolted on them; and when these sockets were let down to their bearing, the tops of these braces were brought to their places and secured to the centre cap-cill by cast iron caps and bolts.

The superstructure consists of six ribs of cast iron 1½ inch thick, resting on the transverse girders, one being under each line of rails and one under each handrail. The ribs over the land arch and the land piers are in two lengths, and finish with flanches forming abutments for the ribs of the fixed and opening arches; the ribs over the centre pier finish at both ends with similar flanches, and the fixed arch is composed of ribs joined at the crown, and bolted to strong brace plates, each 6 feet long, to strengthen the junction and stiffened by two other rows of braces.

The covering plates are of cast iron ⅞ inch thick, strengthened with flanches beneath. They are bolted between these ribs, resting on flanches, cast for that purpose, near the top. Outside the ribs is fixed a cast iron ovolo cornice with a plinth, into which the standards of the wrought irun railing are fitted.

The line of railway is laid across the bridge on contiguous timber bearings, 12 inches wide by 6 inches deep.

The opening arch consists of two leaves precisely alike, each keyed on a cast iron shaft 9 inches square, with turned journals and plummer-blocks and brasses at each rib. Each leaf consists of five pairs of tail-pieces, keyed on to the square shaft, with proper kentledge boxes bolted between the extremities of each pair; and of six ribs bolted at one end to the flanches of the tail-pieces, and at the other end to the cast iron meeting plate, and further strengthened by intermediate pipes and bolts.

The leaf is covered with oak planking 3 inches thick, and a plinth and cornice is made of wood, to correspond with the rest of the bridge.

The railing to the opening arch consists of iron standards and chains, and the railway is laid in the same manner as on the rest of the bridge.

Machinery for raising the bridge.

The machinery for raising the bridge consists of an iron segment of 9 feet radius, keyed on the main shaft and bolted to the ribs. Into this works a pinion 12 inches in diameter, keyed on a second shaft with a wheel 4 feet in diameter, which is worked by a pinion 12 inches in diameter, and by bevel wheels from the capstan. The power is thus multiplied 285 times, or a power of 8 lb. on the handle will balance 1 ton, at 1 foot from the centre of the main shaft. The centre of gravity of the leaf is about ¼ inch below, and in advance of the centre of motion of the shaft.

The resistance of the opening leaves, at first starting, is 32 lb.; when the opening is 20 feet wide, the leaf is just balanced, and 17 lb. at the handle, overcomes the friction and moves the leaf either way, and when it is entirely up, a force of 32 lb. is required to lower it. The time necessary for raising or lowering the bridge is from 50 to 60 seconds, but it has been done in 30 seconds.

At high-water spring tides and in times of freshes, the kentledge boxes and tail-pieces dip into the water; additional force is then required for raising the leaves. When the tide rises 9 feet above low water, one man is just able to lift the leaves, by exerting a force of 80 lb. at the handle of the capstan; when the water rises above this level, powerful crabs, erected at the ends of the bridge, are used; a chain from the barrel being passed over the segment and attached to the meeting plate. A force of 6 lb., applied to the handle of the crab, is of equal effect with 8 lb. applied at the handles of the capstan; and as the leaf rises and the tail plunges into the water, the chain rises off the segment and obtains an increased leverage to lift the bridge.

The resistance caused by the rise of the water is equal to 38 lb. at the handle of the capstan, for every foot above 9 feet that the water rises. The highest fresh, since 1840, was 16 feet 2 inches above low water mark.

The effect of heat in expanding the bridge is considerable; this is provided for by taper iron keys, fitting in the grooves of the meeting plates, and inserted to such a depth as to give a proper bearing for the opposite leaf. The opening is ⅜ of an inch wider in cold frosty weather than during a hot summer.

DRAINAGE OF RAILWAY CUTTINGS.

By Thomas Hughes, Assoc. Inst. C.E.

(Paper read at the Institute of Civil Engineers, Session 1845.)

It is not the object of this paper to enter upon the causes of slips, thoug the subject has engaged the attention of the author for some years; but, presuming it to be agreed that water is the chief cause, it will suffice to give a description of the employment of Watson's drain pipes, and of their application to two railway banks in the neighbourhood of London.

* These pipes were explained, accompanied by drawings, in the Journal of last year, Vol. VII. page 49.

In March, 1844, Mr. C. H. Gregory, the resident engineer of the London and Croydon Railway, permitted an experiment to be tried upon a piece of bank selected as the worst part of the line. The spot chosen was near the Sydenham station, at the side of the up-line. A longitudinal trench, 4 feet deep, was dug on the crown of the bank at a few feet from the edge; and other trenches, about 30 feet apart, descended from it to the open drain by the side of the permanent way. The drain pipes were then laid in, and the clay, which had been dug out of the trenches, was laid over the pipes. As great advantage is, in such cases, to be expected from ventilation, an occasional upright pipe rises from the longitudinal line of pipes to the surface.

An interval of dry weather causes the soil round the pipes to crack in every direction, and thus opens numerous fissures for the passage of water to the drain pipes. This is particularly the case with clay; which, though generally presumed to be unfavourable for drainage, is, in this way, as easily managed as any other soil. This may be readily tested by exposing clay, which has not been manipulated, to a drying atmosphere for a few hours.

This piece of bank has not slipped since it was drained; but, as it is only 120 feet in length, and 20 feet in height, it is wished more particularly to call attention to a bank of ½ mile in length, and rising to upwards of 60 feet in height, having higher ground behind it. This bank is on the down-side of the line, between Chalk Farm bridge and Primrose Hill tunnel, near the London terminus of the London and Birmingham Railway. It was in a very precarious state, when placed in the hands of the author, in June, 1844. The soil was the London clay, and the trenches to receive the pipes varied in depth from 3 feet to 6 feet; the workmen being guided in this respect by the appearance of the ground, as it was opened. The descending trenches were cut about 80 feet apart. The work has proved very satisfactory, and no repairs have been required since it was finished. It was contracted for at £200 and, as the length of pipe laid down was 2600 feet, it is at the rate of 1s. 6d. per foot, including every charge.

Walls of the Euston Incline, Birmingham Railway.

Retaining walls are frequently found to suffer severely from want of drainage, and, perhaps, no one more so than that of the Euston incline, London and Birmingham Railway. The application of these drain pipes was permitted on part of this wall, and every facility was given to the undertaken by the resident and consulting engineers.

It was necessary to bore through the wall, and several feet behind it, in order to insert the pipes, which, for this purpose, were made of cast iron, in lengths of four feet each, and were about 3 inches diameter. Boring through the wall was accomplished by a machine (described in this Journal, Vol. VII. 1844, p. 66); and, at some spots, considerable quantities of water issued instantly; but, in other places, no water appeared for several days, or until rain had fallen; and some of these borings were observed to dry up wet places, which showed in the wall at the distance of several feet. This result was expected, from the admission of air causing the earth to dry, and to crack, all round the pipes, thus opening channels for the admission of water into them, and after a heavy rain all the borings may be seen to yield water. This relieves the wall from the considerable pressure which would otherwise, in time, have caused its destruction.

In boring through the wall, it was found that the bricks, which had been placed in contact with the wet soil, had become soft and decayed, but these bricks (or rather the portions of them brought out by the boring tool) were found to become hard again, when they had been exposed to the air for a few days.

Three portions of the wall were thus drained in March, 1843, by making three borings in each panel. The success of this first attempt was not quite apparent; but Mr. R. Stephenson having approved of a further trial, with five borings in each panel, the result was so satisfactory that thirty more were thus drained, between October and December, 1843. These drains have therefore been more than a year in action; and it is worth noticing that several of them yielded water freely throughout the drought of 1844. The good effect upon that portion of the wall is very plain: though, since the mortar has been washed out in many places, it would hardly be expected that the success should be so complete as it is. This may be attributed to the borings having been made 16 feet deep inwards, and thus collecting the water before it reaches the wall.

The panels operated upon in this way are 25 feet in height, and 20 feet in width. Each of them contains five borings; but, in a more favourable soil, a less number would suffice. The charge for the work, including every expense, was 3s. 6d. per foot for the length of drain pipe inserted.

Remarks.

Mr. Dockray said, that previous to the insertion of the drain pipes, the walls of the Euston incline appeared to be saturated with water, but that they were now drying fast and the water no longer settled behind them, being discharged by the pipes as fast as it percolated through the backing. The slope of the cutting near the Chalk Farm bridge showed a tendency to slip, but the insertion of the pipes appeared, by draining the bank, to have stopped all movement of the soil.

Mr. R. Stephenson said, that the retaining walls of the Euston incline were instructive examples of the discrepancy between theory and practice under peculiar circumstances. They were designed several years since, before he had attained his present experience of the action of the London clay. The usual theory for the amount of pressure against retaining walls was that of Prony,* which might be stated to be, that the pressure was equal to the weight of a prism of earth, slipping upon the face of the natural slope due to the character of the soil.

This theory held good as long as the soil was dry, but when it became, as in the London clay, saturated with water, the position was no longer the same and the pressure was that due to a column of dense semifluid acting upon the back of the wall. In this particular case the inclination of the strata required to be considered, to account for what had occurred. The wall had been forced forward at the spot where, in plan, it formed a considerable curve, thus appearing to oppose the convex surface of the back of the wall to the pressure; while on the other side, where the back was concave, the wall did not stir. On examination it was found, that from the inclination of the strata, the water percolating through the fissures, accumulated against the convex back of the wall, reduced the clay to a semifluid state, and increasing its mobility, reducing the cohesion, until it forced forward the foot of the retaining wall, while the opposite wall, which would have been supposed to be weaker, remained firm; evidently because the inclination of the strata acted as natural drainage. The walls were 18 feet high, they were originally built 5 feet in thickness, but had been increased on rebuilding to 6 feet thick, and their foundations were sunk 5 feet deep below the surface, still they were forced bodily forward. It was natural to attribute the failure to the pressure of a dense semifluid, of a weight due to the altitude of the wall. The drain pipes had acted well in drawing off the water, but fearing that they might not prove sufficient in a long duration of wet weather, the cast iron truss beams were thrown across in order to lend the support of the lower and drier side to the upper side, which was more exposed to injury from the percolated water.

Retaining walls should be built nearly parallel from the bottom upwards. That was the practice of the late Mr. Rennie, and was well exemplified in the walls of the Sheerness Dock. He allowed $\frac{1}{10}$th of the height for the batter of the face and $\frac{1}{6}$th for the thickness. Whether the thrust of the earth was opposed by a wall with a straight or a curved batter, an equally effective resistance was obtained, with a less quantity of material than in a wall with a vertical back and an inclined face; but the curved form was more convenient for dock walls and was more elegant in appearance. The whole question of retaining walls might be reduced to the simple mechanical principle of the lever and the inclined plane, indicated by the angle of repose of the soil which the wall was intended to resist, due allowance being made for an increase of its natural density from the absorption of water.

* Vide 'Architecture Hydraulique,' tome i., pp. 288, 289; also, Hutton's 'Mathematics,' prop. xlv., vol. ii., p. 201.

ALABASTER MINES OF CASTELLINA.

The Geology of Tuscany. By W. Hamilton, Esq., M.P.

(*From the Quarterly Journal of the Geological Society.*)

By far the most interesting and important of the different varieties of gypsum is the fine white alabaster found in the neighbourhood of Castellina, where it is regularly stratified, and is worked in properly constructed mining galleries. The little town of Castellina, distant about twenty or twenty-four miles from Volterra, is reached by a rocky road over wild rugged mountains. It is situated on the W. N. W. slope of the hills of Monte Vaso, overlooking in that direction an extensive and slightly undulating plain of tertiary marls, which there can be no doubt extend round the north point of the Monte Vaso chain, and are connected with those of the Val d'Era and the Volterra district.

We entered the mine by an inclined path, and, passing under ground, soon reached an open well or large inverted cone, round which the inclined path is carried, and where the section of marls and gypsum is well exposed. As the descending road passes through the third and fourth gypsum beds, galleries are seen striking into the rock in all directions. The first and second gypsum beds are of a uniform character and grey colour, and do not contain any alabaster blocks. These are found principally in the third and fourth beds, and occur as irregular isolated spherical masses imbedded in the gypsum, from which they are, mineralogically speaking, distinctly separated by a thin black crust, which indicates to the workmen the existence of the finer nodules. These nodules are most frequent in the lower part of the stratum, and occur in regular layers, never touching, although varying much in their distances from each other. They vary much in size, weighing from 20 or 30 lb. to upwards of 2,000 lb. When the workman discovers the black crust, he is at once aware that he is near a block of alabaster, and by following the direction of the crust, he removes the gypsum all round until he has nearly detached the whole nodule, which is at last carefully separated from the parent rock. Gunpowder is occasionally used to blast the rock when no black crust indicates the existence of the alabaster. This crust in connection with the pure alabaster is perhaps one of the most curious features of the mine. On close examination it appears to be laminar and concentric, and to consist of layers of blue clay and gypsum. Now the whole formation of gypsum contains a small portion of clay which gives it the greyish colour, and it is probable that, when that peculiar principle, whether crystallization, attraction or electricity, which caused the aggregation of the particles of gypsum in greater purity and in a more crystalline state was in operation, one of its chief effects was to expel to the circumference all the particles of argillaceous matter previously mixed up with the gypsum; a process which would continue until either the crust itself opposed a resistance to the further action of this principle, or until two opposing spheres nearly came in contact with each other. Very fine crystals of selenite, and sometimes of a large size, are not unfrequently found in the fissures of the gypsum. They are used for the purpose of making the fine Scagliola cement, and are consequently sold at a much higher price than the more ordinary gypsum. The price of the fine alabaster is 5 Tuscan lire the 100 lb. Tuscan at the quarry, or 8 if delivered in Leghorn.

RAILWAY TOLLS.

(From a Return to an Order of the House of Commons.)

The various Charges made by existing Railway Companies for the Carriage of Passengers, Cattle, Coals, and various kinds of Merchandize, distinguishing

Name of Company.	Passengers, per Mile.						Cattle, per Mile.								Coals, per Ton per Mile.		Manure, Lime, Compost.					
	1st Class.		2nd Class.		3rd Class.		Horses.		Horned Cattle.		Sheep.		Pigs.				Manure.		Compost.		Lime.	
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Arbroath and Forfar[1]	1·9	3	1·4	3	·8	3	6	1·5	1·25	1·5	·5	1	·5	1	3·3	3	2·1		2·1	2	2·5	2
Ardrossan[1] ..	2	3	1·5	3			3	3	2	3	·25	2	·25	2	1·5	3	1·5	2	1·5	2	2·5	2
Ballochney ..	·75	4	·5	4	$\frac{3}{8}$	4									2·25	3	2·25	3	2·25	3	2·25	3
Bodmin and Wadebridge[2] ..	1·5	3	1	2·5			none.	2s. 6d.	none.	2s. 6d.	none.	1s.	1s. whole dis.		4	5						
Bolton and Leigh[3] ..	2·45	4	1·75	4	1	4		4		2		·75		·75		3·5		3		3		3
Brandling Junction[4]	1·5	2	1	2	·75	2			$1\frac{1}{3}$	3	·25	2	·75	2	$1\frac{2}{3}$	1·5	1·5	1·5	1·5	1·5	1·5	1·5
Bristol and Birmingham[4], [5]; on the portion of the Line between Birmingham and Gloucester	2·875	2	2	2	1	2	$4\frac{1}{3}$	1·5	·5	1·5	$\frac{1}{8}$	·25	·25	·5	1	1·5	$1\frac{1}{3}$	1	$1\frac{1}{3}$	1	$1\frac{1}{3}$	1
On the portion of the Line between Bristol and Gloucester ..	2·875	2·5	2	2·5	1	2·5	$4\frac{1}{3}$	1·5	·5	1·5	$\frac{1}{8}$	·25	·25	·25	2·5	3 to 5	$1\frac{2}{3}$	2	$1\frac{1}{3}$	2	$1\frac{1}{3}$	2
Canterbury and Whitstable (6 miles) ..	8	2s. 6d.	6	2s. 6d.	4	2s. 6d.	none.		none.		none.		none.		6	1s.	6	11	6	11	6	11
Chester and Birkenhead ..	2	3·5	1·5	3·5	1·25	3·5	4	1·5	1·5	1·5	·25	·25	·5	·5	none.	1·5	2	1	2	1	2	1
Dublin and Drogheda	1·5	3·5	1	3·5	$\frac{5}{8}$	3·5	3·75	2[4]	$1\frac{7}{8}$	2[4]	$\frac{3}{8}$	·5[4]	$\frac{5}{16}$	1[4]	none.	1·5	none.	1	none.	1	uone.	1
Dublin and Kingstown[6], [8] ..	2		$1\frac{1}{3}$		1		none.		none.		none.		none.		none.	3	none.	2·5	none.	2·5	none.	2·5
Dundee and Newtyle[7]	1·756	3	1·451	3	1·170	3	none.		4	6	·5	3	·5	3	3·121	6	2·146	6	2·146	6	3·121	6
Durham and Sunderland ..	1·5		1		·75		none.		none.		none.		none.		1·125 to ·75		1·5	none.	1·5	none.	1·5	none.
Eastern Counties (Cambridge Line)[4]	$1\frac{1}{8}$ to $2\frac{5}{8}$	2	1 to 2	2	$\frac{7}{8}$ to $1\frac{3}{8}$	2	3 to 4	1·5	$1\frac{1}{4}$ to $2\frac{1}{4}$	1·5	$\frac{1}{4}$ to $\frac{3}{8}$	$\frac{1}{4}$	$\frac{3}{8}$ to $\frac{1}{2}$	$\frac{1}{2}$	2	1·5	2	1	2	1	2	1
Eastern Counties (Colchester Line)[4]	$2\frac{1}{4}$ to $2\frac{7}{8}$	2	$1\frac{3}{4}$ to $2\frac{1}{8}$	2	1 to $1\frac{3}{4}$	2	$4\frac{3}{4}$ to $6\frac{1}{4}$	3	$1\frac{1}{2}$ to 2	3	$\frac{1}{7}$ to $\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{7}$ to 1	$\frac{1}{4}$	2	2	2	1·5	2	1·5	2	1·5
Edinburgh and Dalkeith[9] ..	·75	3	none.		none.		none.	6	none.	6	none.	3	none.	3	1·25	4	1·75	4	1·75	4	1·75	4
Edinburgh and Dalkeith, Leith Branch	none.		·75	3	none.		none.	6	none.	6	none.	3	none.	3	1·75	4	2·5	4	2·5	4	2·5	4
Edinburgh and Glasgow ..	2·082	3·5	1·565	3·5	1·043	3·5	3·130	4	[10]	4		3		3	·875 to 1	$4\frac{1}{2}$		4		4	1·5	4
Edinburgh, Leith and Granton ..			2	6																		
Glasgow, Garnkirk and Coatbridge[11] ..	9 for 10 mls		6 for 10 mls		none.		none.		none.		none.		none.			3		2		2		2
Glasgow, Paisley, Kilmarnock and Ayr[4]	1·75	3	1·25	3	$\frac{7}{8}$	3	3	2	2	2	$\frac{1}{8}$	1	$\frac{1}{8}$	1	1·25	2·5	1·25	2	1·25	2	1·25	2
Glasgow and Paisley Joint Railway Company[4] ..	$1\frac{5}{7}$	2·5	$1\frac{2}{7}$	3·5	$\frac{6}{7}$	3·5	$8\frac{4}{7}$	2	6	2	$\frac{3}{7}$	1	$\frac{3}{7}$	1		2·5		2		2		2
Grand Junction[4] ..	2·44	[12]	1·96		1		3	1·5	6 wagon	·25	6 wagon	·5	6 wagon	·5	·75	1·5	1·75	1·5	1·75	1·5	1·75	1·5
Great North of England[4] ..	3·37	3	2·34	3	1·39	3	6	3	6 wagon	3	6 wagon	1	6 wagon	1		2[13]	2	1	1·5	1	1·5	1
Great Western ..	2·744	3·5	1·878	3·5	1	3·5	4·637		1·534		·156		·188		1·460	1·5[4]	1·735	1[4]	1·735	1[4]	1·735	1[4]
Hartlepool Dock and Railway Company ..	1·5		1·25		·833		3	3	3	3	3	3	3	3	·75	·75	·5	·5	·5	·5	·5	·5
Hayle ..	1·2	1	·9	1	·6	1	none.	2	none.	2	none.	1	none.	1	4·6	3[4]	4·6	3[4]	4·6	3[4]	4·6	3[4]
Lancaster and Preston Junction ..	$3\frac{1}{7}$	3·5	2	3·5	1	1	$4\frac{6}{7}$[14]	6	1·5[14]	2	1·5[14]	·5	1·5[14]	·5	1·25[14]	$1\frac{1}{4}$[4]	1[14]	1[4]	1[14]	1[4]	1[14]	1[4]
Leicester and Swannington ..	1·8006	3	1·2690		none.		none.	1	none.	1	none.	1	none.	1	$1\frac{1}{2}$·789	$2\frac{1}{2}$	2	2	2	2	2	2
Liverpool and Manchester ..	2·28	[8]	1·52		·95		3	[8]	1·5	[8]	16s. wagon[8]		25s. wagon[8]		1·5	2·5	2	3	2	3	2	3
Llanelly Railway and Dock Company ..	1·5	[8]	1			[8]	none.	[8]	none.	[8]	none.	[8]	none.	[8]	1·5	1·5[4]	1	1[4]	1	1[4]	1	1[4]
London and Birmingham Line ..	2·86	3	1·80	3	1	1	4·88	[8]	1	[8]	·1798	[8]	·1749	[8]	1[8]		1·25[8]		1·25[8]		1·25[8]	
Euston Extension ..	2·86	1s.	1·80	1s.	1	1																
Aylesbury Branch ..	2·45	3	2·45	3	1	1																
Northampton and Peterboro' Branch	2	3	1·5	2	·90	1																
Warwick and Leamington Branch ..	2·5	2·5	1·80	2.5	1	1																
London and Blackwall	6 for $3\frac{3}{4}$ miles		4 for $3\frac{3}{4}$ miles				none.		none.		none.		none.		none.		none.		none.		none.	
London and Brighton	2·8	3·5	1·9	3·5	$1\frac{1}{5}$	3·5	4·7	1·5[8]	1·5	1·5[8]	·25	·25[8]	·25	·5[8]	1·5	1·5[8]	1·25	1[8]	1·25	1[8]	2	1[8]
London and Croydon	1·4285	3·5	1·1428	3·5	·8571	3·5	none.		none.		none.		none.		1·5625		none.		none.		rone.	
London and South Western ..	2·5		1.75		1		2·75		2		$3\frac{1}{4}$ per score		7 per score		$1\frac{3}{4}$		1·75		1·75		1·75	

the Charges made, from the Maximum Charges authorized by their respective Acts of Parliament. Each column contain two sets of figures, the first refers to the PRESENT CHARGES, the second to the MAXIMUM PARLIAMENTARY CHARGES.

The following Returns are given as they have been furnished to the Railway Department of the Board of Trade by the several Railway Companies named.

Sugar, Corn, Grain, Timber.						Manufactured Goods, Cotton, Wools.					
Sugar.		Grain.		Timber.		Manufactured Goods.		Cotton.		Wools.	
d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
4·6	4	3·3	4	3·3	4	4·6	6	4.6	6	4·6	6
2	5	2	5	2	5	3	6	3	6	3	6
2·25	4	2·25	4	2·25	3	2 25	4	2·25	4	2·25	4
7	8	6 up. 3 down.				7	8	7	8	7	8
	4·5		4·5		4·5		4·5		4·5		4·5
3	3	3	3	3	3	3·5	3	3·5	3	3·5	3
1·25	2	1	2	1	2	2	3	3·25	3	3·25	3
1·25	4	1	4	1	4	2·75	4	3·25	4	3·25	4
1*s.*	1*s.* 2*d.*	1*s.*	1*s.* 2*d.*	1*s.*	1*s.* 2*d.*	1*s.*	1*s.* 2*d.*	1*s.*	1*s.* 2*d.*	1*s.*	1*s.* 2*d.*
5		4				5	3	5	3	5	3
3	2	2·25	2	2·25	2	3	3	3	3		
none.	3·5	none.	3·5	none.	3·5	none.		none.		none.	
6·243	1*s.*	2·731	6	3·609	6	3·804	1*s.*	3·121	1*s.*	3·121	1*s.*
3	none.	2	none.	2·5	none.	4	none.	4	none.	4	none.
3	2	2	2	3	2	4	3	4	3	4	3
3	6	2	3	3	2	4 to 6	6	4 to 6	6	4 to 6	6
3·5	4	3·5	4	3·5	4	3·5	6	3·5	6	3·5	6
2·5	6	2·5	6	2·5	6	2·5	6	2·5	6	2·5	6
·565	5	·565	5	1·846	5	3	6	1·456	6	1·456	6
	6		6		6		6		6		6
2	3	2	3	2	3	2·5	4	2·5	4	2·5	4
	3		3		3		4		4		4
1·75	2½	1·75	2½	1·75	2½	2 to 4½	3	2 to 4½	3	2 to 4½	3
3	3	2	3	2·5	3	3	4	3	4	3	4
2·133	2[4]	2·133	2[4]	2·133	2[4]	2·542	3[4]	2·542	3[4]	2·542	3[4]
3	3	3	3	3	3	3	3	3	3	3	3
5·4	4[4]	5·4	4[4]	5·4	4[4]	6·3	4[4]	6·3	4[4]	6·3	4[4]
1·5[14]	2[4]	1·5[14]	2[4]	1·5[14]	2[4]	1·5[14]	2[4]	1·5[14]	2[4]	1·5[14]	2[4]
4	4	4	4	4	4	4	4	4	4	4	4
3	3⅜	2·5	3⅜	2·5	3	3 to 3½	4	3	4	3	4
1·5	1·5[4]	1·5	1·5[4]	1·5	1·5[4]		1·5[4]		1·5[4]		1·5[4]
1·5[3]		1·5[8]		1·5[8]		2·5[8]		2[8]		2[8]	
2*s.* for 3½ mls.		2*s.* for 3½ mls.		2*s.* for 3½ mls.		2*s.* for 3½ mls.		2*s.* for 3½ mls.		2*s.* for 3½ mls.	
3·6	2[8]	2·4	2[8]	2·4	2[8]	6	3[8]	6	3[8]	3·6	3[8]
		1·56		3		none.		none.		none.	
1·75		1·75		1·5		2·25		2·25		2·25	

NOTES.

1 In the above return, the "Present Charges" include tolls and haulage, while the column for "Maximum Charges authorized by Act of Parliament," contains only the maximum charge for tolls.

2 Half price back, if on the same day, for passengers.

3 And in addition to the above maximum charges, the Company is authorized to charge the sum of 8d. per ton for ascending any inclined plane worked by a stationary engine, and 3d. per ton for descending such inclined plane; there are two inclined planes of this description, ascending in opposite directions, so that goods starting from either end of the line have to ascend one inclined plane and descend the other, in the transit over the railway. The railway is leased to Mr. John Hargreaves, jun, at the rent of 12,000*l.* per year, and the Company have no knowledge of the Lessee's charge for carriage of goods.

4 These charges are tolls only, exclusive of the expenses of conveyance.

5 The coals on this line are only conveyed an average distance of 7 miles. The Birmingham and Gloucester and Bristol and Gloucester lines being now worked in conjunction by the Midland Company, the returns are made herein for both lines.

6 The rates given are those charged for booked passengers for a single trip, but there are a great variety of modifications of passenger rates; for artizans for short stages, return tickets, and especially for persons subscribing in advance for terms varying from 3 months to 12 months; taking all of which into consideration, it is impracticable to make a separate mileage rate for each class for the whole traffic, but the average receipts for all classes during the last three years have been as follows:—Year ended Feb. 28 1843, 1·05d. per passenger per mile; Year ended Feb. 29 1844, ·968d. per passenger per mile; Year ended Feb. 28 1845, ·893d. per passenger per mile.

7 In the Table of Charges for Conveyance of Goods on this Railway so much per ton per mile is charged; and if the goods are carried over the Law Inclined Plane or the Hatton Inclined Plane, there is an additional charge made on that account. The rates shown in this table or return are the average rates per ton per mile, supposing the goods to be conveyed the whole distance, and including the charges for the inclined planes, but exclusive of weighing or other labourage at the loading or unloading stations.

8 No maximum charge or stipulation in this Company's Acts.

9 Stock and Goods with an additional 3d. per ton for ascending the Inclined Plane at Edinburgh; and also for such coals as pass through the estates of Niddry and Edmonstone, ½d. per ton additional on each estate, as a way-leave, payable to the proprietors of those estates under the Act of Parliament. Also, in certain cases, 1d. of wharfage, or depôt-rent.

10 3rd Class 1d.; 4th Class ·652d. A truck load containing from four to eight head of cattle nearly 5·5d. per mile per truck; if fewer than four, about 1·5d. per mile per head. A truck load, 45 sheep, nearly 4d. per mile per truck; when less than a truck load, rates vary according to number. A truck load of pigs (number varying according to size), nearly 8d. per mile per truck; when less than a truck load, rates vary according to weight.

11 No fixed rate for passengers by the Company's Act of Parliament. Tonnage Dues.—Class First: Coal, dross, ironstone, pig-iron, limestone, whinstone, freestone, gravel, sand, clay, slag and engine ashes, first mile 2d. per ton; each succeeding mile 1d. N. B. Dung and lime for manure, from Glasgow to Stepps depot 4d. per ton; from Gartcosh 5d. from Gartgill 6d. Class Second: Bar iron, charcoal, peats, lime (except for manure), tiles, slates and bricks, first mile 2 5d. per ton; each succeeding mile 1·5d. Class Third: Cotton, wool, yarn, cloth, grain, machinery, timber, bark, and all goods and commodities not above specified, first mile 3d. per ton; each succeeding mile 1·75d. Engines and trains not belonging to the Company, and admitted on the line, are charged the tonnage dues on the net load only, unless that load is under 75 tons weight. Passenger trains not the Company's, ·5d. per passenger per mile, or per carriage, or per trip, in the Company's option, as may be agreed upon. Engine Haulage—Westwards: first mile 1·25d.; each additional mile ·25d. Eastwards: if ascending the inclined plane, 6d. per ton; other parts of the line same charge as westwards. Wagon Hire—Per day, 6d.; per week 2s., for ordinary purposes not involving extra tear and wear, or detention. Trucks, for timber, machinery, and very bulky or heavy articles, per agreement. Crane Dues—Sixpence per ton for lifts under four tons weight, and for heavier lifts 1s. per ton. An extra charge for assistance, if supplied, in working the crane.

12 Toll.—For every person conveyed by the said Company, or any other person in or upon any entirely open and uncovered carriage, or on the outside of any covered carriage, any sum not exceeding 2·5d. per mile. For every person so carried in or upon any covered carriage, any sum not exceeding 3d. per mile. For every person so carried in or upon any four inside or mail carriage, any sum not exceeding 3 5d. per mile.

13 The coal dues are leased, and the lessees charge the following rates per ton: From Darlington to—Croft, 3¼ miles, 1s. per ton; Northallerton, 14¾ miles, 2s. 6d.; Thirsk, 22¼ miles, 3s. 7d.; Shipton, 39¼ miles, 3s. 9d.; York, 45 miles, 3s. 6d.

14 All these Articles, except Horses, are conveyed by a Common Carrier and by Traders who pay the above-mentioned Tolls.

15 All goods which are imported, and travel the line to be exported again, are charged uniformly at the rate of 10s. for the whole distance, being 2d. per ton per mile.

Name of Company.	Passengers, per Mile.						Cattle, per Mile.								Coals, Per Ton Per Mile.		Manure, Lime, Compost.					
	1st Class.		2nd Class.		3rd Class.		Horses.		Horned Cattle.		Sheep.		Pigs.				Manure.		Compost.		Lime.	
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
Manchester and Birmingham ..	2	2	1⅔	2	1	2			7¼load	13·5	7¼load	13·5	7¼load	13·5	1	1·5	1·25	1	1·25	1	1·2	1
Manchester, Bolton and Bury Canal Navigation and Railway	2·25	2·5	1·75	2·5	1·25	2·5	3·5	5		2·5		2·5		2·5	2·5	2·5					2·5	2·5
Manchester and Leeds	2·5	3·5	2		1 to 1·12		3·67	1·5[4]	1·45	1·5[4]	·19	·5[4]	·35	·5[4]	1	3	1	3	1	3	1	3
Maryport and Carlisle	2⅛	3·5	1·5	3·5	none.		2[8]		2[8]		⅜[8]		⅜[8]		2[8]		1·75[8]		1·75[8]		1·75[8]	
Midland ..	3	3·5	2	3·5	1·25	3·5	4·25	1·5[4]	6 wagon	¼[4]	6 wagon	¼[4]	6 wagon	½[4]	1	1·5[4]	1·5	1[4]	1·5	1[4]	1	1[4]
Monkland and Kirkintilloch ..	·75	2	·5	2	⅜	2									1·5	2	1·5	2	1·5	2	1	2
Newcastle-upon-Tyne and Carlisle[15] ..	2·2		1·7		none as yet.		Close box 3*d* Open do. 1¾*d*		1·5		1*s.* whole dis.		1*s.* whole dis.		1⅝	4·5	2	3⅖	2	3⅖	·75	3⅖
Newcastle and Darlington ..	2·75	4	2·1	4	1·25	4			1	5	·25	2·25	·25	2·25	1·5	3	1·5	2·5	1·5	2·5	1·5	2·5
Newcastle-upon-Tyne and North Shields..	1·33	2[4]			No. 1, ·88; No. 2, ·59		1*s.* whole dis.		9 whole dis.		1½ whole dis.		3 whole dis.		4	2[4]	4	2[4]	4	2[4]	4	2[4]
Newtyle and Coupar Angus[16] ..	1·6426	3	1·1722	3											2·5	6	1·5	6	3	6	2·5	6
North Union[17] ..	2·4	3·1	1·6	2·5	1	2·5	4·4	4	1	4	⅛	1·5	⅛	1·5	1·25	1·25	1·25	1·25	1·25	1·25	1·25	1·25
Pontop and South Shields[18] ..		4		4		4		5		5		2·25		2·25	1·55	2·25	2	2·5	2	2·5	2	2·5
Preston and Wyre ..	2·5	2[4]	1·75	2[4]	1	2[4]	6	1·5[4]	3	1·5[4]	·75	·5[4]	1	1[4]	2	2[4]	2[4]	2[4]	2[4]	2[4]	8[4]	2[4]
St. Helen's and Runcorn Gap ..	2⅛		1·5		1		none.		none.		none.		none.		1·5	2	1·5	2	2	3·5	2	3·5
Sheffield and Rotherham—6 miles ..	1*s.*	1*s.*	none.	1*s.*	6	1*s.*	2*s.* 6*d.*	3	1*s.*	3	1	1	3	1	1*s.* 3*d.*	2	2*s.*	1·5	2*s.*	1·5	2*s.*	1·5
Slamannan ..	1·44	4	1·30	4	6/7	4									1·5	3	1½ to 2	2			1·5	1·5
South Eastern ..	2·4	3·5	1·58	3·5	94	3·5	4		1·5	1·5[4]	·25	·25[4]	·5	·5[4]	1⅛	1·5[4]	1⅜	1[4]	1⅜	1[4]	1⅜	1[4]
Taff Vale ..	2	3·5	1·5	3·5	1	3·5			2	3	⅜ to ½	½	⅜ to ½	½	1⅛	1⅙	1⅙	1⅙	1⅙	1⅛	1⅛	1⅙
Ulster ..	1·44	2[4]	·96	2[4]	·64	2[4]	4·32	1·5[4]	2 88	1·5[4]	·4	·25[4]	·4	·5[4]	1·44	1·5[4]	none.	1[4]	none.	1[4]	none.	1[4]
Whitby and Pickering	1·5 to 2	2	1	2			5	5	3·75	5	·25	·5	·25	·5	2	3	2	3	2	3	2	3
Wilsontown, Morningside, and Coltness..	1·5	4	1	4											1	3	1	2	1	2	1	2
Wishaw and Coltness	1·11	4	·88	4	none.		none.		none.		none.		none.		¼ to 3[4], [19]		½ to 1[19]	2	½ to 1[18]	2	½ to 1[19]	2
Yarmouth and Norwich ..	2·1	3	1·5		1			4		4		1·25		1·25	1·5	2	1	1·5	1	1·5	1	1·5
York and North Midland ..	2⅝	3·5	1⅞		1⅜		3		6 wagon[20]		4 score	.5	4 score	1	·75	1·5			1		1·25	1

RAILWAYS ACTS OBTAINED IN THE SESSION OF PARLIAMENT, 1845.

Aberdare (Single line) 8½ miles.
Aberdeen, 57¼ miles.
Ashton, Staleybridge, and Liverpool Junction (Ardwick and Guide Bridge Branches), 1¾ miles.
Bedford and London and Birmingham, 15¾ miles.
Belfast and Ballymena (single), 35 miles.
Berks and Hants, 39 miles.
Blackburn and Preston (Deviation), 3 miles.
Blackburn, Burnley, Accrington, and Colne Extension, 23 miles.
Blackburn, Darwen and Bolton, 14 miles.
Bolton and Leigh and Kenyon and Leigh Junction, North Union, Liverpool and Manchester and Grand Junction Company's Amalgamation.
Bridgewater Navigation and Junction Railway.
Brighton and Chichester (Portsmouth Extension), single, 16 miles.
Brighton. Lewes, and Hastings (Keymer Branch), 9 miles.
Brighton, Lewes, and Hastings (Hastings, Rye, and Ashford Extension), 29 miles.
Bristol and Exeter (Branches), 28 miles.
Birmingham and Gloucester (Gloucester Extensions, Stoke Branch, and Midland Junction), 1 mile.
Caledonian, 135¾ miles.
Chester and Birkenhead Extension, 1 mile.
Chester and Holyhead (No. 2), 4¾ miles.
Clydesdale Junction, 15 miles.
Cockermouth and Workington (single), 8¾ miles.
Cork and Bandon, 20 miles.
Dublin and Belfast Junction (Branch to Kells), 73 miles.
Dublin and Drogheda)Howth Branch), 3½ miles.
Dundalk and Enniskillen, 57 miles.
Dundee and Perth, 20½ miles.
Dunstable and London and Birmingham (single), 7 miles.
Eastern Counties (Cambridge and Huntingdon line), 17¼ miles.
Eastern Counties (Ely and Whittlesea Deviation), 23½ miles.
Eastern Union and Bury St. Edmunds (No. 2), 26½ miles.
Eastern Union (Amendment).
Edinburgh and Glasgow (Branch to Stirling), 6¼ miles.
Edinburgh and Hawick (single), 45 miles.
Edinburgh and Northern (No. 2 single). 41½ miles.
Ely and Huntingdon, 22 miles.
Erewash Valley (No. 2), 25½ miles.
Exeter and Crediton, 6 miles.
Epping (Blackwall and Eastern Counties Junction), 1¾ miles.
Glasgow, Barrhead, and Neilston Direct, 8½ miles.
Glasgow. Garnkirk, and Coatbridge, 5 miles.
Glasgow Junction, 3 miles.
Glasgow, Paisley, and Ayr (Cumnock Extension), 18½ miles.
Gravesend and Rochester (single), ½ mile.
Great Grimsby and Sheffield Junction, 59 miles.
Great North of England (Clarence and Hartlepool Junction), ⅝ mile.
Ditto Richmond (Branch) 9 miles.
Great Southern and Western (Ireland), 98 miles.
Great Western (Ireland). (Dublin to Mullingar and Athlone), 75½ miles.
Guildford Junction, purchased by South Western, 15 miles.
Huddersfield and Manchester (and Canal). 23 miles.
Huddersfield and Sheffield Junction, 13 miles.
Hull and Selby (Bridlington Branch), 31 miles.
Kendal and Windermere, 10 miles.
Lancaster and Carlisle (Deviation).
Leeds and Bradford Extension (Shepley to Colne), 31 miles.
Leeds and Thirsk, 39½ miles.
Leeds, Dewsbury, and Manchester Junction, 20½ miles.
Liverpool and Bury (Bolton, Wigan, and Liverpool), 35 miles.
London and Croydon Enlargement.
London and Greenwich.

Sugar, Corn, Grain, Timber.						Manufactured Goods, Cotton, Wools.					
Sugar.		Grain.		Timber.		Manufactured Goods.		Cotton.		Wools.	
d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
2	3	1·5	2	1·5	2	2·5	3	2·5	3	2·5	3
4·75	3·5	3·5	3	3	2·5	3	4	3	4	3	4
3		2·57	2·5[4]	2 57	2·5[4]	4	3	2.57	3	2·57	3
4[8]		3[8]		3[8]		4[8]		3·5[8]		4[8]	
2·5	2[4]	2	2[4]	2.5	2[4]	3·25	3[4]	2·5	3[4]	2·5	3[4]
1·5	4	1·5	4	1·25	2	3·25	4	2·55	4	2·5	4
3·5	$5\frac{4}{5}$[4]	3·5	5·3[4]	3	3·2[4]	4·5	$6\frac{1}{5}$[4]	4	$6\frac{1}{5}$[4]	4	$6\frac{1}{5}$[4]
2·5	3·75	2		2		3·25	5	3 25	5	3·25	6
8·75	4[4]	2·5	2·5[4]	8·75	3[4]	11·75	4[4]	11·75	4[4]	11·75	4[4]
5	1*s.*	2·5	6	4	6	3	1*s.*	3	1	3	1
1·5	2·5	1·5	2·5	1·5	2·5	1·5	3	1·5	3	1·5	3
3.75	3·75	3·75	3·75	3·75	3·75	5	5	5	5	5	5
4	4[4]	3·75	4[4]	3·75	4[4]	6	4[4]	4	5	4	4[4]
2·5	5	2·5	5	2·5	5	2·5	1*s.*6*d.*	2·5	1*s.*6*d.*	2·5	1*s.*6*d.*
4	4	4	3	4	3	5	5	5	5	5	5
3	4	1·5	4	2	4	3	4	3	4	3	4
$1\frac{1}{8}$	2[4]	$1\frac{3}{8}$	2[4]	$1\frac{3}{8}$	2[4]	2·75	3			2·75	3
4	2·5	2·75	2·5				3·5		3.5		3 5
3·12	2[4]	2·4	2[4]	1·92	2[4]	3·6	3[4]	3·6	3[4]	3·6	3[4]
5	5	3·5	4·5	$3\frac{1}{2}$to5	$5\frac{1}{4}$	5·5	6	5·5	6	5·5	5·5
4	4	3	4	3	4	4	6	4	6	4	6
2[19]	4	2[19]	4	2[19]	4	2[19]	4	2[19]	4	2[10]	4
1·25	2·75	1·25	2·75	1·25	2·75	1·75	4	1·75	4	1·75	4
2	2	2	2	2	2	4	2·5	3		3	2·5

(Notes continued.)

16 Present charge for Labourage, over and above the rates, 4d. per ton. Maximum authorized by Act of Parliament, 6d. per ton.

17 The North Union Railway Company are not carriers of either cattle, sheep or pigs, goods or coals, but charge the above Tolls per ton per mile. The Company carry passengers over the Liverpool and Manchester Railway, when the charges are between Preston and those towns—1st Class, 1·89d. 3·08d.; 2nd Class, 1·25d. 2·5d.; 3rd Class, 1d.

18 An allowance of 20 per cent. on charges is made on all coals shipped foreign. The above rates include the charge made for toll, haulage, and the use of the Company's wagons. The return of the rates of charges for passengers, cattle, and general merchandize, will be made by the Newcastle and Darlington Junction Railway Company, who conduct that traffic.

19 Haulage by Engine power: 1st mile ·75d., each succeeding mile ·25d.

Tonnage Dues, for the Use of this Railway and its Branches.

1st Class.—Coal, Raw Ironstone, Ashlar Freestone, Whinstone, Sand, Fire-clay, Lim Bricks, Slates, and Drain Tiles:

For the first mile, 3d. per ton; for the second mile, 1·5d. per ton; for the third, fourth, and fifth miles, 1d. per ton per mile; for the sixth and seventh miles, ·5d. per ton per mile; for the eighth mile, and each succeeding mile, ·25d. er ton per mile.

2nd Class—Dross, Rubble, Stone, Slag, Ashes, Dung, and Limestone:

For the first five miles, 1d. per ton per mile; for the sixth, and each succeeding mile, ·5d. per ton per mile.

3rd Class.—Burned Ironstone and Coke:

For the first mile, 3d. per ton; for the second, and each of three succeeding miles, 1·5d. per ton per mile; tor the sixth, and each of three succeeding miles, 1d. per ton per mile; for the tenth and eleventh mile, ·5d. per ton per mile.

4th Class.—Pig Iron and Malleable Iron:

or the first and second miles, 3d. per ton per mile; for the third mile, 2d. per ton; for fourth, and each succeeding mile, 1d. per ton per mile.

5th Class.—Grain, Cotton, Wool, Thread, Cloth, Dry Goods, Groceries, Wares, and other Merchandize, and all articles not above specified, 2d. per ton per mile.

20 One drover allowed to pass free with one wagon.

London and South Western (Metropolitan Extension, No. 1 and No. 2). $2\frac{1}{4}$ miles.
Lowestoft Railway and Harbour (single) $11\frac{1}{2}$ miles.
Lynn and Dereham, 26 miles.
Lynn and Ely and Branch to Wisbeach, $37\frac{1}{2}$ miles.
Londonderry and Coleraine, $38\frac{3}{4}$ miles.
Londonderry and Enniskillen, 56 miles.
London and Brighton (Horsham), $8\frac{5}{8}$ miles.
Liverpool and Manchester Railway Branches, $37\frac{1}{4}$ miles.
Manchester and Birmingham (Ashton Branch), 5 miles.
Manchester and Leeds (Burnley Branch, and Oldham and Heywood Branches Extension) No. 2, $13\frac{3}{4}$ miles.
Manchester, Bury, and Rossendale (Heywood Branch), 5 miles.
Manchester South Junction and Altrincham, $9\frac{1}{2}$ miles.
Middlesbro' and Redcar (single) $7\frac{1}{2}$ miles.
Midland (Nottingham to Lincoln), $33\frac{1}{4}$ miles.
Midland (Syston to Peterborough), $47\frac{3}{4}$ miles.
Monmouth and Hereford, 34 miles.
Newcastle and Berwick, $93\frac{1}{2}$ miles.
Newcastle and Darlington, Brandling Junction, 6 miles.
Newcastle and North Shields (Tynemouth Extension), $1\frac{1}{2}$ miles.
Newport and Pontypool, $11\frac{1}{4}$ miles.
Newry and Enniskillen, $71\frac{1}{2}$ miles.
North British, 2 miles.
North Union and Ribble Navigation Branch, $\frac{1}{2}$ mile.
North Wales (Porthdynllaen and Bangor), $28\frac{1}{2}$ miles.
North Woolwich (Eastern Counties) (single). $2\frac{3}{4}$ miles.
Norwich and Brandon Deviation, and (Diss and D reham) Branches, $27\frac{1}{2}$ miles.
North Wales Mineral (Extension), $12\frac{1}{4}$ miles.
Oxford and Rugby, $50\frac{1}{2}$ miles.
Oxford, Worcester, and Wolverhampton, 99 miles.
Preston and Wyre Branches (single), $7\frac{1}{2}$ miles.
Richmond (Surrey), 6 miles.
St. Helen's Canal and Railway, 5 miles.
Scottish Central, $47\frac{1}{2}$ miles.
Scottish Midland Junction (Perth and Forfar), $32\frac{1}{2}$ miles.
Sheffield and Rotherham (Amalgamation with Midland), $\frac{3}{4}$ mile.
Shrewsbury, Oswestry, and Chester Junction, $23\frac{5}{8}$ miles.
Southampton and Dorchester and Branch to Poole (single), 62 miles.
South Eastern (Branch to Deal, and Extension of South Eastern, Canterbury, Ramsgate and Margate), 14 miles.
Ditto Tonbridge to Tonbridge Wells.
Ditto to Widen and Extend Greenwich.
South Wales, 182 miles.
Taw Vale (Extension of Time).
Trent Valley, $49\frac{1}{2}$ miles.
Ulster Extension, 11 miles.
Wakefield, Pontefract, and Goole, 25 miles.
Waterford and Kilkenny, 32 miles.
Waterford and Limerick, 73 miles.
Wear Valley.
Whitby and Pickering (to alter and sell).
Wilts, Somerset, and Weymouth, 121 miles.
Whitehaven and Furness (single), $32\frac{1}{4}$ miles.
West London, $1\frac{1}{2}$ miles.
Yarmouth and Norwich.
York and North Midland (Bridlington Branch), 19 miles.
York and North Midland (Harrowgate Branch), $18\frac{1}{4}$ miles.
York and Scarborough (Deviation), 3 miles.

Total, $2,814\frac{5}{8}$ miles.

(From Herapath's Railway Journal.)

ARCHITECTURE IN MANCHESTER.*

Sir—A notice to correspondents in last month's journal, to the effect that local intelligence of progress in building is peculiarly valuable to you, encourages me to contribute my quota of such information as regards Manchester; and, perhaps, at no period in the existence of the town has there been greater scope for instructive observation and remark than at the present time. Increasing prosperity in trade, and a general improvement in the prospects of the commercial world, have not been without their influence upon building enterprise; and in proof of this we need only glance at the magnificent ranges of warehouses, factories, and shops, in Manchester, and the gentlemens' residences in the suburbs. At the same time it is cheering to notice that more attention is being paid to the spiritual and educational wants of the vast population, and that churches, chapels, and schools, are rising rapidly.

The committee of the Manchester Exchange have for some time past been determined to enlarge the present Exchange, in order to afford the accommodation so long required; Mr. A. W. Mills has prepared plans and specifications of an alteration, which will allow double the space for the use of the subscribers, as compared with that available at present, and arrangements are already completed relative to the purchase of the property required. The present room will be extended westward to St. Anne's-square, and on each side of the extension will be rows of shops, the one towards Exchange-street, and the other towards Ducie-place; these shops with rooms above, and the cellars below the large room, will be let. At the front, towards St. Anne's-square, will be a Grecian Doric portico of noble proportions. The building being about 100 feet wide, and the portico but 70 feet, the difference in width will be occupied by circular corners on each side, with Doric columns in antis; these circular corners will contain staircases to the rooms above. Rising to a considerable elevation above the building will be two towers to light the staircases and to ventilate the building. The whole will be contained under one entablature, and when completed will present a noble and elegant appearance, and will be worthy of the importance of the town in the the world of commerce.

The new Borough Gaol is to be erected on a site of 18 acres of land, situated on the Hyde-road, about two miles from the Exchange. The designs have been prepared by Mr. G. Eldiott, of London, and have been approved of and signed by Sir James Graham. In the general plan and arrangements, advantage has been taken of all the improvements which have been introduced of late years at Pentonville and other places. The buildings generally are intended to be of brick, but the whole of the entrance front and the boundary walls along the main road will be faced with stone. The style of architecture of the exterior will be Italian, and it is understood that considerable architectural effect will be aimed at and obtained. The prison will be in three buildings for males, for females, and for juvenile offenders, each in plan resembling a letter T, and having a central inspection hall where the lines of buildings meet, so that the superintent may view all that occurs in the three avenues, without leaving his central position. There will be 300 separate cells for males, 80 for juveniles, and 120 for females. The bricks are now being made on the ground, and it is expected that the contracts will be taken immediately.

The new Theatre Royal in Peter-street is now nearly finished, and the opening is advertised to take place on the evening of September 29th. The principal front is of stone, and consists of a central recessed compartment having three entrance doorways, and with two Corinthian columns in antis. There are projecting wings on each side, with pilasters at the corners opposite the columns; the recessed part will also have similar pilasters matching the columns, and over the centre doorway will be a niche to contain a bust of Shakspeare. A pediment will surmount the whole, the apex of which will be 70 feet above the street. The interior is admirably fitted up, and the decorations are now being done in the Italian style of the 16th century. The whole will be highly creditable to Messrs. Irwin and Chester, the architects, and to all concerned.

Warehouses.

An extraordinary energy is at this time displayed in the erection of warehouses in Manchester, and some of these buildings are of such a character and magnitude, that they cannot be passed over without mention. A large warehouse is now near completion in Church-street, belonging to Messrs. J. and N. Phillips and Co., of which Mr. Whittaker is the architect. This warehouse adjoins one erected some years since by the firm, and the front of the two forms one design. The building is four storeys high, exclusive of cellar: the main front is faced with stone as high as the second floor, where is a dentelled stone cornice running the whole length. The upper part is of stock brick, with a stone cornice and parapet over all. The windows have stone sills, and moulded frames and cornices. The floors are of the construction commonly called fireproof, *i. e.*, having iron beams connected to each other by tie rods, with brick arches springing between them. The inequalities above the arches are filled in level, and a floor formed above. The new part has one room to each story, about the centre of which are three large openings (to each floor), for giving light from the skylight, around which openings will be counters for exhibiting the goods upon. This arrangement suits the requirements of the trade; but in case of a fire it is objectionable, as the openings would allow the fire to spread rapidly to every room. The stock and wood work alone, however, could be burnt, as the brick arches and iron beams could receive little or no injury.

A large warehouse of stock brick with handsome stone dressings, in the Italian style, has just been erected in George Street, for Messrs. Leo Schuster & Co., by Messrs. Pauline and Heufrey, from designs by Messrs. Holden, architects.

Mr. Walters is the architect of the warehouse in the same street, belonging to Messrs. Salis Schwabe & Co., which is now finishing with the entire front of stone ashlar backed up with brick, in the Roman style.

Mr. S. D. Darbishire has had two large piles of warehouses built in George-street and York-street, which are plain substantial-looking brick erections, more remarkable for their size than for architectural proportion.

Messrs. Bannerman, who own the very handsome pile of brick warehouses, on the opposite side of York-street to those last mentioned, have gone to great expense in removing the former wooden cornice, and replacing it with an admirably proportioned one of stone, in order to escape the additional rate of insurance. In several of the warehouses (four of those last-mentioned) a new description of internal hoist is introduced, so constructed as to remove the danger in case of fire which attends those hitherto used.

At some of the late fires, the rapidity and extent of the combustion were attributed mainly to the communication afforded by the hoist holes: the wooden doors being soon burnt through, and a draught upwards established, which speedily carried the flame to every room. The new plan consists of a peculiar arrangement of wrought iron doors to each story, with an ingenious contrivance, by which the shutting of the doors is made to depend upon the using of the cradle. The extra rate of insurance on a warehouse having the ordinary wooden doors to the hoist hole is five shillings per cent., which, with the new plan, is reduced to two shillings.

A splendid warehouse is to be built at the top of King-street, for Messrs. Ashton. Messrs. Holden are the architects, and the contracts have been taken by Mr. David Bellhouse. The ground is now being cleared for commencement. The last-mentioned architect and builder are now engaged in providing a noble suite of offices for the Manchester and Leeds Railway Company at Hunt's Bank.

Church Architecture.

It is gratifying to be able to adduce instances of improving taste in church architecture, and I am glad to have an opportunity of noticing three new churches now erecting, which will be ornaments to the neighbourhood, and which are evidences of an appreciation of the chaste and beautiful in ecclesiastical architecture. An elegant structure is being built at Birch, dedicated to St. James, towards the expense of which Mr. Anson has given £200, and land for the site of the church and a churchyard; the Rev. G. Anson, the munificent sum of £2000; and a grant has been made by the Manchester and Eccles Church Building Society of £500. The design is by Mr. Derick of Oxford, and is in the early English style of architecture, that which prevailed about the middle of the thirteenth century. The church will consist of nave with lofty Clarestory aisles and chancel with sedilia, and priests' entrance from the south, and vestry and organ chapel at the north. A square tower, and octagonal spire above, will rise at the western end of the south aisle. The roof will be of open timber, and the internal arrangements will be in keeping with the architectural style. At the west end will be a large double window, surmounted by a quatrefoil, on the sides will be double windows alternating with the buttresses, and at the east end will be a large triplet window, with detached shaft inside the tympanum, filled in with a rose widow of twelve divisions. The church will accommodate 700 persons, and 400 of the sittings will be free. The estimated cost, exclusive of the spire is £35000.

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* This admirable letter is a very gratifying proof that our appeal to subscribers to furnish local information has not been fruitless. The style of this letter abundantly proves that the writer is thoroughly versed in the principles of architecture, and in the spirit of a true friend to it, wishes to see its advancement duly recorded.—Ed.

St. John's Church at Longsight is building from designs and under direction of Mr. Gregan. It will be in the early English style, without much minute ornament. A square tower, strengthened by massive buttresses, and surmounted by an octagonal spire with ornamental lights, is situated at the south-west corner of the building, within the square line of plan. The windows in side aisles, clerestory, and sides of chancel, are generally double lancet headed, with some single trefoil headed. At the east end are three windows, lancet-headed, the centre one the longest, having a continuous label over all. There will be an elegant south porch, and a font to the right on entering the church. The chancel will be spacious, and will have sedilia, &c.; the pulpit and reading desk will be situated on each side of the chancel arch.

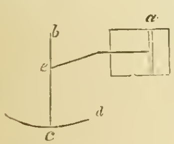
Another church, dedicated to St. Simon, situated in Springfield-lane, Salford, is progressing rapidly. It is being erected from the designs, and under the superintendence of Mr. R. Lane, architect, whose object seems to have been, the designing of an edifice, which shall be in conformity with ancient principles of architecture, and yet be within the limits of outlay to which he was confined. The style is that of the period of the transition from Early English to Decorated, to which date belong some of the most beautiful of our ecclesiastical erections. The principal feature of the design will be a tower of massive construction, with octagonal spire, rising to the height of 150 feet. The chancel will be groined, and will have three windows towards the east. At the ends of the transepts will be three-lighted windows, with quatrefoil tracery. The body of the church will have two-lighted equilateral-arched trefoil windows in the aisles, and cusped windows in the clerestory; and there will be a three-lighted window over the western door. The font will be placed as directed by the canon, near the south porch, and there will be no pews.

Mr. Lane is also the architect of the independent chapel which is building at a little distance from the church just mentioned. It is in the decorated English style. The principal front will have a rich window of flowing tracery, with a crocketted head moulding over it, and beneath the window will be the entrance doorway, which will be approached by a flight of steps. This front will be divided by canopied buttresses, surmounted by carved and crocketted pinacles, into three compartments. The construction of the principal supports of the roof are cast iron is peculiar to this building. At the usual distance of the principals of a roof, iron columns will be built in the side walls, from the top of which will spring large iron segments, firmly bolted together, in the form of a Gothic arch. By the adoption of this plan, heavy timbering is dispensed with, and the height to peak of roof is available. Time will not permit me to notice other buildings at present, so I conclude, subscribing myself,

Yours most truly,
A. B.

ON THE MOTION OF LOCOMOTIVE ENGINES.

Sir,—Suppose the annexed represents the lines of a piston rod, connecting rod, and crank of a locomotive engine, if the steam were acting on the piston *a*, in the direction *b a*, we know from experience the wheel turns in the direction *c d*, and the engine proceeds in the direction *a b*. Considering, however, the rail as a fulcrum, and *b c* as a lever, it is well known any force acting at *e* in the direction *b a* would cause the lever to turn on the fulcrum *c*, and move the extremity *b* towards *a*, just the reverse of the fact in the case of a locomotive. How is this? The steam acting on the piston *a* causes an equal reaction on the cylinder cover, which transferred along the body of the engine acts on the centre of the wheel *b*, and having a greater leverage than the direct pull of the piston, the one acting at *c* and the other at *b*, causes the wheel to turn on *c*, moving the centre in the direction from *a* to *b*, thus the motion of a locomotive, which at first sight seems contrary to known law, is very easily reconciled to them. If the crank be vertically above the centre *b*, the steam acting on the piston in the direction *b a*, the direct pull of the piston is then the preponderating cause of motion, its leverage from the fulcrum *c* being greater than the leverage of the reaction. Thus, in certain positions of the crank in its revolution, the engine is propelled by the preponderating effect of the reaction over the direct influence of the piston, while in other positions the direct effect of the piston urges the engine forward. I shall not now further trespass on your valuable space, but if you are willing at some future period I may point out the practical consequences of a right view of these facts.

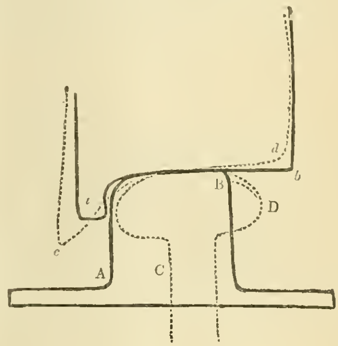


I remain, Sir, your obedient servant,
J. G. S.

*** Our correspondent does not seem to state the action of a locomotive engine quite correctly. It is clear that the action of the steam is to turn the crank (and therefore the driving-wheel) constantly in one direction. The engine gives motion to the train by means of the friction of this wheel and the rail; for it is clear that if the rail were *quite* smooth the train would not be moved. The friction of the wheel and rail arises from minute protuberances or serrations on their surfaces, and the action is therefore analogous to that of the cogs of the rack and pinion. The rail corresponds to the rack, and the reaction exerted by its serrations or cogs is always in the forward direction.—Ed.

THE ACCIDENTS ON THE EASTERN COUNTIES' RAILWAY.

(From the Railway Record.)



A B, Great Western rail.
C D, Eastern Counties' rail.
a b, flange suited for Great Western rail.
c d, flange used for Eastern Counties.

We call attention to the explanations given by Mr. Bidder, at the meeting of the Norfolk Railway Company yesterday, as to the *cause* of the late accidents on the Eastern Counties' line.* These explanations, and the statement made by Mr. Peto, appear to set the question at rest.

The engines referred to were made by Messrs. Slaughter and Stodhert of Bristol. The following rough sketch (not to scale) will show the difference between the rails of the Great Western and Eastern Counties' lines.

The dark lines represent Messrs. Slaughter and Stodhert's wheel and the Great Western rails, and the dotted lines exhibit the Eastern Counties' pattern. Now if any joint were "out," even a quarter of an inch, it would mount, and cutting the rails, like shears, the engine would run off; whereas the bevelled flange instead of mounting and cutting, would *press* against the side, and the engine would pass in perfect sefety.

As stated at the meeting, the engines have been taken off the line, and we understand that the makers will substitute other wheels *at their own cost.*

BUILDINGS IN EDINBURGH.

Sir,—I notice in the August number of your excellent Journal, page 258, a short account of the new buildings lately finished or at present building here, but you complain that the architects' names are not given by the newspaper from which you have extracted the notice.

I beg to supply that deficiency with regard to most of them.

1. *Sir Walter Scott's Monument* was designed by the late lamented Mr. C. M. Kemp, who was accidentally drowned during the erection of the monument.

* It appears that two engines were built with the flanges of their wheels of a shape suited to the Great Western rails, whereas an altogether different form is required for the Eastern Counties' Railway.

2. *The Victoria or Assembly Hall*, Castle Hill, was designed by JAMES GILLESPIE GRAHAM, Esq., Architect.

3. *The Debtors' Prison*, on the Calton Hill, by T. BROWN, Esq., Superintendent of Public Works, Edinburgh.

4. *The Physicians' Hall*, Queen Street, by THOMAS HAMILTON, Esq., Architect, and the three colossal figures of Hygeia, Esculapius Hippocrates in front of it were sculptured by ALEXANDER RITCHIE, Esq.

5. *The Commercial Bank*, in George Street, by DAVID RHIND, Esq., Architect, and the sculptures in the pediment are cutting by ALEXANDER RITCHIE, Esq.

6. *Donaldson's Hospital*, to the west of the City, by W. H. PLAYFAIR, Esq., Architect.

7. *Heriot's School*, Rose Street, is understood to be by ALEXANDER BLACK, Esq., Architect.

I am, Sir, your's truly,
JAMES TOD, *Secretary*,
Royal Scottish Society of Arts.

*** We have to return our best thanks for this letter, and will not lose this or any other opportunity of urging upon our readers how much they increase the value to themselves of this Journal by contributing LOCAL information. We have no lack of letters propounding theories, but there is sad dearth of those which contribute facts.

MECHANICAL PROPERTIES OF AIR AND STEAM.

We are gratified to find that we have succeeded in calling attention to the loss of power in atmospheric traction by preliminary exhaustion. The following letters suggest that the loss may be avoided by the use of double-acting pumps. We think that by this means the loss is diminished, though to what extent can only be ascertained by a separate investigation, which, as the method of double-acting pumps is that actually employed in practice, we will endeavour to give next month.

SIR,—As there seems to be much in the article signed H. C. on the Properties of Air as applied to the Atmospheric Railway, which is calculated to mislead those who are not in the habit of judging for themselves, but take everything for granted which appears in a Journal like that of the "Civil Engineer," I thought it would not be amiss to make a few remarks upon it. I will leave all that part of it which views it historically, and attempts to draw a parallel between the modern atmospheric railway and the contrivance of Papin, which as a means of conveying motive power to distant places could scarcely be equalled for absurdity.

The writer next attempts to prove that the partial exhaustion of the pipe before the starting of the train contributes nothing to its motion, and that is where the writer is so greatly in error, which to prove I will suppose that the previous exhaustion has reduced the air in the pipe to a pressure of five pounds on the inch, and that the cylinder of the pump is of the same diameter as the long pipe in which the travelling piston moves, and that the pump piston moves with the same velocity as the train; then, as the pump piston is working against a pressure of fifteen with five in its favour, the difference being ten for the power required to work the pump, and the travelling piston is moving against a pressure of five with fifteen in its favour, the difference giving a tractive force of ten, there will be that equality between the prime mover and the effect produced which the writer contends for, but if he would only consider, he might see that when the pump piston has finished its stroke the air within the pump cylinder has a pressure of only five pounds to the inch, and consequently the pump piston has a pressure on its underside of only five pounds to the inch, while its upper side has a pressure of fifteen, the difference being ten, which would diminish to seven and a half when it had made a third of its backward stroke, to five when it had made half, and to nothing when it had made two-thirds, the air within the cylinder being then at a pressure of fifteen. And that it would not require any "omnipotent Act of Parliament" or "great monied interest," and but a small share of the "mechanical genius" of the country to avail ourselves of that pressure and to apply it either in working a double pump, each cylinder of which would thus alternately assist the other, or in communicating motion to a fly wheel which in its turn would give back the power (except what was lost by friction and other mechanical defects) in assisting the pump in its next stroke. And therefore it follows that if this pressure be applied that equality which the writer contends for is destroyed, and that the preliminary exhaustion either does or may be made to contribute to the motion of the train.

A WORKING MECHANIC.

Newcastle-upon-Tyne,
July 28, 1845.

*** If our correspondent be a working mechanic, in the ordinary acceptation of the phrase, his letter does him great credit indeed. He will find the cases of the double-pump and of the pump working with a fly-wheel fully discussed in the next number of this work, in the Notes on the Philosophy of Engineering. We have received another able letter on the same subject, but as the first part of it is almost identical with the preceding, the writer will, we trust, excuse the omission of it. The following passages on the effect of steam used expansively put forth views which are for the most part correct enough, and which certainly have not been controverted in this work. The writer is not, however, quite justified in assuming that if the steam be cut off at the ¼ stroke the consumption would be reduced to one quarter, as he may see by turning to the paper on the Lead of the Slide. He will perhaps have the goodness to read that article carefully, and if he have any difficulties on the subject to write again.

. . . . The writer next speaks of your previous correspondent's distinction between the "mechanical effect of steam" and the power of a steam engine in relation to Cornish (or expansion) engines, wherein, as your correspondent says, "you may increase the mechanical effect of a certain weight of steam by the very same operation that diminishes the power of the engine," and the writer does not "know what private interpretation your correspondent gives to the term "mechanical effect."

Allow me to say how I understand the matter. A given weight of steam at a given temperature is capable, in the act of expansion, of exerting a certain amount of mechanical power; and as much of this power as is, in any case, rendered available to our purposes, is termed the "mechanical effect" of this quantity of steam, for while no engine whatever collects anything near the *whole* of the power possessed by the steam, one engine may and does collect a much larger fraction of this power than does another; nay, the *same engine* being used expansively will collect much more of the power of a given quantity of steam than it would otherwise collect. In illustration, suppose a certain steam engine has 100 h. p. while used *un*expansively, and of course consuming a full cylinder of steam at each stroke of the piston, whether upward or downward, now let the same engine be used expansively by cutting off the steam at ¼ stroke, the consumption of steam would evidently fall to one quarter only of the former quantity, while the power of the engine would probably not fall below that of 60 horses. If this be correct, it follows that, the introduction, so far, of the expansion plan, as compared with the non-expansion plan, utilises, as the French say, more of the theoretic power of the steam, and this in the proportion of 60 to 25, and, *other things equal*, is in that proportion more economical, for 25 per cent. of the former quantity of steam is thereby made to yield 60 per cent. of the former quantity of power. Also, "the mechanical effect of a given quantity of steam is increased by means which diminish the power of the particular engine," because while the engine makes much better use of what steam it does consume, the quantity of steam which it will receive is disproportionately small. From this it follows that the highly economical use of the steam requires a steam engine large in comparison with the power obtained, so that it is always a practical question whether to submit on the one hand to a large original outlay in the construction of the steam engine, or on the other hand to a wasteful consumption of coals.

E. H.

NEW BUILDINGS IN LINCOLN'S INN.

(From the *Athenæum*.)

In addition to its own intrinsic merit, the new structure, containing Hall and Library, is so happily situated as to form one of the most conspicuously placed architectural objects in the metropolis; one that shows itself advantageously from every point of view, and from whose windows a most enviable *rus-in-urbe* prospect may be enjoyed of 'trim garden,' bounded by the handsome range of Stone Buildings on one side and of the park-like enclosure of Lincoln's Inn Fields on the other. What adds not a little to its nobleness of appearance is, that the new building stands upon a raised terrace; which is attended with this further advantage, that the basement floor is sunk only a very few feet lower than the general level of the ground; and what shows itself externally as a basement for the offices is a low ground floor, or mezzanine, between them and the Hall and other upper rooms. So well is the building laid out, that although regular and even symmetrical in plan in the direction of its length, the exterior is marked by great variety of outline, at the same time free from any little finical tricks of the picturesque; it being thrown into well contrasted and well balanced masses, as is naturally dictated by the disposition of the principal parts of the interior. We have here that kind of grouping which is one distinctive characteristic of the style itself—at least of the class of buildings which afford the best examples of the style, namely, collegiate ones. Mr. Barry would probably have treated the subject differently—would have shown us *singleness* of composition in one continuous line of building from end to end, with very little external articulation of the plan; nor do we pretend to say that such treatment would have been unsuccessful in his hands. Still we are well content with what we here behold; and are of opinion that the placing the Library transversely to, instead of in continuation of, the main line of building, is highly favourable, not only occasioning a certain piquantness of ensemble, but also giving the extent in regard to depth. From this circumstance the building acquires considerable importance as seen obliquely in a north-west view of it, which satisfies us better than that of the other end, although the latter is evidently marked out as the principal one. For our own part, however, we cannot help feeling that what is there intended for a handsome architectural accessory and a completing feature in the general design, is the poorest part of all—nay, quite unworthy of the rest. We allude to the entrance gateway at the south-west angle, or rather what ought to be a gateway, and therefore disappoints when, on being approached, it is found to be a mere arched opening through a wall, instead of a gate-house forming a covered passage. In one sense of the term it may be called scenic, for it smacks strongly of the theatre, being like a pasteboard arch upon the stage; nor is this its only defect, as besides having a flimsy look, it is otherwise poor in design and rather insignificant in appearance. Fortunately, the mistake is one that easily admits of correction, little more being required to be done than now to add a gate-house to the gateway; and were it to be one of considerable depth, it might be attended with the further good effect of somewhat screening and breaking the now too blank-looking lower part of the end of the Hall, beneath the great south window.

After this brief interruption of it, we may resume our tone of commendation, though we cannot stop to particularize the various merits of the exterior, but conduct our readers within the building. We say conduct; because instead of rushing at once into the Hall, we wish to lead them into it by that line of approach which presents a striking and well-combined succession of architectural parts, all increasing in importance, and terminating in an impressive climax. There are two entrances to the building from the terrace on the east side; which, however, do not communicate with the ground or terrace-floor, but lead immediately to the upper one by means of broad flights of steps; consequently, no internal staircase is required—that is, no principal or state staircase, for others there are of course, and one of them will come in for notice presently. Taking the northernmost of the two entrances, or that appropriated for the benchers, after passing through a handsome porch, we advance up a vestibule or short corridor, which brings us to one end (that next the Library) of an inner vestibule or central hall, which connects the other chief apartments with the great Dining-hall. This part of the interior is striking—far more so than it would be were it entered immediately from the porch, or were it so placed as to be in a line with that and the first vestibule. It does not disclose itself to view until actually entered, when it bursts upon the eye with brilliant effect, at the same time that it is sufficiently spacious for its purpose)being 22 feet by 58). There is no pretence or obtrusiveness about it, as is too frequently the case in the entrance-halls of large buildings; yet, although for the greater part sober in character, it is not a little piquant in arrangement, and in the combined result of *plan* and *section*. The first of these is laid out in three divisions, the middle one of which is a square (of 22 feet), divided from the north and south ends by three open arches on pillars; and the angles of this square compartment of the plan are cut off by four other arches, converting it into an octagon; over which is carried up a clerestory lantern of the same form and diameter, having a window ornamented with painted glass on each of its sides. The combination and transition of forms, and the effect of the stream of light from above, tinging with flickering hues the pale walls and pillars, render this a singularly pleasing architectural picture. The ribs of the vaulting of the octagon are partly relieved by gilding, and have gilded bosses at their intersections. The lower part, however, is by no means so satisfactory as the upper, the pillars and arches being somewhat tame in character, and reminiscent of "James Wyatt" Gothic. One novelty, which must not pass unnoticed, is, that in the ceiling, the soffits of the spandrel spaces cut off by the octagon are left open as triangular skylights, consisting of a single plate of glass, in order to throw down light directly upon corresponding spaces in the floor, which are *paved* with thick *glass slabs*, and thereby serve in turn to admit light into the vestibule beneath, on the lower floor; and to their answering that purpose we can speak with some confidence, for we found that lower vestibule, which would else be nearly dark, better lighted than is usual with places of the kind. Well satisfied as we are, upon the whole, with the principal vestibule, we think it would have been an improvement had the octagon form been defined upon the floor beneath the lantern, by a border of a different colour from the rest of the pavement (which is entirely white), between the pillars. We conceive, too, that it would have been a further improvement if, of the three open arches from either end, the two narrower side ones had been closed up below to the height of between five and six feet by open-work screens; whereby that central division of the plan would have been in a manner marked out as being *en suite* with the Drawing-room, on the west side of it, and the Council-room, on the opposite one. While the passage across from the one to the other would thus have been less exposed, that from end to end, and the vista from the Library to the Great Hall would have been just the same; and instead of seeming at all to confine or interrupt space, low screens of the kind suggested would have tended to fill up what now strikes too much as blankness in the lower part of the walls. Few architects seem to understand or care for the effect to be produced by partial concealment, or to agree with the poet, that "half the art is skilfully to hide." At the south-west angle of this vestibule is an open recess or bay, lighted by a lofty handsome window, and forming the upper part of a staircase to the lower floor, which is carried down between a massive and solid square newel. This newel forms a pedestal to the parapet of the staircase, which is also solid; and the hand-rail is cut out of the wall, with a deep and boldly moulded hollow. The whole of this staircase bay is an excellent taste—perfectly simple and charmingly effective Few, however, will linger to examine it, but eagerly pass on into the Great Hall—lucky if their eagerness does not trip them up, by causing them to overlook a very awkward step at the entrance to it.

The folding doors from the vestibule open upon the dais at the north end of the Hall; and the *coup d'œil* which here presents itself may challenge that afforded by any other apartment of the kind, although, in its dimensions, this noble banquetting-room falls short of the one at Christ's Hospital.* It is in every other respect greatly its superior,—very much so both in actual loftiness and in loftiness of proportion. In spaciousness, it rather exceeds the largest of the collegiate halls at the Universities; and though it cannot boast of the same extent as to length, it altogether eclipses St. George's Hall, in Windsor Castle, which, to say the truth, answers more to the character of a gallery than a hall, and is besides neither in the most correct taste nor of the most dignified character. The noble oak timber roof, designed on the principle of that at Westminster Hall, gives to this new hall of Lincoln's Inn an air of magnificence that is well kept up in other respects, and to which the windows conduce in no small degree. There are five windows on each side, exclusive of that in the oriel or bay at each end of the dais, and of the large window at the south end, above the screen and gallery over it; and in their upper half, all these windows consist almost entirely of stained glass, displaying various armorial bearings and similar devices. The pendants, and some other parts of the roof, are also emblazoned or picked out in colours and gilding; which being the case, we think that some decoration of the kind, however subdued in degree, ought to have been extended to the screen and gallery. The front of this last is, to us, the most questionable, not to say the most unsatisfactory feature of all. In style, it hardly seems of a-piece with the rest; and the low and wide open arches into which it is divided show, to our eyes, little better than so many vacant gaps—too much like a row of boxes in a theatre.

The passage behind the screen, whose openings are filled with plate glass, forms the common entrance into the Hall from the south porch on the east side of the building; at the other end of this passage is the staircase leading from the kitchen. Although not belonging to the "show" apartments of the edifice, this last is worth being visited, it being a spacious vaulted room, whose ceiling is supported on massive pillars and bold arches, after the manner of a crypt; and it is about twenty feet in height, it being carried from the basement through the terrace-floor story. Hardly need we say that it is fitted up with every imaginable convenience, and with every improvement in culinary apparatus. Yet, as if this were not sufficient, there is another kitchen on the terrace-floor, at the other end of the building, adjoining the sub-vestibule, which, we suppose, is to be devoted to the preparation of the more *recherché* dishes for the tables on the dais.

As yet we have mentioned the Drawing-room and Council-room only *en passant*; nor can we now say much, since they offer so very little for description that we have only to express our admiration of them for their noble proportions and dignified simplicity, and for that sort of charm which, however it may be felt, can hardly be expressed in words. Yet one circumstance there is which deserves to be noted, viz. that the ceilings, which are ribbed and panelled, are of deal, unpainted, but stained, and then varnished, so as rival, in depth of tone and beauty of appearance, many of the richest woods.† Both these rooms are now not only finished, but furnished. The Library, on the contrary, is as yet only in a state of progress, and by no means so far advanced as to enable us to judge of it satisfactorily. In its dimensions, it will certainly be a very noble apartment, 80 feet in length from east to west, by 40 in breadth, and 35 high The breadth will be contracted on the floor to about 11 feet, the book-cases being brought out at right angles to the walls, so as to form seven recesses on each side, thus converting the room into a gallery 80 feet by 18 in the clear, terminating at each extremity in a lofty oriel of the same width, and forming three sides of an octagon. These two oriels are of admirable design; their enriched soffits, pillar shafts, and mouldings, all in superior style, and the windows themselves magnificent. The pattern of the glazing in the lower part of the windows, which are filled in with small circular panes, is of pleasing effect, and the glass being slightly embossed or moulded, a sort of flickering brilliancy is produced that is exceedingly agreeable to the eye, partaking, as it does, rather of soberness than of garishness.

Having extended our remarks to such length, we shall only add, that this new structure is entitled to our astonishment as well as our admiration, for the first stone of it was laid no longer than April, 1843 The whole of it has risen up in little more than two years—just about the time which it has taken to erect the row of dwelling-houses which is to be one of the wings of the British Museum, and put up a few columns that are to form the façade of that national edifice!

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* The hall at Christ's Hospital is 187 feet by 51, and 47 high; this at Lincoln's Inn, 120 by 47 (60 feet across at the north end, along the dais), and 64 high. The respective areas in square feet are 9,537, and 5,670. The hall of the Hospital, and St. George's at Windsor, have windows only on the south side.

† We by no means agree with the apparent intention of this sentence, which seems to commend a deceptive imitation, utterly subversive of the dignity of this otherwise stately edifice.—Ed. C. E. & A. Journal.

Great Southern and Western Railway, Ireland.—The Directors of this railway have decided upon the competition designs sent in for the erection of their Dublin Terminus, and have selected those offered by Mr. Sancton Wood, of London, and the works are to be proceeded with immediately under his superintendence.

RESTORATION OF DYMCHURCH, KENT.

(From the Journal of the British Archaeological Association)

This church was no longer than five-and-twenty years since, a very pretty specimen of Norman: indeed Hasted speaks of the arch in the tower as peculiarly worthy of attention. Independently of this, the chancel arch is one of a strikingly bold character, and of very high antiquity, whilst the southern entrance was once adorned with a very chaste specimen of the same style. The first of these is of course preserved from all danger of external violence by a bountiful application of whitewash; and the latter, when the church was *enlarged and beautified*, had an erection placed in front, which the butchers and graziers facetiously pronounce an elegant porch; and only by a careful inspection can the outline of the old rounded arch, with its chevrons and chevronels. be detected The enlargement consisted in pulling down one side of the nave and extending it, so as to form a square ugly barn; the semicircular arches of the windows, springing from light columns, which erstwhile retained much of the Norman character, having been compelled to yield to the humped-backed gothic, the produce of some village carpenter; whilst the venerable Norman font was unceremoniously deposed and converted into a pig-trough, its pedestal into a stepping stone to a granary; and a marble mortar, with an inverted wooden bowl for a cover, reigned, on a garden roller placed on end, in its stead.

These abominations, thanks to the able co-operation of Mr. Elliott, quickened by the appeals of the Archaeological Association, have, I am happy to say, been, as far as practical, cleansed. Of course the church having been enlarged on the cheap conventicle principle, can never be restored to its pristine beauty; but the old font has been recovered, and the mortar returned to its ancient pestle; the whitewash has been removed from a portion of the arches, in one of which was discovered the elegant top of the thurible recently exhibited to the society. The chancel rails have been erected in the proper position, and a niche or priscina restored on the south side of the altar. Independent of this, a vestry, in strict conformity with the old building, having a plain Norman arched door leading from the chancel, has been erected, at the instance of the curate, entirely by the exertions, and in no little degree at the charge of Mr. Elliott; and when the rector shall have performed his part, by repairing the chancel, it is to be hoped the unseemly altar-piece, with its hieroglyphic, will be removed, and the small eastern window once more admit the earliest rays of the sun within the walls of the sacred edifice.

FALL OF THE RAILWAY VIADUCT AT ASHTON LAST APRIL.

From the "Manchester Guardian" of May 3, 1845, we glean the following particulars of the fall of the railway viaduct. On the Manchester and Sheffield Railway is a branch line to Stalybridge, which passes over the river Tame, near Ashton, on a viaduct of nine arches. This viaduct fell whilst between 20 and 30 workmen were upon it engaged in filling up the spandrils of the arches for the permanent way, on 19th April last, when 15 persons were killed and several others wounded. Inquests were held on the 21st of April, and an adjournment arranged to allow time to procure the evidence of disinterested scientific men as to the causes of the giving way of the arches. At the adjourned inquest, held on the 30th of April, a joint report of Mr. Samuel Holme of Liverpool, Mr. David Bellhouse and Mr. Thomas Lee of Manchester, was read and received as evidence. After giving particulars of the examination of the ruins, and as to the possibility of the cause of the accident being occasioned by the giving way of an old coal drift as inferred, the report proceeds:—

"It having been represented to us that it was possible that the accident had occurred through the sinking of some portion of the ground upon which the viaduct stood, and under which, many years ago, a coal drift had been driven, we took especial notice of the appearance of the land in the immediate vicinity of the structure. At 27 feet distant from the sixth pier of the viaduct is a mill of 4 stories high, the gable wall standing in line with the end of the pier. This gable has been built at two periods, one portion of it being of stone and the other of brick, and a vertical joint is visible from the bottom to the top where the junction takes place; not the slightest separation is visible in this joint. Below this pier is the goit which supplies the water-wheel of an adjoining mill; had any subsidence of the ground occurred it must necessarily have altered the level of the goit and feeder, together with the overflow weir, but they remain as before. About two years ago Mr. Lee took the sections of this land previous to the formation of the railway, and on comparing the present surface with the original survey, which will be produced, it appears that not the slightest alteration of the surface line has taken place. We are decidedly of opinion that the cause of the accident has been the collapse of one of the piers, from its improper and most inefficient construction; and we are led to this conclusion by discovering that they are wanting in all those essentials which are requisite to constitute solidity, and to resist the weight which had necessarily to be discharged upon them. The rubble stone filling together with the improper workmanship were alike unfitted for the purposes to which they were destined; and when it is known that the piers were erected with an outer shell of small ashlar stone, and that the whole of the interior was a mass of rubble and scabblings, neither bedded with care, nor flushed, nor grouted, but full of interstices, and, that in addition to all this, it does not appear (with the exception of two small stones which seem to have been inserted accidentally and not from design,) that there was a single binding course throughout any of the piers, no practical man can have any difficulty in perceiving the cause of this melancholy catastrophe. We had no means of examining any portion of the backing of the arches, except that on the abutments; but while we think that it would have been much safer to have had the backing carried much higher, or spandril walls introduced, we are not inclined to attribute the accident to this cause, although the want of more backing may have made it dangerous to ballast the arches in an irregular manner. We found that the mortar had not been made from river sand, but from sand taken out of a neighbouring bank or cutting. Specimens of the mortar were taken promiscuously from all parts of the work, and have been submitted to Mr. Davis, the eminent chemist, whose analyzation of the same will no doubt be laid before the jury. We were induced to adopt this course from observing that not the slightest adhesion had taken place between the mortar and the masonry in any one part, and that no difficulty existed in our pulling up any portion of the work by hand, with the exception of the string-course and springing-stones, as before described. Our attention was also directed to the state of the bricks which had formed the arches: these were not of good quality, and it was evident they had not been bound together by the mortar, as little or none adhered to them.

"We cannot close this painful examination without expressing our opinion that great blame has been incurred, and that the accident has happened through the inferiority both of the materials and workmanship. We refer particularly to the construction of the piers, as these were totally insufficient for sustaining the weight which had been placed vertically upon them. The pressure could only act on the exterior casing; for the interior portion did not, in the slightest degree, contribute to their strength, and would not have borne their own weight if the external casing had been removed from them. The want of binders (bond stones), also, to connect the two sides of the piers together has been a most fatal error, and, painful as it is to us, we are compelled to state, that in our opinion this accident would not have occurred had the work been executed in a proper manner.

"(Signed) "Samuel Holme,
"David Bellhouse,
"Thomas Lee."

Mr. John Davies, practical and analytical chemist, gave the following analysis of the mortar taken from the ruins.

"10, *Quay Street, Manchester, April* 30, 1845.

"Sir,—I have subjected to chemical examination, as far as I presume is necessary, and as far as my limited time would allow, several samples of mortar which you sent me for that purpose.

"The physical characters are sufficient to enable any person to estimate the inefficiency of the article. It is so extremely friable that the slightest pressure reduces it to powder, and the superabundance of sand is visible at once to either the sense of touch or that of vision. I find that a number of the samples, all of which appear to be pretty uniform in their constitution, contain 68 per cent of silica: now sand does not consist entirely of silica, and therefore of the sand a larger proportion than that obtained as silica must have been used in the manufacture of the mortar.

The quantity of caustic or real lime, is, on the average, about $8\frac{1}{2}$ per cent., which is equivalent to nearly 11 per cent. of the slacked or hydrate of that earth. The mortar contains also alumina, iron, and perhaps other ingredients, the amount and even the nature of which I have not had the opportunity of investigating, nor can they, I presume, be of importance in the present enquiry. The results may be thus expressed:—

"Silica	68	68 per cent.
"Lime	8·5	$8\frac{1}{2}$ per cent.
"Alumina, oxide of iron, &c.	23·5	$23\frac{1}{2}$ per cent.
	100	100

"Or the silica is about eight times as much as the lime, and the sand must, as above explained, have been in greater proportion.

"(Signed) "John Davies."

*** We have read the specification of the engineer, which is carefully drawn up, and if the structure had been erected according to its directions there would not have been any accident.—Ed.

PARSEY'S AIR MACHINES —

Fig. 1

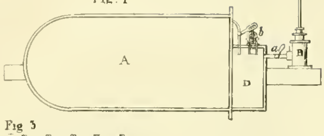


Fig 3

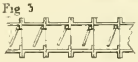
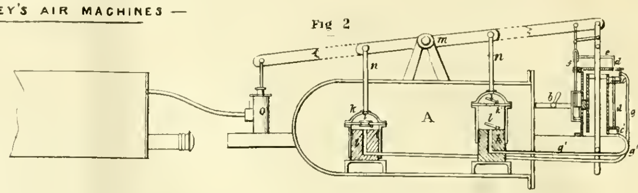


Fig 2



MURDOCKS GAS APPARATUS –

Fig. 1.

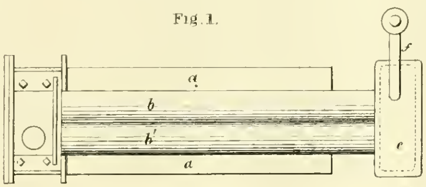


Fig 3.

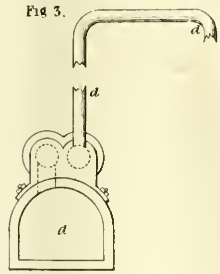


Fig 2.

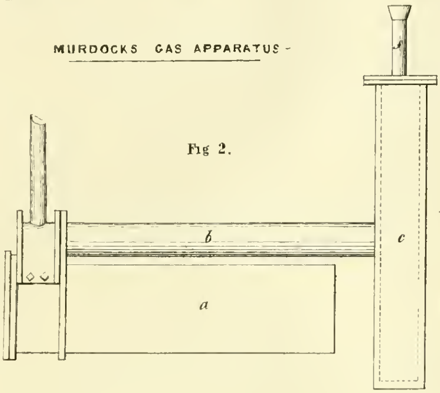
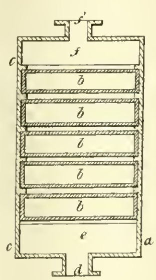


Fig. 2.



SEAWARD'S PROPELLING MACHINERY –

Fig 1.

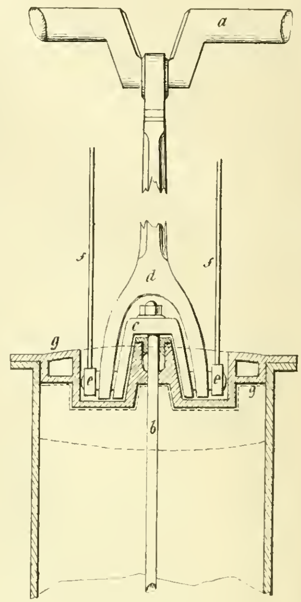


Fig 3

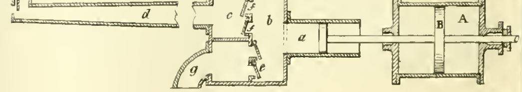
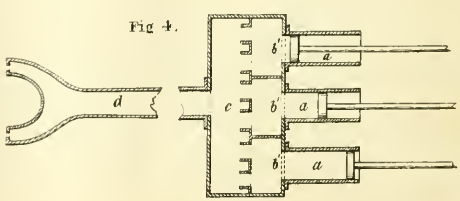


Fig 4.



MABERLY'S RAILWAY BREAK –

Fig 1.

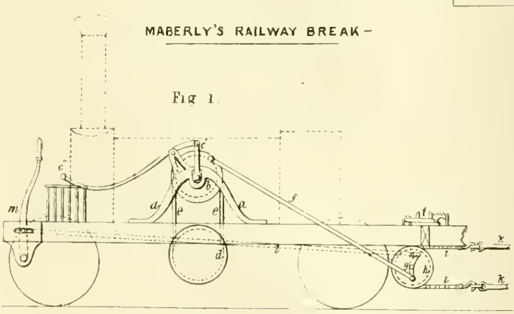
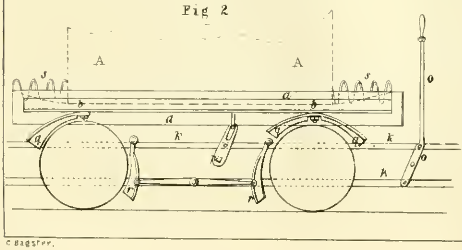


Fig 2



C Bagster.

REGISTER OF NEW PATENTS.

(Under this head are given abstracts of the specifications of all the most important patents as they are enrolled. Any additional information required as to any patent, the same may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

Benjamin Seebohm, of Horton Grange, Bradford, county of York, for "*an Improved mode of manufacturing certain description of chains.*"—Granted Dec. 4, 1844; Enrolled June 4, 1845.

This invention is for a machine or apparatus for manufacturing chains, and consists principally of two main shafts actuating certain cams and arrangements of levers for effecting the purpose. The first operation is that of heating the bar of iron to a welding heat, the bar in this state is passed into the machine and between a pair of cutters which divide it in an angular direction, so as to form a spliced or lap joint; upon one of the main shafts there are a number of cams or tappets, one of which, when the bar has been cut as above described, gives motion to an arrangement of levers which bend the piece of iron round a vertical mandril of the required form for the link, this being effected there are a pair of dies actuated by a cam fixed on the second shaft which forcibly compress the link, so as to effect the welding, this link is then by the action of the machine drawn from the mandril and a second piece of iron passed through it which undergoes the same operation as that above described, and a second link made, and so on with each succeeding link; the bar of iron being passed through the last link manufactured so as to form a continuous chain, one link being made for every revolution of the main or tappet shafts. The inventor claims the manufacture of chains by heating rods or bars of wrought iron, and then cutting them off into proper lengths and turning them with lap, spliced, or jump joints within another link and welding them.

IMPROVEMENT IN METALS.

Arthur Wall, late of Bistorn-place, but now of India-row, East India road, Middlesex, for "*Certain Improvements in the manufacture of steel, copper, and other metals.*"—Granted 18th December, 1844; Enrolled 18th June, 1845.

This invention relates to the manufacture of steel, copper, tin, and zinc. With regard to the manufacture of steel, the specification states that the bars of iron intended for conversion are to be imbedded in charcoal, or in the carbonacious substance now in general use, or they may be imbedded in a mixture of charcoal and chalk; for this purpose the inventor takes six pounds of charcoal to three pounds of chalk, and to one bushel of this mixture he adds one or two pounds of zinc filings. This mixture is to be spread in the bottom of the converting furnace or chamber, or suitable returt, and a fire made sufficient to give off the carbonic oxide, the carbonacious bed being properly laid, the steel is then to be introduced, and arranged in a convenient manner, so as to admit of a continuous stream or current of electricity to be passed through the whole range of bars under operation, which current is to be continued for the space of twelve or fourteen hours, without intermission or a longer time, if it is found necessary for the conversion. The specification is accompanied with a drawing, shewing the mode of arranging the bars in the furnace, in such manner that by connecting the ends of two bars to the opposite poles of a galvanic battery, a current of electricity will pass through the whole range of bars. In the manufacture of copper and other metals, the inventor proposes to pass a current of electricity through the same, in every possible direction, whilst the same is in a melted state, or when in the process of solidification, for which he claims the improvement in the manufacture of steel, copper, and other metals, by subjecting them, whilst in a melted state, and in the process of solidification, to the influence of electricity.

PROPELLING VESSELS.

George Spencer, of Hungerford Street, West Strand, for "*Improvements in propelling vessels on inland waters.*"—Granted Jan. 11; Enrolled July 11, 1845.

This invention relates to a peculiar mode of applying locomotive engines, or carriages combined with certain apparatus, for propelling boats or other vessels on inland waters. The principal object of this invention is to apply at one or both ends, or any other convenient part of a locomotive engine or carriage, guide wheels working either horizontally or at an angle in combination with a guide rail to prevent the locomotive being drawn off the rails when the same is applied to propelling boats on inland waters. The specification shows several modes of applying guide wheels and rails, one of which was lately patented by Mr. Prosser, a drawing and description of which will be found in the Journal for June last.

Another part of this invention relates to the construction of locomotives; the object of which is to construct them with wheels and axles capable of accommodating themselves to any description of curve. One modification consists in supporting one end of the locomotive engine by an auxiliary carriage capable of moving upon a centre pin, similar to the fore wheels of an ordinary waggon, so that the axle of the fore wheels always forms a radial line or nearly so to the curve they are passing. The specification, which shows two or three modifications of the above, and also several modes of attaching the guide wheels, claims the following when applied either to locomotive engines or to carriages used in propelling boats or other vessels on inland waters; first, the use of horizontal guide wheels generally; secondly, the use of oblique guide wheels generally; thirdly, the use of a pivot or turn plate, to enable the axles of such locomotives to assume a line radial or nearly so to the centre of the curve round which the locomotive carriages may be passing; fourthly, the use of a toothed rack fixed to the middle guide rail, in combination with a wheel attached to the driving wheel; fifthly, the application of an additional middle guide rail of wood or iron; sixthly, the application of horizontal guide wheels and frames working on pivots; seventhly, the combination of horizontal guide wheels and axle frames working on pivots; also, a mode described of causing the opposite bearing wheels of engines to run independently of each other, this is effected by keying one wheel on the end of a solid axle, and the other on the end of a hollow axle working upon the solid axle.

MACHINERY FOR PROPELLING.

John Seaward, of the Canal Iron Works, Poplar, Middlesex, engineer, for "*improvement in machinery for propelling.*"—Granted February 5; Enrolled August 51, 845.—(With *Engraving, see Plate* XXII.)

The first part of these improvements in machinery for propelling relates to that class of engines called direct-acting engines, and consist in a mode of constructing the connecting rod, or that rod which connects the piston rod to the crank, whereby such connecting rod may be increased in length without increasing the height of the engines. In order to effect this, the cross head in place of being made straight is bent in a manner shewn and hereafter described, with reference to fig. 1, which represents a front elevation of the connecting rod and cross head constructed according to this invention. *a* shews a portion of the main shaft and one of the cranks, *b* is the piston rod, and *c* the cross head, which is bent downwards, as shewn, and again bent at its lower extremities at right angles, terminating in gudgeons; *d* is the connecting rod terminating at its lower end in prongs which embrace the gudgeons or bearings formed on the ends of the cross head, which ends are continued for the purpose of receiving the brasses *e e*, which work between guides *f f*: *g* is the cylinder cover which is made with two recesses for securing the end of the cross head and connecting rod; there are also corresponding recesses formed in the piston for receiving the projections on the underside of the cylinder cover formed by the aforesaid recesses.

Seaward's part of this invention consists in a novel mode of passing the smoke and other products of the fires through the stern of the vessel, thereby dispensing with the ordinary funnel or chimney. For this purpose there are two chambers, and between them there are three or more air pumps, worked by a small engine. The smoke and other products of combustion are drawn from the fires by means of the air pumps into the first chamber, and from thence are forced by the aforesaid pumps into the second chamber, and through a pipe passing horizontally through the after hold and stern of the vessel, this pipe which is bent down a little at the tunnel, is provided with a valve opening outwards, so as to prevent the sea from rushing in as the vessel heaves. The aforesaid chambers are provided at the top with a perforated plate, through which a stream of cold water is throwing, the object of this arrangement is to cool and condense the grosser parts of the products passing from the fires. The pipe passing through the hold is surrounded by another pipe, so as to leave an annular space between them through which a stream of cold water is made to pass.

The third part of this invention is for a mode of purifying or filtering the water previous to feeding the boiler. Fig 2, shews a section of this apparatus, which consists of a square or oblong iron case *a a*, having a number of drawers or boxes *b b b*, perforated at top and bottom with a number of small holes, these boxes which are made to slide in and out of the case, as may be required, are filled with gravel, sand, flannel, sponge, or other suitable material, for clearing the water, and fastened into the case as *a a*, by means of a door or lid *c c*, bolted to the case. *d* is a pipe connected with the feed pump, the water from which is forced into the space e, found in the lower part of the case, and through the several strata of earthy matter contained in the boxes, and into the space *f*, and through the pipe *f'* into the boiler.

Fourth relates to a mode of applying pumps for forcing or ejecting the water through the stern or sides of the vessels, for the purpose of propelling the same.

Fig, 3 shews a sectional elevation of a steam-engine cylinder, and one of the force pumps; and fig. 4, a sectional plan of the arrangement of pumps, and other apparatus, the cylinders in the plan being left out. A, fig. 3 is the cylinder, and B the piston, the rod of which passes through both ends of the cylinder, one end being cemented, in the ordinary manner, to the crank, the other being connected to the piston of the force-pump, as will be clearly seen. *a a a* are three force-pumps attached to the side of a vessel *b*, fig. 3, this vessel is divided longitudinally into two compartments, *b* and *c*. The compartment *b* is again divided transversely into three compartments *b' b' b'*, so as to form a separate compartment to each pump-barrel. *e* and *f* are inlet and outlet valves for the water which passes through the induction pipe *g* into the compartment *b*, and from thence into the compartment *c*, and through the eduction pipe *d*, which terminates in two prongs or forks, so as to eject a stream of water through the stern of the vessel on each side of the rudder. The apertures at the termination of this pipe are provided with sliding valves, shewn at fig. 3, for the purpose of increasing or diminishing the size of the opening as may be required.

The fifth part of this invention relates to a mode of counterpoising the slide-valves and other parts of engines requiring a counterpoise. This part of the invention is effected as follows. To the weigh-shaft which works the slide-valves there is an additional lever, connected by a pair of slings to the piston-rod of a small cylinder. This cylinder is connected by means of a pipe having a three-way cock, with the condenser of the engine. The action of this arrangement of parts is as follows: when the counterpoise or balance for the slides is required, a communication is formed, by means of the three-way cock, with the aforesaid cylinder and the condenser, a partial vacuum being thus formed in the cylinder, a force equivalent thereto will be exerted on the piston, which force will be transmitted to the weigh-shafts, and thus act as a counterbalance to the slide-valves; the force may be discontinued or cut off, by giving the cock a quarter turn, so as to form a communication with the atmosphere and the cylinder. Where condensers are not employed, the inventor proposes to use the elastic force of steam.

IMPROVED RAILWAY BREAK.

Frederick Hebert Maberly, of Stowmarket, in the county of Suffolk, clerk, M. A. for "*Certain Improvements in machinery or the apparatus for stopping or retarding railway or other carriages applicable also for these purposes in regard to other engines or wheels.*"—Granted February 10; August 9, 1845.

The mode of working and applying breaks to railway and other carriages, for the purpose of stopping or retarding the same, is as follows: Fig. 1, shews an elevation of an engine, with the apparatus for working the breaks of a train, in the following manner; *a a* is a frame, fixed on the framing of the engine, *b* is a grooved or flanged pulley, supported by and moving in a slot formed in the frame *a*! this pulley is capable of being raised or lowered by means of a lever *c*, extending to the front of the engine and slings *c'*, upon the axle of the driving wheel is fixed another grooved or flanged pulley *d*, *e e* is a chain, or friction band, passing round the pulleys *b* and *d*; *f* is a rod, one end of which is connected to the pulley *b*, the other end being connected to a short lever fixed upon a shaft *g*; upon the middle of the shaft, which extends across the angine, is fixed a flanged pulley *h*, to the periphery of which is attached the ends of two chains *i i*; the extreme ends of these chains are attached to rods *k k*, these rods, which are connected to similar rods passing underneath each carriage, one above and the other below the several axles, give motion or put into action the whole of the breaks of the train simultaneously, in a manner hereinafter described. L is the guard rails, which, in the drawings of the specification, are unfortunately placed at the wrong end of the engine, the engineer being supposed, or rather shewn, as standing behind the smoke-box, instead of in front of the fire-box, so that in practice the guard rails, together with the arrangement of levers, ought to be shewn at the opposite end of the engine. *l l* is a rod, shown in dotted lines, one end of this rod being attached to the lever *m*, the other end being attached to a short lever *n*, fixed upon the shaft *g*. To the other end of the lever *c* is fixed a "spring," *c''*, for the purpose of keeping such lever in any required position. It will, therefore, be seen, that by depressing the end of the lever *c*, the pulley *b* will be raised, and will thereby receive motion from the wheel *d*, by means of the friction-band *e e*; this motion will, by means of the rod *f*, be imparted to the wheel *h*, and also to the chains *i i* and rods *k k*, in one direction or the other, depending on the motion of the driving-wheels. In fig. 2, *a a* shews the frame of the carriage, to the side of which is attached a sliding-bar *b b*, which receives a certain amount of motion from the rods *k k* above described, by means of a lever moving on an axis at *p*. To the under side of the sliding-bar *b b* are attached breaks *q q*, one or other of which are brought to bear against the wheels by the sliding of the bar *b b*. The specification shews several other modes of applying and bringing the breaks into action simultaneously, by means of the rods *k k*, the mechanical action of which we cannot say much for. *o o* is a lever attached to the rods *k k*, intended to be worked by the breaksman. The inventor very properly states that this lever may be worked by a screw to give it additional power. Another part of this invention, which consists in making the body of the carriage detached from the framing of such carriage. In fig. 2, A A represents the body of the carriage, which fits in a recess formed in the side framings of the body of the carriage, being held in its proper position by spiral springs *s s* upon the framing; and at each end of the body of the carriage there are inclined planes, shewn in dotted lines, the object of this arrangement being to prevent accidents by concussion or the sudden stopping of the train.

With regard to fig. 1, the specification states that the friction-band *e e* may pass direct from the pulley *d* to a pulley fixed upon the shaft *g*. *t* shews a mode of attaching the carriages by means of links, but the inventor prefers a ball and socket joint. He also proposes to have a flexible tube for the use of the engineer and breaksman to converse through, together with an apron attached to the sides of the carriage, for the purpose of catching any person or thing falling from the train.

MANUFACTURE OF GAS.

James Murdock, of Staple-inn, county of Middlesex, for "*Certain Improvements in the manufacture of gas, and in the apparatus employed therein.*"—Granted February 12; Enrolled August 12, 1845.

We have given three views, shewing the mode of arranging the retorts according to this invention. Fig. 1 being a plan, fig. 2 a side elevation, and fig. 3 a front end view of the retort, the brickwork being omitted. *a a* is an ordinary D retort for distilling the coal. Above this retort, and parallel with it, are two purifying tubes or retorts *b b'*, each having a spiral piece of iron within them, and communicating at one end with the neck of the retort *a*, and at the other end with a retort *c*, which latter is placed at the extreme end of the others, and in a vertical position; this retort, which is to be nearly filled with coke or charcoal, is intended to decompose water, as will be hereafter described. The gas, as it is formed, passes from the retort *a* through an opening, shewn in dotted lines, fig. 1, into the purifying retort *b*, and from thence into the retort *c*, through the incandescent coke or charcoal, and through the retort *b'*, from whence it passes through the pipe *d d* into a circular vessel containing water. The lid of this vessel, and on the underside thereof, is constructed with a spiral channel, in order that the gas may pass over as great a surface of cold water as possible, previous to entering the outlet pipe of such vessel, which leads to the gas holder. *f* is a syphon-pipe extending nearly to the bottom of the retort *c*.

The mode of working the apparatus is as follows. The retort *c* is to be nearly filled with coke or charcoal, and the covers of the two retorts *c* and *a* securely luted, and a fire got under them, which is to be kept up until the retort *a* becomes of a cherry red, the retort *c* being of a bright red heat, the retort *a* is now to be charged with coal and a small quantity of water admitted into the retort *c*, the effect of which is said to be that the gas from the coal is mixed with tar, which passes into the purifying retort *b*, the sulpheretted hydrogen being decomposed by the coil of incandescent iron; at the same time, the tar is said to undergo a second distilation, and thereby converted into gas, which is mixed with that which comes from the coal. The gas, which is now more dense, being combined with the carbon contained in the tar, passes along the tube *b* round the spiral, till it arrives at the retort *c*, where it mixes with the hydrogen formed by the decomposition of water by the incandescent coke. This decomposition takes place at the same time as the distilation of the coal; the water which is dropping in their streams over the coke gives out hydrogen, which mixes with the other gases, and passes into the purifying retort *b'*, carrying with it the volatile oils which may have escaped decomposition; but which, in passing the iron spiral, becomes decomposed, and gives out carbon to the hydrogen, which thus becomes carburetted, without impoverishing the other gas. The gas, on passing to the end of the second purifying retort, passes to the vessel *e* having the spiral channel, for the purpose of cooling it down, after which it passes to the gas holder.

ATMOSPHERIC ENGINE.

Arthur Parsey, of Spur-street, Leicester-square, Artist, for "*Improvements in obtaining motive power.*"

These improvements in obtaining motive power consist in certain modifications of machinery, by means of which compressed air may be employed to work, without a vacuum, pistons, valves, levers, rods, and other appendages, for the purpose of producing mechanical force, and communicating that force for driving other machinery. The application of this motive power is as follows: A, fig. 1, is a vessel made sufficiently strong to withstand a very high pressure into which air is to be forced by means of pumps or otherwise. B is a cylinder provided with a piston, and is, in all respects, similar to the ordinary cylinder of a locomotive or other engine. D is a chamber placed contiguous to the receiver, into which chamber the compressed air may be admitted by the pipe and cock *a*, before it passes to the working cylinder, in order to reduce its density, and determine its elastic force, which may be regulated to the power required for working the engines by means of a spring valve *b* set to the desired force, or by a governor or other contrivance, well known in the construction of steam-engines, and which need not, therefore, be further described. The inventor, in some cases, proposes to have large vessels at the several stations ready filled with compressed air, to which the vessel A may be attached for the purpose of refilling or supplying the same with compressed air.

In order to economise the compressed air, the inventor gravely proposes to return it to the vacuum A, after it has acted on the piston of a high-pressure engine. The mode of effecting this object is as follows: fig. 2 shews a longitudinal section of a locomotive engine constructed according to this invention. A is the receiver for containing the compressed air, which passes through the pipe *b* to the valve-box, and from thence into the cylinder, so as to act on the upper and under sides of the piston alternately; at *c c* there are two valves, connected by a rod *a*, which is actuated by a lever *e*, which lever is connected in some manner (best known to the inventor) to the valve-rod *f*; *g g'* are two eduction-pipes, leading from the eduction-valves *c c* to *the peculiar constructed pumps h* and *i*, through which the air is intended to pass, instead of passing into the atmosphere, These pumps, which are placed within the receiver A, consist of a cylindical block of metal, having a hole drilled through the centres, and connected with the eduction-pipes *g g'*, on the top of each of these blocks there is a valve opening upwards; *k k* are cylindrical caps, made to fit air-tight upon the blocks *h i*; these caps are also provided with valves *l*, opening upwards, and are connected to the ends of a beam *m*, by means of rods *n n* sliding through stuffing-boxes fixed on the top of the receiver. The beam *m*, it is said, may be worked by hand, in the manner following. Suppose the condensed air to be passing from the receiver through the pipe *b*, and to have acted on the under side of the piston, so as to give the same to the end of the stroke, at this moment the valve *c* will be raised, so as to form a communication with the eduction-pipe *g'* and the cylinder, the lever or beam *m* being then raised, so as to elevate the cap *k'*, the air from the cylinder will pass through the eduction-pipe *g'*, and into the cap *k'*, which is supposed to be of about the same capacity as the cylinder. On the return stroke of the piston, which we will no suppose to have arrived at the bottom of the cylinder by the force of compressed air acting on its upper surface, the eduction-valve *e* will be opened so as to form a communication with the *peculiar formed pump i*; by means of the pipe *g*, the beam *m* is again to be moved, so as to depress the cap *k'*, and raise the cap *k*, when a similar effect to that already described will be produced with regard to the air contained in the cylinder on the top side of the piston, at the same time the air from within the cap *k'* will be forced from thence into the receiver A, and will be prevented returning by means of the valve *l*. "Hence it will be observed, that, in accordance with the action of the piston, the caps *k k'* will be made to reciprocate, and thereby draw off the volumes of condensed air above and below, and force the columns of air, in their condensed state, into the receiver A, to be again passed through the pipe *b* into the cylinder, and employed for keeping up the continuous action of the piston, The lever *m* may (it is said) be elongated and connected, in the usual way, to the working piston, and to this lever may also be attached the rod for working the slide-valves.

It has been stated that the lever *m* may be worked by hand; the specification here states, that, in some cases, it may be desirable to work it by power; for this purpose the inventor states that the lever *m* must be elongated, and the piston of a small steam-engine may be attached to it, as shown at *o*, by this means the vibrating action of the lever *m* shall be effected.

Fig. 3 shews a section of a pipe, having a number of valves, which the inventer proposes to employ for the eduction-pipes, the divisions in the pipe he prefers to make somewhat larger as they approach the cylinder; the object of this arrangement is to prevent the air returning from the receiver A. The piston-rod, we ought to have observed, is connected to the cranks of the driving, in the usual manner, and is intended to give motion to such wheels.

The inventor claims first the mode of working engines and machinery by means of compressed air previously condensed, as ascribed and illustrated in reference to fig. 1, however the engines, or other apparatus may be varied in their constructive details, as long as the same system of action is preserved, and the same elements are employed to produce it.

Secondly,, the placing the pumps and the apparatus within the receiver of condensed air, for the purpose of prolonging and economising the working power of the condensed air.

Thirdly, the chamber or vessel D, fig. 1, for regulating the working force of the condensed air drawn from the main receiver or receivers.

Fourthly, the pipe, with a series of valves within it, which may also be attached to pumps and other apparatus.

BORACIC ACID WORKS, MONTE CERBOLI.

(From the Quarterly Journal of the Geological Society.)

I cannot conclude this imperfect notice of the geology of Tuscany without calling attention to the boracic acid works at Monte Cerboli, and the remarkable phenomena therewith connected; for I have no doubt but that many of the actual geological features of Tuscany must be referred to agencies and to causes similar to those which are now exhibited in this locality.

The numerous and violent jets of vapour from which the boracic acid is extracted, rise, with considerable noise and in large volumes, from a narrow rocky valley in the secondary cretaceous limestone, about 15 miles S.W. of Volterra. Huge blocks of this rock and its associated indurated marls cover the surrounding hills, and add to the desolation of the scene. The vapour naturally leaves a considerable deposit; but this is much increased in consequence of its being compelled by artificial means to pass through water collected into numerous reservoirs. By this process, the water is impregnated with the boracic acid previously held in solution in the vapour; while the greater part of the sulphur lime, and carbonic acid gas, which it also contains, is deposited in the muddy bottoms of, the pools, and assumes, when dry, a crystalline form, being, from time to time, thrown out in the course of the operations: sulphate and carbonate of lime are also deposited in the cauldrons and cooling pans where the boracic acid is obtained by evaporation from the saturated water. Amongst the neighbouring rocks, I saw a remarkable instance, where a large fissure or crack, with several smaller ramifications, had been completely filled up by the matter deposited by the vapour which must once have escaped through it. The sides were coated with a hard compact calc-sinter, while the central portions were filled with a more porous substance, so that the passage of the vapour had been obstructed before the central parts had become so densely consolidated as the sides, thereby explaining at least one of the causes by which these vents are constantly changing their positions, and how the jets of vapour escape sometimes in one place and sometimes in another.

The simple mode by which the boracic acid is obtained is as follows. Small reservoirs, from 15 to 30 feet in diameter, are dug round the most convenient and powerful of the many steam vents; and into these reservoirs a small stream of water is conducted from the mountain side. After being for some time exposed to the action of the rising vapour the water is let off from one reservoir into another, until it has passed through five or six, in each of which it remains about 24 hours, the vapour boiling and bubbling up through it the whole time with much noise and violence. By this time the water is sufficiently impregnated with the boracic acid; and after being allowed to settle in another reservoir to deposit the mud, it is led off into the evaporating houses, where, after undergoing a slow and gradual process of evaporation, the boracic acid is at length obtained in numerous vats, where it crystallises with great facility.

The great difficulty formerly experienced in this process was the expense of fuel required for the process of evaporation; until the happy idea at length suggested itself to the proprietor of availing himself of the almost inexhaustible supply of heat prepared by Nature herself in the numerous vents from which the streams of boiling vapours were constantly emitted. Acting on this suggestion, he built a sort of chamber over some of the vents, and conducting the vapour by subterranean channels into the evaporating houses, obtained without a farthing of additional outlay all the heat he could require. The consequence of this simple application of natural power was, that the value of the works rose, in one year, from a capital of one thousand pounds, for which the fee simple was offered, to a rental of twenty thousand pounds per annum.

Similar vapours or "soffioni," as they are called, occur in several other localities in the same district, or within a distance of 12 or 14 miles, as at Sarrezano, Castel Nuovo, Monte Rotondo, and others; and it is impossible not to be struck with the manner in which they throw light on many of the geological phenomena in this and other countries; particularly with regard to the filling up of cracks and fissures in rocks, and the local deposits of various substances, such as calc spar, gypsum, sulphate of lime, sulphate of soda, &c., many of which, occur in this very neighbourhood. It is highly probable that such emissions of gases and vapours may have produced may of those local pheaomena, which have been so frequently attributed to the effect of springs, and are considered as aqueous deposits. That great connection exists between them cannot be doubted, as the soffioni of Monte Cerboli do unquestionably deposit much sulphate and carbonate of lime, and if supposed to rise through water would most certainly deposit much more. On the whole, therefore, whether we consider the remarkable and almost terrific appearanc. of these vents, from hundreds of which the vapours escape with the noise of a steam-boiler blowing off its steam, or the importance they have in connection with other geological problems to which they may offer a solution, they must be considered as presenting to us some of the most interesting, if not important geological phenomena which the Tuscan States can afford to the pursuer of geological investigations.

COAL FORMATION OF NOVA SCOTIA.

By John Dawson, Esq.

(From the Quarterly Journal of the Geological Society.)

The carboniferous strata of this province may be included in three groups; first, the gypsiferous or mountain limestone formation; secondly, the older coal formation; and thirdly, the newer coal formation: of these the two former have almost exclusively attracted the attention of geologists, the latter having been in a great measure neglected. In connection with the Pictou coal field, however, and probably also in other parts of this and the neighbouring colonies, the newer coal formation is an extensively distributed deposit, often attaining considerable thickness. and, though not containing valuable beds of coal, ironstone, or gypsum, yet so associated with the rocks including these minerals, that a knowledge of its structure and relations is essential to their satisfactory investigation.

The coal measures of the Albion mines, on the banks of the East River of Pictou, a series of beds, estimated by Mr. Logan at 5,000 feet in thickness, and constituting our older coal formation, are succeeded, in ascending order, by a great bed of coarse conglomerate, which, as it marks a violent interruption of the processes which had accumulated the great beds of coal, shale, and ironstone beneath, and as it is succeeded by rocks of a character very different from that of these older coal measures, forms a well-marked boundary, which we may consider as the commencement of the newer coal formation.

In lithological character, the newer coal formation of Pictou strongly resembles the lower carboniferous series; the chief differences being that, in the former, the beds of grey sandstone are of greater comparative thickness, and that, in the latter, there are great beds of gypsum and of limestone with marine shells. Our coal measures may thus, in one point of view, be regarded as a subordinate group, included in a great thickness of sandstones and shales, mostly of red colours.

The sections which I have described are included in a district extending about fifty miles along the shores of the Gulf of St. Lawrence, from Merigomish to Wallace; forming, I believe, the largest continuous tract of rocks of the newer coal formation in Nova Scotia.

Synopsis of the Carboniferous Rocks of Pictou.

1. Newer Coal Formation.—The prevailing rocks are alternately of reddish and grey sandstones and shales, with some coarse conglomerates, especially in the lower part. Subordinate to these, are dark grey concretionary limestone, thin beds of coarse sandy limestone, two thin beds of coal and one of gypsum. Thickness, 5000 feet or more.

Fossils.—*Coniferous wood, Calamites, ferns., &c., Ganoid fish. tracks of land animals.*

2. Older Coal Formation.—The prevailing rocks are dark shale and clays, grey and brown sandstones; and subordinate to these are coal, ironstone, dark limestone. Thickness 5000 feet.

Fossils.—*Ferns, Stigmaria, Calamites, Lepidodendra, &c., Cypris.*

3. Mountain Limestone, or Gypsiferous Formation.—The prevailing rocks are reddish sandstones, shales, and clays, with some grey beds; conglomerates, especially in lower parts; and subordinate to these, thick beds of limestone, thick beds of gypsum with anhydrite. Thickness, 6000 feet or more.

Fossils.—*Calamites, fragments of carbonized plants, Producta, Terebratula, Encrinites, Madrepores, &c.*

COAL FIELDS OF CANADA AND THE UNITED STATES.

(*From the Quarterly Journal of the Geological Society.*)

The coal fields of the United States and the British possessions in Canada are beyond all comparison the most extensive and most valuable of any at present known in the world; and the geological position of these deposits of vegetable matter, as well as the conditions under which they occur, are matters of very considerable importance to the future interests of the continent of America.

The great coal fields of the United States are the Appalachian, the Illinois, and the Michigan: those of the Canadas are on the eastern extremity of the colony, and occupy a great space in New Brunswick, Prince Edward's Island, Cape Breton, &c. A large proportion of the coal is anthracite. It is not easy to do justice to these formations by the hasty sketch to which our limits necessarily confine us in this place; but some idea may be formed of their extent, when it is stated that the Appalachian coal fields extend for a distance of 720 miles from north-east to south-west with a width in some places amounting to 180 miles;* that the Illinois basin is not much inferior in dimensions to the whole of England; that the Michigan coal fields and the coal fields of Canada are also of very considerable dimensions; and that the thickness of the seams of fossil vegetable matter in some instances exceeds even that of the Staffordshire coal, amounting at the Lehigh summit mine (where the usually intervening shales and grit have thinned out) to one mass of fifty feet without any greater interpolated matter than two thin layers of clay. In some places this vast bed is quarried in the open air; but in others, where the coal is accessible to a degree scarcely to be imagined by strangers to the conditions of the country, the time has not yet arrived when the value of its fuel is appreciated.

* Its superficial area is calculated at 63,000 miles.

Professor Page's Magneto-Electric Machine.—In 1838, Professor Page published in Silliman's Journal an account of an improved form of Saxton's magneto-electric machine, doing away with many existing objections, and furthermore rendering it at once a useful instrument, by a contrivance for conducting these opposing currents into one channel or direction, which part of the contrivance was called the unitress. The current produced in this way was capable of performing the work, to a certain extent, of the power developed by the galvanic battery; and the machine was found adequate to furnishing of shocks for medical purposes, for exhibiting the decomposition of water, furnishing the elements of oxygen and hydrogen at their respective poles, and producing definite electro-chemical results. These two last results could not be obtained without the aid of the unitress. But, with this improvement, the instrument was still wanting in one property of the galvanic battery—viz., that property which chemists call quantity, or that power upon which depends its ability to magnetize, and also to heat platinum wires. This last property has been given to the machine by the recent contrivance of Professor Page. The machine, in its novel construction under his improvement, developed what is called by way of distinction, the current of intensity, but had a very feeble magnetizing power. By a peculiar contrivance of the coils, (not to be made public until his rights are in some way secured,) the current of quantity is obtained in its maximum, while at the same time, the intensity is so much diminished that it gives scarcely any shock, and decomposes feebly. It has been successfully tried with the magnetic telegraph of Professor Morse, and operates equally well with the battery. It affords, by simply turning a crank attached to the machine, a constant current of galvanic electricity; and as there is no consumption of material necessary to obtain this power, it will doubtless supersede the use of the galvanic battery, which, in the event of constant employment, would be very expensive, from the waste of zink, platinum, acids, mercury, and other materials used in its construction. It particularly recommends itself for magnetizing purposes, as it requires no knowledge of chemistry to insure the result, being merely mechanical in its action, and is always ready for action without previous preparation; the turning of a crank being the only requisite, when the machine is in order. It is not liable to get out of order; does not diminish perceptibly in power when in constant use, and actually gains power when standing at rest. It will be particularly gratifying to the man of science, as it enables him to have always at hand a constant power for the investigation of its properties, without any labour of preparation. We notice among the beautiful results of this machine, that it charges an electro-magnet so as to sustain a weight of one thousand pounds, and it ignites to a white heat large platinum wires, and may be used successfully for blasting at a distance; and should government ever adopt any such system of defence as to need the galvanic power, it must supersede the battery in that case. Professor Page demonstrates, by mathematical reasoning, that the new contrivance of the coils affords the very maximum of quantity to be obtained by magnetic excitation.—*Report of American Commissioner of Patents for 1844.*

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JULY 25, TO AUGUST 22, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Richard Archibald Brooman, of Fleet-street, London, gentleman, for "certain Improvements in dyeing." (A communication.)—Sealed July 25.

William Henry James, of Clement's lane, London, civil engineer, for "certain Improvements in the manufacture of plates and vessels of metal, and other substances suitable for heating purposes, and in the means of heating the same."—July 25.

James Stokoe, of Newton, in the county of Northumberland, millwright, for "certain Improvements in purifying the vapours arising from smelting and other furnaces, and in recovering therefrom any useful matters which may be intermixed therewith."—July 25.

William Breynton, of the Inner Temple, esq., for "certain Improvements in rotatory steam-engines."—July 25.

Alexander Wilson, of Glasgow, manager for Alexander Fletcher and Co., of the same place, spinners, for "Improvements in spinning hemp and flax, and other fibrous materials."—July 29.

John Henry Roberts, of Norfolk Villa, Finchley road, Saint John's Wood, surgeon, for "Improvements in spirit lamps."—July 29.

George Beadon, of Battersea, Commander in the Royal Navy, for "Improvements in propelling vessels and land carriages, in raising and drawing off water for driving machinery, which means of raising and drawing off water are applicable to other useful purposes."—July 29.

Sir Samuel Brown, of Blackheath, knight, captain in her Majesty's navy, for "Improvements in the formation of embankments for canals, docks, and sea walls, and in the conveyance and propulsion of locomotive engines, and other carriages or bodies on canals and other inland waters, and also on rail and other roads, and in propelling vessels on the ocean and navigable rivers."—July 29.

Caleb Bedells, of Leicester, manufacturer, for "Improvements in weaving."—July 29.

Ezra Coleman, of the City of Philadelphia, in the United States of America, for "Improvements applicable to moving of locomotive engines on inclined planes of railways."—July 30.

John Pattrineri, of Skinner-place, Size-lane. London, gentleman, for "certain new and improved modes of obtaining and applying motive powers."—July 30.

Joseph Quick, of Sumner-street, Southwark, engineer, and Henry Austin, of 10, Walbrook, civil engineer, for "Improvements in the construction and working of atmospheric railways."—July 31.

William Cook, of King-street, Golden-square, coach-maker, for "an Improvement in certain description of stoves."—July 31.

Pierre Armand, le Comte de Fontainemoreau, of Skinner-place, Size-lane, for "certain Improved medicines or compounds, and for the application of a new instrument to prevent, alleviate, and cure certain diseases, also for the machinery for manufacturing the said instruments." (Being a communication.)—August 4.

William Longmaid, of Plymouth, gentleman, for "certain Improvements in the manufacture of chlorine, in treating sulphurous ores and other minerals, and in obtaining various products therefrom."—August 4.

Josaih Marshall Heath, of Winchester-buildings, iron-master, for "Improvements in the manufacture of cast steel."—August 4.

William Young, of Paisley, manufacturer and dyer, and Archibald McNair, of the same town, merchant, for "certain Improvements in the construction and means of manufacturing apparatus for conducting electricity."—August 4.

Charles Henry Joseph Forret, of Lille, in France, but now of 17, Great St. Helen's, Bishopsgate, gentleman, for "a new and improved Archimedean screw, which he calls Davaine's screw." (A communication.)—August 4.

Alanson Abbe, of Great Russell-street, Bloomsbury, M.D., for "Improvements in apparatus for preventing and alleviating spinal disorders."—August 4.

William Eccles, and Henry Brierley, both of Walton-le-Dale, Lancaster, spinners, for "Improvements in the machinery or apparatus used in spinning."—August 5.

Peter Francis Maire, of Mark-lane, merchant, for "Improvements in combining iron and other materials for the purpose of constructing bridges, roofs, arches, floors, and other similar structures." (A communication.)—August 5.

Francis Taylor, of Romsey, Hants, surgeon, for "Improvements in giving alarm in case of fire and in extinguishing fire." (A communication.)—August 6.

Frederick Bankart, of Champion-park, Denmark-hill, Surrey, gentleman, for "certain Improvements in treating certain metallic ores and refining the products therefrom."—August 7.

John Evans, of Kensington, gentleman, for "a new perazotic product and its application to the arts." (A communication.)—August 7.

Dalrymple Crawford, of Stratford-on-Avon, Warwick, for "an Improved dibbling machine."—August 7.

Henry Smith, of Liverpool, engineer, for "Improvements in the manufacture of wheels for railways, and in springs for railway and other carriages, and in axle guards for railway carriages."—August 7.

Henry Emanuel, of Pond-street, Hampstead, gentleman, for "Improvements in atmospheric railways."—August 7.

George Brown, of Caperthorne, Chester-land, agent, for "a new seed and manure drill plough."—August 9.

Peter Armand le Comte de Fontainemoreau, of Skinner's-place, Size-lane, for "certain Improvements in apparatus for raising and supporting vessels and other floating or sunken bodies, and its application for the better preservation of life and property."—August 9.

Frank Hills, of Deptford, manufacturing chemist, for "Improvements in purifying gas for illumination and obtaining a valuable product in the process."—August 9.

Charles Searle, of Bath, doctor of medicine, for "Improvements in stoves."—Aug. 9.

Peter Higson, of Clifton, Lancaster, mining engineer, for "certain Improvements in machinery or apparatus for connecting and disconnecting the steam engine, or other motive power, with or from the load or other matter to be driven or moved."—August 9.

William Newton, of Chancery lane, civil engineer, for "Improved modifications and novel applications of known machinery and processes to the purpose of cleaning, softening, dividing, and preparing flax, hemp, and other vegetable fibrous materials." (A communication.)—August 14.

Thomas Henry Russell, of Wednesbury, Stafford, tube manufacturer, for "Improvements in the manufacture of welded iron tubes."—August 14.

Hypolite Louis Francois Salembier, of Mincing-lane, merchant, for "Improvements in the manufacture and refining of sugar." (A communication.)—August 14.

Henry Pearse and William Dimsdale Child, both of Finsbury-place, South, for "Improvements in the manufacture of sugar." (A communication.)—August 21.

Thomas Oxley, of Westminster-road, civil engineer, for "certain Improvements in constructing and propelling vessels, and in the machinery connected therewith."—August 22.

TO CORRESPONDENTS.

Can any of our correspondents give us information as to the dimensions and construction of the Suspension Bridge which has lately fallen at Calcutta?

"A Subscriber, New York."—There is a very full account of the architecture of St. Paul's Cathedral, by Mr. Gwilt, in Britton and Pugin's Illustrations of the Public Buildings of London. Tayler, High Holborn, 1845. 2 vols. 8vo.

"Marcus." Declined.—The pathetic passages are dismal, and the facetious parts incoherent; the whole letter irresistibly reminds us of Collins' Description of Despair.

"I was sad by fits, by start 'twas wild."

There are three things which should find no place in this journal—flippancy, which is not wit—dogmatism, which is not proof—magniloqence, which is not eloquence.

Mr. Rooke's paper on the Harbour of Refuge is accepted, with thanks.

ERRATA. P. 242.

Column 1, line 43, for "support E D C," read "support B A C."

line 47, for $R = \frac{h^2 W}{2}\left(\frac{\sec C - \sqrt{\tan b \tan c + 1}}{\tan c}\right)$ read $R = \frac{h^2 W}{2}\left(\frac{\sec c - \sqrt{\tan b \tan c + 1}}{\tan c}\right)^2$

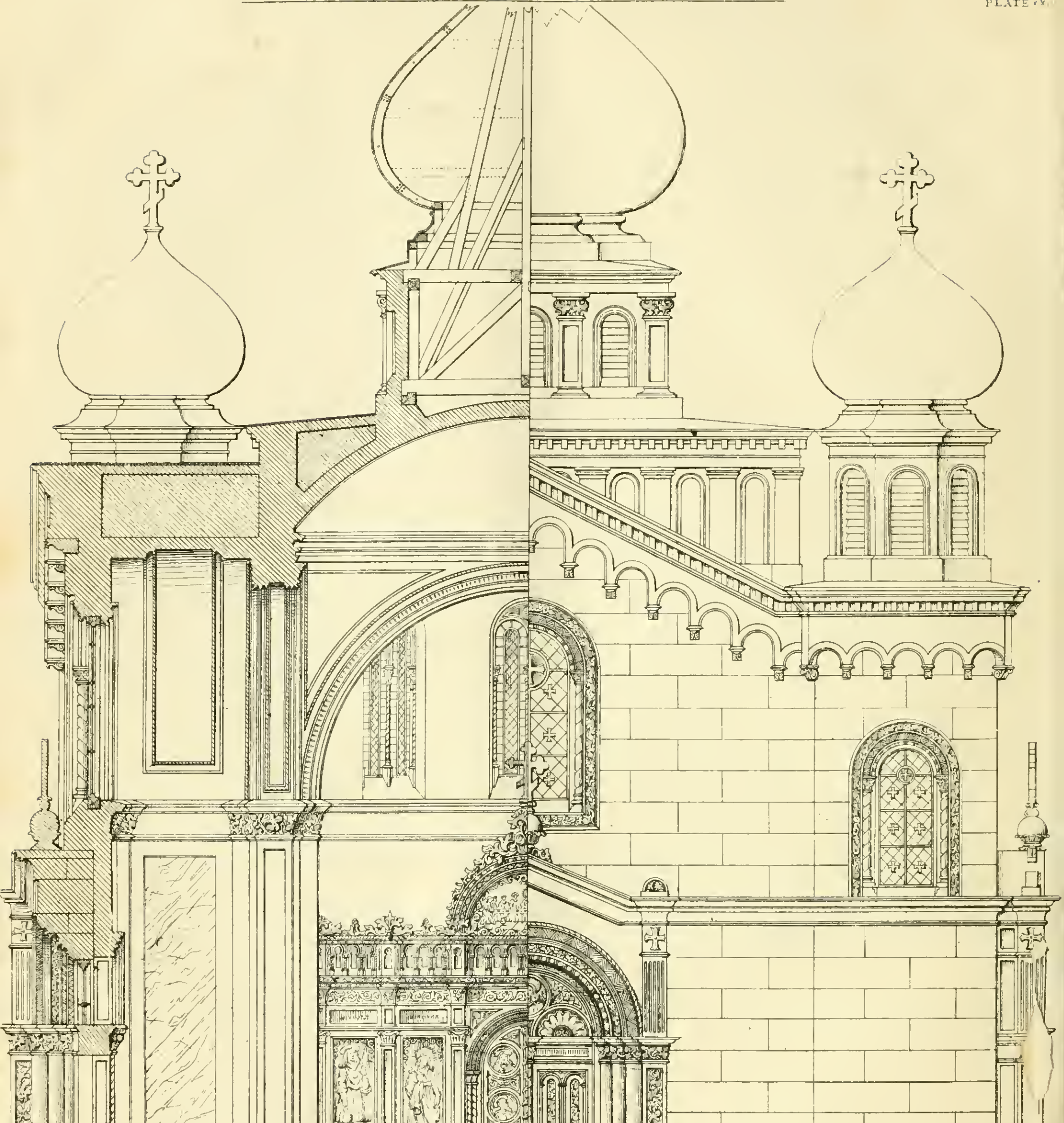
line 49, for $\frac{h^2 W}{2 \tan c}\left(\sqrt{\tan c + \cot c} - \sqrt{\tan b \cot c}\right)^2$ read $\frac{h^2 W}{2 \tan c}\sqrt{\tan c + \cot c} - \sqrt{\tan b + \cot c})^2]$

line 53, for "$C = b$" read "$c = b$."

line 56, for $\frac{\tan c \tan i + 1}{\tan i}$ read $\frac{\tan c \tan i + 1}{\tan^2 i}$

PLATE

CHVRCH – S^T ALEXANDRÉ NEAR NOWOGIEORGIEWSK



CHURCH OF THE ALEXANDRIAN COLONY AT NOVO-GIORGIEOSK (MODLIN).

(With an Engraving, Plate XXIII.)

Very little is known in this country of the Russo-Byzantine style for it is hardly noticed at all even by those who speak of all other styles, or if mentioned by them it is very briefly indeed, and without any specimens of it being shown in engravings; neither has it in any one instance—as far as we are aware—been at all adopted or imitated among ourselves, notwithstanding that we have occasionally sought for novelty—how judiciously or successfully we say not—by having recourse to Egyptian, Hindoo, and other outlandish, not to call them pagan and infidel, styles; whereas at all events the Russo-Byzantine is a *Christian* one. Among the Russians themselves it has lately come into vogue again for church architecture, in preference to the Greco-Italian style which, in common with other European countries, they have adopted. Russo-Byzantine is therefore to them what Gothic is to us,—their ecclesiastical style *par excellence*, nor is it by any means deficient in distinct physiognomy, although its peculiarity depends chiefly upon the bulbous dome, and the mode in which that particular feature is applied and repeated. These domes, no doubt, carry with them an impress of nationality that must greatly recommend or even endear the style in the eyes of natives, as being identified with their own church, and with "the faith of their forefathers," wherefore those who advocate scrupulous adherence to history and precedent in ecclesiastical architecture cannot do otherwise than commend the Russians for reverting to their "orthodox" and "legitimate" national style. Among those architects who have been mainly instrumental in this "*revival*" is Constantine Thon (a German, we believe, by origin), who stands at the head of his profession in Russia, and who has erected several churches in the Russo-Byzantine, not only at St. Petersburgh and Moscow but in several other cities.

The Church at Novogiorgiesk, dedicated to St. Alexandria, which we here give by way of specimen of the style—though how far it is a good or fair specimen of it we do not pretend to say—has been very recently erected by J. Gay (a French architect). The entire building is a square of 85 feet forming internally a Greek cross, a disposition of plan almost invariably adopted. There is no distinction of nave, aisles, and choir, the only division within the building being that the apsis is partitioned off by the usual screen or *Ikonostass*, which derives its name not from being adorned with *images* but with *pictures* of Saints, &c.; and one of those on the Ikonostass of this church is a copy from Leonardo da Vinci's celebrated "Cena." The apsis here is lighted by five long circular-headed windows, above which there is externally an arcade of sixteen small open arches, in each of which a bell is hung. The lower part of the building has no windows. The contour of the domes is not quite so graceful as it might have been; neither do those features express themselves very effectively in mere outline, as here represented, besides which their perspective grouping is of course altogether lost in a geometrical drawing. There is a dome at each angle and one in the centre.

The Engraving presents a view of one half of the principle front and also one half of the transverse section showing the apsis. A portion of the centre dome is omitted for want of room on the plate, it is however finished precisely the same as the side dome.

The above wood engraving shows one-half of the interior plan, and one-half of the roof.

NOTES ON ANGLO-SAXON MASONRY.

Mr. Bloxam, in his interesting article on "Mixed Masonry of Brick and Stone," in the Archæological Journal, pp. 307-317, has been able to discriminate works of the different eras, by pointing out the features characteristic of their construction. This subject has been less attended to than it deserves, for there can be very little doubt, that, although most of the architectural features of our earlier structures have disappeared, a great number of remains are extant in the walls of our churches than is generally estimated. The frequent alterations to which all our churches were subject, those alterations being always made in the prevailing taste of the time, may often lead us into error as to the original period of erection; the style of a door or window are not certain criteria of dates, being so frequently additions, taking place of others of an earlier design.

Mr. Rickman first pointed out peculiarities in several churches, both of architectural feature and construction, which are now well known and generally admitted to belong to the Anglo-Saxon era; he thus opened a new field for research, which has since received considerable attention, and many new facts have been brought to light. The long and short quoining is now genenerally taken as a feature peculiar to Anglo-Saxon construction; it is found in the church of Earls Barton, in Northamptonshire, and many others, of the early date of which there can be no reasonable doubt, and I think it may be questioned if it is ever found in buildings posterior to the eleventh century. It may be well to take note of the materials and construction generally associated with this work, in order, if possible to arrive at some general idea of the features of Anglo-Saxon masonry, always bearing in mind, that the nature of the materials found in different localities necessarily exercises a control on its character; it is for this purpose that the following facts, gathered at random, chiefly from the churches in Suffolk, are offered to the readers of the Journal.

The church of Hemingstone presents a rather remarkable specimen of long and short work at one corner of the nave; the proportions of the upright masses of stone to the horizontal is very singular, the former being nearly three feet in height, the latter but six inches; no architectural feature of an early character remains in this church. The adjoining parish of Gosbeck has the nave of its church quoined in a similar manner, but at Hemingstone the stone is well squared and wrought; at Gosbeck, however, it is of very rude workmanship, and it may be noticed in the specimen of it here given, that the uprights alternately present their narrowest and greatest width at either of the angles. Both these churches are covered with a modern coating of plaster by which the disposition of the materials is concealed.

The greater part of the tower of Debenham church is of early construction, and is no doubt a portion of the church dedicated to St. Mary, mentioned in the Domesday record; it is built of large flints, laid in Herringbone fashion, which occasioned horizontal courses of the same material, not observing a strict regularity in its recurrence: it has the long and short quoining. Brundish church has a tower in all respects similar in construction, the quoining excepted; it is certainly of early date. The nave of Leiston church is quoined with long and short work; it is built of flint laid in herringbone and covered with an original coarse rough-cast, which, from its so frequently accompanying early masonry, may, in connexion with other facts, be considered an evidence of primitive construction. Rough cast is indeed frequently found in Norman work, but there is a peculiar coarseness in that of the Saxon period, which is composed of coarse gravel, lime, and sand, the great durability of which is attested by its preservation through so many centuries.

Practical men say, that the coarser the material mixed with the lime, the less its strength is exhausted: a fact the early builders seem to have well understood. The impenetrable hardness of some of the rough-cast plaster is extraordinary.

One of the most curious instances of early quoining is found in the church at Bedfield, at the west angles of the nave; it consists of Roman tiles placed alternately horizontal and upright, on the long and short principle, having at the point on which the roof rests five tiles disposed horizontally in the usual alternate manner: it is not uncommon to meet with this arrangement in long and short quoining. An early Norman door, ornamented with the zigzag, is on the north side, but it has every appearance of being a more recent addition.

The last example at present to be noticed, is Swanscombe church, in the neighbourhood of Gravesend. It is built of an heterogeneous mixture of materials, chalk, rag, masses of stone of various kinds, and an admixture of Roman tile. The tower shows some attempt at a regular plan in the disposition of its material: it is for the most part constructed of small stones, laid in courses of three and four alternately with one of flint: this disposition is by no means regularly observed, sometimes there are two courses of flints. and sometimes but two of stone. There is something in the above arrangement like an imitation of the Roman flint being used in the place of tile. The quoining presents some curious features, and has evidently been controlled by the nature of the material at hand; it exhibits a strange variety of stones, some disposed in long and short masses, some alternately with Roman tiles, and the latter are found worked into the rubble, here and there, without any order. It may also be well to observe, that a large circular window of Roman tile, on the south side, is now blocked up.

The chancel is chiefly flint-work, set in herring-bone, and covered with the durable rough-cast before noticed: the south-side, where much of this is removed, shows very evident indications of the walls having been formed by planking the sides, until the mortar or concrete had firmly set; the marks of the planks are still very visible. This part of the church has undergone many alterations: an addition to the east end is easily to be distinguished, from its patched appearance; lancet lights of the twelfth century have superseded windows of a much earlier date, traces of which still remain; and a doorway on the north side appears to have been blocked up at the same time as the addition was made to the east end, but its architectural features are quite destroyed.

Herringbone work, according to Mr. Bloxam, is not of itself a criterion of date: but the flint-work in this fashion I have above noticed, appears to me, from its being always connected with other facts, to be one of the indications of Anglo-Saxon work.

The few instances here brought together may not contain matter entirely new, but the subject is worthy of attention, and it is hoped that the other members of the Association will take advantage of opportunities that may occur to them to furnish additional information.

J. G. Waller.

THE ARCHITECTURE OF FRANCE IN THE REIGN OF LOUIS XIII.

Under the Administrations of Richelieu and Mazarin.

(Translated for this Journal, from the Magazine Pittoresque.)

The history of the reign of Louis the Thirteenth is marked by constant dissensions between the king and the nobles, and by the frequency of intrigues and assassinations—Louis reigned but did not govern. The minister Richelieu held the supreme authority uncontrolled, and having reached the highest pinnacle of power and wealth, his ambition of glory led him to encourage letters and the fine arts. He established the Royal Printing Press, founded the French Academy, rebuilt the Sorbonne, and instituted the *Jardin des Plantes*.

In order to judge of the architecture of this period we will examine first of all the sumptuous Palace which the Cardinal built for his own residence. The site chosen for this edifice was at equal distances from the Louvre and Tuileries. The palace was first called the *Palais Richelieu*, and subsequently the *Palais Cardinal*. The designs were furnished by Lemercier, one of the most celebrated architects of his time, and the foundations were laid in 1629; the building was not completed till 1636.

The Palace Richelieu, as designed by Lemercier, consisted of several courts, of which two were central; the second or largest court was surrounded by buildings on three sides only, on the fourth it was separated from the gardens by an arcaded gallery raised on a terrace. The interior of the palace was decorated with a luxury scarce imaginable. The most remarkable apartment was the gallery of illustrious men, adorned with portraits of celebrated persons, by Phillipe of Champaigne, Simon Vouet, &c., and with a large number of antique busts. There were also a chapel and two theatres, or *Salles de Spectacle*. The chapel was remarkable for the richness of its monuments. Of the theatres one was reserved for a select assemblage, and contained about five or six hundred persons; the other three thousand. This last was assigned to Moliere and his company in 1660, and here in 1636 Corneille brought out the *Cid*, to which succeeded the *Horaces* and *Cinna*.

After Moliere's death, the theatre was used for the representation of lyric dramas. This was the origin of the Opera. The theatre was twice burnt down and rebuilt.

In 1639 Richelieu made a present of his palace to the king, whose death however happened so soon after, that he never inhabited it. Four years afterwards Anne of Austria, Regent of the kingdom, quitted the Louvre for this Palace, which thenceforward took the name of the Palais Royal.

The pile has since undergone great alterations. Of the architecture of Lamercier little remains but the decorations of the wings of the second court, where may still be seen in the piers between the windows of the lower story, the prows of vessels which Richelieu put there in allusion to his office of superintendent of navigation which he joined to so many others.

The Louvre under Louis XIII.

The Louvre is one of those immense edifices which must necessarily be the work of successive ages. It had already been the object of the munificence of Philip Augustus, Francis I, Charles IX, and Henry IV., when Louis determined to give to it altogether new importance. Under the superintendence of Lemercier, the court was extended to four times the size originally proposed, and in consequence of this extension Lemercier constructed the central pavilion, crowned with a quadrangular dome, and repeated on the opposite side, the façade already executed in the reigns of Francis I. and Henry II. The architectural decoration of Lescot was copied, except only in the upper part of the central pavilion, where Lemercier followed the bent of his own genius. Not wishing to raise a third range of columns upon the two ranges of the Corinthian and Composite orders which were already surmounted by an attic range, and at the same time desirous of attaining a higher degree of enrichment he employed Caryatides grouped two by two. These Caryatides, the work of Sarazin, have certainly sculptural merit, but are devoid of solidity and severity. The appearance of life and action which the artist has given them is inconsistent with their pupose. The Caryatides of Goujon are in this respect much superior. The three pediments erected one above the other, which crown the composition, must be considered as an arrangement in the worst taste, and deserve severe condemnation. Under Louis XIII., the Louvre was destined to become one of the largest palaces in Europe. Anne of Austria erected a *Salle de Spectacle* in the pavilion. Levau continued the river façade commenced by Lescot, but this was subsequently removed to make way for that erected Perault. The great square central pavilion of the Tuilleries, surmounted by the dome which is seen at this day, was erected under Louis XIII.

The Chateau of Versailles.

Versailles owes its origin to the hunting seat which Louis XIII. caused to be built in this locality. This building, consisting of four sides and four towers at the salient angles, surrounded by a fosse, and protected by a drawbridge, preserved the arrangement and appearance of the ancient feudal mansions. Now it is curious to see this last example of the type of the ancient chateau of the middle ages become the germ of the vast and magnificent seat of Louis Quatorze. The erections of the unpretending retreat of Louis XIII. are easily recognised amidst the rest of the pile; they are stone and brick, and rise in front of the marble court, of which the dimensions are exactly the same as those of the court of the primitive building.

Convents and Public Buildings.

An immense number of convents were erected during this period. That of the barefooted Carmelites and Les Minimes in the Place Royale, the chapel of which rivals the most magnificent churches of Paris, offer examples of the religious architecture of this period. But the most important of the convents founded in this reign is that of Val-de-Grace, a royal abbey of the Benedictines in the Rue St. Jacques, founded by Anne of Austria, who laid the first stone of the cloister in 1624. Despairing of giving an heir to the throne, Anne made a vow to erect a sacred edifice if her desires were accomplished; on the birth of the future Louis XIV. she nobly fulfilled her vow by founding Val-de-Grace.

Among the edifices built at this time in the provinces one of the most important is the Town Hall of Rheims. The first stone of this building was laid in 1627. In the centre of the grand façade is an equestrian statue of Louis XIII. The left wing of the building long remained uncompleted. The Hotel-de-Ville of Lyons is also an edifice of great importance; isolated on all sides, the effect of the court, which is elevated above the adjacent houses, is very picturesque. The principal elevation consists of two wings with a centre façade recessed. A balcony runs along the whole first floor; in the centre of the façade is an equestrian statue of Louis XIII.

Some of the apartments of Fontainebleau belong also to this period. The chateaux of the time of Louis XIII. which yet remain may in general be recognized by the mixture of brick and stone. In some the interior decorations are well preserved, as in the Chateau of Liverny near Blois. The Guard Chamber is still to be seen, and a bed chamber, of which the ceiling, the chimneys, &c., are in complete preservation.

The style of architecture of the reign of Louis XIII. and of the regency of Anne of Austria is far from exhibiting that symmetry which belonged to the preceding era of Henry IV. There was a period of cessation after which architecture sensibly altered. It must, however, be allowed that while the style was inferior in taste to that of the sixteenth century, it at the same time assumed more independence. It still adhered to the Italian model, but it presented a physiognomy more thoroughly national. The architecture of the seventeenth century had become more pompous and monumental than the preceding. To characterize it in a word, it had become more monarchical.

Forgotten awhile amid the civil wars of the kingdom, the Arts in the seventeenth century began to revive, and in viewing the efforts of Lemercier and Mansart in this age we have at least a presentiment of the marvels of the reign of Louis Quatorze.

BRITISH AND FOREIGN INSTITUTE.

This Institute contemplates erecting a building of their own, vying in scale and architectural character with some of the West-end club houses. As there has been no scruple in regard to letting us see the design itself*, we think there need have been no secrecy with respect to the authorship of it, but on that point our curiosity has hardly even food for conjecture, unless we are to understand from Mr. Buckingham's expression, "my first step was to prepare a new set of plans and designs," that the drawings were actually designed by himself; and if such be really the case they show him to be no mean proficient in architectural study,—on the contrary, to possess rather more than less talent than what forms the average among the professional ranks. These designs, we are told, "were submitted to Mr. Tite, who approved heartily of the drafts, and who, with the taste of an accomplished artist, &c. &c., executed a set of beautiful drawings of the proposed building." Still, though Mr. Tite, no doubt, improved the "drafts" in regard to mere architectural calligraphy, we presume that he did not think fit to alter any of the ideas in them; since, if he ventured to make any corrections at all, it is quite unaccountable to us that he should have suffered two features to pass, which are so unlike in taste to everything else in the façade that they seem to have been introduced merely out of perverseness, for the sake of discordance and ugliness and nothing else, without any sort of reason or motive whatever. We allude to the two windows in the ground floor of the façade, which, though of the same size and proportions as the other openings, and like them square-headed, are filled in with puny and most miserable-looking arched Venetian windows of paltry design. Surely Mr. Tite never for a moment sanctioned such a tasteless caprice and downright barbarism. We admit that those deformities are very easily expunged, but why was not that done before the elevation was engraved in order to be published? This fault excepted—the design is in some respects unusually good, for though of more sober than ornate character, it possesses *physiognomy* and manifests artistic feeling, which only renders all the more unaccountable the wilfulness that disfigured such a design by thrusting into it two features of equally gratuitous and unmitigated ugliness.

Thus much premised, we proceed to description: the plan occupies a site of 80 feet frontage by 140 in depth, and would be either entirely insulated or *peninsular*, that is, exhibiting three fronts and leaving other buildings to be erected against the remaining side or rear, which end is occupied by the Theatre for lectures and concerts (measuring 79×75 feet in its lower part on the ground floor, by 48×35 above, where it is contracted by three saloons being carried around it upon the principal floor; the extreme height from the floor of the Theatre to the skylight 58 feet). The façade presents an astylar composition of the kind lately introduced among us under the title of the Italian *palazzo* mode, and has nothing of decoration but what it derives from the dressings of the openings, rustic quoins, moulded yet otherwise plain string-courses, and the general cornicione, above which a deep blocking-course is substituted for an eaves roof. There are three tiers of openings, viz., on the ground floor, mezzanine story, and principal floor, and only five openings in each, three of which on the ground floor, viz., the centre one and that at each end, are doors, the other two being filled in with the windows of most detestable design already mentioned. Even the doors themselves are not quite satisfactory, because the mode of their panelling causes them to look too much like ordinary room doors, only on an enlarged scale, in consequence of which they take away from the size of the other features. Otherwise, taking the mere openings themselves, apart from what is put into them, the ground floor is well treated, and though it does not constitute a distinct rusticated basement, it derives both richness and energy from the bold rustic quoins—both those at the angles and those which serve as dressings and key-stones to the doors and windows; and though the surface between them has only horizontal joints, it amounts to more than what serves to give relief to the moulded quoins, consequently the effect is altogether different from—we hardly need say very superior to—that most *un-Italian* substitute for rustication mere horizontal streakings on the face of the wall, causing it to look as if instead of being constructed of masonry it was covered with boards or planks painted of a stone colour. The mezzanine floor is treated so nearly similar to the ground one that it may almost be said to be in continuation of it. Instead of being made little better than small holes, intended to escape notice as much as possible, the windows are rendered important features and contribute in no small degree to the effect of the *ensemble*. The windows of the next or third tier, which are those of the principal floor, are a good deal in the *Florentine* manner, being round-headed, with jointed or rustic archivolts, triple keystones, and facetted blocks for imposts, from which are carried down plain architraves that extend out below with a sweeping curve: one peculiarity is, that instead of the windows either descending quite down to the string course on which the composition forming their dressing rests, or having a balustrade or other parapet beneath them, there is a sort of large tablet just under each opening, whose lower edge is broken, it being deeper at the ends than in the middle. *Exceptis exceptandis*, that is, the two abominations before mentioned, the general composition is entitled to great praise; it bears the impress of an unaffected and noble *male* simplicity, and is of superior character as to *fenestration*,* in which last respect it is truly in the genuine Florentine gusto, there being only *five* windows on a line of 80 feet, and their openings being not quite one-third of the pier or solid between them. This excess—as it will no doubt be called—of solid over void, is, if it be an error at all, one on the right side, since be the design ever so faulty in other respects, it is sure to produce two valuable artistic qualities—breadth and repose.—Look, for instance, at the back of Exeter Hall: no one would think of quoting it as a piece of architecture, for it makes not even the very slightest pretensions to design, being in fact little more than a lofty mass of brickwork, with a range of a few windows in the upper part of it, nevertheless it is perfect dignity itself in comparison with many of the things which call themselves *façades*, some of them so drawn out and so completely *riddled* with windows that the external wall seems to consist of little more than the upright and transverse bars of a grating.

We regret that it was not thought necessary to show us the full complement of the drawings for the building, only four out of the six mentioned as forming the set being engraved. Yet the longitudinal section was indispensable, since without that we are left quite in the dark with respect to many circumstances. Neither would the corresponding or side elevation have been altogether superfluous, for though it may otherwise resemble the front, there must be considerable difference of character in one respect,—a difference, however, which it was no doubt considered prudent not to let us see, and perhaps thought we should not find out. Each of these side elevations (140 feet in length) has eight windows on a floor (excepting the ground floor which has only seven), and appears intended to form a regular front, yet, strange to say, the windows are very irregularly spaced, for at the end next the principal front the windows are only *four* feet from the angle, while at the other they are *twenty-two!* besides which they are not put at equal intervals from each other, some of the piers being much wider than others. What renders this disregard of even ordinary

* In the first volume of the Transactions of the British and Foreign Institute, lately published.

* We purpose making 'Fenestration,' ere long, the subject of a separate paper.

attention to regularity all the more striking is, that in order to make a front of each of these sides, a great number of blank or we suppose *sham* windows glazed like the others, are introduced, viz., six out of the eight in both the mezzanine and principal floor, thus making a total of twenty-four sham windows!! Notwithstanding this license and that taken in regard to spacing the windows, some of them come in very awkwardly in the interior, and in such a manner as utterly to destroy all symmetry: the hall, for instance, is chiefly lighted by one of the windows in the adjoining corridor, which is open to it; but instead of those windows being exactly on the line of the axis of that hall they are thrown out of it, so as to fall in the line of one of the two pillars forming the screen between the corridors and the ends of the hall. Much consideration does not appear to have been given to *bearings*, for there are solid walls carried from back to front across the ceilings of some of the ground floor rooms, of just the same thickness as the external walls! at least so they are shown in the plan. And yet, notwithstanding all the incongruities we have pointed out—nor are they the only ones that we detect—we are told that Mr. Tite not only heartily approved of the design—*quære* the design or intention of a building being erected—but actually executed the drawings, at least had them executed in his own office. Executed, no doubt, they were with the utmost scrupulousness and literal fidelity as to following *copy*; otherwise a few very much needed corrections would probably have been made in them. However, the design has answered our purpose better just as it is; and we dare say we have bestowed very far more notice upon it than it would have obtained from any one else, and so far it has been singularly lucky in having fallen under our inspection instead of that of one of those short-winded critics who would have dismissed it without saying more than that it was in the Italian style.

FALL OF THE BALLEE KHAL SUSPENSION BRIDGE, NEAR CALCUTTA.

At a time when public attention is directed to the subject of Suspension Bridges any information respecting the failure of so important a structure as the bridge over the Ballee Khâl cannot fail to be interesting. We are indebted to several correspondents for communications respecting the nature of the accident, from which we have obtained our information. In the *Mechanics Magazine*, in Oct. 1844, appeared the following account of the structure, accompanied by engravings, the wood cuts of which have been courteously sent us for the illustration of the present article.

"*Description of a Suspension Bridge on Mr. Dredge's principle, erected over the Ballee Khâl, for the Indian Government, from the designs, and under the superintendance of Captain Goodwyn, R.B.E.*

Fig. 1 of the accompanying engravings is an elevation of one-half of this bridge, and fig. 2, a plan of one-half of the superstructure.

Fig. 3 is an elevation in section of the principle parts of the other half of the bridge, showing the manner in which the chains are secured.

Fig. 4 is a plan of the foundations of the parts represented in fig. 3.

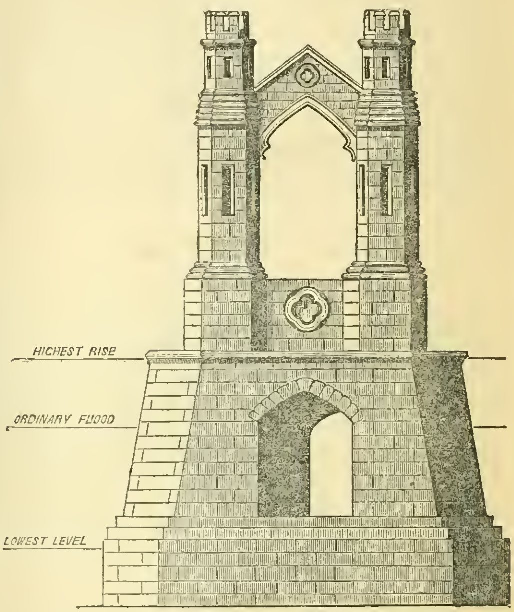
Fig. 5 is a tranverse elevation of the one of the piers on a larger scale than in fig. 1.

The Ballee Khâl is about four miles north-west of Calcutta. The bridge consists of a single curve of 250 feet span, with 18 feet width of the platform. The height of the points of suspension above the plank level, which is equal to the deflection of the chains, is 26 feet, or $\frac{1}{9\cdot61}$ the chord line nearly. The angle of suspension, is therefore about 19° 51′. The platform is supported by two main chains, one on each side of the bridge, composed of links of round bar iron $1\frac{3}{8}$ in. in diameter, and 10 feet long; there are 15 of these links resting on the towers at each point of suspension, and from thence at each joint the number is lessened one link, till at the centre the sectional area of the chain is reduced to two bars $\frac{7}{8}$th inch in diameter. The oblique suspending rods depend from the chains at each joint in pairs; they are $\frac{1}{4}$th of an inch in diameter, and the angles at which they are attached to the platform vary from 67°42′, to 10°, becoming more and more acute as they approach nearer the centre of the bridge. There are three pairs of these suspending rods at each point of suspension, which support 23 feet of the roadway at each end of the bridge, taking the weight thereof immediately to the tower link, without effecting the curve of the chains. Thus, $250-23\times2=204$ feet= the length of platform supported by the chains.

Now the tension at the points of suspension is equal to half weight (of bridge and traffic jointly taken at 128lb. per square foot) × cosecant of angle of suspension, or $\frac{197}{2}2\cdot94=289\cdot6$ tension, for which 45 square inches is allowed, and as the strain to which each bar was subjected before erection was 10 tons per square inch, there is a strength of iron sufficient to resist 450 tons.

The angle of the first auxiliary from the chain is double that of the first chain link, and the common difference of the whole series, is double that of the difference between any two consecutive links of the chain. The pull on the rods is thus as nearly as possible in the direction of their length, and the horizontal force is resisted through the horizontal line of the platform. The angle formed by the last link of the chain, and the horizontal, or central one, is 5°, and that of the centre auxiliary 10°, so that the last link bisects the angle formed by the centre link, the centre auxiliary, and as these forces are nearly equal, the last link is in the best possible position for preserving the equilibrium at the junction, and not allowing the centre link to be strained beyond its power.

Fig. .



The back chain forms a continued line from the rear bolt of the tower links at an angle of 25°, the section of iron being the same throughout as that of the tower links. The mass of masonry to which the chains are secured contains 7,000 cubic feet, which, with the completion of the parallelogram from the point where the back chains meet the road level, gives nearly 19,000 feet of resisting matter on each side, or about double what is due to the most severe tension.

Between the 2nd and 3rd links of the back chains are a series of adjusting loops and eyes, similar to those of the Menai Bridge, admitting of 4 inches correction.

Two back stays depend from the end of the rear tower bolts, and are together in power equal to the three pairs of auxiliaries, to complete the connexion between which and the back stays, bars are introduced or added to the tower links, coupling in with the oblique rods front and rear, and equalizing the bearing on the tower link bolts.

These stays are keyed behind cast plates abutting against stone at the base of the wing walls, and tend to assist in the support of the towers, as well as to counteract the effect of any violent pull on the tower links by a sudden weight impinging on the platform.

The level of the platform is 18 feet above the ordinary, and 10 feet above extreme flood rise, and is composed of two external longitudinal beams 5 in. by $\frac{7}{8}$ in., to which are attached, by means of cast boxes, the transverse beams of T-iron, (4 in. by $\frac{1}{2}$ in. web.) and (3 in. by $\frac{3}{8}$ in.

Fig. 1.

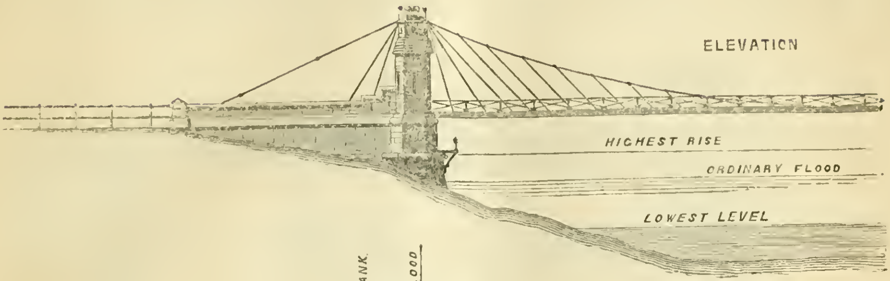


Fig. 2.

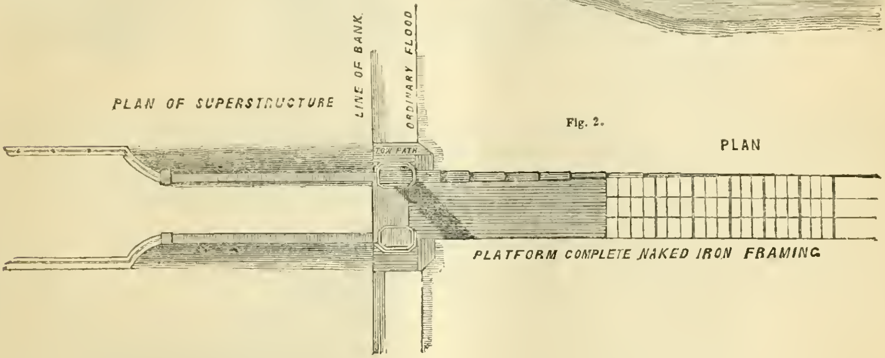


Fig. 3.

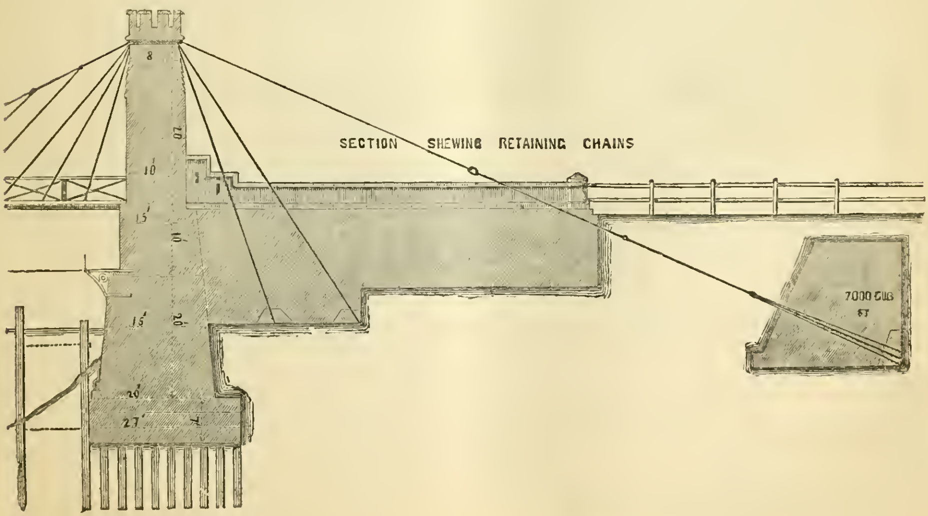
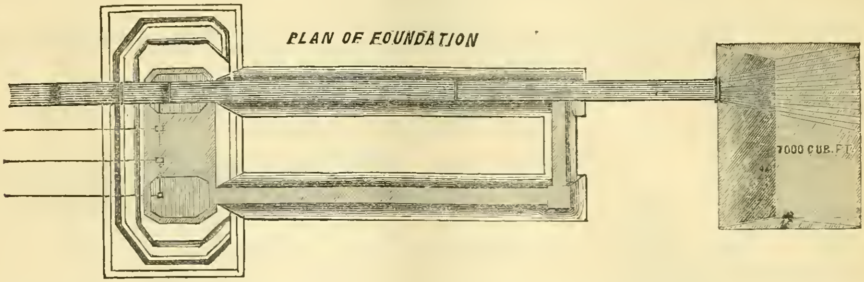


table) every third of which is trussed with a central rod of 1 in. diameter, and 4 rods of ¾ in. diameter. Through the cast trusses, or boxes, in which these rods are connected, pass two internal longitudinal beams, 4 in. by ¾ in., supporting the untrussed transverse beams, and reducing their length between the bearing points.

The planks are 3½ in. thick, teak timber, spiked down to the table of T-iron, and protected by metalling of Kunker, 4 in. thick.

Capt. Goodwyn, in a letter to Mr. Dredge, dated July last, observes, "With the assistance of a very able and first-rate mathematician here, I have studied the theory of these bridges most thoroughly: and the model that I have made, 22 feet long, and 4 feet width of platform, is on so large a scale, that I have been able to test it in every possible way, and it has withstood the utmost efforts to derange its parts. The Governor-General, and all the scientific people here, have perfectly

Fig 4.



satisfied themselves of the efficiency of the system, and all these proofs, with my models, assure me that the theory is correct.

It is in contemplation to erect immediately two other bridges on the same plan, one across the wet docks at Kudderpoor, near Calcutta, and the other over the Hoogly."

Without pledging ourselves to the accuracy of the theoretical calculations on which the method of constructing the bridge seems to have been based, we wish to call especial attention to that part of the description which states that "at the centre the sectional area of the chain is reduced to two bars ⅛th inch diameter." This statement appeared to us so surprising that we wrote to Mr. Dredge to ask for any explanation which he could furnish respecting it. The point is most important, as it appears it was at the centre that the bridge broke. Mr. Dredge favored us with the following reply:—

Mr. Dredge presents his compliments to the Editor of the Civil Engineer and Architect's Journal, and in answer to his enquiries begs to say that the extract he quotes from the Mechanic's Magazine is a misprint, it should have been "is reduced to two bars each 1⅜ in. in diameter." And by referring to Capt. Goodwyn's specification he also sees an error with next sentence, where it is stated "they are ¼ in. in diameter," it should have been "they are 1¼ in. in diameter. The first of these errors is of but little consequence, because as there is no strain at the centre, no iron is absolutely required there, and consequently two bars of ⅛ in. would be as efficient, if the bridge were constructed properly, as ten of 1⅜ in.; the latter one is of more importance and ought to have been corrected at the time.

We have also received some valuable information from Mr. Guppy, of the Great Western Iron Ship Works, Bristol, who has sent an account of the supposed causes of the fall of the bridge which he received by the same overland mail that brought the news of the accident. He has furnished us also with copies of some sketches sent to him at the same time. The following engravings from these sketches materially tend to the explanation of the subject.

We rode over the bridge an hour after it was finished, and within three days it tumbled down.

After the ironwork of the bridge was completed, 3 inch teak planks were laid on the bearing bars—these bearing bars, 6 inches deep and ⅝ inch thick, having previously been keyed into strong cast iron blocks built into the abutments; over the teak planks a flooring of bricks, was laid flat; and over this 4 inches of stone concrete were laid. But the workmen began to lay the planks at one end, and others followed up with the bricks and concrete, so that before the last third was planked the first third was fully leaded. The consequence was that the bridge assumed this shape—

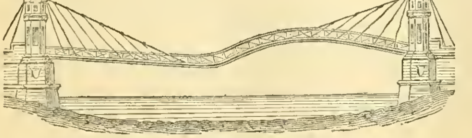


Fig. 5.

—which they attempted to reduce by commencing to load at the other end and cutting the bearing bars loose from the blocks. By this and various expedients they finally got the roadway tolerably level, but the bridge still showed twists in many places, particularly a dip in the middle. It was, however, considered safe, and preparations were making for a ceremonious opening when it suddenly fell. Fortunately only one boy was on it, who jumped into the river and swam ashore. It appears to have parted in the middle, as its appearance afterwards was—

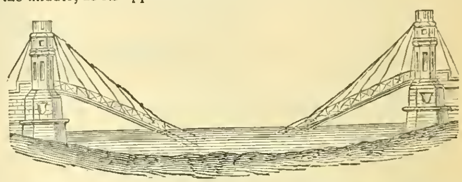


Fig. 6.

We will last insert in this place a paper from Mr. Dredge, (though in part referring to the strictures published by Mr. Bashworth) in order to bring together all the information we we have received respecting the Ballee Khâll Bridge. Our thanks are due to Mr. Dredge for his readiness to give all the information he possessed on the subject.

Sir—I am not at all anxious to defend Mr. Turnbull's Treatise, I have no interest in common with it, and what I said in my last letter was no more than under the circumstances was in justice due to the author. I should quite agree with you Sir, that the whole would be obviously beyond all defence, if the charge of such absurdities were correct, but I am sure no one after a perusal of page IV, would accuse Mr. Turnbull of such rediculous blunders. I am aware of the objections against the treatise, and of the imperfect solution of the problem, but considering the difficulties (as regards data, &c.) under which the author in 1841 must have laboured, I think censure in 1845 might have been spared. I have said this much because it was the first essay, and the author's endeavours deserve to be viewed with some leniency on this account. As I am not at all interested in this treatise, I do not compromise my position by having said what I have.

You observe the question at issue, is, are "Mr. Dredge's bridges stronger weight for weight, than those of ordinary construction." This point has been so often proved by practice, and demonstrated by experiments and calculations, that I thought no doubt existed upon it. If a strain equal to 1875 tons be removed from the centre of the chains of such a bridge as the Menai, the section of iron to resist this may be taken away also, thus not only reducing the quantity of material, but increasing the absolute strength of the bridge in extent equal to the weight of that material. You may inquire what has been done with this enormous horizontal force? Why, the greater part is altogether vanished by the reduction of material at the centre, and the rest is transferred to, and diffused over the whole horizontal line of platform, where it becomes essentially serviceable for the stability of the structure, by producing a rigidity of the platform without injuring its transverse strength to resist the transit loads.

Fall of the Bridge at Calcutta.

In your notes to correspondents, you inquire if any one can give you information of the bridge that has lately fallen at Calcutta. What little I know of the affair is very much at your service. In a letter I received from Captain Goodwyn, R.B.E., dated Fort William, July 10, 1844, he says, "On the receipt of this apply to the London office of the Peninsular and Oriental Steam Navigation Company, and you will receive a tin case, in which are tracings of two taper chain bridges, with specifications, &c. The one a single curve of 250 feet span, is now erecting, and will shortly be completed." The other, &c.—Again, in same letter—

"I want your candid opinion on my performances, and do not imagine that it is likely to detract from your employment, my making some here, for the system is now thoroughly established here, and we want so many that in a short time I hope to send you a large order." The bridge of 250 feet span was described in the specification to cross the Ballee Khall, near Calcutta.

A tracing of the drawings and a copy of the specification were made in my office, and afterwards published in the Mechanics' Magazine for the 19th of October last. Since then nothing has been said of this bridge, nor had I heard a word on the subject until the late Overland Mail brought news of the failure of a suspension bridge across the Ballee Khall, near Calcutta, which, as place and dimensions correspond, I presume to be the same, although I have had as yet no direct information about it. I cannot therefore give you any particulars of the accident, but all the reports agree in ascribing it "to an error of the contractor, which does not in any degree effect the principle upon which the bridge was built." This is so far very satisfactory, though even without it I should not have been at all anxious on the subject, for I could in no ways be responsible for errors committed several thousand miles off, especially as I had not at all interferred with the works.

I remain, your's, very obediently,

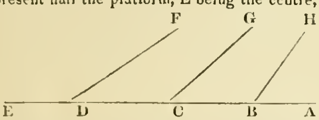
JAMES DREDGE.

Bath, September 3, 1845.

On the whole the main question for consideration seems to be this—whether in a suspension bridge 250 feet long, "two bars each $1\frac{5}{8}$ inches in diameter could by any arrangement be made to support and hold the centre with sufficient security. It can scarcely be supposed but that there is *some* limit, beyond which, if the reduction of the thickness of the central bars be carried, the security of the structure would be endangered. If there be *no* limit of this kind, then we must come to the conclusion that the bridge *might* be so constructed that there should be *no* tension at the centre; that is, that the bridge might be divided at the centre without falling. In this case the platform instead of a tension or strain, must exert a *thrust* to keep the chains in their places.

There is one point in Mr. Dredge's letter which we wish to notice. He says that the central strain "is transferred to and distributed over the whole horizontal line of the platform." If by the phrase "transferred" be meant that the tension at the centre is lessened or removed, we must with submission call the doctrine in question.

If A E represent half the platform, E being the centre, and this half



be acted on by tensions along D F, C G, B H, then by the ordinary rules of statics the horizontal force at E necessary for statical equilibrium is equal to the sum of the horizontal parts of these tensions. To express the same thing analytically, if the oblique tensions be called T_1 T_2 T_3 respectively we have, resolving forces horizontally

Tension at $E = T_1 \cos FDA + T_2 \cos GCA + T_3 \cos HBA$.

This is indisputable to the merest tyro in theoretical mechanics; unless, indeed, we suppose parts of platform to exert thrusts instead of tensions, in which case the statement that the tension is diffused out the platform becomes self-contradicted.

MODERN GREEK FRESCO PAINTING.

There are on Mount Athos twenty large monasteries, two hundred and fifty hermitages, and nine hundred and thirty-five churches, chapels and oratories. All these edifices are painted in fresco, and possess pictures on wood. From this source arise the artists of Greece. M. Didron, in his *Manuel d'Iconographie Chretienne*, gives an interesting description of these painters at their work.

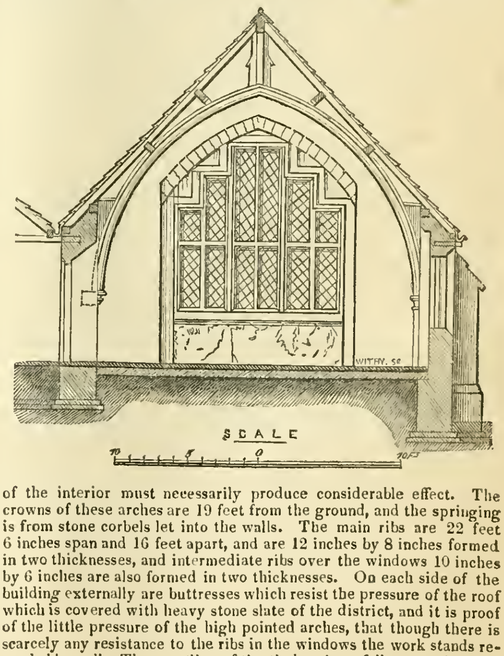
"The first convent which we entered," says he, "was that of Esphigmenou. From the great church just built the scaffolding was not yet removed. A painter of Karès assisted by his brother, two pupils and two apprentices was covering with historical frescos the whole of the inner porch of the nave. I ascended the scaffold on which were the master painter and his assistants, and watched the progress of the work. The brother spread the mortar on the wall, the master sketched the picture, the first pupil filled in the lines which the master had not time to finish, the younger pupil gilded the glory round the saints' heads and painted the inscriptions and ornaments, the two others who were younger mixed the colors. The master painted or sketched from memory or inspiration. In one hour he traced before our eyes on the wall a painting representing our Saviour giving to his apostles the mission to preach the gospel and baptise. The Christ and the eleven other figures were almost of the natural size; they were designed and drawn from memory without any model or rough sketch. While examining the other pictures I asked him if he had executed them also. He replied affirmatively.

We were astounded, for the paintings were far superior to those of our own second-rate artists who paint religious subjects. The painter astonished me by the powers of his memory; he not only finished his designs without rough sketches of any kind, but I heard him dictate to the second pupil the inscriptions and sentences which were to accompany each picture. He recited without notes or book, and all was rigorously the text of the sentences which I had observed in Attica, in Peloponessus, and at Salamis. I expressed to him my admiration, but my surprise greatly astonished him, and he replied with what I thought rare modesty, that it was all very simple—much easier than I thought for; and then he quietly resumed his task."

HORBURY SCHOOL,

Near Wakefield, Yorkshire.

The annexed engraving exhibits the construction of the roof, and the design of the end windows of a National School lately erected at Horbury, near Wakefield, under the superintendence of Mr. R. Sharp, architect. We are indebted to him for several drawings of the buildings, but we have selected the transverse section as it exhibits the principal features of the construction. The design appears to be a pleasing and satisfactory proof that architectural effect does not necessarily involve great expenses. The building cost £800, and the repetition of the high arched molded ribs throughout the length



of the interior must necessarily produce considerable effect. The crowns of these arches are 19 feet from the ground, and the springing is from stone corbels let into the walls. The main ribs are 22 feet 6 inches span and 16 feet apart, and are 12 inches by 8 inches formed in two thicknesses, and intermediate ribs over the windows 10 inches by 6 inches are also formed in two thicknesses. On each side of the building externally are buttresses which resist the pressure of the roof which is covered with heavy stone slate of the district, and it is proof of the little pressure of the high pointed arches, that though there is scarcely any resistance to the ribs in the windows the work stands remarkably well. The scantling of the timbers is as follows: principals $6\frac{1}{2}$ inches square, plate 7×5, rafters $3\frac{1}{2}$ by 3 inches, thickness of walls 2 feet 6 inches, with buttresses 2 feet projection and 2 feet on face.

GOETHE'S ITALIAN TRAVELS.

Translated for this Journal by J. Lhotsky, Ph. Dr.

"Ingenio vivimus—cetera mortis erunt."

[Goethe undertook his travels in Italy in 1786, 87 and 88. His letters, containing his journal, were addressed to the Grand Ducal family of Saxe Weimar, amongst which Herdes and Wieland were living as members. The whole was not published until 1817, and is much appreciated in Germany. In England Goethe is comparatively little known, except as a poet, but his artistic talent has been fully appreciated by his countrymen. He for many years superintended the public works of Saxe Weimar.]

[Perugia, Oct. 25, 1786.*] I knew from Palladio and Volkmann that a beautiful temple of Minerva, built in the time of Augustus, existed yet in perfect preservation. I left, therefore, near Madonna del Angelo, my vetturino, who pursued his way towards Foligno, and ascended in a heavy gale the hill of Assissi, because I was longing to make a pedestrian excursion through a world so lonesome to me. The immense substruction of the several churches, heaped Babylon-like one upon another, where St. Francis reposes, were to the left.—I then asked a pretty lad for Sta. Maria della Minerva; he conducted me up to the town, which is built on the slope of a hill. In fine, we reached the properly so-called town;—and lo! the most praiseworthy work stood before my eyes, the first complete monument of olden time which I ever saw. A modest temple, it is true, as it suited such a small town; still, so perfect, so beautifully conceived, that it would shine everywhere. First, of its position. Since I have read in Vitruvius and Palladio, how towns are to be situated, how temples and public edifices are to be placed, I have a great reverence for such things. In this, also, the ancients were so great in their adherence to the natural. The temple is situated on the middle part of the mount, just where two slopes of hills meet, on a place which even now is called *la Piazza*. This rises a little onwards, and is the centre of four roads, which form a very oblique St. Andrew's cross, two from upwards two from below; probably the houses which stand opposite the temple and bar the whole prospect, did not exist in olden times. If we remove them in our fancy, the richest prospect is opened towards the south, and Minerva's sanctuary could be seen from all sides. The laying out of the streets, however, may be ancient, because they result from the shape and inclination of the hill. The temple does not stand in the middle of the piazza, but is so placed that it will appear in a beautifully fore-shortened shape to those coming up from Rome.

I could not enough admire the facade. The order is Corinthian; the distance of the columns somewhat more than two models. The bases and the squares of the columns underneath seem to stand on pedestals—they *seem*, only; because the socle is five times cut through, and each time five steps pass between the columns, so that we reach thence the plane on which the columns stand, and enter the temple. The attempt of cutting the socle was here in its right place, because, as the temple stands on a slope, the flight of stairs leading thereto would have been too much prolonged forward, so as to encroach on the space. How many steps there may have been underneath, we cannot ascertain; they are, except a few, covered with *débris*, and paved over. With difficulty could I quit the scene, and I decided on calling upon architects to procure us an exact plan. Because I also had occasion to remark this time, what uncertain things the reports of others mostly are. Palladio, to whom I trusted entirely, gives us, it is true, a view of this temple, but he could not have seen it himself, as he placed real pedestals on the plane, whereby the columns come to be placed too high, so as to make an ugly Palmyrean monster of it, whereas, in reality it exhibits a quiet, lovely sight, satisfying the eye and reason. What I felt in the mere viewing of this work, cannot be stated in words, and will leave a lasting impression. I descended, on the finest evening, the Roman road, completely quieted in my mind.

Venice; Oct. 1786.—I went to-day, with my guarding angel, on the Lido, the slip of land that shuts up the Lagunes, and divides them from the sea. We left the boat, and went across the tongue of land. The sea mounted high towards the shore, it was noon-time of low water. On the Lido, not far from the sea, Englishmen are buried, and further on, Jews, as if both should not lay in sacred ground. I found the grave of the noble Consul Smith, and his former wife; I owed to him my copy of Palladio, and thanked him on his unsacred grave: and not only unsacred is the grave, but ha f covered.

October 9, 1786. A delicious day, from morn to night! I went as far as Palestrina, opposite Chiozza, where the great constructions are, called *Murazzi*, which the Commonwealth has caused to be erected against the sea. They are of hewn stone, and destined to protect the long slip of land, called Lido, which divides the Lagunes and the sea, from the encroachments of the wild element. The Lagunes are a work of nature; an extended tract of bog is found on the upper end of the Adriatic, which, visited by high water, is left partly uncovered by the ebb. Art has taken hold of the highest spots, and thus lays Venice, grouped together by a hundred isles, surrounded by a hundred. Deep channels have been furrowed in the bog, with astonishing trouble and cost, for the sake of being able to reach, even at low water, some place with ships of war. What human skill and labour have invented and executed in times of old, prudence and industry must now preserve. The Lido, an extended slip of land, divides the Lagunes from the sea, which cannot enter but at two places, namely, at the Castello, at the opposite end, at Chiozza. It would be quite different if the sea were to seek new channels, and abrade the slip of land, passing arbitrarily to and fro. Not to take into account that the little places on the Palestrina, St. Peter, and others, would be destroyed—those channels of present communication would be obliterated, while the water would altogether convert the Lido into islands, and the isles now laying behind into slips of land. To prevent that, they must preserve the Lido as much as they can, that the element may not continually attack and alter that which men have already taken possession of, to which, in fine, they have for a certain purpose, given form and shape. In extraordinary cases, when the sea rises to an overwhelming height, it is especially useful that it cannot enter but at two places, and that the remainder is shut up; it can, consequently, not enter with its main strength and violence. However, Venice has nothing to fear, the slowness with which the sea decreases, gives her many thousands of years truce. To-day I went on the steeple of St. Mark; because, as I had seen the Lagunes in their splendour at the time of high water, from above, I wanted also to see them in their state of humility at the time of ebb, and it is useful to combine both these sights. The mural constructions erected against the sea consist first of some steep steps; then comes a slightly sloping plane; then another step, and again a slightly sloping plane; then a steep wall, with an overhanging cornice. On those steps and planes ascends the flooding sea, until, in extraordinary cases, it bursts at last on the wall and its protruding part.

October 2, 1786. Before all, I hurried into the *Carità*; as I had found, in the works of Palladio, that he had here projected a monastic building, in which he intended to represent the private dwellings of the rich and hospitable ancients. The plan, excellently drawn, even in its details, had caused me the greatest pleasure, and I expected to find a miraculous work; but, lo! there is hardly the tenth part finished. Still, even this portion, worthy of his divine genius, has a completeness in the conception, and a finish in the execution, of which I had no idea. Years ought to be passed in the contemplation of such a work. I believe that I have seen nothing more elevated, nothing more perfect.

The church existed previously. Thence we enter a vestibule of Corinthian columns; one becomes enwrapt, and forgets at once all priestcraft. At one side is the vestry, on the other a room for the chapter, at the side the finest winding staircase in the world, with an open wide newel, the stone stairs built in the wall, and so arranged that one supports the other. One does not tire to go up and down; and how well it has turned out may be judged from Palladio himself mentioning it as well done. From the vestibule we come in the inner large court. Of the buildings which had to enclose it, unfortunately only the left wing is completed. Three orders of columns are one above the other, on the ground floor are porches, on the first floor arcades along the friars' cells. The upper story consists of a wall with windows. But such description must be completed by the view of the plans. Now a word on the execution.

Only the capitals and the bases of the columns, and the cloisters are of hewn stones; all the rest is, I dare not say, of bricks, but of burnt clay. Such bricks I did not know before. The friezes and cornices are also of the same, the tops of the arches also, all formed in pieces, and then the whole only united with a little lime. It is as if cast in one piece. If the whole could have been completed, and we were to see it cleanly rubbed and coloured, it would have been a divine sight.

The conception, however, was too great, as in so many buildings of modern times. The artist had not only supposed that the present monastery would be broken up, but also that adjoining houses would be purchased; and for so doing money and patience ran short.

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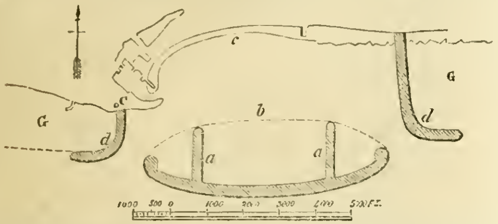
* Italienische Reise, vol. i.

HARBOURS OF REFUGE AND DEFENCE.

By John Rooke, Esq., Author of *Geology as a Science.*

Harbour in Dover Bay.

Admitting given exceptions, proposed to be answered in this article, the Harbour Commissioners have most justly recommended the construction of a Harbour of Refuge in Dover Bay, with a pier run out on the West from Cheesman's Head into 7 fathom of water, along with works finally enclosing 520 acres up to low water mark, or 380 acres without the two fathom line. Yet Sir William Symonds with equal justice dissents from this report "because" he "cannot recommend a close harbour at Dover, where the pilots consider the holding ground generally indifferent; and the engineers say it will silt up." Looking nevertheless to Dover as a harbour of refuge, defence, and offence, it becomes exceedingly desirable that the defects connected with a national work, as stated by Sir William Symonds, should be satisfactorily reconciled. Moorings may be amply provided for; and the harbour proposed should not be left a mere shingle trap. But this objection should be repaired by the construction of a pair of traps one on its Western extremity, and a corresponding one on the eastern side thereof, as shown in the diagram here annexed, *d d*. With these



provisions admitted, we shall find the leading incidents at Dover, speaking in a physical sense, admirably adapted to the construction of a complete harbour of refuge, provided the work required were effectively completed. This subject is capable of the most distinct illustration in physical experience.

Action of Silt and Shingle.

As geological results, we find along the Southern and Eastern shores of Great Britain, from Torbay to Saint Abbs Head, no portion of the coast free from and untroubled by masses of moving silt and shingle, attributable to the debris dropping from various projecting cliffs along this sea line, composed as they are of the newer orders of fossiliferous strata, in connexion with silt carried to the sea by the several land streams within these given points of coast. In proof of this, none of the coast from Land's End to Exemouth, where the older rocks obtain, more free from silicious debris and mouldering materials than the newer fossiliferous strata, is liable to either barred rivers or the objection of moving silt and shingle, perplexing harbour construction by artificial means.

Among the remarkable instances shown experimentally, the rivers Tamar and Plym, the Fal, the Dart, the Fowey, and the Avon, may be fairly stated in illustration of the theory here brought into view. On this line of coast, indeed, not only rivers inconsiderable in their volume of back water, but even streamlets, offer favourable incidents for harbour construction. Not to say that such facilities are eminently geological in their structure, as well as adequately freed from silt and beaches of drifting shingle. But the instant we go eastward of Torbay, to the river Exe, a considerable stream mainly from off new red sandstone, we not only find the channel of navigation barred, but perplexed by shifting sand banks; and this is almost uniformly the rule up to Saint Abbs Head. Geology, as a science depending on physical laws, accounts for the prevalence of such a rule undeniably.

These proofs show that any coast with an adequate depth of water inshore, where silt and shingle are not driven along shore by the scour of tides and the violence of winds, may be favourable to the construction of secure and permanent harbours. But such materials do pass along the coast at Dover, and insomuch Dover is ineligible on ordinary means for the construction of a harbour of refuge; on the other hand, effectually check and stop the movement of silt and shingle along the coast from off Dover, and it becomes decidedly favourable for the construction of the necessary works required. Hence, I would suggest an elongation of the pier resting on Cheesman's Head, and bent Westward, as shown in the accompanying diagram, *a a*, so as to afford an efficient shingle trap, which, combined with a similar form on the Eastern extremity of the harbour, as given in the diagram referred to, would arrest the course of silt and shingle drifting along shore, and prevent a silting up of Dover Harbour, as contended by the engineers referred to by Sir William Symonds.

Efficiency of Shingle Traps.

It may be said that such shingle traps would be liable to beach up. True. Yet the very admission of the fact proves their efficiency, and points out a direct remedy in their ready and progressive elongation in correspondence with results; probably enough eventually providing the groundwork of a military railway along shore, and bearing moveable batteries to any point of the adjacent coast assailed by foreign invaders. For the construction of an artificial beach might be comparatively easy, when the resting point of such a structure were efficiently laid. In this respect Dover is pre-eminently advantageous for the artificial attainment of a harbour of refuge. The heights already fortified would command and protect such a line of railway; and batteries might be then formed on the Western and Eastern piers at *d d*, when beached up on their open sides, for the protection of the entrances of the harbour; besides the facility of speedily embarking troops under the extended works and results here suggested, promising an expectation eventually that a breakwater alone should lie within the range of flowing and ebbing tides in advance of Dover Harbour.

Hence the problem of its form involves the highest resistance against the violence of tides, by the application of the weakest works advisable; effective strength being thereby brought more fully within available means. It is proposed that the breakwater shall, in the form of a ship, hold its extremities to the flowing and ebbing tides, so that the moving body of waters be merely divided, instead of being stemmed and repelled as in the instance of the Plymouth Breakwater; rather balancing than restraining the tidal waters, and producing an easy diffusion of those waters within the area of the harbour, so as to preserve a scour amidst gentle eddies drifting each vessel to its berth, in place of violent rebounds arising from directly lineal action on abutting points. By the two inner jetties, *a a*, resting on the breakwater it is proposed to equalize and protect the moving waters within the harbour during the action of flowing and ebbing tides, and direct a light scour from the convex range of the deep water and dotted line *b*, on the inshore and concave form of the shallow water line c. The form of the Western and Eastern piers at *d d*, would contribute to steady and ease the water at the two entrances. It may be, however, said that the jetties, *a a*, are not essential to the scheme. Granted: yet the equal distribution of scour they would provide for, the strength they would add to the breakwater, and the security they gave to the best portion of the harbour, would seem to recommend them eventually. They may be said, indeed, to be essential to the physical balance and diffusion of waters within the harbour; and therefore form a leading feature in the scientific balance of smooth and yet gently flowing waters, drifting vessels into the centre of the harbour, and next disposing of them around a deep and central anchorage. Perhaps a single jetty in the centre might answer equally well; still the problem they involve is one of vast moment in harbour engineering.

In conclusion, it would be useless to construct a little harbour at Dover;—none of the leading conditions admit of a successful prosecution of such a scheme. It would be equally ill-advised to construct a harbour incomplete in details;—a mere shingle trap would be the result. The ground would be better as it is, than disturbed by projecting points producing little benefits and great evils. Once begun, the entire works should go on vigorously, lest shingle were brought into the bay and stuck there ere the two extreme traps were completed. With the anchorages of Dungeness and the Downs, Westward and Northward of Dover, an artificial harbour there would add another trophy of Art combined with Nature to the many national blessings we enjoy. Dungeness as a splendid anchorage and a great shingle trap, so justly admitted as geological in its structure by Sir John Rennie, it would be exceedingly ill-advised to lay the imperfect hand of Art upon as a corrective of the perfect laws of Nature. It is there the natural tides overlap each other, Westward and Eastward; the result is a huge deposit of shingle on the side of England, whilst it is driven eastward on the side of France from Cape Blancnez. Pevensey Bay is another of these natural deposits of shingle on the side of England; and Pegwell Bay also. These deposits should be promoted by artificial works adapted to their purpose, as the sure mode of improving the channels of navigation. Little groins, like little harbours, are next to useless. A large groin bearing on Dungeness from the westward of Folkestone —a pier composed of loose stones, and a second commencing at the cliffs eastward of Hastings bearing on Beachy Head, would stop the progress of shingle drifting along the coast, and provide two additional harbours, which, accordingly as they beached up, might be elongated indeterminately, providing at the same time advanced batteries on the waters of our shores. This pair of groins need be begun only to be continued at a future day; whilst the river Stour carried through Ramsgate Harbour would form a third great shingle trap in Pegwell Bay, and scour that highly valuable harbour effectively.

PRACTICAL PROBLEMS

IMPORTANT IN PLANE TRIGONOMETRICAL SURVEYING.

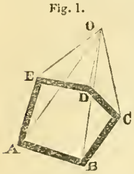
By Professor Oliver Byrne, Mathematician.

The common phrase, "Things that are really useful are always simple," is far from being generally true; people do not like to give themselves the trouble to understand a subject that may appear a little compound, in fact, that which appears difficult, whatever may be its usefulness or excellence, often falls into disuse, especially if one of those simple, clumsy substitutes be convenient. The truth of the foregoing observations will be readily admitted by the mathematician, and a more striking illustration conld not be given than that afforded by the class of problems which is here arranged under the title "*Plane Trigonometrical Surveying*" and will be found of great use to the practical surveyor, if only in the way of tests; the principles upon which they are based are simple, and may be explained as follows:—

Proposition I.—If any number of lines A, B, C, D, &c., be drawn, the ratio compounded of the ratios of A : B, B : C, C : D, &c., continued in order to A, is a ratio of equality: or which is the same thing, when each becomes an antecedent and a consequent, taken in the above-mentioned order, the continued product of the antecedents is equal to the continued product of the consequents.

Proposition II.—If triangles be formed by joining in succession the extremities of the lines of any contour and any point O, fig. 1, the continued product of the sines of the angles opposite the antecedents is equal to the continued product of the sines of the angles opposite the consequents taken as in the first proposition.

Fig. 1.



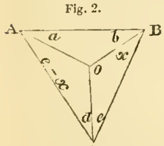
O A : O B : : sin O B A : sin O A B
O B : O C : : sin O C B : sin O B C
O C : O D : : sin O D C : sin O C D
O D : O E : : sin O E D : sin O D E
O E : O A : : sin O A E : sin O E A

Because by the first proposition the product of the first antecedents is equal to the product of the first consequents; therefore, the product of the second antecedents must be equal to the product of the second consequents. Or, sin O B A × sin O C B × sin O D C × sin O E D × sin O A E is equal to sin O A B × sin O B C × sin O C D × sin O D E × sin O E A, which are the sines of the angles subtended by the lines drawn from the point O, alternately taken. If from the angular points of any rectilineal contour right lines be drawn to any point O, a ratio of equality will exist if, instead of the ratio of any two consecutive lines, the ratio of the sines of their opposite angles be substituted; or if, instead of the ratio of the sines of the angles, the ratio of the lines be substituted, the ratio of equality will also exist. It is often convenient in practice to deal with the angles and at other times with the lines; with the latter especially when two points or more fall in a line drawn to the point O, and with the former when more than two lines are drawn to the point O, from points given in the same right line.

Examples.

(1.) The distance between two stations A and B, fig. 2, is known (26105 feet); C and O are stations in the same plane with A and B; the known angles are—O A B = a = 23° 29′, O B A = b = 35° 27′, O C B = c = 19° 9′, O C A = d = 35° 51′. Required the remaining angles and the distances O A, O B, O C, A C, and B C. Let 26105 = m, angle O B C = x; then will angle O A C = 180 − a − b − c − d − x = e − x, by making $e = 180 - a - b - c - d$ = 66° 4′. Then, by the last proposition, O A : O B = sin b : sin a, O B : O C = sin c : sin x, O C : O A = sin $(e-x)$: sin d. ∴ sin b sin c sin $(e-x)$ = sin a sin x sin d, by prop. 2.

Fig. 2.



But sin $(e-x)$ = sin e cos x − cos e sin x. ∴ sin b sin c (sin e cos x − cos e sin x) = sin a sin d sin x.

Hence sin b sin c sin e cos x − sin b sin c cos e sin x = sin a sin d sin x. By dividing by sin x, and transposing, &c., we have

$$\cot x = \cot e + \frac{\sin a \sin d}{\sin b \sin c \sin e}$$

∴ cot x = cot e + sin a cosec b cosec c sin d cosec e. Therefore to find the value of x we have the following

Practical Rule.—*Add together the logs of the sine of a, of the cosecant of b, of the cosecant of c, of the sine of d, and of the cosecant of e; the natural number corresponding to this sum, rejecting 50 in the index, added to the natural cotangent of e, will give the natural cotangent of x.*

sin a = sin	23° 29′	.. ..	log = 9·6004090
cosec b = cosec	35° 27′	.. ..	log = 10·2365778
cosec c = cosec	19° 9′	.. ..	log = 10·4840700
sin d = sin	35° 51′	.. ..	log = 9·7676494
cosec e =	66° 4′	.. ..	log = 10·0390452
			50·1277514

The natural number corresponding to ·1277514 of a logarithm = 1·3419970
to which if nat cot of e = 0·4438352

be added we have .. .. .. 1·7858322
= the natural cotangent of x = 29° 14′ 50″
∴ e − x = 36° 49′ 10″

When x is obtained, the other linear and angular distances may be easily determined by the rules of plane trigonometry. O A = 17676·01 feet; O C = 18087·388 feet; A C = 28810·93 feet; B C = 27682·2 feet.

(2.) From the first of four stations, figs. 3, 4, 5, in the same plane, the angular and linear distances of the second and third stations are known, as well as the angular distances of those three stations observed from the fourth. Determine the remaining linear and angular distances of those stations. In any way this problem may be taken,—the first station is the best for the point O, round which, as before, when we have particularized the distances, we shall compare the ratios.

Fig. 3.

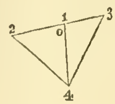


Fig. 4.

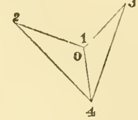
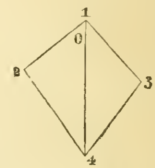


Fig. 5.



The linear distances from 1 station. 1, 2, = 3755 feet = n; 1, 3, = 4600 feet = m. Angular distances at 4 station. 2 4 O = 44° 33′ = a; O, 4, 3, = 55° 17′ = b. And the angular distance at station 1, in fig. 3, or ∠ 2 1 3 = 180° 0′; in fig. 4, ∠ 2 1 3 = 232° 16′; in fig. 5, ∠ 2 1 3 = 127° 44′. It is required to find the linear distances of 2, 4; 4, 3; and 4, 1; as well as the angular distances 1 2 4 and 1 3 4. Supposing A, B, and C, to be at the stations 2, 4 and 3.

Put the angle O C B = x, then will O A B = 360 − a − b − c − x = d − x, making d = 360 − a − b − c = 80° 10′ (fig. 3); = 27° 54′ (fig. 4); = 132° 26′ (fig. 5).

Then, as usual, O A : O B = sin a : sin $(d-x)$
O B : O C = sin x : sin (b)
O C : O A = m : n

∴ m sin a sin x = n sin b sin $(d-x)$; but sin $(d-x)$ = sin d cos x − cos d sin x.

∴ m sin a sin x = n sin b (sin d cos x − cos d sin x)

Dividing by sin x we have,

$$m \sin a = n \sin b\,(\sin d \cot x - \cos d)$$

$$\therefore \cot x = \frac{m \sin a}{n \sin b \sin d} + \frac{n \sin b \cos d}{n \sin b \sin d}$$

$$\cot x = \cot d + \frac{m}{n} \sin a \operatorname{cosec} b \operatorname{cosec} d.$$

Which expression in words gives the following—

Rule.—Add together the sub log of n, the log of m, the log sine of a, log cosecant of b, and the log cosecant of d; the natural number corresponding to this sum, when a proper allowance is made in the index, added to the natural cotangent of d will give the natural cotangent of x.

n	= 3755	.. ..	sub log	= 6·4253201
m	= 4600	.. ..	log	= 3·6626578
sin a	= sin 44° 33′	.. ..	log sin	= 9·8460471
cosec b	= cosec 55° 17′	.. ..	log cosec	= 10·0851396
cosec d	= cosec 132° 26′	.. ..	log cosec	= 10·1319066
				40 1512510

Rejecting 40 in the index we have ·1512412, to which log the natural number 1·41658 corresponds. The natural cotangent of d = nat tan 42° 26′ = ·9141929, which is negative.

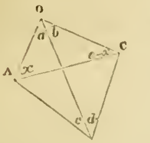
∴ from 1·4165800 take ·9141929, the natural cot of x = ·5023871.

∴ x = 63° 19′ 32″, fig. 5; = 13° 38′ 9″, fig. 4.

When these two cases are understood there can be no difficulty in finding x in fig. 3, as it is a mere repetition of the last case with the exception of taking d = 80° 10′

(3.) The distance between the second and fourth of four stations, fig. 6, taken in the same plane, forming a trapezium, (as in the next diagram,) together with the angular distances taken at the first and third stations, measured from an unknown diagonal, being given to find the remaining linear and angular distances connecting those stations. In this problem the best position for the point O, is the second or fourth station.

Fig. 6.



Let A be the 1st station, B the 2nd, C the 3rd, O the 4th; and the angle O A C = x, angle A C O then will = $180° - a - b - x$, or $e = 180 - a - b$, $c = 108° 15'$. Having thus far premised we shall now apply the general proposition.

$$O A : O B :: \sin O B A : \sin O A B :: \sin c : \sin (a+c)$$
$$O B : O C :: \sin O C B : \sin O B C :: \sin (b+d) : \sin d$$
$$O C : O A :: \sin O A C : \sin O C A :: \sin x : \sin (e-x)$$

$\therefore \sin c \sin (b+d) \sin x = \sin d \sin (a+e) \sin (e-x)$. $\therefore \cot x = \cot e + \operatorname{cosec} (a+c) \sin (b+d) \sin c \operatorname{cosec} d \operatorname{cosec} e$. From which we have the following practical logarithmic

Rule.—Add together the log cosecant of $(a+c)$, the log sine of $(b+d)$, the log sine of c, the log cosecant of d, and the log cosecant of e: the natural number corresponding to this sum, when a proper allowance is made in the index, added to the natural cotangent of e, will give the natural cotangent of x.

Given—Lineal distance from 1st to 3rd station, A C = 19712 feet = n.

Angular distances at 2nd station, A O B = 39° 47′ = a; B O C = 31° 58′ = b.

Angular distances at 4th station, A B O = 25° 17′ = c; O B C = 36° 25′ = d.

To find x.

log cosec $(a+c)$	= log cosec 65° 4′	= 10·0424890
log sin $(b+d)$	= log sin 68° 23′	= 9·9683285
log sin c	= log sin 25° 17′	= 9·6305243
log cosec d	= log cosec 36° 25′	= 10·2264673
log cosec e	= log cosec 108° 25′	= 10·0224140

Rejecting 50 — 49·8902231

we have $\bar{1}$.8902231, which corresponds to 0·776646 of a natural number. Now, the natural cotangent of e = nat cot of 108° 15′ = nat tan of 18° 15′ 0·3297505, but negative.

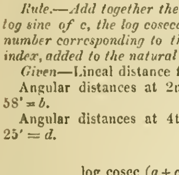
Then, from 0·7766460
take 0·3217505

nat cot x = ·4468155 hence
x = 65° 55′ 14″.

When this is known, the determination of the other linear and angular distances can present no difficulty. O A = 13976·96 feet; O B = 29675·6 feet.

(4.) The distance between two stations, fig. 7, and the angular distance taken at each of them, to two others on the same side, being given when one of the stations is inside of the triangle formed by connecting the other three:—To find the other angular and linear distances.

Fig. 7.



Let A be the 1st station, B the 2nd, C the 3rd, O the 4th; the linear distance from the first to the second station 3000 feet; the angular distances at the first station, O A B = 33° 49′ = a, O A C = 29° 45′ = b; the angular distances at the second station, O B A = 36° 18′ = c, O B C = 45° 21′ = d.

As before we find

$$\cot x = \cot e + \sin a \operatorname{cosec} b \operatorname{cosec} c \sin d \operatorname{cosec} e$$

which gives the following

Rule.—Add together the log sine of a, the log cosecant of b, the log cosecant of c, the log sine of d, and the log cosecant of e; the natural number corresponding to this sum, rejecting 50 in the index, added to the natural cotangent of e, will give the natural cotangent of x.

log sin a	= log sin 33° 49′	= 9·7454943
log cosec b	= log cosec 29° 45′	= 10.3043288
log cosec c	= log cosec 36° 18′	= 10·2276686
log sin d	= log sin 45° 21′	= 9·8521218
log cosec e	= log cosec 34° 47′	= 10·2437636
		50·3733771
Cancelling 50, we have		·3733771

2·3625290 natural number corresponding to ·3733771
1·4397048

3·8022339 = nat cot x, hence x = 14° 44′ 7″.

A O, O B, O C, can be readily found by the rules of plane trigonometry.

ON THE PREPARATION OF LIME

FOR FRESCO AND OTHER PURPOSES OF PAINTING AND ARCHITECTURE, AND THE DEFECTS OF PLASTER KEYING.

Without entering too minutely into the mere traditional theories of Pliny, and which were very considerably adopted by his successors, or following the moderns in their misapplications of chemical science, we may justly assert, that if no actual retrogradation has attended the various uses of lime no advances have been made or improvements achieved during many hundred years. And, although I demur to the usually received encomiums lavished on Roman skill and Roman perfection in the manipulation of lime and formation of cements, and firmly believe their opinions to have been erroneous, except with reference to their own climate, and their laws for keeping mortar *three years* to have been the result of necessity not choice—that is to say, instead of a general improvement and greater intensity of indurating power having been acquired by such keeping, that the mortar so kept must have been palpably and extensively deteriorated, in other words, carbonated or returned to the state of chalk, and therefore improved only for their use, simply because the proportions of the elements—lime, sand and water—as handed down to posterity, were infinitely too strong, too fierce and too rapidly indurating for such a climate in the first instance, as presumptively proved by the fact of Pliny's proportions for a strong mortar being much richer than those used by our masons in a damp atmosphere requiring double the strength; and I am satisfied we mis-read Pliny as to the proportions, in consequence of the masons of his day having carefully slaked *all* their lime, as we do chalk lime, the day before, and that his measurement of quantity referred to the slaked hydrate, not the dry caustic lime as with us, still this supposed error rather corroborates than weakens the presumptions that Roman mortar, *when first mixed*, was infinitely too strong for Roman use, *i. e.* had far too much lime.

Roman Proportions.	English Proportions.
1 part (or one-third) river sand 2 parts of lime —which, if I am correct in believing this to mean hydrate of lime, is equal parts of lime and sand.	1 load of lime, which is pretty nearly two of the hydrate 2 loads of sharp sand —that is, equal parts of hydrate of lime and sand.

Be this, however, right or wrong, Roman mortar could never gain *strength* by three years' keeping, and English mortar so kept, though much pleasanter to the workmen, as being more plastic, would be good for nothing.

Higgins, the only practical English writer on the subject, appears to have perplexed himself as much about carbonic acid, and its action on cements, as M. Vicat the French writer, who absolutely made a series of experiments to ascertain, to the breadth of a hair, the depth to which it would penetrate a thin stratum of hydrate of lime, in so many weeks, days, hours and seconds; as if two facts were not obvious to common sense, viz., 1st, that carbonic acid would return it to the state of chalk, and must, in the nature of things, be the palpable destroyer, not invigorator of cements, and 2ndly, that whether it could penetrate such stratum of exposed hydrate to the depth of one line or fifty were equally immaterial to the practical man, for it never can be supposed to enter *appreciably* the internal structure of a six *feet* wall, and very insignificantly that of an eighteen *inch* one, and that too after the setting of the mortar, when chemical action must be lessened in proportion to its dry state.

Every mason's man knows two facts, viz., that in direct proportion to the sharpness of the sand and the rapidity and fury of the slaking (technically called boiling), especially the slaking together the lime and sand by water, is the present strength of the *indurating power* and the future firmness of the cement,—which enables us to combat another error arising out of the flippant applications of chemical theory by bookmakers and elementary teachers, viz., the foolish supposition that sand or silica acts chemically as an acid on hydrate of lime, than which nothing can be more grossly absurd, for were this the fact silicate of lime would be palpable in every old wall, and its original sand nearly, if not entirely, invisible, whereas the reverse is the fact, and moreover, if such wire-drawing science were correct, the finer and more soluble the sand the better the mortar, while a pure silica, or even ground flints, would surpass all other forms for cement, which is palpably a ridiculous, nay a proved error—for more than one worthy and talented member of society has been so far mislead by these smattering gentry as to waste time and money in forming compounds of no value whatever to mankind; indeed a patent has been very recently taken out by an ingenious man[1] for making an artificial stone by mixing solutions of a true silicate of potas with ground flints, granite, &c., on these wire-drawn theories, and which must, in the nature of things, prove a failure, when by abstracting the pseudo-science and

[1] Ransom.

combining the materials on the plain and simple practical principle of a mere induration of water by hydrate of lime, receiving strength mechanically, not chemically, by the enclosure of real dovetails of coarse sand, aided and assisted by the hydraulic pressure of the patentee, an infinitely superior cement block would be formed. Indeed, no man of practical science would for one minute entertain the bare idea of adding to mortar (and it is infinitely worse to add it to the block) either silicate of potas or any other *soluble salt;* the grand object in making cements being to avoid them, and prevent, if possible, their future formation. It is, in fact, an inattention to this desideratum which has begotten all the efflorescing, scaling off, discolouring and salt forming characteristics of our artificial stone and stuccoing compounds, not one of which that I have examined bespeak any intelligent practical knowledge of true principle. Similar errors destroyed all the real worth of Keane's labours, for supposing that in soaking plaster of Paris (sulphate of lime) of the first burning in a solution of alum (sulpate of alumina) and calcining it again, he drove off the sulphuric acid and left aluminous earth commixed with his plaster. He also became grossly deceived—he lost pelf, and the public lost all the benefits which might have accrued from a really beautiful and invaluable compound, whereas the subject of his patent proved to be an intensely acid, efflorescing, injurious and readily decomposing and decomposable one,[2] and certainly one which no rational being would rely on for the decorative purposes of painting, for it must be obvious to the veriest tyro, that in lieu of driving off sulphuric acid and leaving *alumina* behind, his second calcination could only drive off excess of water (with some *little acid*), and leave a concentrated *super-sulphate* of the earth, in a word a stronger alum, the very existence of which would not only jeopardize a painting, but absolutely destroy in time an ordinary joint between two marble blocks—however beautiful in appearance at the onset; for he could scarcely be a sane man who anticipated carbonate of lime, in a crystalline state, should withstand sulphuric acid in sulphate of alumina. But enough, let us return to lime in its real worth for practical use; and give such directions as will ensure an infinitely better cement than any Roman mason ever used; one which, without setting a single degree faster, the grand objection to any general use of compo', even in a slight admixture in building, gives infinitely greater indurating power, and increases in hardness by time, in lieu of carbonising and failing until pulverisable by the fingers wherever its surfaces are exposed to air and internally from its defective nature perishing *per se.* One which not only has *no* soluble salt in its present character but actually precludes the future formation of *all* soluble salts, and, in a word, becomes as all mortar should do, harder than the surrounding bricks, forming a real adhesion to them[3] and requiring the pickaxe to separate the layers of work in lieu of the human hand, which certainly suffices to take down eighty out of every hundred modern buildings—certainly the buildings of modern London.

Here, perhaps, I may be allowed an episode, as of practical worth. The suggestion was submitted to Mr. Barry,[4] but either from the always injurious tendency of the system now universal of dividing works into distinct contracts, leaving very little real control with the architect, or from some other sinister cause, he has raised upon a very beautiful and efficient foundation, as regards the brickwork, a common-place superstructure, the foundation itself being defective only in one point—the non-adoption of the expedient[5] actually forced upon Mr. Stephenson for draining the wallings of certain railroads were damp earth abuts upon brickwork, which would not only have drained away circulating water but have been a wise provision against any accidental injury to the asphaltic foundation from frost or other casualty. I repeat that on this excellent foundation he has raised a common-place building with common-place mortar, in lieu of one which might have been the lasting memento of an enlightened mind and original genius,[6] and rendered a real benefit to society. But to return; I would beg to impress on the minds of architects, civil and military engineers, builders, &c., that the more they reject the dogmas of the closet, the more they repudiate the chemical nonsense about silica as an acid and its action on lime, and look upon cement as an induration or solidification of water mechanically strengthened by dovetails of the coarsest sand, (a fact observed even in Pliny's day, for he directs you to mix pieces of broken flint of a certain size not exceeding "*librum unum,*") the more perfect will be the result; but to practice—let us give a tabular formulary which cannot be mistaken and then explain its theory to bear us out.

Dorking, Bath or Durdhan Down lime one load.
Sharp river sand two loads,
Native carbonate of barytes, finely ground, two hundred weights,

The barytes being sifted into the mortar *after* it is mixed, that is, in working it up; and in using blue lias or any other lime for hydraulic work or military works where additional power is required, the practice should vary thus much—one half of the native carbonate should be mixed with the lime and sand first and slaked (boiled) with it. The theory of which is singular indeed, and became known to me more than thirty years ago, that is to say, this refractory carbonate, which adheres so intensely to its carbonic acid gas as to defy the lime kiln and ordinary furnaces—so perfectly so that all experimentalists have been driven to the calcination of the artificial *nitrate* when caustic barytes might be wanted—yields, at once, by the slaking process, to lime in the active state, its gas and becomes caustic, and gives an almost incomparable power in solidifying water without swelling injuriously, and further, by the intense affinity of the barytic earth, wholly and solely destroys sulphuric acid or soluble sulphuric salts, at present the real curse of all grout work—no further proof of which need be advanced than one moment's reflection with any practical man, for every practical man knows that in one month he can observe the formation of sulphates of lime, alumina, magnesia, &c., all arising from the oxygenisement of sulphur in the slaking process,[7] and subsequent action of sulphuric acid on the various bases existing in strong limes. And, as sulphate of barytes is strictly insoluble and non-decomposable in itself, and really adds to the density of a cement *mechanically* where it is specially required *not to swell,* and *chemically* also, though in a lesser degree than carbonate, solidifies water like all barytic salts, it becomes as elegant an agent scientifically as it is a practically useful one.

The expense of this addition even at the present moment would be for buildings of magnitude trifling, and it is so abundant in Derbyshire, Anglesea, &c., as well as in North America, and very far from scarce in Ireland, that the moment demand enters the field the cost will be quite beneath either public or private notice.

I have a specimen in a wall, now before me, of the mortar with which the fresco frame mentioned in my last paper was filled which has been examined and tried by many practical builders, none of whom believe, until the explanation is given, the sheer simplicity of its character; all declare it to be very fine compo indeed, and so unusually hard that a powerful blow with a strong spade scarcely makes an impression upon it, while, as I before said, the setting power was not visibly increased. I have now only to add, blocks of this mortar moulded and compressed, as practised by Ransom, exceed in density and practical worth all the mixtures, and their name is legion, I have either made or examined; and it was an inspection of three wedges shown by me to my late friend Sir Anthony, then Mr. Carlisle, and by him shown to Nicholson, by Nicholson to the late Samuel Parkes, which gave rise to Parkes' suggestion in one of his essays, then in M.S. preparing for the press, for the use of barytes in mortar, and after many fruitless attempts to calcine and render caustic the native carbonate (for no explanation had been conveyed to him)—the essay went to press with engravings for calcining this carbonate? No; for calcining a different salt—the sulphate, commonly called cawk, and which is really an inefficient and improper addendum; for blue lias or even Dorking and other flare limes are sulphurous enough, albeit Phillips and other analysts attribute to bitumen what belongs to sulphur. Parkes was ignorant of the really beautiful natural action of caustic lime on this refractory carbonate, which sooner vitrifies by fire than part with its carbonic acid gas.

Twenty-five years ago I built with it, and can most confidently call on architects, builders and men of fortune to try its powers; they will never regret it, on the contrary, in benefitting themselves and their posterity, will materially benefit the state; for, once fairly tried, the demand will be immense; and its extent of worth is not easily appreciated, for, independent of its indurating power, its texture in obviating the circulation of damp by capillary attraction, and its total prevention of saline formation (if ordinary care be used as to washing sea sand, which is always charged with muriate of soda and magnesia) stamp it as a real desideratum. While its powers are not limited to the mere uses of ordinary works, it ought to enter the finest plasters

[2] Mr. Latillo was compelled to use soap suds, solutions of carbonate of soda, &c., to destroy the sulphuric acid, and even then the surface of the painting reminded you of the small pox.

[3] Every observant man knows, that in the ordinary brickwork of our day there is no adhesion at all; whereas, as we observe considerable adhesion in old Roman work (the mortar of which we presume to have been kept three years), I should shrewdly suspect the Roman masons wetted all their bricks, an expedient ours never recur to except by necessity, i. e., with new and porous bricks

[4] That is, the use of native carbonate of barytes, as suggested by me to the Royal Commission of the Fine Arts.

[6] It was suggested by me also, through the same channel, to leave drainage gutters above the surface of the asphaltic foundations so as to guard against any casualty, and then to carry on the whole work of the superstructure with barytic mortar, so that neither from above nor below could any injury ever accrue from damp.

[8] I have specimens of the effect of this barytic mortar put into a wall in May, June and July, 1844, which have been much approved by practical builders.

[7] As fully explained in my last.

and most especial intonacos for painting in lieu of marble dust, so commonly used by the Greeks, Romans and modern Italians, and for which purposes it merely requires more impalpable grinding.

One caution perhaps may be given judiciously, *en passant;* the carbonate of barytes of nature, though not so soluble as the artificial or *precipitated* carbonate, and therefore *less* injurious, is still inimical to animal life, and consequently care ought to be taken that no waters in which it is mixed or ground (if ground wet) should be discharged into running streams or ponds to which horses or cattle may go; and here it may not be amiss to repeat, that for ornamental plasters and fresco painting as a pigment, *if water free from iron be used*, it surpasses infinitely every pigmental white, and that not in beauty only but utility, for as much as pigmental lime *lays on the surface* and is too identical with the ground, whereas pigmental carbonate of barytes is distinct in *tone* and becomes part and parcel of the intonaco, and therefore adds materially to the permanence of fresco.

Now, a passing word on plaster and plaster-keying, which it may be said also we have grossly neglected; for, with the exception of some very clumsy attempts by German artists to give an additional tooth by the use of pebbles[8] in the under coats, one single advance *has* not been made during seven or eight centuries; in fact, our ceilings are infinitely inferior to many old Roman works, where the artists in endeavouring to imitate marble took considerable pains. Nothing can be more common than the separation of the coats or layers of plasters, and nothing more obviously to be expected; there is no sort of provision for *securing a connexion*, much less for enabling that connexion to carry a great body and weight of fine plaster on an extended surface. It is, indeed wonderful, that fine paintings in fresco or distemper should have existed any length of time under such careless and inefficient managemement; and I consider the fresco frame mentioned in my last paper (in the August number) amply proved the possibility of applying Smeaton's principle in forming the foundation of Eddystone light-house to plaster-keying up to the finest intonaco, for each coat was so perfectly dovetailed into the other, at regulated distances, that it would be difficult indeed to separate its strata; in fact, it could only be done by the saw. Now two precautions only were used in the work—First, to regulate the sand from the sharpest specimen of sea sand (*well washed*) to fine silver sand, as to ensure an universal gradation of tooth or frieze; secondly, to indent by a wooden tool each coat in the angles, after dividing its surface into squares or diamonds, making each indenture or mortice pretty deep, so that, at regular distances, the coat of plaster added gave not only the covering surface but the tenon for each mortice, by which the last and finest coat might have been enabled to carry a ton of plaster to every twenty feet square of work, in lieu of holding only by the suction (as the workmen call it) oof a very irregular surface carelessly and irregularly wetted, and often scored by the pressure of an ordinary trowel, the worst tool in the world, for the somewhat *polished surface* left by an inclined, or half flattened, trowel has little or no key at all, hence the frequent use of wood in scoring.

Allow me the use of native carbonate of barytes from the onset of the rough cast, and in very *special works* (such as for fresco in the Palace at Westminster or other national buildings) that of caustic barytic water,[9] to wet my surfaces with, joined to this mode of keying, and I will defy either time or human hand, except by the saw, to separate one square inch in five hundred square feet of surface; the coats become so homogeneous a body, in fact, that the work is the real antipodes of the common layer upon layer of heterogeneous plaster scarcely keyed at all, simply because it is both *mechanically morticed* and *chemically united*.

W. MARRIS DINSDALE.

Sept. 8, 1845.

[8] Than which nothing can be more clumsy or defective or difficult to work over.
[9] For fresco joinings, after cutting away the superfluous edges of the day before work, this caustic barytic water is invaluable; well wetted with the minutest interstice or sharpest edge becomes one mass really harder than the general surface.

ON DREDGE'S SUSPENSION BRIDGES.

By F. BASHFORTH, B.A., *Fellow of St. John's College, Cambridge, and of the Cambridge Philosophical Society.*

SIR—Any new plan for a suspension bridge unaccompanied by its correct mathematical theory is, in my opinion, unworthy of confidence. My object was only to call attention to the singularly defective state of that to which Mr. Dredge referred all for answers to their objections. Now seeing that when suspension bridges do fail, lives by hundreds are sacrificed or placed in imminent peril, it did appear to me to be worthy of animadversion. Had it been a mere matter of curiosity, its faults would have been harmless and consequently unworthy of notice—but when we find the patentee of a bridge, engaged in carrying out his plans in various parts of the world, referring to this as an authority, the state of the case becomes entirely changed. I do not dispute the fact of Mr. Dredge's having constructed bridges with a smaller quantity of material than would have been required on the old plan—but I do call in question *their safety*, if built on the theory authorized by Mr. Dredge, which he appears still determined to support in face of its palpable absurdities. So long as we have no satisfactory theory we have no means of comparing the intrinsic merits of the old and the new plan; and again I repeat that the complication introduced by the oblique suspending rods is such as in my opinion places it beyond the reach of the most accomplished mathematician. If this be the case, and since practical experience would have to be purchased in every separate case at too great an expense, I conclude that the plan is not of any great value, for it is a poor economy to sacrifice safety to avoid the necessary expense to ensure it.

The theorist after some 30 or 40 pages of assumptions and demonstrations gives an example of the application of the *general theory* to a particular case. I pointed out distinctly the step which could be allowed in the general theory, and to shew that this did not even give an approximation, I pointed out that the results were impossible.

The only mathematical theory of Mr. Dredge's Suspension Bridges published by Mr. Weale, that I have seen, forms the Supplement to the Papers on Bridges, and I cannot find any other in the University Library. It is *anonymous* and *without preface*, but by the quotation from page IV., I first learn that the treatise is Mr. Turnbull's.

Mr. Dredge has had the boldness to charge me with unfairly quoting his remarks, and unfortunately for himself has ventured to give a specimen of my delinquencies. I was desirous of compressing my remarks as much as possible, and for that purpose deemed it sufficient to give the author's meaning fairly and fully.

I found the announcement, "Mr. Weale is about to publish, &c.," on one of Mr. Dredge's reprinted letters, and I could not suppose it placed there by any other than his own authority. In consequence of this omission of the publisher's name, Mr. Dredge wishes to make it appear that I have put at least the responsibility on him. On referring to page 456, vol. II. of your valuable Journal the following letter will be found.

"Sir—An entire description of my patent suspension bridge would occupy too much space in your Journal, and employ more time than I can at present spare, and as an abridgement would perhaps produce more cavilling than would be interesting to your readers, or necessary to the investigation of truth, I will refer Mr. Fordham to a *full mathematical description*, which will be published in a few days, by Mr. Weale, to four foot-bridges in the vicinity of Regent's Park, and similar works in various parts of the kingdom, so *that as a mathematician, and man of science,* he may be able to *read, see, and judge* for himself, and from *these evidences* form what *opinion he thinks fit, and I shall be most happy to see that opinion publicly expressed through the medium of your pages.*

"I remain, Sir, your obedient servant,

"J. DREDGE."

This is my justification, and taken as the standard length of Mr. Dredge's sentences will I hope be deemed a sufficient excuse for having quoted those parts of sentences which gave his true meaning. As he informs us that he is a mathematician, he ought to have examined the theory of which he *took upon himself* the reponsibility.

Although Mr. Dredge has come forward to say something in favour of the theory, he has not thought proper to notice my objections, which are most distinctly pointed out. The quotation from page IV. has little or nothing to do with the matter, and shews in a remarkable manner the clear notions and strict reasoning, employed by the author and approved of by Mr. Dredge, by which they will no doubt be able to prove any thing.

Mr. Dredge must have been quite aware that I did not say that practical experience was worthless—but this I do say—the authors of the letters could not have had time and opportunities for gaining practical experience, and then what else than theory would remain to be depended on?

Since I wrote my remarks, intelligence has arrived from India respecting a bridge of 250 feet span, which was in progress at Calcutta. In the Mechanic's Magazine for October 1844, will be found a copy of a letter from a Captain of Engineers to Mr. Dredge. "With the assistance of a very able and first rate mathematician here I have studied the theory of these bridges most thoroughly; and the model I have made 22 feet long and 4 feet width of platform, is on so large a scale, that I have been able to test it in every possible way, and it has withstood the utmost efforts to derange its parts. The Governor-General and all the scientific people here, have perfectly satisfied themselves of the efficiency of the system, and all the proofs with my models assure me that the theory is correct." We here see a laudable desire to take every precaution to ensure success—the theory is studied, a model is made, $\frac{1}{12}$th of the size of the bridge, yet somehow theory, common sense, and experiment all fail, and the blame is laid on the contractor; In my opinion there was another weighty reason. The time of its occurrence is singular enough.

Mr. Dredge asserted that "the Menai chains weigh 1,935 tons," and he still affirms that on his plan only $\frac{1}{27}$th of the weight of iron would be required to construct a bridge of equal strength. I should like to know by what means Mr. Dredge has arrived at this result. If there be such virtue in the mere inclination of the suspending rods and the variation of the thickness of the chains, I am very naturally surprised that such an eminently practical man as Telford never thought of that modification. As Mr. Dredge does not understand the difference between undermining an erroneous theory and accomplishing an impossibility, I do not see the force of his "ergo."

Mr. Dredge might as well have told us at once, that a weight of one pound, placed on a table, would produce a pressure of two pounds, half of it acting in each direction, for action and re-action are equal and opposite. In the "Penny Cyclopædia" is a simple and correct illustration of the meaning of tension; "when a weight is supported by a string, the tension of the string is the weight suspended by it."

It will be unnecessary for me to write any more on this subject unless Mr. Dredge abandons his authorised theory altogether, or removes my objections. I also feel it to be equally vain and useless to attempt to argue with one who countenances such absurdities, shews his ignorance of one of the commonest of terms, and lays claim to be considered a mathematician.

It is, however, desirable for Mr. Dredge to state distinctly what is given and what is to be found by theory, and also what theory it was that the Indian engineer studied.

I hope enough has been said, backed by the subsequent failure of theory and practice in India, to induce those in authority to insist on a satisfactory mathematical theory being given, and approved of by a competent judge. If the plan be good, there will be no need to fear the ordeal, and if not, it is for the good of all to abstain from using it.

ATMOSPHERIC RAILWAYS.

ABSTRACT OF THE EVIDENCE BEFORE THE COMMITTEE OF THE HOUSE COMMONS.

(Continued from page 284.)

[We again earnestly invite our readers' attention to the analysis of this invaluable mass of evidence of which we have carefully endeavoured to give a complete abstract; we are well satisfied that it will repay the trouble of perusal.]

Level Crossings.—Explanation of witness's contrivance for allowing roads to cross an atmospheric railway upon a level; its self-acting principle described—(*Samuda.*)

"A cover is placed over the tube, which cover is raised by the vacuum formed in the tube, working on the lower side of a piston; the cylinder descends by the removal of the pressure from below it, and in descending raises the cover, which had been previously lying flat on the pipe, and that forms a barrier to prevent carts passing till after the train has passed; when the train has passed, that tube being refilled with air at the atmospheric density, equalizes the pressure on both sides of the piston, and the cover, by its own weight falls.—When the cover is raised it forms a barrier, so that carts cannot come upon the railway at the time the train is passing; and at the same time it gives an intimation that the train is approaching, though it is out of sight. There would be no difficulty in connecting this cover with an actual barrier outside the line. Mr. Brunel's idea, upon seeing this, was to modify it to that extent to make the cover, instead of dipping partially only over the tube, a continuous barrier over the entire width of the road.—Supposing there were a cart passing, it might so happen that you might catch the cart between the two wheels? That would scarcely happen, because the heavy numbers of the vacuum are formed very slowly, and the cart would have plenty of time to pass over during that time. There would be no difficulty in making the barrier the height of a horse. And those barriers might be in the form of an ordinary gate."

Lines of Rails:—1. *Generally.*—2. *Sufficiency of a single Line of Rails on the Atmospheric Plan.*—3. *Impossibility of working an Atmospheric Line with a single Tube.*—4. *Opinion that a single Line is as applicable to the Locomotive System as to the Atmospheric.*

1. Reasons for witness taking provision, in the schemes in which he is engaged as engineer, for laying down a double line of rails—(*Vignoles.*)

"Have you any objection to state why you have taken provisions in those schemes in which you are now engaged as engineer for laying down a double line of rails, anticipating, as you have stated you do, that the atmospheric system will be applied to some of those lines?—I have not the least objection to state the reason. The reason is, that a great number of the directors and persons connected with those railways have not that confidence in the atmospheric system which I have; in fact, I may say that I am somewhat in advance of the companies and the public generally upon that point.

"The line I have more particularly in view is the line between Blackburn and Bolton. The traffic upon that line is very great indeed, and it has to pass over a summit of nearly 600 feet in the course of seven miles. The gradients I have laid down are 1 in 70, and I can get nothing better; and even with those gradients of 1 in 70, I have an enormous tunnel, and several viaducts of very great height: but still the traffic is such as to justify the construction of a line, and the Board of Trade have approved of the line. The question has not been raised how that line is to be worked, but I have no doubt that when the atmospheric system comes to be tried and proved, (and it requires, in order to convince the public mind, to be tried somewhere on a sufficiently large scale), the directors of that company will be prepared to listen to my suggestion for a single atmospheric line, instead of a double locomotive line. If the directors of that company had, in the first instance, adopted a single atmospheric line, a considerable expense might have been saved. The length of the line is 13 miles; and I am quite certain that in that distance I might have saved 50,000*l.* in earthworks, and so forth. You would not have considered it necessary to have a gradient of 1 in 70, if the atmospheric system had been adopted?—No, I should have substituted gradients of 1 in 40, and 1 in 50; but, at the same time, the peculiar character of the country is such, that the deep chasms on the side of the mountain cannot be overcome, even with a gradient of 1 in 40, or 1 in 50. But you could not have overcome the difficulties of the country, even with a gradient of 1 in 40?—No. If I had had a tunnel for a single line only, of course it would have been much cheaper; the great saving would have been in lowering the viaduct, and shortening the tunnel, and in the general character of the earthworks being somewhat smaller; and I consider that about 50,000*l.* would have been saved in earthworks. Is the expense of earthworks enhanced by the difficulty of making an embankment at the summit sufficiently strong to carry two lines of rails?—No, it is increased, but not in proportion to the height. I must also mention that there is another point peculiar to this line. The country through which we pass is full of manufactories with ravines of water. Wherever we cross those ravines we have an opportunity of making dams to hold up the water; it is in working a line like this that economy would be obtained, from the great traffic that there would be upon it; working by the atmospheric system over these gradients would be a great deal cheaper than working by locomotive engines.—You would be able to keep the stationary engines in constant work?—Yes; or we might keep a smaller description of engines, and work our air-pumps by means of reservoirs."

2. At present the atmospheric principle might not answer so well with a single line upon a great trunk railway; more experience is needed before that is tried—(*Field.*)

The single line of the South Devon Railway will be sufficient for its traffic, even if it should be as great as that of the London and Birmingham.—On the inclined planes on the South Devon line there will be double lines of rails, as the descending trains may run down without a tube; this will give great facilities for meeting trains to pass each other—(*Brunel.*)

Manner in which witness could carry out his suggestion for a single atmospheric line between London and Portsmouth; it would be perfectly adequate for all the traffic of that district—(*Cubitt.*)

"Between London and Portsmouth there is to be a single line if they obtain their Act. I think it will be adequate for all the business of that district. The means of carrying it out are by having what I call a double station, at intervals of six or eight miles, or whatever upon experience may be deemed most convenient, but about that distance, where the trains could meet and take in passengers, and hook on wagons and goods, and transact their business there in a few minutes, and then proceed on again; then the whole would work regularly, the stoppages there taking place at the same time, and the trains starting at the same time."

3. Upon the most mature consideration witness is perfectly satisfied that working a line with a single pipe is physically impossible; reasons for entertaining this opinion—(*Stephenson.*)

"As an abstract question, supposing the electric telegraph to be applied to, say, the London and Birmingham line throughout, I can see no more reason, looking at the regularity of the trains and the comparative certainty of operation with the locomotive engines, why I should not, upon a piece of paper, devise a plan and system of operations by which trains might move with locomotive engines, on a single line of railway, with an electric telegraph, between here and Birmingham, as easily as upon a line constructed upon the atmospheric system; I can see no difference. But in the case of a traffic like that, sometimes the trains passing from Euston-square within a quarter of an hour of each other, and the average times of the trains being about an hour after each other, I should never recommend the use of a single line, nor should I think it feasible or practicable to work traffic like the London and Birmingham traffic upon a single line. Ever since the question was broached about working a line with a single pipe, I have maturely considered it, and most anxiously, with a view of coming to a correct conclusion upon it; and I am perfectly satisfied, after 20 years' experience, working a railway daily, that the thing is physically impossible. Will you state your reasons for entertaining that opinion?—The number of intersections would be so great, and the irregularities arising upon lines are numerous. The application of the atmospheric system implies the utmost conceivable regularity in the velocity from end to end of the line, in order that the meetings of the trains may take place at the same time, under all conditions of weather. Now we work with a varying power; the power is very great sometimes in the case of the locomotive system, when we make up for time lost under any circumstances. Any irregularity upon a double line only affects that one train, whereas any irregularity upon a system of trains like the London and Birmingham would affect the communication throughout the whole country; it would affect the trains upon every line of country in connexion with the London and Birmingham, whether near or far off. Any system, I conceive, in which the working of the traffic in one part of the country depends upon the regularity of every other, is one that is totally inadmissible; that is the broad principle; to go into practical detail would be almost impossible, without a model; but the system itself, upon the face of it, bears that, that every train between Liverpool and London would be dependent upon every other train moving; if the one lost time, or happened to meet with an accident, all the others would be affected by it."

4. Witness is not aware of any circumstances applicable to the atmospheric system, and inapplicable to the locomotive, rendering it feasible to work trains upon a single atmospheric line that could not be worked upon a single locomotive line. The Yarmouth and Norwich railway is so worked on the locomotive principle. Of the Peterborough and Northampton, there are 45 miles of single line, and from Blisworth to Northampton five miles of double line—(*Stephenson.*)

With a well-arranged system of police a single line of locomotive railway might be worked with the same, or very nearly the same, safety and punctuality as a double line—(*Locke.*)

See Cost of Construction. Crossings of Lines. Long Lines. Passing of Trains. Short Lines. Stoppages.

Locomotive Engines:—1. *Cost of Locomotive Engines.*—2. *Wear and Tear of Engines.*—3. *Cost of Repairs.*—4. *Average Duration of Locomotive Engines.*

1. Original cost of the engines on the London and Birmingham railway; probable price for which they would now sell—(*Bury.*)

"What average amount of repairs would keep it always in a state as good as new. I think about 300*l.* to 350*l.* a-year would keep our engines in a state as good as new.—You have not worn out any locomotive engines since they commenced running upon the London and Birmingham line?—Not one; I think that our locomotive engines now just are as good as they were the day they came on the road; I do not see any difficulty in their lasting as long again as they have lasted.—Do not they become antiquated in their construction?—We alter them occasionally, and increase their capability; but the first engine that we had upon the line, which was in July 1837, is just as capable of taking the trains, and perhaps more capable of taking the trains now than she was when she started in 1837. What was your total stock of engines upon the opening of the line?—The order was for 90 to start with; 60 passenger engines and 30 luggage engines. What is your present number?—Ninety; *we have not had a new engine since we started; nor have we thrown any aside yet since we started.*—Can you state what the cost of the 90 engines was?—The engines differ; they might be taken at 1,500*l.* each.—If you were to contract for the London and Birmingham, you would be willing to take them at 1,500*l.* each?—Yes, but I would not take them at that if I had to sell them again. I wish to correct Mr. Bidder's answer, connected with the passenger traffic; we have 17 trains a day instead of 14."

2. Upon the Great Western railway they run on an average 150 miles each day on which they are at work. Two days work out of three is hard work to keep them in good order. There are 150 engines to 250 miles. A locomotive engine, to save weight, must generally be worked up to its full power; this is not the case with a stationary engine—(*Brunel.*)

How far the vibration of a heavy locomotive engine damages the whole condition of the line, as regards slips, wear of rails, wear and tear of engines, &c.—(*Locke.*)

"I have made several experiments, in order to ascertain the effect of the wheels of the carriages passing over the rails, with a view of testing the strength of the rails, not with a view of testing the extent of vibration. I do not myself believe that the vibration generally (whatever the effect might be upon some soils) would damage the rails to any considerable extent. There is no doubt that the concussion, and the effect of the blows upon the engines, has a great deal to do with their wear and tear; but if you were to analyse the cost of the repair of a locomotive, you would find that the wear and tear does not arise so much as you would fancy from the concussion; I have known an engine run 25,000 miles, without ever being taken into the shop or undergoing repair. I have ridden upon an engine, perhaps, as frequently as most engineers, and have gone at considerable speeds; I have travelled at at 50 miles an hour, and I will undertake to say that I have stood as quietly upon that engine as I could have done upon any carriage in the train, and I attribute that to the engine having six wheels; I have noticed it over and over again; the last instance I had of the kind, was an engine of a very large weight, weighing 17 or 18 tons; it was in bringing the Queen from Portsmouth; I travelled at the rate of 48 miles an hour continually and uniformly, and I stood as steadily upon that engine as I could have done upon any carriage in the train; it is not in that one instance only that I have observed it, but I have observed it repeatedly, hundreds and hundreds of times, for I generally ride on the engine when I am travelling."

3. Expense of repairs of engines on the London and Birmingham line—(*Stephenson.*)

"For good engines we pay 1,600*l.* or 1,700*l.*, but for passenger engines we do not pay more than 1,400*l.* The price of locomotives has fluctuated between 1,400*l.* and 1,600*l.* It has been stated that the actual payment for repairs in one year upon the London and Birmingham amounts to 25,000*l.*; do you think that statement is correct?—I do not know what has been the amount, that is under the charge of Mr. Bury. I can tell you the cost per mile upon the Birmingham; it is $10\frac{1}{2}$*d.* Will you state what that includes?—The whole of the repairs and the purchasing of new engines, whatever there may have been purchased; the whole of the expenses of the locomotive establishment. Do the Company set aside a depreciation fund?—I think they have not done so lately; there was a depreciation fund set aside for some time, but I am not quite sure whether it has not been dropped lately"

Cost of the repair of locomotives on various lines—(*Locke.*)

"The wear and tear of the engine is very great; it is increased by the increase of speed, but the cost of the repair of locomotive engines has very much diminished in the last six years. It would increase in a ratio according to the increased speed. On the Liverpool and Manchester railway, where the cost of repair of locomotive engines was 2*s.* 6*d.* a mile, I know that it is not 1*s.* now, and that it is done on some lines at 9*d.* and 7*d*; therefore, when you speak of the great destruction of locomotives, it is all measured within those figures. Upon the South Western the expense of repair of locomotives is $11\frac{1}{2}$*d.* and 1*s.* a mile. Upon the Great Western about the same. I know that the Grand Junction, and on the South Western, they do not vary $\frac{1}{2}$*d.* a mile; and did not during the last half year. On the South Western and the Grand Junction it has come down from 1*s.* 4*d.* a mile, in the last two years, to 1*s.*, and 11*d.*, and I believe in a short time it will be brought down to 9*d.* a mile. How will that economy be produced?—By lessening the consumption of coke, and lessening the consumption of oil; by a better system of management, and greater durability in the engine itself."

4. There can be very few locomotive engines 10 years old, even if all their parts have been renewed in the meantime—(*Brunel.*)

The average duration of an engine is 10 years—(*Stephenson.*)

Locomotive Lines.—A locomotive line might be converted into an atmospheric; but the facilities with which this could be effected would depend upon the gradients, which would probably be different for the two lines. It was originally proposed to combine the locomotive with the atmospheric principle on the South Devon line; no difficulty will arise from the circumstance of the South Devon being the continuation of a locomotive line; but being at the end of a long line, it may be subject to irregularities in the arrival of the train—(*Brunel.*)

London and Croydon Line.—The portion of the line from the Dartmouth Arms to Croydon is to be worked by atmospheric power; that between the Dartmouth Arms and London by locomotive engines; thus both systems will be tried together. Mode of effecting the transference from one power to the other—(*Samuda.*)

"The first five miles of railway, from London to the Dartmouth Arms, will continue to be worked with locomotive power upon the present line until the atmospheric new line is completed; and the trains will in the meantime be transferred from the locomotive haulage to the atmospheric at that point; we shall, therefore, have an exemplification of exchange from the one to the other system; the passengers will not be disturbed, but the engine will leave them at the Dartmouth Arms, and the train will run into a siding, where it will be attached to the piston-carriage which will be there ready to receive it, and, being attached to it, it will proceed to Croydon, propelled by atmospheric power. In its journey to Croydon it will pass from one exhausted section of the tube into another exhausted section of the tube; the intermediate engine will be placed at the Jolly Sailor station somewhere about halfway between the distance I have now referred to. You will not have a passing place from one tube to the other?—We shall not run on from the Dartmouth Arms towards London by means of a tube at present, because we shall have the locomotive engines carrying the trains on, but we shall there have precisely the same arrangement which will subsequently exist when the trains are passed from one atmospheric line to another atmospheric line, instead of being passed from the atmospheric line to the locomotive line."

Longitudinal Valve.—On the Dalkey line the longitudinal valve has required repair when the leather was bad; it is easily repaired, and has never interrupted the working of the line.—(*Gibbons.*)

Important alteration in the construction of the valve upon the Croydon and Epsom railway; instead of being pressed by a sharp edge, it will be so by a smooth bar of iron; the leather, therefore, will not be exposed to a violent short bending from an abrupt edge Mode in which the leather is kept flexible—(*Bergin.*)

"The leather is thoroughly saturated with grease. In the case of ours, I have found that it gets hard in that part which is compressed by the bar I have spoken of, and nowhere else. I should expect that, under the other arrangement, it would continue much more flexible; there is no difficulty in supplying it with oil from time to time; indeed, that is a point to which we have not been sufficiently attentive. Do you find that the heating apparatus for the closing of the valve acts satisfactorily?—Very satisfactorily. I had an opportunity of trying some experiments upon that; at an early period we broke the apparatus and worked the line for a fortnight without it, and the leakage was very nearly doubled during that time. I have the particular figures here. On the occasion of one experiment, when the heating apparatus was in proper order, the leakage was then $4\frac{6}{10}$ths cubic feet of air per second through the whole length of the valve; the heater, or to speak more correctly, the rubber, was then in proper operation. That experiment was tried on the 19th of November 1843. Shortly after that we broke the apparatus; it got worn out; and on the 13th of January, when we had then been running a week without this apparatus, I found that the leakage was increased to seven feet per second. Subsequently we restored that apparatus; and I happened to try another set of experiments on the 11th of March 1844, and the leakage had come down to $3\frac{6}{10}$ths; the so called heating apparatus, therefore, makes an enormous difference in the leakage of the long valve. It is erroneous to name it a heating apparatus; for if it is heated, it destroys the whole thing; the object of warming it is merely to prevent the composition sticking to it as it passes over it; it is barely warm. If, by any accident, the train rests for a moment, and this becomes heated, we are obliged to send a man to relay the composition."

Composition used for sealing the valve—(*Bergin.*)

"Mr. Gibbons mentioned an occasion on which it was necessary to change the grease; I had that done last October or November; it was then done throughout the line. I found that a very serious mistake had been made by our foreman in using the wrong materials for the composition, and that instead of making it of bees'-wax and oil, which was the direction given by Mr. Samuda, he had made it of bees'-wax and hard Russian tallow, so that though it acted pretty well in the warm weather of summer, it became inoperative during the cold weather. The mistake not having been observed during the first part of the working year, a considerable quantity of this wrong composition had been put along the line. Being apprehensive of the result, I directed that all the old composition should be taken out, and the new put in, which occupied ten or twelve nights; but ever since that, though we have had the thermometer much below freezing, we have not had the slightest interruption, whether it was wet or frosty. What is the nature of the composition?—I do not remember the proportions, but it consists of bees'-wax and what is very well known in the London market as expressed oil of lard, elaine; it is better known as lard-oil to the trade. Do you find that composition, from long exposure to the air, becomes ultimately less susceptible of change from the difference of temperature?—I certainly find that it undergoes very material change, which I did not at all anticipate. From frequent working we have found that the composition becomes of a very peculiar consistency; I hardly know anything to compare it to, but it acquires a degree of tenacity that I never saw in any other waxen composition before, and adheres with great force both to the leather and to the iron. I found with the thermometer below freezing, it did its duty perfectly, and continued quite soft."

Long Lines.—The peculiar advantages of the atmospheric system can only be developed on a long line, where the maximum velocity can be attained—(*Robinson.*)

The atmospheric system is perfectly applicable to very long lines; there may at present be some difficulties, but there is no doubt experience will overcome them—(*Vignoles.*)

It is doubtful whether the atmospheric system is equally adapted to long lines as to short lines, with a large passenger traffic; it is most probable that, with experience and good management, it will become so. In very long lines with great traffic a double line would be preferable—(*Cubitt.*)

Luggage Trains.—There will be no large luggage trains, but they will be subdivided so as to maintain nearly an uniform weight and speed for every train—(*Samuda.*)

Mail Trains.—On the atmospheric system the mail trains must be worked at a very great expense—(*Locke.*)

"If you take a railway 100 miles long, and consider that in the night the mail train has to be dispatched; take the case of the Grand Junction, with a mail train leaving Birmingham at 11 o'clock at night, and another coming up at three o'clock; if the line is 100 miles long, there are 33 engines at 200-horse power each, and they would require 6,600-horse power to be exerted for the purpose of carrying one train; and the attendance upon the engines would be three men to an engine of that kind, two stokers, and a fireman, which is 99 men, besides all the attendance to the valve and pump, instead of one locomotive, with two men attending it, to carry that train through; I say that in the night, for one or two trains, the atmospheric system must be immensely more costly. I do not think that there is one railway in the country that has not one or two trains passing along it in the night; and for the purpose of carrying the mails it must necessarily have those trains passing along it."

Allusion to the objection made by Mr. Locke as to the running of mail trains at night on the atmospheric system—(*Samuda.*)

"Mr. Locke assumed that one train would pass during the night, and that the whole staff arrangements of the company would have to be brought out for the purposes of that single train. I conceive, however, the most convenient way of working railroads, and the way most generally adopted, is to send the greater number of the goods trains at night; and when we have subdivided our goods trains, for the purpose of avoiding the gigantic trains which now go, we shall have a distinct call for our night work upon such lines, and not only so, but we make provision for it in our estimate; we introduce a relay of men for the purpose of carrying it out."

Maintenance of Road:—1. *On the Atmospheric System.*—2. *On the Locomotive System.*

1. Calculation of the cost of maintaining an atmospheric line—(*Samuda.*)

"The expense necessary for maintaining a line we find to be, first, the maintenance of the tube, and that we find requires a man a mile for the ordinary traffic, which, if taken upon 12 trains per day, will give a cost of 1·5*d.* per train per mile; take it at 6 trains it gives 2*d.* Then we have the composition to supply any material which may have become evaporated or wasted from the groove, that is 15*l.* per mile per annum; this, upon the same number of trains, will represent ·4 of a penny, making a total charge of $1\frac{9}{10}d.$ per train per mile, for the maintenance of the atmospheric main and groove with 12 trains a day; and if this be taken upon six trains a day, it increases the cost per train per mile to $2\frac{8}{10}d.$ For six trains will be 8*d.*; for 12 trains 5*d.*; and for 24 trains a day, 4*d.*, the price of coal taken at 10*s.* per ton."

2. General cost of the maintenance of way upon locomotive line—(*Stephenson.*)

"The maintenance of the London and Birmingham railway was originally let for 340*l.* a mile; that was the estimate, including every species of responsibility for slips of all kinds. Of that amount I imagine that not more than 150*l.* a mile has been spent in keeping the road in order in the upper works, that is, the rails; the rest has been absorbed in repairing the slips of cuttings and embankments, repairing bridges, clearing out watercourses, fencing, painting the iron-work of all the bridges over canals, and a great number of things of that kind. The repairing of the North Midland was let by contract; that was merely the upper works of the railway, with the bridges; there was no responsibility attached to the contractor for slips, consequently it is more nearly a fair comparison of the cost of maintaining the rails in good order; that was let at 119*l.* a mile. The Great North of England line is kept in repair by the Company; I do not think they let, and I do not know what it costs; but the maintenance of locomotive lines of railway will, in my opinion, sink down to about 120*l.* a mile. That is rather more than the Midland is let for, but it greatly depends upon the material; when the railway is in a clay country the subsidence goes on very rapidly for three or four years, and then it gets stationary, the embankments and cuttings settle. The 340*l.* included everything, sleepers and all.

"In working a railroad we may take it for granted that in the course of 20 years the whole of the rails must be replaced. The wear of the rails depends upon the weight of the engines, but has been very much overstated, as I will explain. The engines weigh 16 tons; some of the goods engines, that go at an inferior rate of speed, weigh 18 tons, and even some passenger engines too; but we will assume them to be 16 tons. If they are working upon six wheels, supposing the weight to be uniformly distributed in the first instance, that will give $2\frac{2}{3}$ tons upon each wheel of the engine; but the weight is not uniformly distributed amongst the wheels; the greater portion of the weight is thrown upon the middle wheel, that is, the driving wheel; there is probably $3\frac{1}{2}$ tons upon that, therefore there will be seven tons upon the two. In a goods wagon running upon four wheels, we frequently have six and seven and eight tons weight, which alone comes to two tons per wheel for the eight tons; they frequently exceed that: sometimes they carry 10 tons, that is too much, but they will load them in that manner. A four-wheel goods truck is by no means so long as the engine, because the length of a goods truck is probably only nine feet, whereas the length of the engine is double that. The motion upon the railway depends very much indeed upon the distance between the extremities of the axles, that is, an engine having axles 12 feet apart runs infinitely more steadily than a goods wagon, which has axles placed only five or six feet apart; the goods wagon also has the goods elevated, and certainly the quantity is considerably higher than it is in the engine, and thereby the goods trains moving quickly along railways do far more damage than the engines themselves, and the injury to the rails becomes very much aggravated by high velocities; and therefore that is one reason why I maintain, that supposing the atmospheric system to be susceptible of higher velocities than the locomotive, it would give rise to a greater wear and tear, and instead of requiring only light rails, I give it as my decided opinion, that in the end they would require rails fully as heavy, because the engines do not in my opinion do the most harm to the rails."

Newcastle and North Shields Railway—(*Nicholson.*)

"We ran, in the year 1844, an average of 23 trains each way per day; and in 1843, 22 trains. Not quite half-hour trains throughout the whole day; from 12 to 2 they are hour trains, but excepting those they are half-hour trains. I have kept a very accurate account for the years 1843 and 1844 of the expense per mile. In 1843 it was 6·75*d.* per train per mile; in 1844 it was a fraction less, it was 6·73*d.*; the length of the railway is 7 miles."

North Midland Railway.—Calculations and estimates with a view of showing that the whole cost of working the North Midland line as a locomotive line is than the bare interest of money had it been laid down upon the atmospheric principle—(*Stephenson.*)

"On a line such as the Midland, I apprehend they must have a diameter of tube of 15 inches, therefore it would hardly admit of any reduction below what Mr. Samuda has stated, if the atmospheric were applied to that line. That is a line of great thoroughfare, the trains acquire great velocity and carry heavy loads: the cost of the Midland locomotive power comes to 240*l.* per mile per annum;* if we take 6,000*l.* a mile, which was Mr. Samuda's estimate for a single line of atmospheric, at five per cent. as before, here is a sum again exactly similar to the sum upon the Yarmouth and Norwich, except that the application of the atmospheric system might, if it had been contemplated originally, have reduced the cost of the original works, but as

* The 240*l.* per mile for locomotive power on the Midland is just four per cent. on the 6,000*l.* cost of the atmospheric line per mile.

it stands now I am making the calculation; therefore the whole cost of working the locomotive line as it stands now, is less then the bare interest of money upon the atmospheric.

"You have stated that if the Midland Railway had originally been intended to be worked by atmospheric traction, a great saving might have been made in the construction account; can you give any estimate of what that would have been ?—It is exceedingly difficult; I made an attempt the other day to remodel the London and Birmingham line, supposiog I had to arrange that egain *de novo* for the atmospheric system, but I found that it would ocupy more time than I had to spare to make a model of that kind for 20 miles, in order to compare it with the expense of the line as it stands now; but there are a few considerations which will satisfy the Committee. I think that a very large reduction is not to be expected; though you may diminish the cuttings and embankments very materially, a large proportion of the bridges must remain; some of them will be augmented in expense, and some will be diminished; for instance, all the river bridges must remain pretty much the same, except that they may not be so high; all the bridges over canals, and over most of the turnpike roads; in fact, the greater number of the bridges must remain the same. But in order to show in few words that the reduction could not have been so very large if the cuttings and embankments were entirely taken off the Birmingham; supposing there were none at all, which could not be the case with the atmospheric, they only cost from 7,000*l.* to 8,000*l.* a mile; that is, supposing the surface of the country to be absolutely level, and that therefore the cuttings and embankments were entirely cancelled, the deduction would not be very much more than the additional cost of the atmospheric in the carrying establishment, and that is the case that I made out in my report: I assumed that the London and Birmingham line might have been made for 8,000*l.* a mile, and I am confident that I assumed that figure in favour of the atmospheric rather than against it."

(To be continued.)

AMALGAMATION AND LEASING OF RAILWAYS.

The multiplicity of plans and projects to prevent and promote competition and combination, by the advocates of either side, and the present complex nature of the arrangements of the different Railway Companies as they at present exist, induced me, for my own information, to compile from the various documents within my reach the following remarks on the subject of the heading of this paper, and I send it to your valuable Journal as a continuation of my former Notes. We have now the declared opinion of Parliament and their organ the Board of Trade, as also that of the recent experience of the different companies, learnt in their late arduous contests in the Session of Parliament now closed, and declared by their different chairmen at the half-yearly meetings. The Chairman of the Birmingham Company states that "Experience had hitherto been entirely against the hypothesis of competition, for in all large undertakings an increased number of companies had uniformly led to combination and an increased scale of charges." The Chairman of the Croydon states that "it is likely the companies will combine with advantage to themselves and to the public." The evidence of other parties who were examined before the Select Committee of the House of Commons is equally conclusive in favour of the hypothesis that companies would not compete, but come to an arrangement, and that by economy of management and avoidance of ruinous competition, and that by vigilant control, the public may get their share of the benefit, and the railway system be extended into rural districts by the extension of lines already in existence. The Board of Trade in their Report dated May 7, 1844, under the term Amalgamation Bills include "all applications to Parliament for powers either to consolidate the stocks of two or more independent railway companies, or to authorise the purchase or leasing of one railway by the proprietors of another, or in any other way to transfer the control and management of a railway from the hands of the company to whom it was originally intrusted by Parliament to those of another company constituted for different purposes;" and report in favour of the lease to the Midland of the united companies of Birmingham and Gloucester and Bristol and Gloucester, and in favour of the union of the Sheffield and Rotherham with the Midland, also in favour of the union between North Shields and Newcastle and Berwick, and the union of the Whitby and Pickering with the York and North Midland. The Board of Trade report against several other intended amalgamations, and amongst others the amalgamation of the Bolton and Leigh, Kenyon and Leigh Junction, North Union, Liverpool and Manchester, and Grand Junction Companies, which has however obtained the sanction of Parliament, as also the union of the St. Helen's Canal and Railway.*

The following have ceased to exist as independent Lines.

Ashton, Staleybridge and Liverpool Junction	Leeds and Selby
Aylesbury	Leicester and Swannington
Ballochney	Liverpool and Manchester
Birmingham and Gloucester	Lowestoft Railway
Blackburn, Burnley and Accrington and Colne Extension	Manchester Bolton and Bury
Blackburn and Preston	Manchester, Bury and Rossendale
Bolton and Leigh	Midland Counties
Bolton and Preston	Monk and and Kirkintilloch
Brandling Junction	Northern and Eastern
Bristol and Gloucester	North Midland
Canterbury and Whitstable	North Shields
Chester and Crewe	Norwich and Brandon
Croydon and Epsom	Northern Union Railway.
Durham Junction	North Union
Edinburgh and Dalkeith	Sheffield and Rotherham
Great Western Union	Slamannan
Kenyon and Leigh	Stanhope and Tyne
Lancaster and Preston	West London
	Whitby and Pickering
	Yarmouth and Norwich

Previously to the Session of 1844 the *Eastern Counties* leased in perpetuity the Northern and Eastern line at a certain rent, with a participation in profits if they exceed the amount fixed as rent; this arrangement took place Jan. 1, 1844. The *York and North Midland* purchased the Leeds and Selby Nov. 17, 1843, and have since purchased the Whitby and Pickering for their Scarboro Branch at a fixed sum. The *Manchester and Leeds* bought the Ashton, Staleybridge and Liverpool Junction, whose Act received the royal assent July 19, 1845. The Bolton and Preston line amalgamated with the North Union in the Session of 1843, and the latter line Nov. 9, 1844, amalgamated with the *Liverpool and Manchester*, which last line had previously purchased the Bolton, Kenyon and Leigh Railway, and is now itself uniting with the Grand Junction Railway, which latter line in 1840 had bought the Chester and Crewe line.

The *Lancaster and Carlisle* (69¾ miles) have purchased in fee the Lancaster and Preston (20 miles 18 chains) at 5 per cent. on

* In the Session of 1845 an Act was passed called "A Bill to restrict the powers of Selling or Leasing Railways contained in certain Acts of Parliament relating to such Railways;" in which it is required to have a distinct provision in some Act of Parliament specifying the Railway to be leased, sold, or transferred, and the party by whom such may be accepted. And on the 10th July, 1845, by a Minute of the Lords of the Committee of Privy Council for Trade, the Railway Department was reconstituted, and now the Railway business is to be managed by the Lords of the Privy Council in the same manner as the ordinary business, and no reports are to be prepared for Parliament, but copies of the plans and a written description of the course of an intended railway, as also a sketch on an Ordnance map are to be deposited with the Board as heretofore, and the Board will report to Parliament, if they see fit, any unusual departure from ordinary custom, without presuming an opinion on the actual or comparative merit of any railway scheme, and will publish their intention of preparation of any minute in the Gazette for the information of those whom it may concern. By a return to an order of the Commons, dated Aug. 4, 1845, of the Railway Bills and projects, classified in their groups, which have been considered by the committees to whom they were referred, I find 28 projects unsupported, 23 rejected, 3 dropped, 31 withdrawn, 3 considered, 10 postponed, 14 lost on standing orders, 136 recommended. Both Houses of Parliament have made provision for the Bills before the different Committees to take up their present state of forwardness at the point they are now at in the Session of 1846, but it is considered of little advantage to the different schemes.

The result of the decisions of the Committees of the House of Commons as compared with the now defunct department of the Board of Trade is, that 16 were decidedly against their recommendation, 3 with them, and 4 partly for and partly against. The lines in which the two bodies agree are the Belfast and Ballymena, the Monmouth and Hereford, and the South Wales; and those in which they partially agree are the Dublin and Belfast Junction, the Leeds and West Riding, the Newry and Enniskillen, and the Liverpool and Manchester. The general Acts of Parliament referring to railways are—Aug. 14, 1838, "An Act to provide for the Conveyance of the Mails by Railways;" Aug. 10, 1840, "An Act for Regulating Railways;" July 30, 1842, "An Act for the better Regulation of Railways, and for the conveyance of troops;" Aug. 9, 1844, "An Act to attach certain Conditions to the Construction of future Railways authorised or to be authorised by any Act of the present or succeeding Session of Parliament, and for other purposes in relation to Railways;" Sept. 5, 1844, "An Act for the Registration, Incorporation, and Regulation of Joint Stock Companies;" Sept. 5, 1844, "An Act for Facilitating the Winding-up the Affairs of Joint Stock Companies unable to meet their Pecuniary Engagements." The dates of the Reports of the Select Committee are—First, April 26, 1839; Second, Aug. 9, 1839; Third, May, 1840; Fourth, July, 1840; Fifth, July 10, 1844; Sixth, July 22, 1844.

The lines of 1843 and 1844 were more or less competing and injurious to existing interests, and the Select Committee on competing lines excluded from the Committees on Railways all local and individual interests, and the Board of Trade expressed a decided opinion against amalgamations and branch extensions that might impede new and legitimate enterprises, so that the present feeling, as in the case of the London and York, is decidedly more in favour of new companies than inclined to vested interests.

The first Act of Combination was the sale of the Chester and Crewe, in 1840, to the Grand Junction Railway; and nothing intervened until in Oct. 25, 1843, the Eastern Counties leased in perpetuity the Northern and Eastern, so that the extensive combination has been the rapid work of only 18 months; and the Hudson Bay Company's first work was the purchase of the Leeds and Selby for the York and North Midland, Nov. 17, 1843. The different forms under which it has been accomplished are—direct purchase for a fixed amount; leasing in perpetuity at a fixed rent and participation of profits; leasing for a fixed period, terminable at the option of either party on notice at certain periods, with a fluctuating rent depending on the increase of the weekly receipts; leasing on a fixed amount and participation in profit up to a certain per centage, with the option of purchase when the amount arrives at the fixed per centage; lease in perpetuity with option of purchase at a fixed period at a certain amount; amalgamation of interests with the foregoing, any profit for a fixed period and an unequal per centage on the receipts; a consolidation of interests with instant admission into stock at a certain depreciated per centage; a consolidation of interests by the creation of stock with a guaranteed dividend for a fixed period without participation of profits; leasing for a limited period at an increasing rent, increasing at fixed periods at different per centage on the gross receipts. In the enumeration of the dates of the Reports of the Select Committees, I have omitted those for Railways in Ireland, appointed October 1836, re-appointed November 1837; date of First report, March 1837; Second, Nov. 1838; also the Report of the Committee on the best line between London, Edinburgh and Glasgow; as also Capt. Alderson's Report on the Brighton lines, and the appointment of a Royal Commission on the Gauges, July 5, 1845.

£400,000 from Sep. 1846, and to be paid 6 per cent. should the Carlisle pay that amount; the North Union and Grand Junction take shares in the last line to £315,000.

The *London and Croydon* have, Aug. 22, 1844. bought the Croydon and Epsom atmospheric, and propose an extension from Epsom to Portsea and Portsmouth lines, also ⅓ of the branch of the South Eastern Company to Bricklayers' Arms.

The *Norfolk Railway* is composed of the late Norwich and Brandon and Yarmouth and Norwich railways, and has received the Parliamentary sanction, and they propose to lease the Lowestoft Railway and Harbour, for which an Act is obtained, and to make arrangements with the proposed Diss and Colchester and Wells and Dereham Companies.

The *Newcastle and Darlington Junction* purchased the line of the Durham Junction for £88,500, as also the Brandling Junction line for £55 per share, and have a perpetual lease of the Newcastle and Berwick line at 5 per cent, with which latter line the Newcastle and North Shields line is amalgamated at par. The two latter companies are guaranteed 5 per cent. on the share capital for 3 years, with a right to require the Newcastle and Darlington to take a lease in perpetuity.

North British have purchased the Edinburgh, Dalkeith and Fisherrow Branch for £113,000 (8¼ miles), and are negociating for Leith Branch, which is in the hands of other parties, they also subscribe £25,000 to the Edinburgh and Northern line through Fife, and have extended their Dalkeith Branch to Hawick and Galashiels. Share capital £800,000; loans £266,666; length 62 miles; Haddington Branch 4½ miles.

The *East Lancashire*, formerly the Blackburn and Preston, (9½ miles) which obtained an Act June 6, 1844, has been amalgamated on equal terms with the Manchester, Bury and Rossendale, date of Act July 4, 1844, and Blackburn, Burnley and Accrington and Colne Extension. It is proposed to extend the Rossendale from Rawtenstall to Bacup, The Company is favourable to the proposed Clitheroe Junction and Liverpool, Manchester and Great North of England Junction.

Ballochney Railway (5¼ miles) is amalgamated with Monkland and Kirkintilloch (10¾ miles) and Slamannan (12½ miles) Railways. Interest at 3½ per cent. to be paid to each company; the latter company to have no profit for two years, and the profits to be divided afterwards in the following hundreth parts—the first company 46, second 43, and third 11.

The *Hayle Company* is negociating for sale of the West Cornwall.

The *London and Brighton* have purchased the Brighton and Chichester at £12 10s. per share premium, also the Brighton, Lewes and Hastings at £7 per share premium, and propose a branch from the Three Bridge Station to Horsham, also an extension from Chichester to Fareham and Portsmouth.

The *South Western* (76 miles 55 chains) have purchased for £75,000 the Guildford Junction Railway (6 miles), and obtained an Act in 1844 to make a branch (21 miles) from the Basingstoke station to Salisbury.

The *Midland Railway* Act May 10, 1844; amalgamates the North Midland (72 miles 29 chains), Midland Counties (47 miles 36 chains), and Birmingham and Derby (38 miles 68 chains) Railways, and the united companies have purchased the Sheffield and Rotherham (5 miles 26 chains) Railway on perpetual lease at 6 per cent., also the Leicester and Swannington (16 miles 5 chains) Railway for £140,000, for which they pay 8 per cent., with the power of redemption at the end of 3 years at the rate of £100 per share. They guarantee the Barnsley Junction 5 per cent. on their whole and 4 per cent. on their half shares, and the Erewash Valley (13 miles, 5 miles branch) 6 per cent.; and have obtained Extensions from Nottingham to Lincoln (33⅝ miles), and from Syston to Peterborough (47⅞ miles); and have taken possession of the united Birmingham and Gloucester (51 miles 30 chains) and Bristol and Gloucester (22 miles 10 chains) companies, which they have agreed to lease at a fixed rent of 6 per cent. on £1,800,000, with power to purchase in 3 years at £150 for £100 stock, and the last two companies have taken the name of the Bristol and Gloucester Railway Company (353 miles). The above company with others has jointly agreed to purchase the Great North of England line for £250 per share.

The *Great Western* (118 miles) amalgamated with the Great Western Union (18 miles) 1844, also with the Oxford Branch (9 miles), and have a lease of the Bristol and Exeter (74 miles), and own the Cheltenham and Gloucester (18 miles) jointly with the Birmingham and Gloucester Railway, and contribute £150,000 to the intended Plymouth and Exeter or South Devon line (54¾ miles), and also contribute to the intended South Wales line (182⅔ miles, £2,800,000) for which an Act was obtained in 1845, and have made arrangements for a permanent lease of the intended Oxford, Worcester and Wolverhampton (103½ miles, £1,500,000) and Wilts, Somerset and Weymouth (129½ miles, £1,500,000), for which latter lines the Acts have been obtained in the Session of 1845; and they have purchased the Berks and Hants (39 miles, £400,000), the Oxford and Rugby (50½ miles, £600,000), and the Monmouth and Hereford (36¼ miles, £550,000), for which also Acts have been obtained in the Session of 1845; and they project lines from Oxford to Worcester, and from Oxford to Cheltenham (20 miles), and from Worcester to Port Dynllaen.

The *South Eastern and Dover* (66 miles 20 chains) rent the Canterbury and Whitstable (6¼ miles) at £12,000 per annum, and extended their own line by the Maidstone Branch 19 miles, which was opened Sep. 1844; and in 1844 they obtained an Act for Branches from the Ashford station to Canterbury, Margate and Ramsgate, 32 miles 65 chains in length, at an estimated cost of £400,000; and in the Session of 1845 they obtained an extension of Margate and Ramsgate to Deal and Canterbury, of 9½ miles, at an estimated cost of £187,000, and for improving their line from Tunbridge to Tunbridge Wells, and for an extension and widening of the London and Greenwich (3 miles 60 chains), which they had leased for 999 years and obtained possession of on the 1st of Jan. 1844.

The *Chester and Birkenhead* are now an independent company, and have £350,000 in the proposed Birkenhead, Lancashire and Cheshire Junction, which latter company had proposed to amalgamate with them, which has also the former vale to the Chester and Holyhead Company, for the sum of £500,000, have fallen through, or not taken effect.

The *Sheffield and Manchester* have repudiated a proposed lease by the Midland and Manchester and Birmingham. Length of line, 40 miles 66 chains, only open partially. They guarantee 5 per cent. in in £200,000 to the Bainsley Junction, and lease the Sheffield and Lincolnshire Junction at 4 per cent., and division of profits.

Chester and Holyhead, obtained an act in 1844, with the exception of the crossing the Menai Strait, which was obtained in the session of 1845. Length of line 84¾ miles. The London and Birmingham subscribe £100,000 towards the capital. A branch 10 miles to Mold is proposed, and £300,000 stock has been taken in the Ellesmere and Liv rpool and Birmingham Junction Canal Companies, which are proposed to be converted into railways, and shorten the distance between Chester and Holyhead. Capital £2,100,000 in shares, and loans £700,000.

The *York North Midland* (23 miles 11 chains) opened June, 1840), the Company by Act 1844, have purchased the Leeds and Selby Railway, as also the Whitby and Pickering, a line 6½ miles long; for £80,000, and have extended their line to Scarborough 48 miles. The return of the Leeds and Selby only amounted to £6 a-week, and 14 miles of it out of 20 have been closed. The above line, nearly 120 miles long, is in close alliance with the Midland group, the Company have intimated the hope of amalgamation at a future day, having already leased the Hull and Selby line. 30 miles 50 chains long.

Eastern Counties (51 miles 10 chains, amalgamated with the Northern Eastern (53 miles 11 chains) January 1st, 1844; and, in the session of 1844, obtained an extension to Brandon and Peterborough (72 miles in length, as also a branch to the Thames, 2½ miles. The total length is nearly 180 miles, with a share capital of about five millions, and with power to borrow two millions more.

London and Blackwall (3 miles 38 chains), and, up to 30th June, £1,083,951 8s. 9d. had been expended. The line was opened in 1841; and, in 1845, an extension was obtained, to join the Eastern Counties at Old Ford, commencing at Stepney station; and an extension is proposed into South Essex to Rochford and South End; and should the Eastern Counties decline next year the accommodation of the districts towards Loughton, Chigwell, or Epping, it is contemplated to be taken up, either by the Blackwall or an independent company.

The *Manchester and Leeds* (49 miles 76 chains) opened theirs March 14th, 1841. In the session of 1844, an act was obtained to make a branch, 6½ miles in length, to Ashton and Staley Bridge, called Ashton, Staley Bridge and Liverpool Junction. An attempt to amalgamate the Hull and Selby with this line was unsuccessful. Numerous extensions are proposed, and sums subscribed to projected lines, requiring an additional capital of £1,735,000. The amount expended to December, 1844, was £3,293,716. An amalgamation, from January, 1845, with Manchester, Bolton, and Bury (10 miles long) and take shares in the Manchester, Bury, and Rossendale.

R. *Manchester and Birmingham*, 31 miles long, opened 10th May, 1842. This company, in conjunction with Midland, proposed to take a joint lease of the Sheffield and Manchester line, which has not been carried out. This company guarantee 4 per cent. to the proposed Manchester and Bixton line, and take shares to the amount of 200 in the Trent Valley line. In three years the line will be amalgamated with the London and Birmingham, although some of the shareholders wish it to remain an independent line, propose to lease the intended

Bixton line at 4 per cent., and participation of profits up to 6 per cent., and the option of purchase.

S. *Newcastle and Darlington* (23 miles in length) originally called the Northern Union, opened 18th June, 1844, the Company have bought the Durham Junction for £88,500, as also the Brandling Junction, for £55 per share, and purpose to lease the Northern Counties and Berwick line at 5 per cent., with which line is amalgated the late North Shields line. The line was leased at 6 per cent., on a capital of £800,000. The amount of £30,000 was contributed as follow; Great North of England, £8000; West North of England, £8000; North Midland, £5000; Middle Counties, £3000; Manchester and Deeds, £3000; Brandley Junction, £750; Durham Junction, 750; Newcastle and Carlisle, 500; these were found to be too many interests, and the guarantee was abandoned.

Newcastle and Carlisle (61 miles 67 chains) opened June 18th, 1839.

Maryport and Carlisle (28 miles 3 chains) opened January, 1845. Share capital, 297,946. Loans, 99,000.

Preston and Wyre (19 miles 60 chains) opened 20th July, 1840. Share capital, £300,000. Loans, £100,000.

London and Birmingham (112 miles 10 chains) opened September, 1838. Leamington and Warwick branch (9 miles) opened December, 1844: and the Northampton and Peterborough branch, opened 1845, 44 miles long. The Aylesbury line, 7 miles long, leased for 7 years, from June, 1841, at a rent of £2000. The West London ($5\frac{1}{2}$ miles) was transferred for £50,000, on lease for 999 years, at a rent of a quarter of the gross proceeds; in three years hence, it is proposed to amalgamate with the Birmingham and Manchester, and to rent the proposed Trent Valley line, sharing the same dividend as the parent line. There is subscribed to the Chester and Holyhead a million. The Manchester and Birmingham have 3889 shares, of £20 each, in the proposed Trent Valley.

Stockton and Hartlepool ($8\frac{1}{4}$ miles long) made without an act, the Company have leased the Clarence line (36 miles long) for 21 years, at per cent., on the gross receipts for the 7 years, at 70 per cent.; less the coal haulage, for the fourth and subsequent years. The West Durham line ($5\frac{1}{2}$ miles long) to Crook and Billey row, joins the Byer's Green branch of the Clarence. The Clarence is the only line that as yet has been offered to public competition by the hammer. The Clarence line is also joined by the Durham and Sunderland (16 miles long). The other isolated line of the company of Durham are the Hartlepool Railway and Dock (15 miles), and the Pontop and South Shields, about the same length.

Stockton and Darlington (54 miles long) opened September, 1825, and the parent of public railways. The Black Branch is joined by the Bishop Auckland and Weardale Railway, a line $8\frac{1}{2}$ miles long.

Glasgow, Paisley, Kilmarnock, and Ayre (40 miles long) opened through 12th August, 1840, the Company have an act for a line to Cumnock, and leased in perpetuity the Kilmarnock and Troon Railway, and also, when made, of the Glasgow and Belfast Union, at 4 per cent., and an equal division of profit, under deduction of $33\frac{1}{3}$ for working expenses. Advantage is anticipated by the intended construction of the British and Irish Union Railway, from Portpatrick to Dumfries; and it is proposed to lease the intended Glasgow, Dumfries and Carlisle line, which joins the Cumnock branch.

Taff Vale ($2\frac{1}{2}$ miles) from Cardiff to Merthyr Tydvil, opened 12th April, 1841. It joins the Aberdare line at Navigation Henge, 16 miles from Cardiff, for which an act was obtained in session 1845.

Dublin and Kingston (6 miles 4 chains) opened throughout December, 1831 Share capital £200,000. Loans, £152,000. This Company bought the Kingstown and Dalkey atmospheric line, and proposes to extend it to Bray.

South Devon ($51\frac{3}{4}$ miles long) with a 7 feet gauge, and on the atmospheric principle, commences at Exeter, and terminates at Plymouth, Share capital £1,100,000. Loans, £336,500, of which £400,000 is contributed by the Great Western, Bristol and Exeter, and Bristol and Gloucester. The works are in progress. The royal assent was given to bill 4th July, 1844.

Eastern Union (17 miles long) from the Eastern Counties at Colchester, terminates with junction in the Yarmouth and Norwich, passing through Ipswich and Stowmarket, with a branch to Bury St. Edmond's. The Eastern Union Extension line from Ipswich to Bury St. Edmond's, is an independent company; but promoted by the same parties. The Eastern Counties line offered to take the line at par; but the offer was indignantly refused; and the Eastern Counties, in conjunction with the Yarmouth and Norwich, projected an intended line, called the Diss and Colchester, as they had also previously done to meet the Eastern Union by branches to East Dereham and Diss, all of which have miscarried. The Yarmouth Company obtained an act in 1845, for a branch from Wymendham to East Dereham and Wellst The share capital of the Eastern Union is £200,000; and loans, £66,650; and the royal assent was obtained 19th July, 1844. The capital of the Eastern Union Extension is £550,000. Joseph Locke is engineer.

Leeds and Bradford ($11\frac{3}{4}$ miles) is in junction with the North Midland, and terminates at Bradford. Royal assent, 4th July, 1844. Share capital £400,000. Loans, £133,333.

North Wales Mineral (11 miles) at Chester is in junction with Chester and Holyhead. Received the royal assent August 6th, 1844. Share capital, £120,000. Loans, £10,000.

Whitehaven and Maryport (12 miles) in junction with the Maryport and Carlisle. Received the royal assent 30th June, 1844. Share capital, £100,000. Loans, £33,000.

BRITISH ARCHÆOLOGICAL ASSOCIATION.

The following are the most interesting of the proceedings of this Society, at the annual meeting now terminated.

THE CHURCH AND HOSPITAL OF ST. CROSS.

Sept. 9.—A party paid a visit to St. Cross, the hospital and the beautiful church attached, and examined its architectural features. St. Cross is about a mile from Winchester, situated in a valley, and presents a very picturesque object from the neighbouring hills, the scenery around being beautifully varied by the winding of the Itchen River and its tributary streams. The hospital was founded by Henry de Blois, Bishop of Winchester, and brother of King Stephen. In the course of time its charitable purposes were diverted from their original benevolent purpose, but were fully restored and added to by William de Wykeham and his successor, Cardinal Beaufort, particularly in the year 1444. During the wars of the Roses, it suffered greatly, and at the Reformation a great number of its remaining possessions were sequestered and alienated. The hospital, though considerably diminished in its revenues, still maintains a master, steward, chaplin, and thirteen brethren. The church, chiefly of Norman architecture, was built in the reign of King Stephen, in the form of a cross, with a tower in the centre. The length of the church is 160 feet, and its breadth 120 feet. It possesses features of all the different styles of Gothic architecture, and in the examination of its details, the differences of the styles pointed out by the gentlemen above mentioned, afforded a most pleasing, instructive, and interesting lecture to all present. The chivron, the pellet, the billet, and other peculiar ornaments of Norman architecture, are here executed in a very superior style. There are one or two good brasses, particularly that of John de Campden, and some very peculiar encaustic tiles, inscribed "Have mynde," said to be for the purpose of reminding the brethren of their duty of praying for the dead. There is an old leaden font, but a basin is now used within it. There is some fine old stained glass, sadly jarred by the contrast of some very poor new work. One of the most curious features, is a triple-headed Norman arch, with the zigzag moulding, in the outer wall of the corner, between the chancel and north aisle. Its origin is supposed, by Mr. Blore, to have risen from the want of space, otherwise unattainable in making an entrance to the church, which had since been closed up.

Winchester Cathedral.—Professor Willis's Lecture.

September 11.—At half-past 11 the St. John's room was crowded to hear the lecture of Professor Willis, upon the Cathedral. The Professor repudiated the idea of any of the Saxon foundation of Ethelwood remaining, and attributes the remaining portion to the time of Walkelyn, the Norman bishop, appointed by William the Conqueror. It was a general rule with the Norman bishops to pull down their cathedrals, and rebuild others in their place. The Professor quoted a chronicle entitled "The Annals of Winton," to show that Bishop Walkelyn "destroyed the whole of the old church in a year, with the exception of the apse and the high altar," and again, "the succeeding year, the relics of St. Swithin were removed from under the high altar," which of course involved its destruction. In regard to the statement that the tower only was rebuilt by Walkelyn, this was satisfactorily answered by the legend that the tower fell in consequence of the burying under it the remains of William Rufus, who died without receiving the last rites of the church, and who was also a king of bad reputation. Now, Walkelyn died eleven years before Rufus, consequently could not have rebuilt the tower, which was most likely done out of the funds left by Walkelyn for the repairs of the cathedral. The Professor alluded to the fall of the tower of Ely Cathedral, built by Simeon, the brother of Walkelyn, and most likely by the same hands, and under similar directions, and concluded that both towers fell from the piers being too infirm to bear their weight, and this accounted for the immense size of the present piers, being as much too large as the others had been too small, and it was from the faults thus committed on both sides that the medieval architects learned those true and beautiful propositions which were now so admired by all who viewed them with any interest. The plan of the crypt showed that Walkelyn's choir was the same size as the present. From examinations that had been made under the auspices of members of the association, a bed of concrete had been found, which proved that it was originally intended to have towers at the west front, making the nave fifty feet longer than at present. In 1202, according to a MS. in Queen's College, Oxford, Bishop Lucy built the aisles and vaulting outside the Lady Chapel. In 1370, Bishop Edgington left a sum of money for the completion of the nave. In 1357, William of Wykeham was appointed architect by that bishop; and, having thus brought down the building to the time of William of Wykeham, the Professor read a long extract from the will of William of Wykeham, showing what had been done, leaving funds behind him for the work. Professor Willis entered at great length into the alterations made by that prelate, and, with the assistance of plans, easily made his auditors comprehend his meaning, and enabled them to appreciate, not only the talent of that learned prelate, but the research of him who, by infinite trouble and examination, now afforded them the means of doing so. There was no historical account left of the choir, but from its heraldic decorations, they were enabled to place the date during the time of Bishop Fox and his contemporaries.

At the conclusion of the lecture, the Marquis of Northampton proposed, and it was carried amidst unanimous cheering, the cordial thanks of the meeting to the Professor for his truly excellent lecture.

Mr. C. R. Cockerell then read a very interesting paper on the two St. Mary Winton Colleges, highly eulogistic of the talent displayed by William of Wykeham in those two buildings.

At the conclusion of the President, and a large number of members accompanied the lecturer to the college in Winchester, and pointed out the beauties and peculiarities of the prelate's style of architecture on the spot. Some few then visited Wolvesley castle; and at 4 o'clock Professor Willis accompanied a very large party over the cathedral and almost repeated his lecture, proving his deductions, and showing the method of his research in a manner most gratifying to those who had the pleasure of accompanying him.

PORCHESTER CHURCH.

September 13.—A large body of the members visited Porchester. The church is within the walls of the castle, and has a Norman west front of considerable richness, which has undergone less alteration than any similar structure we have in England of the same date. In fact, if we except a little work about the coping, which has not however changed the pitch of the gable, it may be looked upon as an untouched specimen. The nave, central tower (which is low and massive), and north transept are also pure Norman. The south transept has been destroyed, and the chancel shortened at a late period. The font is a very fine one. It was the church of the priory founded by King Henry I. within the walls of the castle, and removed about twenty years afterwards to a more peaceful situation at Southwick, about three miles distant. Many found time also to visit the curious little Saxon church at Boarhunt, and the fine church and house at Titchfield.

In the evening the following paper was read at St. John's room:—

On Porchester Castle. By the Rev. C. H. Hartshorne.

The natural position of Porchester rendered it eligible as an early fortress so soon as the Romans had gained a footing in Great Britain; the precise age of it is uncertain; probably later than the works at Richborough, Pevernsey, and Dover.

The inhabitants of Hampshire having assisted those of Brittainy in their revolt against the youthful Crassus, urged Cæsar the following year to undertake the conquest of Britain. Landing-place doubtful, but it happened exactly 1,900 years back.

In the uncertainty as to the precise dates of the different Roman fortresses on the southern coast, it is essential to examine the methods of construction employed in the works themselves, since this plan will exhibit the close analogy and characteristic marks of Roman architecture in England with what is observable on the opposite coast, and show that all the military works of that age are precisely the same in their principles, the works on the coast the earliest; as the conquest of the country extended, the same quadrangular forms of encampment followed its progress.

The foundations of these buildings, upon examination, show them to have been laid in conformity with the rules given by Vitruvius. The towers in the walls, the modes adopted to give them stability, and the methods of binding together by means of Roman bricks the bad materials employed in the work, are all in obedience to the precepts of this great architect, as shown at Leicester, Richborough, Dover, Porchester, and other places. The same system, in fact, prevails from Caerwent and Caernarvon to Dover and Silchester, and from Lillebonne and Soissons to Autun, in France. The duribility of these tiles is occasioned by the clay having been thrown up a long time previously to its being used.

The more important question of cements was next entered upon, from which it appeared, by a careful analysis having been made of several, they were found to agree with the rules of Vitruvius, and moreover showed that their peculiar hardness depends upon their coarseness, which hastens chrystalization, and causes the latent cohesiveness of the slacked lime to be brought into action, so that the mass becomes more perfectly carbonated.

By the application of this kind of inquiry it is found that Porchester still exhibits, notwithstanding the continued repairs it has undergone from the reign of Henry II to the present day, indisputable marks of its high antiquity; but there is no connecting link between the genuine Roman work of the second century and the Norman keep of the twelfth. This keep, which was the temporary residence of King John on nineteen different occasions, gives a curious insight into the domestic inconveniences of the early English monarchs, who when compelled to stay within doors must, of necessity, have passed much of their time in murky twilight, a gloom they tried to dissipate by the great quantity of wine that was always ordered to precede their visits.

These castles were always held by constables under the Crown, and garrisoned by his tenants, who were bound to perform service here during time of war, on which tenure they frequently held their estates.

During the prevailing taste for the study of ecclesiastical architecture it is to be feared that the military remains of England, which do not make the same sacred appeals for preservation, do not receive the attention that patriotism should excite, and thus they are suffered to perish without any exertion been made to record their character. Yet they must ever be dear to the history of our country, as having been at once its terror and safeguard—structures, it is true, that rose at the bidding of ambitious rulers, and at a time when the upper classes tyrannically repressed every exertion that aimed at extending the natural rights of society, yet still to be preserved, as the memorials of a despotism which civilization has overthrown, to show posterity that the misery and rapine inseparable from feudalism has been transferred from bitter endurance to the pages of history, or the records of national injustice, and to teach them how dearly those privileges should be cherished which a gracious Sovereign has ratified to an united people. Stained as those fabrics may be by the deeds of unrelenting and merciless men, still let their tottering walls be kept from entire destruction, were it only to afford a sequestered spot where the unlettered hind may gaze in mute astonishment and moralize, where the painter may gather up those broken lines of beauty that charm and captivate the eye when traced upon his canvass, and where the exploits of chivalry, and the songs of wandering minstrels, and the fictions of legendry lore, and the charities of holy men, may become idealized by the creations of poetry. Mr. Hartshorne then referred to various documents, illustrative of several interesting points, as the expense, the number of workmen employed, &c., and showed their importance and value in investigations of this description.

MEMOIR OF THE CANAL OF EXETER.

(*Paper read by* James Green, M. Inst. C.E., *at the Institute of Civil Engineers.*)

In 1824 the demands for a more perfect navigation of the Exeter Canal became so general, that the authorities were constrained to enter on an entire revision of the works, and as it was evident, for the interest of the trade of the city, that facilities should be given for bringing up larger vessels, further surveys were made, and on the 1st of March, 1824, a report was presented, stating that it would be practicable to extend the canal to Turf, two miles lower down the estuary than had before been contemplated, and to which point vessels drawing 12 feet water could navigate on all tides. This report was approved and adopted, and the works were soon afterwards commenced.

In executing these works, it was necessary to carry a considerable portion of the extended line over mud-lands, which were overflowed by the sea at every tide; much difficulty was therefore experienced in maintaining the embankments to the required height, and some extraordinary high tides and floods which occurred, having made extensive breaches in the shore which separates the estuary from the sea near Exmouth, it was found that the tide rose several feet higher within the estuary than it had been accustomed to do before these breaches in the sands of the shore had occurred. In consequence of this, it became necessary to raise the embankments over the mud-lands 3 feet higher than had been originally intended.

The raising of these banks, on such a foundation, was a work of considerable difficulty and expense, and it could only proceed slowly; but its completion being imperative, it was accomplished by the persevering energies of the Chamber. This induced the idea and the determination of increasing the depth of water in the canal to 15 feet, and of constructing the entrance lock at Turf, of dimensions adapted to vessels drawing 14 feet of water; hence also arose the necessity of adapting all other parts of the canal to vessels of that class. These works would have been in a great measure useless, unless the larger class of vessels could arrive at the river basin at Exeter; an entire new and walled basin, capable of accommodating such vessels, independently of the river, was therefore made at the upper end of the canal, close to the city, and was opened for trade on the 29th of September, 1830. Experience has shown, that this increase of the depth of water in the canal was not greater than was necessary. It was found during the progress of the works, that as the depth of water in the canal increased from time to time, the demands for a still greater depth became more urgent, and the success of the exertions of what may almost be called a private corporate body "in a corner of the kingdom," is proved by the fact that the revenues of the canal have trebled since the commencement of the extension of the works.

The Entrance Lock.

The excavation for the entrance lock at Turf proceeded very favourably through a stiff alluvial clay, without water, to a depth of nearly 20 feet below the surface of the marshes, when on the occasion of a pile being driven, to ascertain the depth at which a harder foundation would be obtained, water forced its way up around the pile, and the following morning the sides of the excavation were found to have sunk perpendicularly at least 10 feet, and the bottom of the lock-pit had risen to a greater height than the sides, exhibiting on its surface, peat moss, roots of trees, and a great variety of marine plants, rushes, fern, &c., but with very little water. It was, however, now evident that there would be much water to contend with in sinking to the required depth for the foundation. In order to accomplish this, a complete close kirbing of whole timber piles was driven, enclosing a space for the invert and the side walls of the lock; these piles were well strutted by transverse whole timbers. The excavation was then made, and the lock was founded in short lengths between the transverse struts. It was presumed that the pressure of water from the tide without the lock would have a tendency to force up and raise the invert and the gate platform; several flues, formed of elm plank trunking, were therefore laid in the rubble masonry, which formed the bed for the invert; these flues were carried under and throughout the lock, and terminated in a vertical well, beyond the upper gates of the lock; thus the sub-water was allowed to circulate, and to rise, without obstruction, to a corresponding height with the tide. This had the desired effect, for the platforms never exhibited any tendency to rise, and there was no settlement in the masonry.

Mr. Telford, who saw this work in progress, declared he had never seen so troublesome a foundation, and he highly approved of the method adopted for preventing the upward pressure of the sub-water.

Circumstances occurred of a very similar character in forming the canal from the lock, upwards, across the mud-lands in the tideway. This was accomplished by excavating the bed of the canal, through the mud, which was tolerably stiff, and embanking the sides. When the tide was once excluded, there was very little trouble with the water in the cutting; the work stood well for some months, and did not subside to any remarkable extent; but suddenly the substratum, in several places, rose up in the bed of the canal, to the height of 9 feet or 10 feet, exhibiting peat and vegetable deposit, similar to that found in the lock-pit, and the banks, on the sides, sunk perpendicularly to a depth equivalent to the rising of the bottom. In these places strong piles were closely driven in the lines of the bottom of the canal. These piles were supported by transverse inverted arches of rough stone, about 6 feet in width, and were laid about 20 feet apart; when these were finished, the excavations were re-made, and the banks were reformed; after which the work stood well.

Observations.

Sir John Rennie, President, said, he believed there was little doubt of the Exeter canal being the earliest canal upon which true pound-locks had been constructed in this country, and that the Sankey cut was next in date. There was much obscurity as to the first use of locks on continental canals; their introduction had been attributed to Leonardo da Vinci, but there were reasons for believing they had been used earlier in Holland and in China, which was rendered probable by the great attention paid to hydraulic architecture in those countries.

The ancient method of navigating rivers, was by waiting for the flashes of land-water, when whole fleets of boats were carried simultaneously over the shoals; then came single gates for pounding the water, and producing the same effect by artificial means; at length the true locks, in side cuttings, were introduced; and at present there were many specimens, not only of very perfect river and canal locks, but also of immense locks leading to docks. One of very extraordinary dimensions had been recently proposed, by Mr. H. Martin, for the East India Docks. The design was for a lock 300 feet long, and 75 feet in breadth, with its cills, 16 feet below low water mark.

Oblique Weirs.

Mr. Cubitt, V.P., objected to the construction of locks on the direct course of a river, for many obvious reasons, which, however, he would not then enter upon, as he would do so fully in an account of the works upon the river Severn, which he would request Mr. Williams, the resident engineer, to draw up for the Institution. When he undertook the improvement of the river Stour, in Essex, he found a very primitive system of navigation. There were 13 locks, and there were also 13 "stanches" along the course of the river, in the middle of the stream, without any side cuts. As few, if any, "stanches" now existed, he would explain their construction. Two substantial posts, with a bottom cross cill, were fixed at a given distance apart, sufficient to permit a boat to pass easily between them. Upon one of these posts was a beam turning on its centre, and long enough to span the opening. When the stanch was used, the boatmen turned the beam across the opening, and placed vertically in the stream a number of narrow planks resting against the bottom cill and the swinging beam, thus forming a weir, which raised the water in the stream about 5 feet high; the boards were then rapidly withdrawn, the swinging beam was turned back, and all the boats which had been collected above were carried by the flash over the shallows below. By repeating this operation at given intervals, the boats were enabled to proceed a distance of about 23 miles in two or three days. This system was, at one period, very common in England. Then succeeded the pound-lock, containing sometimes twenty boats. The necessity of rapid conveyance had induced gradual improvements, until the locks, as now constructed, appeared to be almost as perfect as they could be made. The method of filling and emptying them from culverts, with several lateral openings, was practically very advantageous. This system had been adopted in the locks in the Severn; but the principal novelty in those works were the oblique weirs, relative to which there had been so much discussion before the Parliamentary Committee on the Bill.

The object of those weirs was to raise the water, and to retain it at a proper height, for the navigation of the shallow parts of the river, without opposing such barriers as should prevent the free discharge of the flood waters. This end had been completely answered; there was now a depth of upwards of 6 feet of water at all times, where formerly there was only a depth of 18 inches, and during floods the back water did not rise higher than before the establishment of the weirs. A similar result might, he believed, be always attained, by making the obliquity of the weir sufficiently great; a regular sheet of water would constantly flow over it, and its capacity would enable it to discharge any increase with facility.

Mr. R. Stephenson had seen the Severn improvements, and had been much pleased with their apparent success. The subject was of great interest to engineers, as it involved a seeming paradox, that the placing an enlarged obstacle across the bed of a stream, should not increase the height of the floods above it. Such, however, was the case, and he could only attribute this result to a diminution of friction, arising from the retention of a certain depth of water over shoals; the flood waters, as they came down, were no longer retarded by the friction of a number of obstacles, but they flowed readily and more rapidly along, until they reached the weir, where from its greater capacity arising from its oblique position, the body of water was more easily discharged. In fact, the reduction of friction enabled a greater quantity of water to pass along the channel in a given time.

Mr. Cubitt, V.P., agreed with Mr. Stephenson's views. The oblique weirs would raise the water to a certain height, above which it could not rise in a greater degree than heretofore. It had not been assumed that this effect would be to reduce the ordinary height of floods, but that they would prevent the sudden effect of floods upon the adjoining lands. It should be stated at the same time, that the channel of the river had been improved in several parts, and the capacity of the stream had been slightly increased, by the works which had been executed. The practical result of these works had proved, that an oblique weir, placed in a narrow channel, offered no greater resistance than did its cross section by a line at right angles to the course of the stream.

Sir John Rennie, President, thought that the natural consequence of the improvements in the channel was to gain a greater capacity for getting rid of the flood waters.

COMPETITION DESIGNS.

Sir—Some four months since I forwarded a set of drawings which I had prepared as a Design for a New Church to be built at Camden Town. The instructions of the committee were sufficiently clear and decided, indeed rather unusually so, and in them the amount to be expended was strictly charged as not to exceed £6,000. These instructions I kept in constant consideration, anxious to do all that was possible for the £6,000—*and no more*; and of course relying on the honest judgment of the Committee, and a spirit of honourable and generous competition amongst my professional brethren.

The Committee had (with much judgment as I *then* thought), limited the competition to a certain PRIVILEGED number of architects, and in truth every prospect was afforded of a fair and just decision.

After the prize drawing had been named, the others were exhibited, and I paid a visit to satisfy myself as to the justice of the selection. Now, I own myself beaten; there were, I was going to say, half-a-dozen designs that even in my partial judgment excelled mine. But how was it? I knew that they could not be executed for the money; indeed one of them did not profess it, for the estimate was £6060, and yet it was allowed to remain in competition, and to my knowledge was voted for as the design which aught to be accepted!

The design which *was* chosen, it has since been discovered would, if executed, much exceed the prescribed amount. In this dilemma, the Committee have desired the architect to make a new design which *will* come within that sum—never dreaming of the justice due to those gentlemen who expended their time and skill in their production of the other designs, and which it is fair to infer were rejected, because they were honestly prepared! Out upon it! say I—and let us have no more to do with competitions, whether they be open or limited. As well—and with more justice—might you set Brodie, Lawrence and Suthrie, in competition upon a dead subject, in order to discover who was best fitted to practice on the living one. But which of the three would submit to the ordeal? So long as Committees forget that they are as bodies by the same rules of honour and honesty which mark their *individual course*, so long will architectural competition be nothing better than a delusion and a fraud. To this I would add that so long as there are those in the profession who will take a mean, dishonest, and ungentlemanly advantage of their brethren, by submitting false estimates of their works, so long will the more worthy of their number be precluded from joining issue.

I am, Sir, your very humble servant,

C. W. T.

Portsmouth, August 19, 1845.

ATMOSPHERIC AND ROPE TRACTION RAILWAYS.

Mr. P. BARLOW'S *Experiments comparing the* POWER LOST.

TABLE, showing a COMPARISON of the USEFUL MECHANICAL EFFECT of the DALKEY ENGINE, as applied by the ATMOSPHERIC PIPE, with that of the TYLER HILL ENGINE on the CANTERBURY and WHITSTABLE RAILWAY, as applied by the ROPE.

DALKEY ENGINE; 100 Commercial H.P.; Cylinder 34 inches.

No. of Experiment.	Vacuum.	Weight of Train.	Horse Power indicated during Experiments.	Average Velocity per Hour.	Average Velocity per Minute.	Resistance due to Friction and Gravity.	Useful Mechanical Effect.	Lost Power per cent.	Author of Experiments.
	In.	Tons.		Miles.	Feet.	lb.	H.P.		
1	18·5	26·5	151	15·3	1355	781	32·1	78	Stephenson.
2	19·0	30·8	150	14·2	1256	907	34·5	77	Ditto
3	20·0	34·7	162	10 3	915	1023	27·8	83	Ditto
4	20·7	36·8	158	12·7	1128	1084	37·0	76	Ditto
5	21·0	38·3	160	11·8	1048	1129	36·0	78	Ditto
6	22·1	42·5	160	10·6	930	1253	35·3	78	Ditto
7	22·5	43·8	164	10·7	951	1292	37·2	78	Ditto
8	22·7	45·5	163	9·6	853	1341	34·6	79	Ditto
9	23·3	51·0	163	9·0	795	1503	36·2	78	Ditto
10	24·0	53·5	165	7·8	690	1576	33·0	80	Ditto
11	23·8	58·0	161	7·9	703	1709	36·3	78	Ditto
12	23·6	59·8	167	7·8	690	1763	36·8	78	Ditto
13	24·4	64·7	164	6·6	580	1907	33·5	89	Ditto
14	24·25	36·5	160	7·9	705	1076	23·8	85	Samuda.
15	23·75	42 5	160	7·8	700	1253	26·6	83	Ditto
16	22·75	43·6	160	8·0	716	1268	27·6	83	Ditto
17	24·75	60·40	160	6·5	575	1825	31·3	81	Mallet.
18	24·75	70·40	160	6·1	536	2075	33·8	79	Ditto
19	24·75	72·54	160	6·0	527	2140	34·1	79	Ditto

TYLER HILL ENGINE; 25 Commercial H.P.; Cylinder 20⅝ths in.; 5 feet Stroke.

No. of Experiment.	Weight of Train.	Horse Power indicated during Experiments.	Average Velocity per Hour.	Average Velocity per Minute.	Resistance due to Friction and Gravity.	Useful Mechanical Effect.	Lost Power per cent.
	Tons.		Miles.	Feet.	lb.	H.P.	
1	23·45	50·5	7·2	634	1312	25·2	50
2	35·00	46·3	5·6	493	1958	29 2	37
3	19·57	34·6	7·2	631	1095	21·0	39
4	31·14	36·0	6·1	537	1765	28 7	20
5	12·12	32·5	9·2	810	678	16 6	48
6	27·80	34·5	5·9	519	1555	24·4	29
7	14·81	35·4	7·7	680	828	17·0	51
8	35·22	55·6	7·4	655	2000	39·7	28

Note (1).—The resistance due to friction and gravity in the experiments on the Dalkey Line is calculated for an incline of 1 in 115, instead of the actual gradient of 1 in 138, which allows 3 lb. per ton for the friction from the curve.

Note (2).—In estimating the power of the Engine on the Whitstable Line no deduction has been made for the friction.

It will be seen by this Table that the loss of power by Rope traction varies from TWENTY to FIFTY-ONE per cent., and by Atmospheric traction SEVENTY-SIX to EIGHTY-FIVE per cent.

THE GREAT BRITAIN.

The Great Western Steam Ship Company originated with a few directors and proprietors in the Great Western Railway Company, who entertained the idea, that on the completion of the railway from London to Bristol, a direct line of communication, by means of steam-boats, to New York, as the focal point of the New World, might be established with advantage. The Great Western fulfilled the expectations entertained of her by her projectors, in all respects, except in that, like many other moderate sized steam vessels, so large a part was occupied by the machinery, relatively to that which could be appropriated to passengers and goods, the deficiency of space was soon found to operate disadvantageously, in a pecuniary point of view. At first it was intended that their second ship should be of timber, but the superior advantage which the introduction of iron appeared to hold out, induced a very careful comparison, and an investigation into the state of some small steam vessels already constructed of this material, and the result was the abandonment of the previous resolution. As no example of an iron steam ship of sufficient size existed, on which to base any calculation of the thickness of the iron to be employed in its construction, or of the disposition of the material, in order to obtain the greatest relative degree of strength; much consideration was requisite, and it became necessary to organize an establishment for building iron instead of wooden ships, before the keel of the new vessel was laid.

Dimensions, Tonnage, &c.—The principal dimensions of the hull of the Great Britain are, length of keel, 289 feet; length aloft, 322 feet; main breadth, 50 feet 6 inches; depth of hold, 32 feet 6 inches. The tonnage, according to the usual mode of builder's measurement, is therefore, 3,444 tons. The weight of iron used in the hull is about 1,040 tons: which is equal to an average thickness of 2¼ inches. The weight of wood-work in the decks, fittings, &c., is about 370 tons. And the weight of the engines and boilers (exclusive of the water) is 520 tons. The total weight, therefore, is 1,930 tons; which, at a draft of water of 10 feet 6 inches aft, corresponds exactly with the calculation of the displacement of the hull, which is as follows:—

Draft.	Fore Body.	After Body.	Total.
Feet.	Tons.	Tons.	Tons.
12	1053	851	1904
14	1315	1099	2414
16	1594	1386	2980
18	1904	1714	3618

She will therefore be able to take 1,000 tons of coal, and 1,000 tons of measurement goods, weighing perhaps 400 tons, at a draft of 17 feet forward, and 17 feet 6 inches aft.

Keel.—The keel plate consists of plates ⅞ths of an inch in thickness, by 20 inches wide, which are welded into lengths of 50 feet to 60 feet, and these lengths are joined together, by very accurately made scarphs, 1 foot 6 inches in length, and riveted all over, at distances of 4½ inches apart. The end pieces of the keel, which are more liable to touch the ground, are full 1 inch in thickness. The stem is 12 inches deep at the forefoot, by 5 inches thick, and at the 8 feet water mark, it is 16 inches by 2½ inches; thence it diminishes gradually to 12 inches by 1½ inch. It is welded in one piece 18 feet long.

Ribs.—The ribs or frame are formed principally of angle iron, 6 inches by 3½ inches by ⅝th inch, at distances of 18 inches from centre to centre, but inclining gradually to 24 inches at the extremities, where also angle iron, 6 inches by 2½ inches, and 4 inches by 3 inches, is used. In that part of the body of the ship which is occupied by the engines, the ribs are doubled, by having a similar angle iron riveted to them, with the web inside, or, as it is termed, "reversed."

Plating.—The outside plating commences with plates, 6 feet to 6 feet 6 inches long, and 3 feet wide, by $\frac{11}{16}$ inch thick; of these plates there are four courses; these are followed by several courses of ⅝ inch thick, which is the strength of the whole of the immersed part, up to the deep load water line. Above that height the same thickness is preserved a-midships, but it is gradually reduced to ⅜ inch thick quite high up, and at the extremities, with a view to lighten them.

Sleepers.—The longitudinal floor sleepers are ten in number; they are 3 feet 3 inches in depth, and ½ inch and $\frac{7}{16}$ inch thick. The middle sleepers extend throughout the length of the vessel; those on the sides are level on their upper surface, and consequently are terminated by the rising of the bottom of the ship. These sleeper are tied to the bottom and are preserved in their verticle position, by inverted curves of strong angle iron, which are riveted to the ribs and also up the sides. Along the upper edge of each, there is an angle iron, and over the whole is riveted an iron deck ⅜ inch in thickness.

Keels.—There are two bilge keels, consisting of a middle plate, 1¼ inch thick, and two angle irons, 5 inch each way by 1 inch thick. These bilge keels are 110 feet long, and their under edges are on the same horizontal level with the under side of the keel, so that in docking the ship, if long baulks of timber were extended across the dock by way of blocks, the weight of the body of the ship (where the boilers and machinery are placed), is supported at given parallel distances on both sides of the keel, all risk of straining it, or the machinery, is avoided, and the vessel is not obliged, in the usual manner, to rest upon her keel, until the bilge shores can be got under.

Decks.—The upper cargo deck forward is made of plate iron, $\frac{5}{16}$ inch thick in the middle, and $\frac{9}{16}$ inch round the sides; it is riveted together throughout, as well as to the iron deck beams, and to the sides of the vessel. The main deck is made of pine timber 5 inches thick, and the planks are cross bolted at distances of 4 feet a-part. As this deck is situated on the load floatation plane of the vessel, where transverse stiffness is of more importance then longitudinal strength, the planks are placed athwartships, and their extremities are firmly bolted down, through two longitudinal stringers of Baltic timber, to the shelf plates, which are 3 feet wide by $\frac{5}{8}$ in thick, and are very securely fixed to the sides. The middle or promenade deck is also of pine timber 4 inches thick, placed lengthwise of the ship; it has also strong iron shelf plates 3 feet wide by $\frac{1}{2}$ inch thick, and Baltic stringers to attach it to the sides of the ship. The upper deck is of red pine timber, and is also placed lengthwise. As the sides of the vessel at this height, and also this deck, may be considered as the truss, which is to resist longitudinal deflection, or drooping of the extremities, the outside plates are there $\frac{1}{2}$ inch thick, and they have been strengthened by an outside moulding-iron strap, 6 inches by 1 inch, and by additional straps of iron 7 inches by 1 inch, welded into lengths of 60 feet, and riveted to the inner sides of the upper line of plates. The shelf plate of the deck is 3 feet wide by $\frac{1}{2}$ inch thick, and upon this, outside of the water-way plank, which is $4\frac{1}{2}$ inches thick, there is a course or tie of Baltic pine timber 340 inches in section, carefully scarphed and securely bolted to the ribs, and to the shelf plate, throughout the length of the ship. There are three rows of timber pillars, or staunchecns, which are fixed to the bottom of the ship, passing up between longitudinal ties at each deck, and are secured to the upper one. The beams of all these decks are made of single iron, 6 inches by $3\frac{1}{2}$ inches by $\frac{1}{2}$ inch, and their ends are bent down, and riveted to the ribs on each side. Upon them, the shelf plates before mentioned are riveted, and thus form a horizontal band 3 feet wide at each deck. A crutch or strut is introduced at each end of nearly every deck beam, which is riveted to it, and to the ribs at about 3 feet from the angle of junction.

Division by bulk heads.—One of the most important improvements which has recently been introduced in the construction of vessels (particularly those of iron), is the water-tight bulkhead; as in the greater number of cases, when an injury may be sustained in one compartment only, it may absolutely preserve the vessel from sinking; several instances of this have already occurred, and even where it may not suffice for this purpose, it at least separates the leaky and injured from the secure parts, and gives time either to attempt to stop the leak, or to make other preparations. In iron vessels, these bulkheads can be made much more effectual than in wooden ones, by their exact contact with the bottom and sides, while at the same time they form admirable ties and stiffeners. In the Great Britain there are five such bulkheads. The first separates the forecastle from the forward passengers' cabin and hold, and as it is in the forepart of a vessel that injury is most likely to be sustained, this partition is made particularly strong and secure. The next bulkhead divides the forward cabin from the engine-room, or more properly, from the fore-hold for the coal and the stokers, at the forward end of the boilers. The third bulkhead is abaft the engine-room, but in this there is necessarily a hole for the screw shaft to pass through; this is secured by a well fitted collar, and there is also a door, which is so arranged as to be shut and bolted quickly. These three bulkheads pass up to the upper deck; there are also two others; one separating the after coal-hold from the after cargo-hold, and another nearly at the stern; both these terminate under the saloon deck.

Screw Propeller.—At an early stage in the construction of the Great Britain, but not until her sides had assumed the form adapted for paddle wheels, the small steamer Archimedes, belonging to the company owning the patent of Mr. F. P. Smith for the application of the Archimedean screw, visited Bristol, and amongst other parties invited to make an excursion to the Holmes, on board of her, were some of the directors of the Great Western Steam Ship Company. The performance of the screw on that occasion induced the author to requested permission of Mr. Smith and Captain E. Chappell, R.N., who were officially appointed by the Admiralty to report upon her, to proceed in her to Liverpool. On the passage, enough rough weather was encountered to show that the screw possessed several good points, and was not so absolutely impracticable as had been asserted; and although far from venturing to give a decided opinion, on the author's return, he wrote such a letter to the Board of Directors, as induced them, after some days of deliberation, to decide upon suspending, during three months, the progress of the machinery for paddles, and also that part of the vessel which might be affected by the change, and to call upon Mr. Brunel during that period to investigate the subject. At the end of the proposed delay, the report which Mr. Brunel made was so favourable, that, undaunted by the novelty and vastness of the experiment, the directors resolved to adopt this mode of propulsion, of the success of which they have now such cause of congratulation. From that period, until it became necessary to decide on the exact form of screw to be used, all possible means were taken, by experiment and observation, to arrive at the best shape and angle of inclination of the blades, or as it is commonly called "the pitch." Amongst others, the proprietors of Mr. Smith's patent liberally lent the Archimedes to the Great Western Steam Ship Company, for a period of several months, which afforded ample opportunity of trying the performances of the several forms of screws recorded in the following table;—

Performances of the several forms of Screws.

Number of Experiment.	Strokes of Engines per Minute.	Horse Power by Indicator.	Speed of Vessel in Knots.	Speed of Screw in Knots.	Ratio of Speep of Vessel to 1· of Screw.		Diameter of Screw.		Pitch.	
							Ft.	In.	Ft.	In.
1	25·41	67·1	8·375	10·6·16	·787	Smith's two half threads, made of wrought iron.	5	9	8	0
2	20·75	53·7	8.16	10·88	·75	Ditto ditto	5	9	10	0
3	26·25	63·59	7.55	8·23	·917	Ditto, made of cast iron	7	0	6	0
4	26·5	57·13	7.42	8·52	·87	Ditt ditto	7	0	8	0
5	20·	57·3	8·175	8.	1·02	Woodcroft's increasing pitch, 3 blades, made of cast iron, as first made.	7	0	7	$7\frac{7}{8}$
6	21·5	62·6	8·1	8·1	1·	The same, with 3 inches cut off the termination of the blades.	7	0	7	$2\frac{1}{4}$
7	22·5	62·12	8·2	8·73	·94	The same, with 4 inches cut off the entering edges of the blades.	7	0	7	5
8	20·5	51·4	7·49	8·566	..	4 wrought iron arms, with blades, each 2 feet 9 inches long, by 1 foot broad.	7	0	8	0

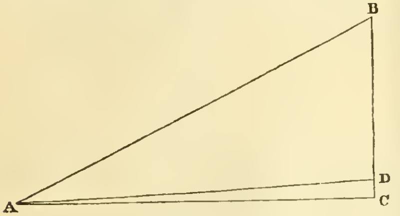
These experiments were made in the British Channel under circumstances of weather, as nearly as possible similiar, and the distances were very carefully measured by two of Massey's Logs, whose accuracy had been previously tested. It will be observed, that the greatest velocity of vessel, 8.375 knots, was attained by Mr. Smith's screw of 5 feet 9 inches diameter, the angle of which was $19\frac{3}{4}$ degrees, and the slip was 21 per cent.; that is, the ratio of speed of the vessel to that of the screw, was as ·787 to 1. Particular attention is due to experiments Nos. 5, 6, and 7. Reasoning upon the assumption, that the effort of the entering edge of each blade, must cause the water to recede, and that each succeeding portion of blade should so increase in pitch, as to impinge with uniform force against the water, which was so receding, a screw of this description was made and tried before it was discovered that it was the subject of a patent by Mr. Woodcroft. The first trial served to show, that the curvature or increase of pitch, which had been given to it, was too great, since the speed of the vessel was greater by 2 per cent. than that due to the mean pitch of the screw, whence it was evident, that the entering edge was really retarding, and the terminating portion alone was doing the duty. On the second trial, when a radial strip, 3 inches in width had been cut off the after part of each blade, the speed of the vessel was exactly that due to the screw; whence it was also evident, that the front edge still did not assist. On the third trial, after a second radial slip of 4 inches had been cut off the entering edge of each blade, the vessel attained a speed of 8·2 knots, and the ratio of speed of the vessel was as ·94 to 1 of the screw.

The horse power employed on this trial, was by indicator, 62·12, and the speed of the vessel 8·2 knots, against 67·1 in the before-named trial, with the original screw of the Archimedes, when the speed she attained was 8·375 knots. Although, on neither of the trials numbered 5, 6, and 7 with this screw, was so great a speed of vessel attained, as on that first named, it is important to draw attention to the fact, that the slip was reduced to a very small quantity. But the horse power exerted was also much less than in the first trial, arising from some imperfections in the cutting down of the screw, and other causes which would probably have been remedied had there been time to cast a new screw of this description; but unfortunately, just at this period, the Propeller Company required the Archimedes for service, and the experiments ceased. This screw was afterwards tried by Mr. Barnes, in the Napoléon, a very beautiful French Post-Office vessel, built by M. Normand, of Havre, when the following result was obtained:—Horse power exited, 95·5; speed of vessel in knots, 10 15; speed of screw, 11·2; speed of vessel to 1· of screw, $·895 = 10\frac{1}{2}$ per cent. In the two cuttings down, this cast iron screw with three blades, 9 feet in diameter, which was originally very slight, had been so much reduced in substance, that it weighed only 833 lbs. Mr. Barnes, therefore, could not venture to permit the engines to exert their full power, otherwise it is probable that a higher speed would have been attained. The commencing angle of 17°, and the terminating one $19\frac{1}{2}$°; the increase of pitch is therefore $\frac{1}{12}$th, or $8\frac{1}{3}$ per cent. The screw of the Great Britain, which is of wrought iron, consists of six arms, formed by placing and riveting together four distinct forgings, or centre pieces, with arms welded to them, each of which is 6 inches thick. Upon the extremities of these are rivetted palms of plate iron, which are 4 feet $4\frac{1}{2}$ inches long on their circumferential edge, by 2 feet 9 inches in height, and $\frac{7}{8}$ inch thick. The diameter is 15 feet 6 inches, and the pitch or helix of one revolution is 2o feet, which equals an angle of 28 degrees. Its weight is 77 cwt. The area of the six palms, which may be considered as the effective part of the screw, is 56·25 feet; but the area, calculated as a plane perpendicular to the exis, that is, as portions of a disc, is only 47·4 feet, and the portions of the arms within the blades, present a similar area of 26.88 feet. As the rotary velocity of the outer edge of the blades is nearly 30 miles an hour, it is important, in order to diminish friction, that they should by as accurately shaped as possible, and should present no irregularities of surface. In this instance, the object was attained, by mounting the screw on a face plate and planing the surface, by means of a tool, to which the proper motion was given; after which, it was painted several times, rubbed very smooth, and varnished. On the second trial of the Great Britain, on the 20th January, in the Bristol Channel, in smooth water and during a calm, the engines attained the speed of $18\frac{2}{3}$ strokes per minute, when the speed of the vessel through the water, measured by an experienced seaman, with the common log, was $12\frac{1}{4}$ knots.

$$\begin{array}{rl} & \text{Feet.} \\ 18{\cdot}66 \times 2{\cdot}948 \times 25 = & 1375{\cdot}242 \text{ velocity of the screw.} \\ 12\frac{1}{4} \text{ knots} \times 101.2 = & 1247{\cdot}796 \\ \hline & 127{\cdot}446 \text{ slip—} \end{array}$$

thus, the speed of the vessel was ·907 to 1· of the screw.

The area of the midship section of the ship, at the time of this experiment, was 408 feet. The diagram, fig. 1, is intended to illustrate this effect, thus:



the angle subtended by A, B, C, is an entire revolution of a screw 15 feet 6 inches diameter, and 25 feet pitch, of which B D is the forward effort communicated to the vessel, and C D is the slip, or yielding of water. Consequently, although the apparent angle of the screw is represented by A B C, the real angle is only A C D, since A B D represents the velocity of the vessel. The steam-engine employed to drive this screw, consists of four steam cylinders, each of 88 inches in diameter, by 6 feet stroke, into which steam is admitted by piston-valves of 20 inches in diameter. As it is very troublesome to lift large piston covers, manholes are made in them, and in the pistons, so that the bottoms of the cylinders can be easily examined. The large diameter given to the steam cylinders was purposely with a view to working very expansively, and on the trial recorded, the steam, being at 4 lbs. pressure in the boiler, was throttled on its passage, and cut off by the expansion-valve at $\frac{1}{6}$th of the stroke, that is, 1 foot from its commencement. The connecting rods of these engines are applied in pairs to crank pins, at either end of the main shaft, and the same crank pin carries the connecting rod of one air-pump, of the same length of stroke by $45\frac{1}{2}$ inches in diameter. This air-pump is inserted in the wrought iron condenser, which receives the steam from the cylinders. The main shaft is of wrought iron, 17 feet long, by 28 inches in diameter, in the centre, and 24 inches in the bearings, which are 30 inches long; through this shaft, as through the cranks and crank pins, a hole is bored, and a stream of cold water is constantly injected, which has an important influence in keeping the bearings cool. Upon this main shaft, is a toothed drum, of 18 feet in diameter, with a face 38 inches in width, around which, and a lesser drum of 6 feet in diameter, placed below it, four sets of pitched chains work; the motion of which is remarkaby smooth and noiseless. Each set of these chains consists of two links, and three links, alternately: the sectional area of the four sets is 24 inches. The best method of giving the requisite speed to the screw shaft, was long under consideration, and the usual means, by gearing, straps, &c., were not overlooked; but each appeared to have some objectionable quality; at length, Mr. Brunel suggested the pitched chain, which was finally adopted. These links were very carefully forged; they were then brought to a dull ret heat, and placed in a proving-maching, where they were stretched one-eighth of an inch, and, while in that state, they were rigidly examined. After boring and planing, they were all finished on one gauging-tool and case hardened. As the engines are intented to work at 18 revolutions per minute, and the speed is got up at the rate of nearly 2·95 to 1, the screw will then make about 53 revolutions per minute. The lower shaft, to which the screw is attached, consists of three lengths. On the first, which is 28 feet 3 inches long, by 16 inches diameter in the journals, is fixed the lesser drum, which is 6 feet in diameter, and at the forword end of this, is the step, which resists the thrust, or effort of the screw, which will be presently described. The second piece is a hollow wrought iron shaft, 61 feet 8 inches long, and 30 inches in diameter, formed of two courses of plates, each $\frac{3}{8}$ inch thick, riveted together by countersunk rivets $1\frac{3}{8}$ inch in diameter. The third piece is 25 feet 6 inches long, and as the screw has no bearing at its outer end, it is 17 inches in diameter in the journal, just within the stern-post. The shaft does not rest in the stern-post, but in another bearing, outside of it, and the water is kept out by a packing, composed of leather and copper. The thrust, or effort of the screw, is received by a step, composed of a steel plate, 2 feet in diameter, against which a gun-metal plate, of similar diameter, affixed to the heel of the shaft, presses. A stream of water is admitted to a cavity, in the centre of these plates, and very satisfactorily lubricates them.

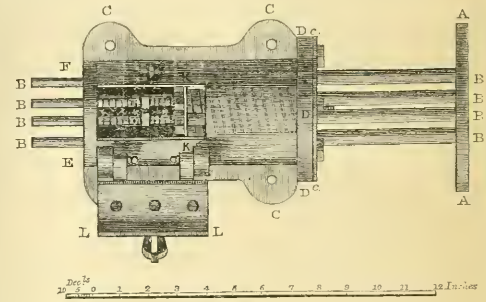
(To be continued.)

ACCOUNT OF EXPERIMENTS UPON THE FORCE OF WAVES.

By Thomas Stevenson, C.E., Edinburgh.

In forming designs of marine works, the engineer has always a difficulty in estimating the force of the waves with which he has to contend. The information on such a matter, which is derived from local informants, who, although intelligent in the departments of trade which they follow, are, nevertheless, more or less prejudiced from being constantly on the spot, is not satisfactory; and it has, therefore, often occurred to me that it would be most desirable if the engineer could be enabled, to some extent at least, to disregard the prejudiced statements of others, and the vague impressions left by them on his own mind, and really to ascertain by direct experiment, what force, expressed in pounds per square foot, the sea actually exerts upon the shores where his buildings are proposed to be erected.

Before considering the results obtained, however, I shall explain the construction of this simple self registering instrument. The letters D E F D



represent a cast-iron cylinder, which is firmly bolted at the projecting flanges G to the rock where the experiments are wanted. This cylinder has a flange at D D. L L is a door, which is opened when the observation is to be read off. A A is of iron, and forms a circular plate or disc, on which the sea impinges. Fastened to the disc are four guide-rods B B B B. These rods pass through a circular plate C C (which is screwed down to the flange D D), and also through holes in the bottom E F, Within the cylinder there is attached to the plate C C a powerful steel spring, to the other or free end of which is fastened the small circular plate K K, which again is secured to the guide rods B B B B. There are also rings of leather T T, that slide on the guide-rods, and serve as indices for registering how far the rods are pushed through the holes in the bottom; or, in other words, how much the spring has been drawn out or lengthened by the force of the sea acting upon the plate or disc A A. The object of having four leathern rings, where one might have answered the purpose, was merely that they might serve as a check upon each other; and so perfectly did they answer the purpose intended, that in every instance they were found equidistant from the bottom of the cylinder; proving thereby, that, after the recoil of the spring, they had all kept their places. The guide-rods are graduated, so as to enable the observer to note exactly the quantity that the spring has yielded.*

This instrument, which may, perhaps, be not improperly termed a *Marine Dynamometer*, is, therefore, a self-registering apparatus which indicates the maximum force of the waves. In the graduation of the instrument, the power of the spring is ascertained by carefully loading the disc with weights so that when the quantity that the spring has yielded by the action of the sea is known, the pressure due to the area of the disc exposed is known also. The discs employed were from 3 to 9 inches diameter, but generally 6 inches, and the powers of the springs varied from about 10 lb. to about 50 lb. for every $\frac{1}{8}$ inch of elongation. Their respective effects were afterwards reduced to a value per square foot. The instrument was generally placed so as to be immersed at about three-fourth tide, and in such situations as would afford a considerable depth of water. It is not desirable to have the instrument placed at a much lower level, as it has not unfrequently happened during a gale, that for days together no one could approach it to read off the result and re-adjust the indices to zero. It must, however, at the same time be remarked, that it is in most situations almost impossible to receive the force unimpaired, as the waves are more or less broken by hidden rocks or shoal ground before they reach the instrument.

In 1842 several observations were made on the waves of the Irish Sea at the Island of Little Ross, lying off the Bay of Kirkcudbright. Since April

* The plate or disc of the Marine Dynamometer is intended to represent in the circumstances of its exposures, stones or other obstacles to which the sea has access on every side, which is the case in all dry stonework, of which harbours and breakwaters are commonly composed, as also open pilework of every kind. It may also be observed that by the time that the crest of the wave (if unbroken) has proceeded so far as to be above the disc, the instrument will have registered its maximum, although that maximum will probably be to some extent affected by the statical pressure on the side of the disc next C C. But the experiments have reference solely to bodies immersed in water.

1843 till now, continued observations have been made on the Atlantic at Skerryvore and neighbouring rocks, lying off the island of Tyree, Argyllshire. And in 1844 a series of similar observations was begun on the German Ocean at the Bell Rock. It will be seen, that in selecting these localities a varied exposure has been embraced, comprising the comparatively sheltered Irish Sea, the more exposed eastern shore of Scotland, and the wild rocks of Skerryvore, which are open to the full fury of the Atlantic, the far distant shores of North America being the nearest land on the west.

In the *Atlantic Ocean*, according to the observations made at Skerryvore rocks, the average of results for five of the *summer* months during the years 1843 and 1844, is 611 lb. per square foot. The average results for six of the *winter* months (1843 and 1844), is 2086 lb. per square foot, or thrice as great as in the summer months.

The *Greatest result* yet obtained at Skerryvore was during the heavy westerly gale of 29th March 1845, when a pressure of 6983 lb. per square foot was registered. The next highest is 5323 lb.

In the *German Ocean*, according to the observations made at the Bell Rock, the greatest result yet obtained is 3013 lb. per square foot.

It thus appears, that the greatest effect of the sea, which has been observed, is that of the Atlantic at Skerryvore, which is nearly equal to three tons per square foot.

These experiments, amounting to 267 in number,† and on the Atlantic alone extending over 23 months continuously, are not intended to prove anything farther than the simple fact, that the sea has been known to exert a force equivalent to a pressure of three tons per square foot, however much more.

Ascertained effects of Waves.

I shall now contrast the indications of the Marine Dynamometer by stating a few facts regarding the ascertained effect of the waves in the elevation of spray, and in the transportation of heavy masses of rock. In the first instance, to give some idea what may be looked for in comparatively small expanses of water, such, for instance, as the lakes of North America, which, however, exhibit during gales of wind, all the characteristics of an open sea. In the north-eastern corner of LAKE ERIE, the HARBOUR OF BUFFALO was constructed at a cost of about 40,000*l*. It is mentioned in the "Civil-Engineering of North America," that the author "measured (at this harbour) several stones which had been moved; and one of the largest of them, weighing upwards of half-a-ton, had been completely turned over, and lay with its bed or lower side uppermost." In the FIRTH OF FORTH, at the GRANTON PIER works, on the 19th December 1836, after a gale from the north-east, one stone was moved measuring fifteen cubic feet, or about one ton in weight, and thrown on the beach, after having been built into the wall; and a stone containing eighteen cubic feet was moved thirty feet from its place; while the *pierres perdues* or mound-stones were washed down to a slope of about 4 to 1. The following instance, which occurred at the landing slip of the Calf Point, ISLE OF MAN, affords a proof of the great force of the waves even in the Irish Sea. During a gale from the north-west, a block was lifted from its place in the wall and thrown landwards, which measured 123½ cubic feet, equal to about 10 tons weight. At the island called the Barrahead, one of the Hebrides, a remarkable example occurred during a storm in January 1836, in the movement of a block of stone, which, from measurements taken on the spot, is 9 feet × 8 feet × 7 feet = 504 cubic feet, which, allowing 12 feet of the gneiss rock to the ton, will be about 42 tons weight. This great mass was gradually moved 5 feet from the place where it lay, having been rocked to and fro by the waves till a piece broke off, which rolling down, and jamming itself between the moving mass and the shelving rock on which it rested, immediately stopped the oscillatory motion, and thus prevented the farther advance of the stone.

Experiments.—With reference to the following experiments I have only to observe, that those which were made at Little Ross, upon the Irish Sea, cannot, from the unusual fineness of the weather at the time, be regarded as affording a true value of the effects of a hard gale in these seas. Of the others it is to be noticed, that where two or three instruments were for some time employed as a check upon each other, and only one or two readings are given, the want has occurred either from the instruments being under repair, or being difficult of access in stormy weather, or during neap tides. It often happened also, in consequence of the springs proving too weak, when new ones had to be made, or the area of the disc reduced. Registers of the state of the weather, apparent height of spray, &c., were generally kept; but it was not considered necessary to complicate the Tables by inserting these, excepting in one or two instances.

A more exposed point of the Skerryvore Rock was chosen for the experiments of the second table; and with the view of ascertaining the effect of the waves at different heights upon the rock, two instruments were fixed, the one (No. I.) several feet lower, and above 40 feet seaward of the other (No. II.) It was observed, that about half-flood the waves were a good deal expended before they reached the place where No. I. was placed, from there being so little water on the rocks outside. Whereas when the tide was higher the waves were, from the greater depth of water, not so much broken when they reached No. II. The results of the Marine Dynamometer shew generally about twice the force at No. II. as at No. I.; a result which shews how important it would be to ascertain the relative forces of the waves at different levels upon our breakwaters and other seaworks.

† It was not thought necessary to give all the observations in the table appended to this psper.

The observations at the Skerryvore Rock, and the neighbouring Island of Tyree, distant 13 miles from the Skerryvore, are as follows:—

TABLE I.

Dates.	lbs. to a Square Foot.	Dates.	lbs. to a Square Foot.
1843.		1843.	
April 24	455	" 22	723
May 7	243	Sept. 5	866
" 16	364	Oct. 5	1535
June 3	182	Nov. 18	1711
" 9	173	" 29	2353
July 2	476	Dec. 8	3421
" 30	433	" 14	At least 2460
Aug. 9	346		
1844.		1844.	
Jan. 28	3313	June 15	1828
Feb. 2	429	July 11	1028
" 3	429	" 23	1532
" 15	312	" 27	457
" 24	1284	Aug. 1	571
" 26	2032	" 30	1713
March 4	3316	Sept. 12	1028
" 10	1925	" 20	457
" 12	3316	" 25	685
" 13	1142	Oct. 2	2399
April 10	457	" 11	3427*
" 14	571	" 22	800
" 17	800	Nov. 2	1942
" 19	800	" 16	2056
" 24	1949	" 23	3427
" 30	222	Dec. 9	2738
May 15	343	" 10	1825

TABLE II.

Date.	Remarks.	Pressure in lb. per Ft. I.	II.
1845.			
Jan. 7	Heavy sea	1714	4182
" 16	Heavy ground swell . . .	2856	4752
Feb. 5	Fresh gales	856	3042
" 24	Fresh breezes	1256	3802
March 11	Short sea	1028	
" 29	Strong gale, the highest waves supposed 20 feet high, aod the spray 70 feet	2856	6038

From the Transactions of the Royal Society of Edinburgh.

TIDAL HARBOURS.

Report of the Royal Commissioners.

In our last number we gave an abstract of the Report of the commissioners on the condition of the Harbours of Refuge in the United Kingdom—we propose at present to continue with the Report on Tidal Harbours.

The various points of inquiry to which the attention of the commission was directed in the instructions given to them for their guidance may be conveniently classed under four heads, viz.:—

First.—As to what changes have taken place in any of the tidal harbours or navigable rivers.

What encroachments have been made upon them; by whom and by what authority so made; and the effect that such encroachments have produced or may hereafter produce.

What injury may have been done to those harbours and rivers, or may accrue to them by neglect, or by the unauthorised removal of shingle or other materials from the shores, or by the improper discharge of ballast, or by the drainage of mines, or by the diversion of their tides or streams.

Secondly.—What measures are necessary as well to abate any of the said injuries as to prevent any future mischief.

Whether there are sufficient legal powers for enforcing such remedy, and if not what further powers are necessary.

Thirdly.—To inquire into the state of the law as regards the powers of the Lords Commissioners of the Admiralty for the conservation of all the harbours, shores, and rivers of the United Kingdom.

How far the powers conceded to particular authorities or persons, by charter or by royal grant, or by Act of Parliament, may be held to supersede or to interfere with the jurisdiction of the Admiralty.

Whether any, and what, legislative measures are necessary to give the Lords Commissioners of the Admiralty sufficient powers to remove any present or future encroachments, and to prevent the construction of any works which may have an injurious effect on any harbour, shore, or navigable river.

Lastly.—To inquire what measures it may be expedient to adopt for the general improvement of the harbours and rivers of the United Kingdom.

The River Clyde and Harbour of Glasgow.

From the reports of Smeaton, Golborne, and Watt it appears that, about

* On this occasion, 14 stones were slightly moved, and 14 scattered, all of which had been built into the round-head or end of Hynish Pier, which was still in an unfinished state, and a Dynamometer which was attached to the Pier, registered on this occasion 2557 lb. These stone weighed from 1 to 1½ tons, and exposed, when built into the wall, about 2 square feet of surface. The stone to which the instrument was fixed was turned upside down, although it weighed 1¼ ton = 2800 lb.

90 years since, the navigation of this river, as well as the flow of the tide, was so much obstructed by sand-banks, that barges drawing 3 feet water could alone be employed in the trade of the city of Glasgow; that its manufactures were necessarily carried down to Port Glasgow or Greenock for exportation; and that its imports were transhipped into barges to be brought to the city. At this time the rise of spring tides at Hirst Sand, a little below Glasgow, was only 1 foot 9 inches, and the total depth at high-water spring tides was but 3 feet 3 inches. So hopeless did the case seem, that in 1755 Smeaton proposed a lock across the river at Marling Ford, about four miles below the city, so as to form the upper part of the river into a canal. For this an Act of Parliament was actually obtained. Happily, however, for the commercial interest of Glasgow, Golborne, in 1868, took a different view of the capabilities of the river, and recommended the contraction of the channel and the free use of the dredge. These means having been adopted and employed by subsequent engineers, the result is that at this moment there is a depth of 17 feet at high-water at Glasgow Quay, and that large ships now embark and unload their cargoes where formerly a laden barge could barely swim.

	Vessels.	Tons.
In 1844 the number of arrivals was . .	13,919 of	1,101,949

And there are now 60 steam-vessels belonging to the port; as well as 940 arrivals and sailings annually of traders, not one of which, at the former period, could have approached nearer than Dumbuck Ford, 12 miles below the city.

In 1770 the gross harbour dues for the year were .	£147
In 1841 " " .	50,292
And the total receipts since the year 1770 exceed .	830,000

The River Tay.

The river Tay is the largest of all the Scottish streams; its extreme length being about 183 miles, draining an area of 2300 square miles, and pouring more water into the ocean than any other river of Great Britain.

Down to the 1834, the upper portion of the Tay, as far as navigation was concerned, seems to have been entirely neglected. Landed property on each side of the stream, and the right of salmon fishing seem to have been paramount to every other interest: jetties or dikes, in order to form new ground, were run out at pleasure; and large heaps of stone, called fishing cairns, were erected at will in the bed of the stream; while, below, only a single fairway buoy was placed to mark the entrance between two dangerous sands at the mouth of the river. The Perth Commissioners at length became alive to the mischief of neglect; and, in 1834, a bill was obtained to empower them to raise money for the improvement of the river. During the next five years, the process of deepening the bed, and straightening the channel was steadily continued, and by thus affording a free passage to the tidal waters, a depth of 15 feet at high water of spring tides has been obtained near the city, and the flood tide now begins to flow three-quarters of an hour earlier than formerly at Perth bridge.

The value of such unrestrained action to the tidal waters seems not to be confined alone to the upper channel of the river, for according to the report of the Admiralty surveyor, it has caused an increase of depth at the Tay Bar, and dispersed a large quantity of the sand which had there accumulated.

Nor have the trustees of Dundee Harbour shewn less energy in keeping pace with the extension of manufactures in their town; by the establishment of suitable docks and basins they have raised it to a first-class commercial port; and by their judicious enterprise during the last 30 years they have more than quadrupled the number of its shipping, as well as the amount of its revenue.

In June, 1815, the total revenue of the port was	£4,096
In June, 1844......................................	23,895

while the number of vessels had increased to 3791, having a burthen of 272,239 tons.

Montrose.

At Montrose there is a similar instance of encroachment on the banks of the South Esk, where the proprietor of the adjoining land even questions the authority of the Admiralty to oblige him to restore to the harbour a part of the tidal water of which it appears it has been deprived by his embankments. The Montrose Trustees having, with much public spirit, recently expended the large sum of 42,000*l.* in constructing a wet dock and in improving their harbour, have not the means of contesting with a wealthy proprietor, the point at issue, and therefore naturally look to the Admiralty for protection. But as this case is now in course of legal process by the Lord Advocate of Scotland, we abstain from further comment.

Arbroath.

Arbroath, a port on the east coast of Scotland, about half-way between Montrose and the river Tay, and the seat of extensive manufactures, falls under a different head of inquiry from the harbours we have hitherto examined into.

The evidence laid before the Commission evinces an extent of public spirit on the part of the inhabitants and trustees of this burgh in the highest degree deserving encouragement. Seven years ago the harbour was the property of the Corporation, and its revenues were applied in lighting, paving, and cleansing the streets. The harbour was insufficient for the shipping belonging to the place, and unfit for the reception of vessels of any considerable size. But in the year 1838 the inhabitants voluntarily came forward and taxed themselves in order to pay those municipal expenses; and an Act of Parliament, in 1839, having empowered the trustees to raise money, a sum of not less than 58,000*l.* has been since that time expended in works for enlarging and improving the port, whereby the accommodation for shipping is more than doubled.

	£
In 1746 the shore dues amounted to . . .	21
In 1823 " " . . .	616
In 1843 " " . . .	3050

showing, since the internal improvements of the port, a rapid increase in the amount of traffic.

But the estimated expense of executing those works, as in nearly all similar cases, has proved too small. As far as they have been carried out they are of a substantial and staple character. But the deepening of the harbour, with its entrance and approaches, is still unfinished; and having exhausted all their resources, the trustees have memorialized the Government for a small grant, to enable them to complete the projected works; without which, what has been done will be in a great measure unavailable.

The works proposed would give a mean depth of 16 feet at high-water of ordinary spring-tides,—they would render Arbroath a tidal harbour of refuge, for 12 hours out of the 24, for all vessels of the size which usually frequent that coast; and they would thus be as great a benefit to the public as to their owners; for the greater part of that rocky coast, when it becomes a lee-shore, is extremely dangerous, and was too fatally proved in the gale of January, 1800, when 40 vessels were wrecked, and 13 of them within a few miles of Arbroath.

Taking these circumstances into consideration, it appears to the Commission that this case seems deserving of the encouragement of the Government.

The River Blyth and Harbour of Southwold.

It appears that the whole area formerly covered by the spring-tide waters of the river Blyth was about 2,000 acres, and that by means of several embankments, than area has been reduced to 450 acres. It likewise appears that over more than half the original area the depth at high water ordinary springs would be two feet; that in the event of high springs it would be four feet, and in north-west gales or equinoctial springs, fully six feet. From this it appears that the quantity of water excluded by these embankments is, (taking the lowest estimate, that of a common spring tide) in round numbers 150 millions of cubic feet, or 4½ millions of tons on every tide, and as there are 78 such tides in a year, some notion may be formed of the enormous loss of scouring power sustained in consequence of these embankments.

The merchants of Halesworth (the great corn mart of this part of the county of Suffolk) had repeatedly urged the propriety of deepening the bed of the Blyth; yet nothing was done till an Act of Parliament was obtained in 1830, and though under direction of the present harbour surveyor, the lower part of the harbour has been somewhat improved; yet as the Act did not touch the embankments, the bar has been at times since that period dry at high water, so that no vessel could get in or out.

Harwich Harbour.

The ancient and well-known port of Harwich is an estuary formed by the junction of the rivers Stour and Orwell, and contains about 700 acres of good anchorage. The value of this port was well understood during the last war, and will be so again when we have occasion for another North Sea fleet. Here not less than 60 ships of war have been built, 15 of which were two-deckers; and the fishing vessels belonging to the port some years since were estimated at 3,000 tons, and employed 500 of our most hardy seamen.

Its general depth of water, its wide extent, its perfect shelter, its easy access by night or by day, in all weathers, and in all states of the tide, render Harwich the only harbour of refuge, properly so called, between the Thames and the Humber.

Yet it will be seen from the evidence taken before the Harbour of Refuge Commission of 1844, that this harbour, which in easterly gales has given shelter to 500 sail of shipping at once, has been suffering a rapid deterioration during the last 30 years from the removal of the cement stone at the foot of Beacon Cliff and Felixstow Ledge. The consequence is, while the sea has gained considerably upon the Essex shore, threatening to break through the isthmus, that Landguard Point, on the opposite side, has advanced 500 yards upon the sea during the same period, thereby blocking up the chief entrance into the harbour; and so much so, that where, in the year 1804, there was a channel seven fathoms deep at low water, there is now a shingle beach as many feet above high-water mark.

But the attention of the Government having at length been called to this state of neglect by the Report of that Commission, it appears that immediate measures are to be taken to restore this port to its former value as a Harbour of Refuge.

Rye Harbour.

This harbour is in the lower part of the channel of the river Rother, and just below the junction of the Tillingham and the Brede, two small streams flowing from the north-west. A rubble-stone pier, which does not reach within 1200 yards of low-water mark, is in the course of construction on the eastern side of the harbour, and an embankment of earth has been thrown up on the western side, leaving an entrance between of 290 feet in width.

The average rise of spring-tides at the town of Rye is 14 feet, at the pier-head 17, and in the bay 23 feet, or greater than anywhere on the south-east coast of England. At low water the harbour is left dry.

For several miles round the town of Rye, and immediately adjacent to the harbour, there are large tracts of marsh land, the greater part of which are owned by proprietors residing in the neighbourhood. Over a great portion of this plain the sea formerlly flowed, forming, at every tide, a considerable back water, which operated as a scour to the harbour of Rye, and kept the channel open. The proprietors, however, uncontrolled by any guardian of the port, began by degrees to exclude the tide, and no steps being taken to restrain their encroachments, they obtained an Act of Parliament, erected dams and sluices across the rivers, a short distance above the town, and finally excluded the tidal waters.

By these means, hundreds of acres of marsh have been reclaimed, while the barbonr, deprived of its back waters, yielded to the mass of sand and shingle which rolled in with every wave, and which have now nearly obliterated the appearance of a channel.

The rivers drain this tract of country; and had there been no obstructions in their channels, they would have afforded an ample reservoir for tidal waters; and indeed would still do so, judging by the effect produced when, in March, 1812, owing to a high tide blowing up Scott's Float Sluice, the sea flowed freely to Robertsbridge, 15 miles up the country, and the returning ebb, as it appears in evidence, so scoured the harbour, that vessels drawing 16 feet water could get up to the town.

Landed interest, however, again prevailed, and in the following year the sluice was rebuilt. In 1830, a Jury at Croydon found "that Scot's Float Sluice, as then erected, was a nuisance," and alterations in it were directed to be made; these alterations not being made, the people assembled and pulled the sluice down.

An inquiry took place which led to the Acts of 1830 and 1833, under which one of the Rye Commissioners was named on the part of the Admiralty, and we learn from his evidence, that since his appointment, an extensive creek, called the Nook, to the westward of the entrance, and covered every high water, has been in great part damned out; and upwards of 700 acres of marsh land, lying on both sides the river, and overflowed by the sea to the depth of 3 feet, has been embanked, thereby losing the scour over the bar of 30 million cubic feet of water on every spring tide.

It appears, from reports of engineers and others, that between the years 1724 and 1717, a sum of not less than 200,000*l.* was expended in vain attemps to form a new harbour about two miles westward of the present outlet to the sea, but which, after those 63 years' waste of time and money, they were compelled to abandon.

We have dwelt longer on this subject than, at first sight, it would seem to warrant, but the case of Rye is extremely instructive, as bringing broadly into view the apparently antagonist principles of the local and the shipping interests, and the absolute necessity of some controlling power to protect the latter. There is a still more important consideration. Rye is situated on a part of the coast, where a harbour is most wanted; and where it would be of the greatest benefit to our shipping, whether for steamers to obtain fuel in the event of hostilities, or, which is of far more consequence, for the safety of our merchant vessels in time of peace. And when we consider the capability it offers, the abundance of level land on either side of the river fit for docks or basins; the great value of a 23 feet rise of tide in the bay; and the extent of back water at command, we are led to believe that skilful engineering would readily turn these advantages to account for national benefit.

The Rivers Forth, Dee, &c.

In addition to the examples we have given in detail, numerous instances of encroachments, of neglect, and of want of efficient control, have come before us in the course of our inquiries. For instance, on the banks of the Forth, near Stirling, large enclosures of marsh land have been formerly effected. Similar embankments, but to a much greater extent, have been carried out on the level lands by the side of the Dee, near Chester. At Whitby, it is a common practice to throw the refuse of the town behind the west pier head, which the next flood tide washes into the harbour. At Bridlington, great delay has occurred in completing the works for the improvement of the harbour, while a passing toll to pay for them is leveled on all shipping.

At the Spurn Point, six vessels, of 50 tons each (paying 1*l.* a load to the lord of the manor), are daily engaged in carrying off the shingle from the beach, at the rate of 50,000 tons a year, to mend the roads in Yorkshire and Lincolnshire. By this removal of shingle the Spurn Point has lost half its breadth within the last 20 years, and the lighthouses, as well as the anchorage of Hawke Roads, may be eventually endangered.

At Portland, ballast is thrown overboard with impunity. Similar complaints come from Fowey and from Falmouth; and with the addition from Milford Haven, that the water-bailiff remonstrates in vain, and has practically no power to enforce his commands.

We have the evidence of engineers, and of the Admiralty surveyor, that the rivers Lune and Ribble, and Dee, are all susceptible of very great improvement; the Thames, even, the high road of the commerce of this great empire, for want of systematic conservancy and dredging, has shoals with only 11 feet depth over them, even as low as Barking Reach, which prevent more than half the loaded vessels that come up to London from passing at low water spring tides; in short, there is hardly a harbour we have inquired into, that, under efficient control, might not be in a much improved state.

Having thus briefly adduced a few examples of the want of efficient control in all our ports, and shown the necessity of immediate legislative measures in order to stop the daily increasing evils to navigation,

The Commissioners conlude by recommending:—That a Board of Conservancy be established for the superintendence and protection of all the tidal harbours and navigable rivers in the united kingdom of Great Britain and Ireland; that it be in connection with the Admiralty: and that it be permanent.

That this board have jurisdiction by summary proceedings over the waters of the tidal harbours and navigable rivers, notwithstanding any charter or Acts of Parliament to the contrary, with a reservation of private rights under the charters, and the continuation of local commissioners where the board may think fit.

That the board should have full powers, by the assistance of engineers surveyors, and others, to ascertain the extent of all nuisances and obstructions in tidal harbours and navigable rivers.

That the board should be enabled to have a jury summoned by the sheriff to ascertain whether or not any encroachment or other nuisance in a tidal harbour or navigable river, has existed years; and if it be found to have been made within that time, that the board have power, by their own order, at the expense of the party who made such encroachment or nuisance, to remove it.

That the whole of the coasts of the United Kingdom be divided by this board into districts, and that each be placed under the superintendence of a competent person, who shall visit each river, port, harbour, and creek, at least once a year, or oftener, as it may be necessary, to inquire into and report on the state of each river, port, harbour, and creek, in his district, and of all works which may be in progress there.

That the board should have power to enforce the appointment of a resident engineer or harbour-master, or both, at every port they may consider of sufficient importance to require such constant superintendence.

That every commission or trust of a harbour or navigable river, or if there be none, every resident engineer or harbour-master be required to make out and forward to the board, before the 1st of March in each year, a detailed report, made up to the 31st of December, consisting of an account of all such works as have been executed, with the expenses thereof, within the limits of his superintendence, during the past year; and a report on those works he would recommend to be undertaken during the ensuing year. And, also, to include in that report an account of all changes that may have taken place during the year in the depth of water or formation of shoals, or any other change affecting the navigation of the river or harbour.

That if any works, public or private, shall be commenced or proceeded with on grounds within the high-water mark of ordinary spring-tides, without having first obtained the sanction of the Board, or their superintending Officer, it shall be lawful, and the Board should be empowered immediately to stop such works, and to direct the removal of the same by the parties erecting them, and if they refuse so to do, the Board may direct their removal, and charge the parties with the expenses.

That for the protection of the public interests in the navigation of every river, port, harbour, and creek of the United Kingdom, a clause be inserted in every future Act, Charter, or Commission, which affects the tidal harbours and navigable rivers of the country, giving power to, and requiring the Admiralty to appoint one-third part of the whole number of Commissioners to execute the trusts nder such Acts, Charters, and Commissions, and also to have the power to change the whole or any of such third part of Commissioners from time to time, as the Admiralty shall think fit, so as to secure at all times a sufficient number at each board or meeting of the Trust, to protect the public interests against any bias or local interests.

That the Lords Commissioners of the Admiralty should direct the surveying officers employed in the seas of the United Kingdom to transmit to them, for the information of the Board of Conservancy, a list of all the parts of the coast on which they have been engaged surveying, and the harbours, ports, creeks, and navigable rivers they have examined, and on which they feel competent to give an opinion, in case of any improvements or alterations being proposed: also, that in future, in every port they visit, they shall make inquiries relative to any embankments or encroachments on the harbour or river, and generally as to any neglect in the preservation of the ports; and forthwith shall report the same to the Secretary of the Admiralty for the information of the said Board.

That the Board should have power to order that a tide scale be placed in all harbours; and in certain ports that a self-registering tide gauge be erected, accompanied by a barometer, and that a record of these be strictly kept; as well as a journal of the winds and weather; of the arrivals and sailings, of cases of wreck, or of anything affecting the interests of navigation, and transmitted periodically to the Board of Conservancy.

That accurate plans and surveys be procured on a sufficient scale of all the ports and navigable rivers of the United Kingdom; not only for the present value of such plans as showing the actual state of the port, and as affording the basis for improvements; but also to be preserved as documents for reference hereafter, in order to determine at any future time what changes may have taken place.

RAILWAYS IN INDIA.

(From the Foreign Quarterly.)

If any one accustomed to the modes of travelling in Europe were to be transported suddenly into the territories of Hyderabad or Nagpore, or even into many districts of the Bombay Presidency, he would imagine himself carried back to the primitive ages of mankind, when all the arts of government were in their infancy, when there was little or no science, and when people were perfectly content if they could satisfy the primary wants of nature. The interior provinces of that great table-land which stretches from the Nerbudda to Cape Comorin, are all of them destitute of one of the principal necessaries of life—we mean salt, which has, therefore, to be conveyed to them perpetually from the coast. Its price, consequently, is in many places so high, that the poorer classes are unable to purchase it; so that they are driven by a rude kind of process to extract from the saline earths, found in various districts, a coarse and unwholesome substance, which they use as a substitute for salt.

To facilitate the transport of this latter article, therefore, it might have been expected that a high-road would, from time immemorial, have been constructed by the united efforts of all the governments of the peninsula. But what is the actual state of the case? Thousands of Brinjarri bullocks, laden with salt, may constantly be seen traversing the Concan at the rate of only six or seven miles a-day, threading the narrow passes of the Ghauts over paths which their own feet have worn, and, arrived at the summit, breaking into separate lines, and taking their way towards every point of the country along the crests of the mountains, or besides the beds of rivers, where Nature's hand may have prepared for them a level track. Something we have ourselves done towards facilitating this and other branches of internal trade. In the Bombay provinces, for example, between five and six hundred miles of road, have, we believe, been constructed. But how imperfectly! In some places it has been thought sufficient to clear a space of about forty feet broad, and run a shallow trench for drainage on either side. Elsewhere, the simplest rudiments of a road have been created: thin strata of broken stone or of moorum* have been laid upon the face of the soil, sufficient to support the feet of men and cattle, but seldom adapted to the passage of wheel-carriages, which would speedily plough up deep ruts and render the road impassable.

Yet government has received every possible encouragement to proceed with the work of improvement. Each amelioration in he public ways has been immediately succeeded by an increase of traffic, so that the tolls and duties levied, though in themselves extremely moderate, very soon repay to government the sums expended on the roads, after which they become a permanent source of profit. One example may be worth mentioning. A considerable trade in cotton has long been carried on between Bellary and Kamptee, Canara. To facilitate the traffic, government, in 1839—40, constructed 140 miles of cart-road from the former town to Sirsee on the top of the Ghauts. Thence down the slope, and across the low country to the sea, the road is hitherto only passable to laden cattle, so that a stoppage takes place at the summit of the Ghauts, where the cotton is transferred from carts to the backs of beasts of burden. Nevertheless, this trifling advance towards civilisation has had a remarkable effect upon the cotton trade of Bellary. During the first four years after the formation of the 101 carts plied upon it, while in the ensuing year the number increased to 443, and has probably gone on augmenting to the present hour. The change, however, has not been confined to the substitution of one mode of carriage for another, but a much greater amount of cotton has been sent down to the coast. The value of the entire exports at Kamptee multiplied rapidly, rising in three years from 160,000*l.* to 400,000*l.*, whilst the customs increased from 4,622*l.* to 18,015*l.* 10*s.* This holds out, we think, an extremely encouraging prospect to government, which should at once render the remaining forty miles of road from Sirsee to Kamptee practicable for carts. One year's increase of the custom's would defray the whole expense.

If we now consider the effect of this improvement upon the price of the cotton, we shall find it to be very great. Formerly, when bullocks only were employed in conveying it, the cost of carriage amounted to 4*l.* 10*s.* per ton, or 7¼*d.* per ton per mile. It is now reduced to 2*l.* per ton, or 3½*d.* per ton per mile, which is still double the price of carriage in England. This cotton, ill-cleaned, and subject to much damage from thorns and bushes on the road-side, and dust during its passage on the backs of oxen below the Ghauts, sells at Kamptee for little more than twopence a pound. Thence it is shipped for Bombay, where it is screwed into bales for the English market. It has been found upon calculation, that the cost of bringing this cotton from Bellary to Kamptee, a distance of 184 miles, considerably exceeds that of conveying it to England, a distance of 17,000 miles! Taking the price of carriage in India at two and a half annas per ton per mile, and reckoning the value of money according to the price of bread corn at six times what it is in England, it is equal to twenty-two pence and a half there; whereas in England the expense is tenpence per ton on common roads, and about threepence per ton on canals in general, or even as low as one penny. If threepence be the average, it is less than one-seventh of the cost in India. The expense of the transport of goods from Madras to Trichinopoly, 230 miles, is thirty-five rupees, or 3*l.* 10*s.* per ton, which is nearly as much as the frieght from Madras to London. The most important fact, however, still remains to be considered: when brought into the market at Liverpool, this cotton often sells with difficulty at threepence per pound, so that the merchant importing it profits very little by the transaction. . . .

Let no man in haste traverse the Deccan. The snail is and must be the prototype of all wayfarers there. Your head has almost time to grow gray whilst on a journey! Locomotion is usually performed on foot, on horseback, or in palanquins. There are, as will readily be supposed, no inns or places of resort where strangers may find shelter or accommodation. Individuals belonging to the industrious classes, who journey on foot, proceed when they enter a town to that quarter of it where persons of similar occupations reside. There they obtain permission to pass the night in some shed or out-house, near which they prepare their own food, and wait as well as they can upon themselves, renewing and closing their journey under the same circumstances upon the morrow. The landlord, who in this manner receives a guest is required, as on the continent of Europe, to report his arrival and departure to the police, and should he have been lodged within the house he becomes responsible for his appearance.

Travellers who move in numbers, or who have equipages of tents with them, encamp in the neighbourhood of the town, and their attendants procure from the shops what they require, and prepare their food in vessels they bring along with them. Nothing can be more tedious, expensive, or inconvenient than this mode of travelling. Troops moving from station to station to the distance of several hundred miles, are required to march thirty-six miles in four days, or rather to advance twelve miles three days successively, and rest on the fourth. Travellers proceed at about the same rate, and the trade of the country conveyed on hired cattle, does not proceed nearly so fast for a continuance. Consequently, according to the Indian rate of travelling, and of commercial intercourse, it would require three weeks for a passenger to reach Liverpool, York, or Exeter from London, a distance which is now daily accomplished in ten or eleven hours. In England, a first class passenger on a railway pays at the rate of about fivepence per mile, and travels from twenty to thirty miles per hour; in India he pays, by the most expeditious conveyance, one shilling per mile, and travels at the rate of three miles per hour.

Such at present is the state of internal communication in India. But the people of this country, who certainly cannot be accused in general of going too fast, or engaging rashly in any enterprise, appear to be at length taking into consideration the benefits they may confer on their subjects and themselves, by extending the advantage of railroads to that noblest of all our dependencies. The reasons which would justify the adoption of such a policy as this are far too numerous to be all stated here. Possibly, even the most practised and sagacious statesman would not, from the point of time on which we stand, be able to foresee or point out the whole of them. But many are at once so obvious and so cogent, that the most ordinary reflection must suggest them to every man's mind.

It has been very justly observed, that no nation can be expected to undertake great and expensive public works from mere motives of philanthropy. It is the spirit of gain that imparts an irresistible impulse to enterprise; but, fortunately, it has been so ordered by Providence, that the gains of industry and commerce bless, like mercy, both those who give and those who take. The principle that constitutes the very basis of commerce, always presupposes reciprocal advantages to those who engage in it; and it is true, not only of commerce in its simple rudimental state, but applies equally to its most elaborate and recondite forms, over which the highest science and political wisdom preside.

In projecting railways for India, therefore, the capitalists of this country need not to be called upon to put forward any other views than those of profit, which are intelligible to all the world. The process was begun many centuries ago. We have projected moveable roads from the shores of England to those of India, by means of which we greatly enriched ourselves as a nation. It is now found that we have not gone far enough; that the riches of India cannot find their way down to the coast; that they are pent up by certain restraints in the interior, where they rot and perish, without conferring any benefits on the natives or on us. We must, therefore, extend the lines of communication from the decks of our ships and steamers athwart the peninsula, up to the very roots of the Himalaya, and thus facilitate the outpouring of those vast sources of national prosperity, which we know to exist in every province.

When the Roman republic extended its conquests, its first care was to link the newly-conquered territory to Rome by a great road, over which the legion could move rapidly to and fro, and thus bring to bear the irresistible strength of the parent state upon any point that might be threatened, either by internal commotion, or invasion from without. In this matter we should imitate Rome: not, however, for the purposes of war only; but for the higher and more beneficial purposes of peace and civilisation. In whatever direction we may carry a railway through India, it must enrich the districts through which it passes, not merely by supplying, in the instance, labour to those who need it, and exchanging the actual commodities of different provinces, but by imparting a new and extremely powerful impulse to population and industry, and calling forth the hidden capabilities of the soil. By degrees a town would spring up around every station, while the land, beginning from the very banks of the line, would be cultivated like a garden, and afford an inexhaustible supply of many of the articles most coveted in Europe.

Among these, if we commence operations with the Deccan, the most important, by far, will be cotton, of which a sufficient quantity may speedily be raised in India to render us completely independent of the slave states of America. And here we may briefly allude to a fact which

* Near Hushungabad, in the valley of Nerbudda, is one of the finest coal fields in India, or perhaps the world, situated moreover in the vicinity of inexhaustible iron mines.

will not be regarded with indifference by the friends of humanity: a company has just been established in London, expressly for the purpose of promoting the cultivation of cotton in India, primarily with a view of combating slavery, by depriving it of the aliment on which it feeds. But, in whatever motive such an association may have originated, its results cannot fail to prove beneficial to commerce. Recently, great efforts have been made to improve the quality of cotton in the collectorate of Poonah. In one district an extremely fine sort, equal to the best Baroche, has been introduced, and fetches a very high price at Bombay. In other parts arrangements are making for cultivating the New Orleans cotton, which the most experienced agriculturists in Western India expect will thrive admirably. It will be comparatively of little avail, however, to expend money on the cotton grounds of India, unless, at the same time, we provide the means of conveying the produce of those grounds to the coast.

MOTION OF LOCOMOTIVE ENGINES.

Sir—Your stricture on my communication of last month seem to presuppose I had no conviction of the friction which takes place between the wheel of a locomotive and the rail. The fact of my calling the rail a fulcrum for the wheel, proves I did suppose such a resistance to take place. However, considering the rail as a rack, and the driving-wheel as a cog-wheel, would not alter the truth of my conclusions, which can be experimentally demonstrated on any wheel-carriage. The following I have often performed on a small locomotive engine, any carriage whatever will answer the purpose, but perhaps that will be most satisfactory example:—by placing the crank in the position of the figure, page 293, and pushing the piston-rod, or cross-head, in the direction I have supposed the steam acting on the piston in that diagram (no reaction on the centre of the wheel then taking place), the force being an external pressure, I have uniformly found the engine move as I stated the extremity of a lever would in my former letter—that is just exactly in the opposite direction it would do if urged by steam,—the reaction on the cylinder-cover then having the predominant effect. The same experiment can be performed on the lowest vertical spoke of any wheel carriage, and will be attended with the same results.

I remain, Sir, your obedient servant,

J. G. H.

*** Our correspondent's experiment is not analogous to the case in point. He applies a muscular force from without, the forces of the locomotive engine are generated from within. Let him now repeat the experiment, while sitting in the carriage, and see which way it moves.

The lowest point of a driving-wheel surely must not be considered the fulcrum of a lever, for then the centre of the wheel should move in the arc of a circle, whereas its motion is rectilineal.

Motion cannot be produced in a system by equal and opposite internal reactions, but the steam pressures on the pistion, and the cylinder-cover are are of this nature. So also are the mutual pressures of the connecting-rod and crank. The *only* external force in the direction of motion is the reaction of the serrations of the driving-wheel against those of the rail. It is that, therefore, which produces the motion.

LINCOLN'S INN NEW BUILDINGS.

Sir,—Since you thought fit to introduce a note of commentary expressing doubt as to the propriety and judiciousness of employing unpainted varnished deal for the ceilings of the Drawing-room and Council-room in the new buildings at Lincoln's Inn, you will, both as matter of courtesy and of justice, allow me to explain those words of mine, whose *intention* you seem to have altogether misunderstood. I must have expressed myself very unluckily, and without that admirable perspicuity of language for which those who speak of buildings are so celebrated, for what I said was most assuredly not *intended* to recommend deceptive, imitative, and sham materials; so far from it, that the instance in question is particularly noticed as an example of a mode precisely the reverse, the real material showing itself undisguised and perfectly free from any sort of sophistication, unless the means employed to bring out the grain, and impart to it as much beauty of surface as it is susceptible of, is to be deemed sophistication, and censured as partaking of the deceptive and artificial. Your doctrine may be right, but it would lead you a far greater length than, I dare say, it is at all your "intention" to go; because it would follow from it that whenever the actual material is meant to show itself without disguise—without any coating of paint or other surface applied to it, nothing should be done to heighten its effect, out of the silly conceit of *improving* upon the work of nature,—the bare idea of which is enough to draw an awful shake of the head from all the old women in the parish. This last remark you will, perhaps, set down as a piece of that impertinent "flippancy" which you are determined no longer to countenance;—and you are welcome to call it that, or what you will, provided you do not call it humdrum. However, let that pass; be it right or wrong, we certainly do fancy that both marble and wood look all the better for being highly polished, although it is very well known that they do not polish themselves, therefore the lustre and beauty of surface so imparted to them, may—if we are determined to be exceedingly precise indeed—be termed factitious. So is it in regard to the ceilings spoken of; whatever be the actual process employed, no more is done to the deal than what serves to give it a rich depth of tone, to bring out the graining of the wood, which is hardly perceivable in its natural state, and to bestow on it a lustrous surface.

I have now, I trust, sufficiently explained myself, and removed all disagreeable doubts; but I cannot let you off yet. Whether it was in consequence of your honouring my paper in the *Athenæum* with more than ordinary attention I know not, but you there detected and animadverted upon what you considered a solecism contrary to sound taste, after having suffered to pass, without any remark from you at all, an instance of sham material being employed where, I dare say, imitation cost as much as, or very little less than, the reality would have done. I allude to the two closets—for they are no more—in the Garden Pavilion at Buckingham Palace, the walls of which are "painted in imitation of grey marble." To be sure that was done under the sanction of royal taste; yet criticism should pay no respect to persons, but animadvert quite as freely upon royal taste as any other,—or rather far more freely and more strongly, because if such taste goes astray it misleads a vast number of other people who confide in its infallibility. Besides which, royal whims and blunders sometimes prove exceedingly expensive matters. Even if you did not care to touch so ticklish a point, there was at least one thing which called for a note pointing out the very strange contradiction in one part of the description, where after telling us that those rooms are twelve feet high, it goes on to say that the walls are painted in imitation of marble to the height of twelve feet, therefore, as it would seem, up to the very ceiling, nevertheless, *over* that "*wainscoting*," as it is termed, there is a series of panels. Now, though the mistake was not your own, nor might you be able to set it to rights, still it would not have been amiss to show that it had not escaped your observation. With a single exception, not one of those who have spoken of that Pavilion have noticed, otherwise than by mentioning it, one of the most extraordinary things of all in the whole building—namely, its having a *kitchen*, though it stands only a few yards from palace! This has induced one periodical—and only one—to compound some *sauce piquante* for the occasion, and in so doing it has not spared its cayenne;—that it has more of the latter than what sounds like loyalty may easily be conceived.

So, now you have got from me note for note; therefore putting a finis to my flippancy,

I subscribe myself,

The Writer in the Athenæum.

*** "The Writer in the *Athenæum*" disapproves of sham, imitative and deceptive materials; we have no need, therefore, to argue for the general principle, but only for a particular application of it. Had no other change been produced in the appearance of the deal than that of polishing it and bringing out its veins in their natural colour, the alteration would not have amounted to a deception. But when the wood assumes a "rich depth of tone," totally different to its ordinary appearance, is moreover placed in an inaccessible position, and forms a timber roof of exactly the same kind as that for which we know that our straightforward ancestors used oak, the eyes of most observers will be deceived.

It makes nothing for the apology to say that the change is produced by varnish and not by paint. It is the deception itself, and not the mode of producing it, of which we complained.

Our correspondent modestly says that he "cannot let us off yet," and asks why we did not criticise the Pavilion at Buckingham Palace in the same way as the Lincoln's Inn Buildings. This proposition to make the canons of criticism independent of their objects argues but little for the clearness of the writer's notions. To examine a lady's boudoir and a public hall, or a "closet" and a cathedral by the same rule would lead to endless absurdities. For instance, the most fastidious could scarcely object to wood-work in private apartments being painted in resemblance of oak or maple, yet we presume "The Writer in the *Athenæum*" would be somewhat startled to see the great doors of Westminster Abbey nicely grained and varnished.

Our correspondent is in error in supposing that we reject *all* flippant letters—we insert his.

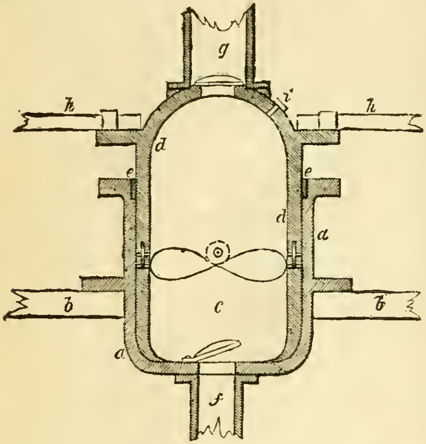
REGISTER OF NEW PATENTS.

(Under this head are given abstracts of the specifications of all the most important patents as they are enrolled. Any additional information required as to any patent, may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

PUMPS.

Agustus Coffyn, of Paris, gentleman, for "*Improvements in Pumps.*"—Granted March 17; Enrolled Sep. 17, 1845.

These improvements consist in a peculiar mode of working the piston of pumps as well as in the construction thereof. The novelty consists in the application of stationary double inclined planes for raising the piston, which have a rotary as well as rectilineal motion. The accompanying figure shews a sectional elevation of one of the pumps; *a a* is the pump barrel supported in any convenient manner by means of timbers *b b*; *c* is a cylinderical piece of metal made to fit the interior of the pump barrel, the upper edge or end of this piece of metal is made with an undulating surface consisting of double inclined planes, there being four in number, as will be clearly seen by the form of the curved line. *d d* is the piston made to fit tight within the barrel of the pump by means of parking at *e e*, the lower end of the piston is also made with an uneven surface similar to that of c, and is provided with small

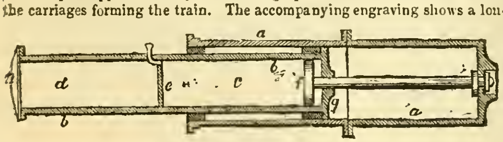


rollers which rest upon the undulating surface c. It will, therefore, be seen that by giving a rotary motion to the piston *d* the same will rise and fall as the rollers traverse over the surface consisting of double inclined planes as above described. *f* is the induction pipe and *g* the eduction pipe; *h h* are pieces of wood attached to the piston for the purpose of giving motion to the same, in a similar manner to the ordinary capstan. Breviously to starting this pump it will be found necessary to put a little water within the barrel, which may be done by removing the screw at *i*. The specification shews another modification of this process marked by double inclines, which may be applied to ordinary pumps as is desired.

RAILWAY BUFFING APPARATUS.

Henry Samuel Rayner, of Ripley, Derbyshire. gentleman, for "*certain Improvements in the means of preventing accidents to carriages on Railways and common roads.*"—Granted March 18; Enrolled Sep. 18.

This invention for improvements in preventing accidents to carriages on railways and common roads consists in a peculiar mode of constructing the buffers which may be applied to carriages in the ordinary manner, or the same may be applied to a separate carriage placed between the tender and the carriages forming the train. The accompanying engraving shows a lon-



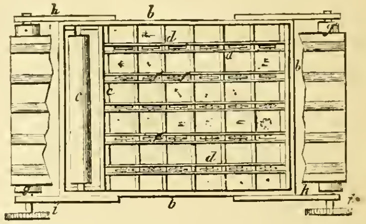
gitudinal section of the improved buffing apparatus; *a a* is a tube composed of two parts joined together by means of bolts in the ordinary manner; *b b* is also a tube made to slide within the tube *a a*, perfectly air tight, by means of packing this latter tube is divided into two compartments c and *d* by means of a diaphrigm *e*. Within the tube c there is a piston *f*, the rod of which passes through a stuffing box at *g* and is permanently fixed to the extreme end of the tube *a*, which portion of the tube is filled with compressed air; the compartment *c* of the tube *b b* is filled with water, and the compartment *d* filled or blocked up with wood. The action of the apparatus is as follows: Suppose the end of the tube to be struck at *h* by any other body coming against it, the effect would be to drive the tube *b* further into the tube *a*, and thereby bring into action the "two elastic forces, namely, the water and air," that is to say, the end *g* of the tube *b* will meet with the resistance of the compressed air, and the piston *f* with that of the water, which is allowed to pass through a number of small holes drilled through the piston, the size and number of which may be varied according to circumstances. The inventor claims generally the hydro pneumatic bufler, and the described method by which it is applied on any variation of its construction or application whatever.

IMPROVEMENT ON DYEING.

Louis Joseph Wallerand, of Basing Lane, merchant, "*for Improvements in dyeing or staining various kinds of fabrics.*"—(Communication.) Granted Dec. 30, 1844; Enrolled June 30, 1845.

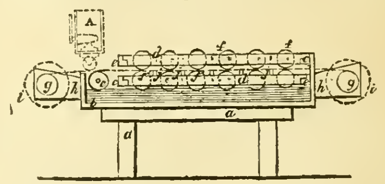
This invention is said to consist in giving shaded stripes of colour for woollen, cotton, silk, and other fabrics, by the employment of a peculiar arrangement of machinery which produces the effect in a more expeditious, economical, and perfect manner than by the ordinary hand process. This machine may also be used for dyeing shaded stripes to form grounds upon fabric intended afterwards to receive a printed pattern. The machinery for effecting the purpose above described will be clearly understood by the following description reference being had to the drawings in which similar letters denote corresponding parts in all the figures. Fig. 1. shows an elevation of

Fig. 1.



the machine having one side removed, and fig. 2 a plan view thereof; *a a* is the fanning of the machine supporting a colour vat *b b b*, at one end of this vat there is a cooller *c* capable of being raised or lowered by means of a lever, not shown in the drawing, so as to bring it in contact with the cloth which is in fig 1 shown by dotted lines; *d d* are frames of wood supported by cross bars *e e* attached in some convenient manner to the sides or end of the vat. These frames support a number of small rollers *f* and *f* so as to turn freely on their axis; the peripheries of these rollers and also the roller *c* are covered with felt or other absorbant material *g g* are two cloth beams supported by brackets *h h* at each end of the machine, round which the piece of fabric to be dyed is passed; *i i* are wheels keyed on the axis of the rollers *g* intended to give motion to the same from some convenient piece of machinery; *j j* are rods placed across the vat for supporting the cloth between the rollers *f f'*.

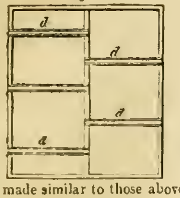
Fig. 2.



The operation of the machine is as follows: the piece of fabric to be dyed is wound on to the cloth beam *g'*, and is passed between the rollers *f f'* which latter, that is to say, the bottom roller is partly immersed in the dyeing liquor. Motion is then imparted to the cloth beam *g*, the cloth in passing from one beam to another give motion to the series of small rollers *f f'* and thus becomes charged with the dyeing liquor which as the cloth is wound round the beam *g* spreads by means of capillary attraction; the cloth may then be wound back again on to the beam *g'* and so on until the required depth of tint be obtained. When the cloth is required to have a light even tint over the whole of the surface the roller *c* is to be raised by means of the levers above referred to, so as to be brought in contact with the surface of the fabric which is to be passed backwards and forwards until the requisite tint or shade is obtained.

When the cloth is of a thick strong quality, the inventor purposes to have another vat containing dyeing liquor shown at A, fig. 1, in dotted lines below this vat, there are rollers corresponding with the several stripes; above these rollers, and within the vat, is a cock for the purpose of regulating the flow of dyeing liquor from the vat into the several rollers; these cocks are so arranged as to be opened or shut simultaneously by means of levers, so that any required quantity of dyeing liquor can by this means be allowed to flow on the top side of the cloth or fabric as well as on the under side.

Fig. 3.

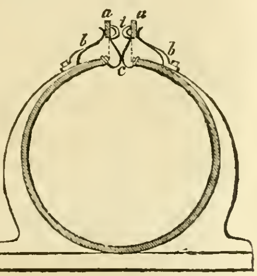


The dyeing liquor in the vat is heated by an arrangement of pipes through which steam is allowed to pass, when the liquor is required to be applied boiling, the inventor proposes to have in place of the rollers last described, which will have the effect of retaining the heat of the liquor for a longer time than by the rollers aforesaid. Fig. 3 shows the mode of arrangement when two colours of stripes are required; *a a* represent the frames which may be made to support any required number of small rollers made similar to those above described.

William Henry Talbot, of Laycock Abbey, in the county of Wilts, for *"Improvements in obtaining motive power, and in the application of motive power to railways."*—Granted March 3; Enrolled Sep. 3.

The first part of this invention consists in the application of carbonic acid gas for obtaining motive power. For this purpose the inventor takes frozen carbonic acid in a form resembling snow; this snow is placed within a suitable vessel, through which is made to pass the wires of a voltaic battery, so that when a voltaic current is made to pass through the wires, the snow in the immediate vicinity of such wires is melted, and forms a vapour which passes off to actuate the piston of an engine suitably constructed for the purpose.

Another part of his invention consists in a mode of obtaining motive power by means of electromagnation. A third part consists in a peculiar mode of constructing a machine to work somewhat in the manner of an horizontal windmill, and lastly, in a peculiar mode of constructing the valves for closing the longituninal opening in the traction pipe; but in order to understand any part of these several improvements it would be necessary to read very carefully the specification, even then considerable difficulty is experienced in getting a knowledge of what the inventor means. The fact is, Mr. Talbot has enrolled a number of ideas which require working out, and which we may venture to say would be no easy matter in some cases to make a machine worthy of protecting by a patent. The accompanying figure is the only drawing which accompanies the specification, with the exception of a small plan of a tube, and even these are executed in a manner which is almost unpardonable. The view we have given shews a transverse section of a traction pipe; *a a* are plates of metal supported by bent plates *b b*; *c* are peices of India rubber or other flexible material, which, when a vacuum is formed in the pipe, are forced by the external pressure of air into the position shown, so as to form a cussion, but as the arm passes along they assume the position shown by dotted lines. There are also cussions formed of flexible material at *i*, but which are anything but clearly delineated.

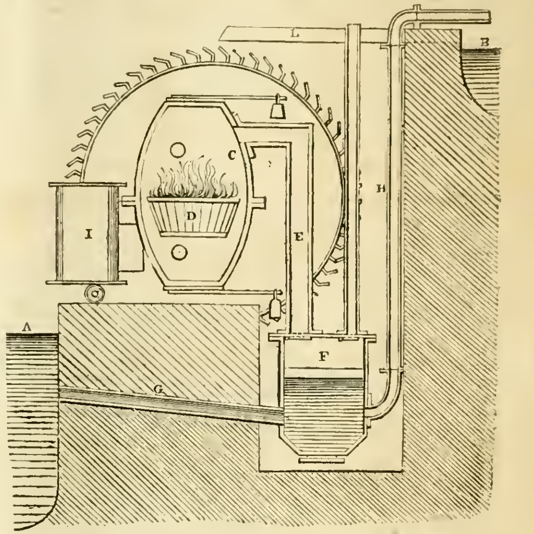


FUMIFIC IMPELLER.

Alex. Gordon, of Fludyer-street, Westminster, for *"an Improvement in obtaining motive power by the action or agency of heat, and in the application of that power to purposes of locomotion and navigation."*

The following is a description of the apparatus for effecting the purposes above described, which will be understood by referring to the drawing, which shows a sectional elevation of the apparatus, which is intended to raise water from one level to another, viz., from A to B, in the following manner: C is a strong oval shaped vessel inclosing a fire placed within the grate D; E is pipe leading from such vessel to a cylinder F; G is a pipe through which the water passes from the reservoir A into the cylinders F, and H is a pipe through which the water passes from the cylinder F to the reservoir B. The oval vessel C is formed of two parts bolted together, and has an opening at the top and bottom, each opening being provided with a lid or cover, which are to be taken off during the lighting of the fire, but when the fire is burned up the lids or covers are to be luted in a similar manner to that now practised mode of closing gas retorts. I is a blowing machine, for supplying air to the vessel C by means of two pipes which are so arranged that the air may be admitted either above or below the fire; J is a water wheel for giving motion to the blower and other parts of the apparatus, which will be described in the action of the machine, which is as follows.

The fire in the grate D having burnt up the bonnets or covers on the ends of the vessel C are, to be luted, (these covers may if required be provided with weighted levers to act as safety valves,) this being done the water wheel may be moved round a few times so as to force a quantity of air into the vessel C, should there not be any water for this purpose the inventor proposes to inject a few ounces of water into the fire for the purpose of generating a quantity of gas or "fumific" matter to give the first impulse to the machinery. Mr. G. observes, that for every degree of heat, air expands about one four hundredth and eightieth part, so that at a temperature of 480° the bulk of air admitted into the vessel C will be doubled, in which state it will pass through the pipe E into the vessel F, and will force the water from such vessel up the pipe H into the reservoir B, a portion of the water so raised passes along the trough L to drive the water-wheel, the motion of which after the water is forced from the vessel F closes a valve at the bottom of the pipe E, and opens a valve at the bottom of the pipe M, which latter allows the



expanded air to pass into the atmosphere, the rarefied air in the vessel C being prevented passing into the cylinder F by the closing of the valve aforesaid. The air having escaped from the vessel F, the same is refilled with water from the reservoir A, which passes through the pipe G ready for another stroke of the engine, which is performed in the manner above described. The specification shows the mode of applying this description of engine to the purpose of propelling boats or vessels and also carriages upon a line of railway, in the former case the "fumific" matters pass through pipes, which pipes pass through the sides of the vessel so as to give motion to the vessel by the reaction caused by the fumific matter acting against the water. In the latter case the gas or fumific matter is allowed to escape through a pipe which passes through the longitudinal slit or opening of a traction pipe, similar to those now employed in atmospheric railways, but which traction pipe may be constructed of brick or other material, as its object is merely to prevent as much as possible the lateral expansion which would be the case if the fumific matters escaped into the open air. The inventor in some cases proposes to supply the fire with coal dust or pounded resin or other combustible matter.

IMPROVEMENTS IN IRON AND STEEL.

John James Osborne, of Macclesfield, Chester, Gentleman, for *"An Invention of Certain Improvements in the Manufacture of Iron and Steel, and in Furnaces to be employed for such or similar Manufacture.* (Communication.)—Granted 16th January; Enrolled July, 1845.

The improvement consists, first, in a composition to be added to pig-iron, or cast iron, when in a melted state, consisting of 2 lbs. common salt, 2 lbs. lime, and 15 lbs. iron slag from the forge, for an ordinary charge of 3 to 4 cwt. of pig iron, the ingredients to be well incorporated, and, by means of an iron spoon, added, in small quantities at a time, to the melted mass, and then stirred up. The iron is then to be puddled and heated, in the usual way of making bar-iron. For making sheer-steel, a mixture of 2 lbs. common salt, 2 lb. quicklime, and 2 lb. pearl ash, or 4 lb. carbonate of soda, mixed, and added as before, to a charge of 5 cwt. of pig iron, melted at a white heat, 20 lb. slag to be added. The mass, after being properly worked, is made into balls, hammer and rolled. For cast-steel, the mass is treated in the same way as last described, as regards the mixture, but not puddled or balled, a blast furnace may be used. The charge being tapped, and run into a bed, for making a plate, 1½ inch thick, the slag will rise to the surface, and upon being cooled by sprinkling water, it will be easily separated when cold. The plate is then broken up, and remelted in crucibles or pots, in a blast furnace, in the following manner:—To 28 lb. of the plate obtained as last described, add 1½ lb. green bottle glass, 8 oz. pearl ash, or 16 oz. carbonate of soda, and 8 oz. black oxide of manganese, all to be stirred up in the melted iron; and, when cast into ingots, cast steel will be formed.

The second part of the invention relates to the peculiar construction of a blast furnace, consisting of a furnace formed of an iron pot, 2 feet 6 inches high, and 3 feet in diameter, with 8 holes at equal distances, near to the bottom, and round the side, to admit the blast more equally. The pots are lined with fine clay, about 4 inches thick; in the centre of the pot there is a stand, formed of fine bricks, 1 foot high. The pot is placed within a can, made of firm iron plates, 2 feet 6 inches high, and 3 feet 8 inches in breadth, bolted together, and cemented, so as to form, with a circular plate at top, an air-tight chamber, with a space of 3 inches left round the pot. The blast is first admitted into this outer can, which forms an air chamber, by two or more openings, by which means the air is more equally distributed through the several openings into the pot.

PROCEEDINGS OF THE ROYAL SOCIETY OF EDINBURGH.

Monday, 17th March, 1845.

Sir George Mackenzie, Bart., in the Chair.

The following Communications were read:—

1. *On the improvement of Navigation in Tidal Rivers.* By David Stevenson, Esq.

Three compartments are pointed out as existing in all rivers, when viewed in connection with the sea, possessing different characteristics, and requiring different classes of works for their improvement. These are, *first*, the "sea proper," characterised by the presence of unimpaired tidal phenomena, and including all works connected with the improvement of bars. *Second*, the "tidal compartment of the river," characterised by the modified flow of the tide, produced by the inclination of the bed, and embracing works connected with the straightening, widening or deepening of the beds of rivers; the formation of new cuts; the erection of walls for the guidance of tidal currents, and the shutting up of subsidiary channels. And the *third* compartment is the "river proper," which is characterized by the absence of all tidal influence, the improvement of which is generally effected by means of dams erected in the bed of the river, and forming stretches of canal communication with each other by means of locks in the dams. The practical remarks are confined to the improvement of the tidal compartment only, which possesses sufficient importance to entitle it to form the subject of a distinct communication; the prosperity of the ports of London, Bristol, Newcastle, Glasgow, and many other places, being intimately connected with it.

The author shows, that, owing to the smallness of the rivers of this comparatively narrow country, they can be advantageously navigated only while their waters are deepened by the influx of the tide, and proposes, as the surest means of effecting improvement, such works as produce an *increase in the duration of tidal influence.*

Instances of the success of the works are given. The rise on the bed of the Tay from Newburgh to Perth (8·56 miles), in consequence of works that have been executed, has *reduced* from *four* to *two* feet. The time occupied in the passage of the tidal wave between these places has been *decreased fifty minutes*, and the speed with which it travels *increased* 1⅝ *of a mile per hour.* The duration of flood-tide at Perth has been *increased fifty minutes*, and the time during which the river at that place is uninfluenced by the tide, has been *decreased forty-five minutes.* It is also calculated that an additional quantity of sea water, amounting, on an average, to 760,560 tons, is propelled into, and again withdrawn from, that part of the river extending above Newburgh every tide. At the Ribble, in Lancashire, similar benefits have resulted from similar operations; the tidal range at Preston having been *increased* between *three and four feet*, and the propagation of the tidal wave *accelerated about forty minutes.*

The following are the practical inferences which the author draws from the facts brought forward:—

First, that owing to the comparatively contracted country from the drainage of which our rivers derive their supplies, it is chiefly from *increased duration of tidal influence* that we must improvement in tide navigation, the regulation of the fresh water stream being an operation of secondary importance, but not, on that account, to be overlooked.

Second, that the whole tidal phenomena of the navigation to be improved ought to be ascertained, in order that the engineer may be enabled to discover in what part of the river the most prejudicial retardations of the tidal wave, and obstructions of the current, take place.

Third, that in tracing these retardations to the proper cause, and suggesting means for their removal, works should be adopted which do not injuriously abstract tidal water from the sea channels.

Fourth, that the works best suited for attaining the desired and consist chiefly in lowering the bed of the river, and removing all natural or artificial obstructions, and in erecting low rubble walls for the direction of the currents.

Fifth, that although *general* views of the nature of these operations may be given, the precise details of such works as shall be best suited to particular localities can, in the present state of our information, be determined only by engineering experience. And,

Lastly, that, by the execution of works designed in accordance with these general views, very beneficial results have been, and may be produced, for a comparatively small expenditure.

2. *On the Solvent Action of Drainage Water on Soils.* By John Wilson, Esq., F. G. S. Communicated by Dr. Gregory.

The author, being resident for a time in East Lothian, in order to study the system of agriculture, it occurred to him that the very extensive and complete drainage must materially affect the soil by removing large quantities of this soluble ingredient.

He was disappointed, owing to an accident, in examining, quantitatively, the water which had been first collected for the purpose; but on examining, qualitatively, some that was collected after the drain had been running very copiously for 36 hours, he found it to contain 18·4 grains of soluble matter per gallon. This was chiefly the usual salts of lime and organic matter.

He examined the surface and subsoils of the field, and found them to contain, besides silica and alumina, iron, lime, and traces of magnesia, with organic matter. The iron in the surface soil was in a state of protoxice, but in the subsoil it was found peroxidised.

The author concludes that the drainage water carries off a very large quantity of the soluble matter of the soil, which he calculates as possibly amounting to 775 lbs. per acre in the year, a quantity equivalent to a good dose of manure. He recommends the adoption of some means to prevent this great loss, and promises to continue his researches, and bring forward more precise results.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM AUGUST 21, TO SEPTEMBER 25, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Alfred Vincent Newton, of Chancery-lane, mechanical draftsman, for "certain improvements in machinery for manufacturing India rubber fabrics." (Being a communication.) —Sealed August 28.

William Edward Newton, of Chancery-lane, civil engineer, for "improvements in machinery or apparatus for spinning." (Being a communication.)—August 28.

Mathieu Francois Isoard, of Paris, for "improvements in obtaining motive power."—August 28.

John Vaux, of Frederick-street, Gray's-inn Road, gentleman, for "improvements in apparatus for warming boots and shoes."—September 4.

Henry Samuel Rayner, of Ripley, Derby, gentleman, for "certain improvements in locomotive engines."—September 4.

Henry Bewley, of Dublin, chemist, for "certain improvements in flexible syringes, tubes, bottles, hose and other like vehicles and vessels."—September 4.

Charles Lampitt, of Banbury, engineer, for "an improved dibbling machine."—Sept. 4.

Alexander Haig, of Great Carlisle-street, Portman-market, engineer, for "certain improvements in machinery for ventilation and other similar purposes, to which the said machinery can be applied."—September 4.

Elisha Haydon Collier, of Goldsworthy-terrace, Rotherhithe, engineer, for "certain improvements in the manufacture of nails, and in the machinery or apparatus to be used for such purposes"—September 11.

Henry Mandeville Meade, of New York, America, for "Improvements in distilling from Indian corn and other grain."—September 18.

Joseph Francois Lauberau, of Paris, gentleman, for "Improvements in obtaining power."—September 18.

Charles Hodgson Horsfall, of Liverpool, merchant, for "Improvements in the manufacture of iron."—September 18.

William Eccles, of Blackburn, power-loom manufacturer, William Cook, of Livesey, hand-loom weaver, and William Lancaster, power-loom weaver, of Blackburn, all of Lancaster, for "certain Improvements in looms for weaving."—September 18.

Charles Murland, of Castlewellan, Ireland, flax spinner, and Edward Lawson, of Leeds, machine maker, for "certain Improvements in machinery for preparing and spinning flax, and other fibrous substances."—September 18.

James Polkinghorne, the younger, of Hoxton, gentleman, for "certain Improvements in treating ores, and in separating from them the metals which they contain."—Sept. 18.

James Caldwell, of Broad street, Radcliff, engineer, for "Improvements in ships' riding bits, and in windlasses."—September 18.

Stephen Higginson Perkins, of Charlotte-street, Bedford-square, for "certain Improvements in the steam engine, and in its application to steam navigation." (Being a communication.)—September 18.

Edward Chrimes, of Rotherham, brass founder, for "Improvements in cocks and taps." —September 25.

TO CORRESPONDENTS.

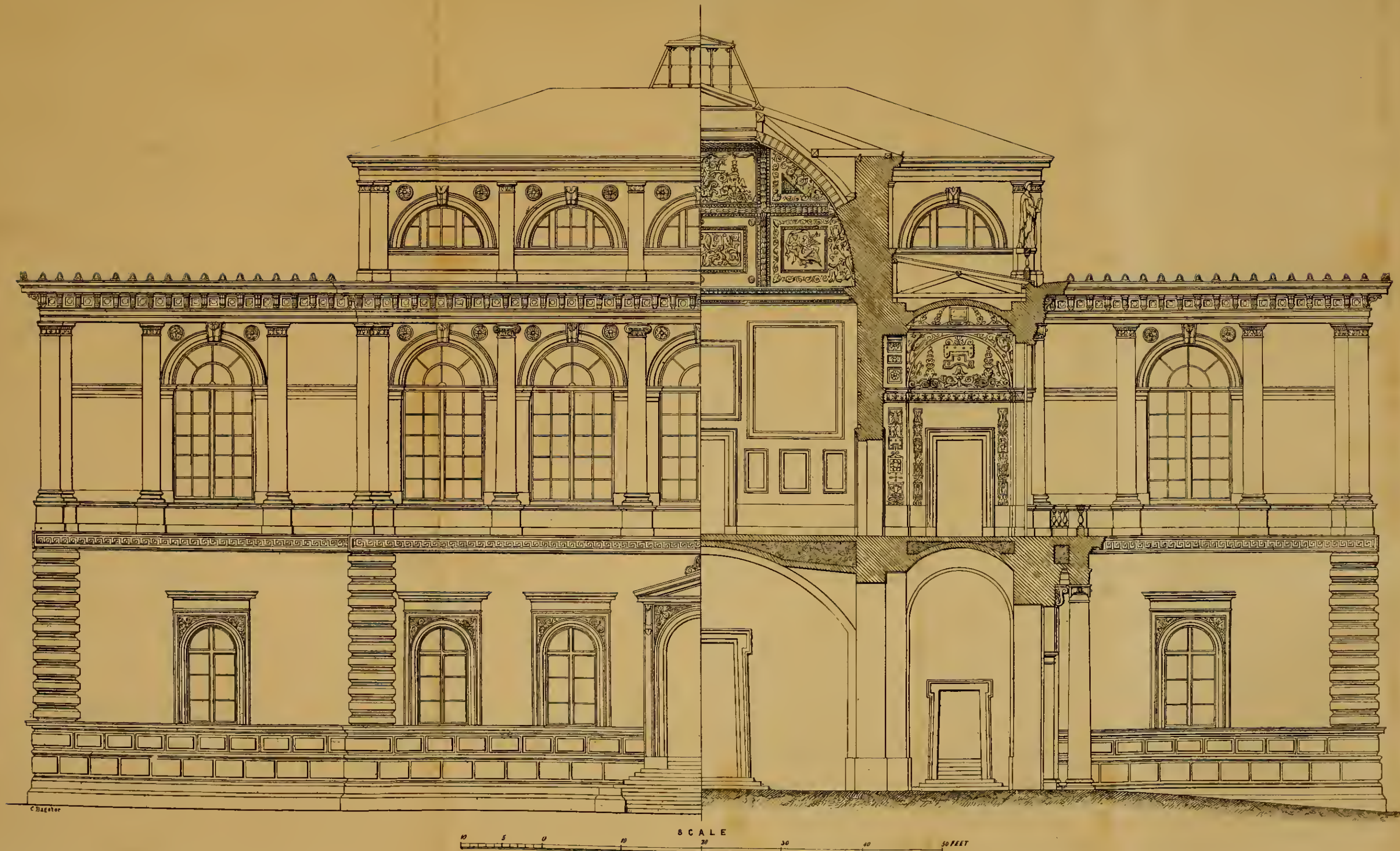
"A. B." We are unable to insert the paper, as a similar one, accompanied by a diagram nearly identical with that sent, has already appeared in our pages.

A correspondent informs us that the cost of the Church at Birch, near Manchester, was wrongly stated in our last number, it should be £3,500.

"E. H." Before publishing the paper we wish to make a few remarks on some parts of it, and shall feel obliged if the writer will send us his name, or at least an address, to which we can direct a letter.

Mr. Mullet's paper has not been sent to us.

PINACOTHECA — MUNICH —



THE PINACOTHECA, OR PICTURE GALLERY, OF MUNICH.

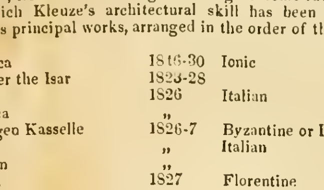
(With an Engraving, Plate XXIV.)

Among all the reigning sovereigns of Europe Ludwig, King of Bavaria, holds by far the highest rank as a patron of the Arts. The capital of his kingdom owes to his munificence, taste, and zeal its noblest public buildings, which in number and extent far exceed the modern specimens of architecture in the larger European capitals. Nor has the patronage of Ludwig I. been of that passive character which too often belongs to royal patronage, but has exhibited itself energetically—in zealous encouragement of the artist, the architect, and the sculptor—in foregoing a large part of his personal revenue for the sake of founding public monuments—in constant and careful inspection of these works during their progress—in active co-operation with the architects of them—in the promotion of the study of the fine arts by personal precept and example.

Of the modern public buildings of Munich the best known in England are the Glyptotheca and the Pinacotheca, and although these two Museums form in reality but a small portion of the buildings erected under the present king, either of them singly would be considered a sufficient and honourable proof of the taste of any other monarch. The Pinacotheca and Glyptotheca are the works of the architect Baron Kleuze, who erected also the New Palace (Konigsbau), the Fest-bau a vast addition to the Old Palace, the Post Office, the Church of All Saints, &c. The following list will give some idea of the extent to which Kleuze's architectural skill has been exercised in Munich; his principal works, arranged in the order of their construction, are—

Glyptotheca	1816-30	Ionic
Bridge over the Isar	1823-28	
Odeon	1826	Italian
Pinacotheca	"	
Allerheitigen Kasselle	1826-7	Byzantine or Romanesque
Bazaar	"	Italian
Hofarkaden	"	
Konigsbau	1827	Florentine
Festbau	"	Palladian
Prince Maximilian's Palace	1828	Florentine
Leuchtenburg Palace	"	Italian
Obelisk	1828-33	
Polycrome Temple	1833	Ionic
St. Bonifacius	1833	Byzantine
Post Office	1834	Florentine
Monument of Max. Joseph I.	1835	

Of the Pinacotheca, or Museum of Pictures, of which we have now to speak more particularly, Dr. Granville, who saw it in its unfinished state, says, "Unquestionably, after the loggia of the Vatican, no other edifice will bear comparison with what this promises to be." The upper or first floor is the principal part of the building, and is that alone which contains works of art, the ground floor being occupied by offices and a library. The plan of the upper floor is symmetrical, and may be described as a rectangular parallelogram with projecting wings at both ends. The shape somewhat resembles the following—



The principal elevations front the north and south; the projecting wings at the east and west ends give an appearance of solidity and extent to the building, and produce a varied effect in the principal front, which is 500 feet in length. The part of the interior marked *a* is a magnificent vestibule parallel to the south front, and devoted to fresco painting. This vestibule or series of loggie forms a distinct portion of the building set apart to fresco paintings. The designs, which are by Cornelius, are executed by Zimmerman.

The first stone of the building was laid in 1826, on the anniversary of the birth of Raphael, by the royal founder himself.

The engraving by which this article is illustrated represents the eastern façade of the building, part of the external walls being removed to exhibit the decorations and arrangement of the interior. There are three windows on each side of the entrance, supported on rustic work, and surmounted by bold moulding. There are five windows on the second or principal floor, with Ionic pillar against the piers between. The attic above is in very questionable taste; in the southern and northern façades especially this attic presents a very heavy ungraceful appearance, as on this side it has no windows. The effect is further impaired by the range of lanthern skylights which light the principal apartments of the building. The attic is not immediately in a line with the north and south fronts, but is set as far back as the inner wall of the loggie.

Of the decorations of the interior, it is difficult to give an adequate idea. They are elaborate in the extreme; the walls and ceilings are profusely decorated with inlaid marbles. The upper floor is approached by a staircase in the south-east wing, and contains nine principal rooms *en suite*, each devoted to separate schools of painting. Besides this central suite and the magnificent loggie, parallel to iit on the south side, already mentioned, there is another range of 22 smaller apartments along the side of the edifice.

The gallery will hold in all about 1,500 paintings, exclusive of the frescoes.

PNEUMATIC RAILWAY.

New Invention of M. M. Jobard and Seguier.

We have, in the *Journal des Chemins de Fer* of Oct. 18, an account of a method of pneumatic propulsion invented by M. le Baron Seguier, of the *Institut*, and M. Jobard, director of the *Musée de l'Industrie* at Brussels. The latter gentleman is known by his Report on the French Exposition of 1839.

In the newly invented system the motive force is communicated by the compression and not by the rarefaction of air. A tube is laid the whole length of the railway, and has a longitudinal slit resembling that of the existing atmospheric railways. The manner of closing this slit is, however, different; the method adopted is that of M. Hallette, described some time since in the *Civil Engineer and Architect's Journal.* M. Hallette's valve has this peculiarity, that it acts both ways; that is, prevents the air from either entering or escaping by its own pressure. M. Hallette, our readers will remember, fills and closes the longitudinal slit by two long pieces of Indian rubber tubing, which are inflated; these pieces of tubing extend the whole length of the slit, being fastened one to each edge of it, and pressing firmly against each other like lips, so as to entirely seal the tube. M. Hallette's invention is engrafted by M. M. Jobard and Seguier into their system.

Their atmospheric tube has also another peculiarity; it is square instead of cylindrical; neither does it contain a travelling train piston, but the compressed air is drawn up from it into the *boiler of a locomotive engine*, and acts in the cylinders of the engine in the stead of steam. This is the leading idea of the invention. A locomotive engine accompanies the train, as in the case of the old railways, but this engine instead of being worked by steam is worked by compressed air supplied to it at every point of its course by the continuous pneumatic tube. We should have mentioned that the compression of the air is proposed to be carried to three atmospheres, or 45 lb. to the inch.

The manner in which the communication is effected between the pneumatic tube and the locomotive engine is not a little curious. We have have not here an arm communicating from the interior of the tube to the train; it is conceived that the friction of this arm would soon wear out the elastic tubing which forms the air valve. The connection is made in the following manner;—a piece of apparatus is provided which in form resembles a double-convex lens; this lens is hollow, and is made of two convex metallic plates perforated by small holes at their circumference; the holes are closed by valves inside the lens, which prevent escape from the interior of it; the lens turns on hollow axes, which communicate by tubes with the air chamber (or what corresponds to the boiler) of the locomotive engine. It will be readily conceived that if this disc roll along the valve of the pneumatic tube, dipping a little way into it, each hole in the circumference of the lens will, in its turn, be brought into communication with the compressed air, which will rush up through it into the cavity of the lens, and thence, by the hollow axles, to the air-chest of the engine. The perforations of the lens, as they revolve, successively dip into and leave the pneumatic tube. As they leave it they are closed by the internal valves, which the compressed air within the disc keeps closely shut. The thickness of the disc is two-fifths of an inch, but its diameter is upwards of a yard.

This invention, like all new inventions, is to supersede every thing similar to it already in existence. But beside the objections which we believe exist against all systems of atmospheric railways, from the loss of power sustained in communicating motion by an elastic agent like air, the present invention has this additional disadvantage, that it requires two steam engines (the stationary and the locomotive) to do the work which is at present done by a single engine.

CANDIDUS'S NOTE-BOOK.

FASCICULUS LXVI.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. The tables are now completely turned;—after being contemptuously derided and rejected as utter barbarism, Gothic Architecture has come nearly all at once to be considered by us the architecture *par excellence*, and to be regarded with a degree of earnest and apparently sincere affection on the part of the public generally—that portion of it at least which has any voice in such matters,—that contrasts most forcibly with the positive indifference, and the gross ignorance resulting from that indifference, in regard to those styles which are of more universal application, not only among ourselves, but throughout all Europe; and which, moreover, must continue to be so. Without saying that by far too much attention is now given to the study of Gothic architecture and ecclesiastical archæology, it may truly be affirmed, that by far too little is bestowed on the study of the art generally. Most assuredly it is not on account of a competent knowledge of it being more easily acquired than that of Grecian and Roman, and the styles derived from them, that Gothic architecture recommends itself to amateur students, since it is by far more complex—beyond all comparison more intricate. Whether it be that Gothic is thought better calculated for, and is better relished as an amateur pursuit, on account of its not having been reduced to dry and formal technical rules and measurements, and so far answers more to the character of art, and the study of it accordingly is looked upon as a less mechanical one than that of our usual styles,—and a good deal may be attributed to this particular view of the matter,—most indisputable it is, that Gothic now engrosses public favour and attention almost entirely. As far as that style is concerned, we seem most anxiously solicitous to do the very best we can, according to our means and our knowledge—though it must be admitted, that we do not always show our knowledge in proportion to our means and the occasion afforded; and such solicitude is praiseworthy enough; but then, on the other hand, we are just as markedly indifferent to all that is *not* Gothic. The worthy public appear to be of opinion that whatever be done in any other style of architecture than Gothic, it is no affair of theirs,—that it is one in which neither they, nor good taste and our national credit for art, are interested;—one so completely out of their jurisdiction, that they have no right to exercise even the control of opinion over it. National monuments and monumental structures may be left to take their chance for turning out bad or good,—if the former, well; if otherwise, "'tis pity, but it can't now be helped!"—and what is almost the worst part of the matter is, that no warning is taken by us from previous signal failures and unlucky mishaps of the kind, but mischief is left to work undisturbedly till it brings us to that wonderfully consolatory "Can't be helped."

II. If we could now get rid entirely of all the other styles employed by us, and henceforth confine ourselves to Gothic alone, as our national, universal, and exclusive one for buildings of every class, both public and private, there would be something like reason and good sense in the giving our undivided study and solicitude to that one style of the art. We might then be justified in treating all the others as Gothic itself was treated at the "Revival," by the classical or rather pseudo-classical school, who fairly kicked it out of doors as an illshapen monster—a hideous Caliban brute, that had taken possession of, and defiled the sanctuary of art. If we actually can discard all other styles, well and good; but surely so long as we either are under the positive necessity of having recourse to them, or continue to make use of them voluntarily, the public ought to be just as much interested in understanding those styles, and in securing for themselves equally worthy productions of their kind in them, as in Gothic, if they can at all distinguish between what is good and bad—what is in conformity with, or in opposition to, the professed style in other modes of architecture. Why then, if it be worth while to cultivate architectural taste at all, should it be cultivated only on one side, when one side is not sufficient for us? Or, if we can tolerate the most crude abortions for our national—at least public-edifices, for those which, if not ornaments, are very conspicuous objects in cities—provided they do not come under the denomination of Gothic, why should we be so especially anxious and fastidious in regard to the latter style,—so excessively scrupulous as to literal exactness for every particular in our modern imitations of it? If any sort of Grecian—or whatever else be its particular name—will serve our purpose, any sort of Gothic might do so just as well. Why it does not—why we are so much less patient of bad Gothic than of bad anything else, is easily explained: the public have begun to take up the study of it as a pet pursuit, and the taste for it is now growing and spreading itself very rapidly. Wonderful to say, people have at length discovered, or are beginning to discover—at least as far as Gothic is concerned—that there is considerable interest in the study of architecture for its own sake, and as matter of taste and mental occupation, without the slighest reference to any farther results, and without any interference from the question of *cui bono?* The same might also be the case with the study of architecture generally, were but the silly prejudices which stand in the way of its being done, once resolutely pushed aside.

III. Hardly would the taste for Gothic architecture have extended itself as it has done, had it been looked upon in the same light as the study of the art taken generally, is; for that seems to be considered of no value or interest except to those who pursue it professionally,—dry and dull, difficult of acquisition, and useless when acquired; in short, a study which any well-educated person may avow or betray his utter ignorance of without the least discredit to his information or his taste. The exception in favour of Gothic architecture as a recreative study, seems to be partly owing to its not having fallen into the clutches of professional men, and been chopped up by them into dry rules, and formal professional treaties. For the impulse in the direction of *Gothicism*,—at first considered a widely errant and eccentric one,—we are indebted not to professional but to amateur students; to the diligence with which they have prosecuted their inquiries, and to their industry in communicating to the public the fruits of their labours. The zeal which they have manifested in this last respect, and their efforts to disseminate more and more widely a relish for their own pursuits, certainly form a distinguishing trait between them and professional men generally, and have perhaps caused some feeling of soreness and jealousy on the part of the latter. It is not every one, however, that has been equally courageous or else equally indiscreet as Gwilt, when he ventured both openly and in the most marked manner to censure those who not being professional persons take upon themselves to write upon Gothic architecture, or architecture at all; hinting at the same time pretty plainly that they were not only very officious with their services where they were not wanted, but that they neglected their own proper duties, while attempting to study what they could not understand. Yet it is mainly to writers of that class that the public are indebted for what knowledge of Gothic architecture they possess, and for the means of studying it; nor is it the public alone who have been so benefited, but professional men also. Therefore even admitting that the labours of such writers may be more or less unsatisfactory and imperfect, still they ought to be received by those in the profession with some sort of graciousness as free-offering contributions towards the common stock of architectural information. Or if architects deem it both mischievous and presumptuous that any other than themselves should undertake to instruct the public, why do not they themselves take up the pen?—why do they not condescend to abate a little of their professional dignity—I have heard it sometimes called sulkiness—and write upon their art, in its character of a liberal study, unconnected with the merely operative processes of building?

IV. The truth is, very few professional writers upon architecture seem at all to understand what kind of information it is that other persons require, or how to communicate it in an attractive and interesting manner. They are apt—whether they do it wilfully or not—to make strange mysteries of many things which if properly explained would be found perfectly simple and intelligible. They scarcely ever care to enter into the *rationale* of the matters they treat of, or to elucidate principles. Even as regards the Orders, their knowledge for the most part appears to be little better than empirical—merely such as is acquired by memory and by rote; and after all our slavish mechanical copies of the Orders, employed as they are on every occasion alike with the most wearisome repetition, say more for the skill of the mason, than for any sort of mind or imagination on the part of the architect who *designs* them. Whereas it may be presumed, that a real knowledge of the orders and members of ancient architecture, founded upon artistic study of them, would enable architects to do much more with them than merely reproduce them according to extant examples, even therein limiting themselves to a very few, without so much as trying to catch a single fresh idea from other models, which, though they may be less perfect and less satisfactory upon the whole, afford hints that we ought to take advantage of. By adopting a system of mere copying—which now, that the examples in use are all to be found accurately drawn out in engravings and books, requires nothing deserving the name of study or exercise of mind,—by adopting such system, architects virtually renounce both the name and privilege of artists, at least as far as the Orders are concerned. If only correctness is to be aimed at, one man's Doric or Ionic is just as good as another's. Those who have talent and *genetic* taste of their own, forbear to exercise it; and those who have none, can nevertheless exhibit to us most unexceptionable columns so long as they have nothing to do but merely take what they find ready provided for all alike. To be sure the "correct" people of the latter class do frequently betray themselves very egregiously, since they are apt to put on the "lion's hide" of classicality in such a blundering manner that the ears, and not the ears only, but a great deal more of the real animal that is so disguised, is plainly perceivable.

V. In speaking of Cottage Architecture, Gwilt has told us that it requires the minimum of mind, but he forgot to inform us how much mind, and what degree of *nous*, are required for sticking up a row of columns in front of a building, as is frequently done where, so far from there being anything in the building itself to warrant them, either on the score of utility or of decoration, they are in positive contradiction to its character, utterly at variance with its style in all respects, merely show total ignorance of composition, and cause the opposite extremes of taste to appear jumbled up together. Instead of being admired for their porticoes, productions of that stamp would not even have been tolerated, had the public been but as capable of judging of architecture as they are of the other fine arts, music included. So far there may be policy in keeping, or endeavouring to keep, the public in their present ignorance of architecture,—in scaring them away from the study of it by mystifying it as much as possible, and by ridiculing the very notion of their attempting to become acquainted with it. Still the policy is as short sighted as it is ungenerous,—injurious also to the interests of the art itself, since it is, of all of them, the one which is most dependent on and most at the mercy of public taste, and must flourish or decline accordingly as that taste happens to be good or bad, intelligent or the reverse. There is, besides, this peculiar disadvantage attending the influence of bad taste in architecture, namely, that after it has ceased, and a better one come up in its stead, the unlucky productions of the former ill-fated period remain to disgrace us, and after having been ignorantly admired in their day, to excite derision, contempt and disgust. For be they ever so paltry as architecture, buildings—more especially such as are intended for durability—cannot be got rid of, nor shut out of sight at pleasure. We cannot afford to pull them down because they are eyesores, nor is it always that propitious Vulcan will come in the shape of a conflagration and sweep them away, as he did Wyatt's Gothic House of Lords. Instead of reproaching Nash for building in "lath and plaster," we ought rather to feel obliged to him for not having perpetrated his wretched designs and "monstrosities" in more durable materials, inflicting them upon posterity as well as upon the contemporary generation. After all, the public are the real arbiters of the fate of architecture, though it is a truth which architects themselves do not, or it may rather be suspected *will* not, see. Taking their motto from Horace, they say with him, "*Odi profanum vulgus, et arceo.*" They seem to be of opinion that the more ignorant the public, all the better for them; and so, indeed, it may be—well for *them*, yet deplorable enough for the Art.

ATMOSPHERIC TRACTION.

By F. S. Haydon, B.A., Jesus College, Cambridge.

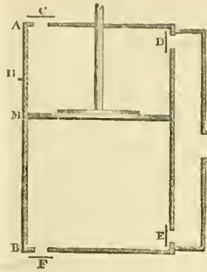
Investigation of Power Lost by the Preliminary Exhaustion.

It is proposed in this paper to investigate the relation which subsists between the power expended and the useful effect obtained on an Atmospheric Railway, in which the dimensions of the exhausting and working apparatus and the working pressure in the train piston are known, the effects of friction and leakage being omitted.

The construction of these railways is so well known that any description of the machinery used to produce motion would be superfluous.

The diagram represents the air-pump and part of the branch-pipe connecting the top and bottom of the barrel of the pump with the main.

A B is the barrel of the air-pump; C, F valves opening outwards;



D, E valves opening inwards. Let A B $=a$, A M $=x$, area of piston M $=k$, A = capacity of air-pump, B = capacity of branch-pipe, C = capacity of main, density of atmosphere $=\rho$.

Then, by known principles, the density of the air in the main after n strokes of the pump, will equal

$$\left(\frac{B+C}{A+B+C}\right)^n \times \rho = R^n \rho \text{ suppose.}$$

The piston is supposed to be performing its nth stroke. Let H be that point in its path at which the valve C opens, and let A H $=b$; we have (since in order to open the valve the density of the air between H and A must be greater than that of the atmosphere),

Density at $(n-1)$th stroke : density in A H :: $R^{n-1}\rho : \rho :: R^{n-1} : 1$.

But these two densities are in ratio of A H : A B.

$$\therefore\ b = R^{n-1} a \qquad (1)$$

Next, to determine the pressure of the air on both sides of M, we have—

Press. of air in A M : press. of air in A H (= press. of atmosph.) :: A H : A M :: $b : x :: R^{n-1} a : x$ by (1)

$$\therefore \text{ Pressure against M} = \frac{R^{n-1} a}{x} \times k \times 15 \text{ lb.} \qquad (2)$$

Again, the air which flows in from the main filled at the beginning of the stroke a volume B + C; in the present position of the piston it fills a volume $B + C + A\frac{a-x}{a}$, therefore

Pressure of air from main when piston is at M : pressure of air in main at end of $(n-1)$th stroke :: $B + C : B + C + A\frac{a-x}{a}$.

$$\therefore \text{ Pressure in direction of M's motion} = R^{n-1}\frac{B+C}{B+C+A\frac{a-x}{a}} \times k \times 15 \text{ lb.}$$

$$= 15\, k R^{n-1} (S-A) \times \frac{1}{S - \frac{Ax}{a}} \text{ lb.} \qquad (3)$$

Putting A + B + C = S for shortness.

The first of these two pressures continually increases until $x=b$, when it becomes equal to the pressure of the atmosphere; after this it remains constant. The second diminishes continually throughout the whole extent of the stroke.

The *work done* in the nth stroke will be obtained by integrating the expressions (2) and (3), the first from $x=a$ to $x=b$, the second from $x=a$ to $x=o$, subtracting the second integral from the first and adding to the result the product

$$15\, k \times b = 15\, R^{n-1} a k$$

corresponding to the constant pressure against M after the opening of the valve C. Thus we have, if W_n represent the work done in the nth stroke,

$$W_n = 15\, R^{n-1} a k \left\{ 1 + \int_b^a \frac{dx}{x} + \frac{S-A}{A} \int_o^a \frac{d\left(S - \frac{Ax}{a}\right)}{S - \frac{Ax}{a}} \right\}$$

$$= 15\, R^{n-1} a k \left\{ 1 - (n-1)\log R + \frac{S-A}{A} \log \frac{S-A}{S} \right\}$$

Giving (n) the values 1, 2, 3, &c. up to n in this expression, and adding the results, we find for the whole work done in n strokes, remembering that $\frac{S-A}{S} = R$, the expression

$$15\, a k \left\{ \left(1 + R + R^2 + \ldots + R^{n-1}\right)\left(1 + \frac{S-A}{A}\log R\right) - \left(R + 2R^2 + \ldots \overline{n-1}\, R^{n-1}\right)\log R \right\}$$

$$= 15\, a k \left\{ \frac{1-R^n}{1-R}\left(1 + \frac{S-A}{A}\log R\right) - \left(R\frac{1-R^{n-1}}{(1-R)^2} - \frac{(n-1)R^n}{1-R}\right)\log R \right\} \qquad (A)$$

To take an example—suppose the numerical values those of the Dalkey Railway, namely—

A = 134 65 cubic fect $a = 66$ inches = 5·5 feet
B = 1767·76 cubic feet $k = 3421·2$ square inches
C = 8771·33 cubic feet

$$\text{Then } R = \frac{B+C}{A+B+C} = \frac{10539·09}{10673·74} = ·99 \text{ nearly.}$$

$$\frac{S-A}{A} = \frac{B+C}{A} = \frac{10539·09}{134·65} = 79 \text{ nearly, } \log R = \bar{0}·0043.$$

To determine (n) suppose the exhaustion carried on until the pressure of the air in the main is reduced to 5 lb. per inch, then we have

$$R^n = \tfrac{1}{3} \quad \therefore n \times 0·0043 = ·4771 \quad \therefore n = 111 \text{ nearly.}$$

Substituting in (A) we find, after some troublesome arithmetic, the work done to be equivalent to 15,947,068. (4)

After the train piston has started, it is clear that in nrder to preserve the rarefaction obtained by the preliminary exhaustion we must have

$$k\,s = k'\,s' \qquad (5)$$

Where s, s' are distances simultaneously described by, and k, k' the areas of, the pump and train pistons respectively. So that if m be the number of strokes made by pump while the train piston travels over a distance s', and a, as before, the stroke of the pump, we have

$$m\,a = s = \frac{k'\,s'}{k} \quad \therefore m = \frac{k'\,s'}{a\,k} \qquad (6)$$

In this case the pressure in the direction of M's motion is constant, and equal to 5 lb. per inch. The pressure against M varies until the valve which comunicates with the atmosphere opens, after which it remains constant.

We have—

Pressure against M : Pressure at beginning of stroke (= 5 k lb.)
:: A B : A M :: a : x

$$\therefore \text{Pressure against } M = 5k\frac{a}{x}\text{lb.}$$

Supposing C to open when M arrives at H, where A H = b, then $b = \frac{1}{3}a$. The work done in any stroke when the train is in motion is therefore—

$$5\,a\,k\int_b^a \frac{d\,x}{x} + 15\,k \times \frac{a}{3} - 5\,a\,k = 5\,a\,k\int_b^a \frac{d\,x}{x} = 5\,a\,k \log 3$$

The work done while the train piston travels over a distance s' is therefore—

$$W = 5\,a\,m\,k \log 3 = 5\,a\,k\frac{k'\,s'}{a\,k}\log 3 \text{ by } (6) = 5\,k'\,s' \log 3.$$

Suppose, for example, that $k' = 176·7$ square inches and $s' = 7147·5$ feet—

Then $W = 5 \times 176·7 \times 7147·5 \times 0·477$ nearly = 3.012,167. (7)

From (4) and (7) we see that the whole work done in order to enable the piston to travel through a distance of 7147 5 feet is equivalent to

18,959,235 (8)

The work done by the piston in travelling over 7147·5 feet is equivalent to

$10 \times 176·7 \times 7147·5 = 12,678,225$ nearly. (9)

From (8) and (9) we have the power lost = 18,959,235 − 12,678,225 nearly = 6,281,010 nearly.

Hence the proportion of the work done to the useful effect obtained is about 3 : 2; so that about ⅓rd of the power of the engine are thrown away without producing any useful effect. In other words, the power lost is more than 33 per cent. of the whole power expended, and this loss is independent of friction and leakage.

NOTES
ON THE PHILOSOPHY OF ENGINEERING.
II.
LOSS OF POWER ON ATMOSPHERIC RAILWAYS.

It is now about twelve months since I ventured to publish in this Journal some observations on an objection to atmospheric traction which seemed to have been previously overlooked. The observations which I have offered from time to time on the subject, have excited an opposition due rather to the important nature of the conclusions arrived at than to their invalidity.

The present paper will be preceded by one which may be confidently ranked among the most valuable that have ever appeared in this work. The conclusion of Mr. Haydon's paper on Atmospheric Traction deserves the most attentive consideration—"Hence the proportion of the work done to the useful effect obtained is about 3 : 2; so that about *one-third of the power of the engine are thrown away* without producing any useful effect. In other words, the power lost is more than 33 per cent. of the whole power expended, and THIS LOSS IS INDEPENDENT OF FRICTION AND LEAKAGE."

The calculations, from which these grave results are deduced, are founded on data exactly according with actual practice. The reader must carefully consider that the investigation, though necessarily presented in a mathematical form, is not an abstract theory but really and practically true. The dimensions of the air pumps have been supposed in calculation the same as the actual dimensions of the air pumps on the Dalkey Railway, the dimensions of the main pipe and connecting tube have been supposed the same, the pump has been supposed to be of the same construction as that of the Dalkey line, namely, double-acting; the working pressure has been taken at 10 lb. per inch, and where numerical calculations have appeared they have been carried to several places of decimals.

The object of the present paper will be to explain, as far as possible, that which precedes it, in language divested of mathematical symbols, so that the general reader may judge of the accuracy of the investigation and ascertain how far he may place reliance on the results obtained. A few words may, however, be perhaps admitted to show that no effort has been omitted to ensure accuracy. The obliging offer to furnish the calculation which I had myself intended to attempt was gladly accepted, from a conviction that the task was resigned to one who would give it more value and authority than I myself could possibly command. It was a great satisfaction to find that the separate steps of the calculation resembled those which I had taken in my own rough notes, except that the investigation assumed a degree of simplicity and elegance which could scarcely have been anticipated from the complexity of the subject. The numerical calculations were repeated *five or six times*, and since have been put into my hands I have gone over them again by myself, and where there was any discrepancy the whole was examined and re-examined until the cause of the difference was ascertained. I am thus minute in giving the history of the paper that the reader may not imagine it to have been inconsiderately written or hastily published.

The air pumps used on the Dalkey line are double-acting—that is to say, the effect of the piston is to pump out the air when moving either forwards or backwards. It is clear that this arrangement is a source of economy of power. The pump has also valved covers at both ends, so as to be relieved as far as possible from the resistance to its motion from the pressure of the external atmosphere. The construction of the pump is sufficiently explained by reference to the diagram in the preceding paper.

In comparing the power expended with the useful effect, we may conveniently classify the former under two heads. 1. The power expended in getting a vacuum before the train is started. 2. The power expended in maintaining the vacuum after the train and train-piston are in motion.

1. We will consider the power expended in effecting the preliminary exhaustion. To do this it will be necessary to estimate the number of strokes of the pump necessary to rarify the air in the main and branch pipe to ⅓rd its original density; for supposing the atmospheric pressure 15 lb. per inch the pressure in the tube must be reduced to 5 lb. per inch in order to a preponderating external pressure of 10 lb. per inch. Now it appears that on the Dalkey line the capacity of the air pump is about $\frac{1}{78}$th of the capacity of the main and branch pipe together. Let us then suppose the pump begins its work. After the first stroke the same air which previously occupied the main and branch pipe occupies the additional space of the pump also; that is, its bulk is $\frac{1}{78}$th more than it was before, and its density is therefore decreased in the same degree, or is now $\frac{78}{79}$ths of the natural density of the air. After the second stroke the rarified air of the tube suffers a further dilation, and it will be easily seen that, as in the first stroke, the air was rarified in the proportion 78 : 79; this rarified air is in the second stroke again rarified in the same proportion: or, as $\frac{78}{79}$ expressed the density in the first case, $\frac{78}{79} \times \frac{78}{79}$ expresses the density in the second case. After the third stroke, likewise, the density will be $\frac{78}{79} \times \frac{78}{79} \times \frac{78}{79}$, or $(\frac{78}{79})^3$, and after the fourth stroke the density is expressed by $\frac{78}{79}$ multiplied by itself four times, or $(\frac{78}{79})^4$. In this way it is found that after the 111th stroke the density is $(\frac{78}{79})^{111}$, and as this fraction is found on calculation by logarithms to be as nearly as possible equal to ⅓, we conclude that to reduce the air to one-third its original density 111 strokes of the pump are required.

Having ascertained then the number of strokes necessary on preliminary exhaustion, the next step is to find how much work is done in making these strokes. For this purpose we must find the power exerted for each separate stroke, for it will be observed, that the power exerted differs in amount for each stroke; the first strokes requiring much less exertion of power than those made when the exhaustion has been nearly completed. In the first stroke of all, very little more effort is required than that necessary to overcome the inertion and friction of the pump piston. For the air in the pump being the same density as that in the main, the moment the piston moves the valve opening to the external air rises (that is to say, if we suppose the friction and weight of the valve neglected).

To give some idea of the manner in which the mathematical calculation of the power exerted by each stroke is made, we will take a particular instance. We will suppose that at the beginning of a certain stroke the exhaustion has been carried to such a point that the pressure of the air in the main is 10lbs. to the inch, that is, the density is two-thirds of that of the external air. We have, then, on the starting of the piston, a pressure of 10lbs. per inch in the direction of its motion in its favour; in other words, the same amount of pressure exists on the other side of the piston; but it will be observed on examining the construction of the pump, that this latter pressure constantly increases till it is equal to the external atmospheric pressure. For the effect of the motion of the piston is to compress the air in the pump till the valve C (or the valve F) open, that is, till the density in the pump slightly exceeds that of the external air. Now, we suppose the exhaustion has been carried to two-thirds; it is clear then that the compression we are speaking of requires that the piston perform one-third of the stroke. When the piston is advanced thus far, the air which before occupied the whole pump occupies only two thirds of it; and, therefore, the pressure in the pump is increased from 10lbs. to 15lbs., and the external valve begins to rise. It will be seen then, the pressure resisting motion gradually increases up to a certain point, and then remains constant. Now if we take the average of the first pressure, and multiply it by the number of inches equal to one-third the stroke, and add the pressure of 15lbs. multiplied by two-thirds the stroke, we get the power exerted against the piston in terms of 1lb. moved through so many inches. And if we take the average pressure on the other side of the piston, multiply it by the whole length of the stroke, and subtract this product from the first, we clearly have the total work actually performed during the stroke.

This is in effect done in the analytical calculation for each stroke; the amounts of work done during each stroke, added together, give the whole work done to effect the preliminary exhaustion. It is found that this total power is equivalent to 1lb. moved through 15,947,068 inches.

In the second part of the calculation the train-piston is supposed to have started, and in order that the degree of exhaustion may remain unchanged in the main, it is clear that for every cubic inch of air pumped out the train-piston describes one cubic inch of space. The averages are here taken as before to ascertain the work done by the pump during the passage of the train. This is added to the preliminary work; the useful effect or pressure on the train-piston multiplied by the distance traversed, and the preponderance, is, as has been stated, one-third of the whole. According to experiments actually made by Mr. Samuda and Mr. Stephenson, and published in the last number of this Journal, the actual loss of power averages 80 per cent. It will be seen then from the above what proportion of the loss is due to friction and leakage.

H. C.

REVIEW.

Elements of Physics. By C. F. Peschel, Principal of the Royal Military College at Dresden, &c. Translated from the German, with Notes, by E. West. Illustrated with Diagrams and Woodcuts. London: Longman & Co., Paternoster-row. 1845.

There has been long wanted a manual of physics, which should embrace something more than a mere detail of the facts of science, although arranged in a systematic order, and yet distinct from the purely mathematical treatises which have at different times emanated from the universities. The study of physics has become of late a very important branch of education, arising from the practical application of scientific principals in the details of almost every department of manufacturing and agricultural industry. To civil engineers, architects, surveyors, &c., a knowledge of physics is of the first importance, and yet their ideas on scientific subjects frequently display incertitude and inexactness, which we think are traceable to the want of sound mathematical knowledge. Practical men, generally, do not feel disposed to subject themselves to the preparatory amount of preparatory mental labour, which the acquisition of even the elementary mathematics implies; they imagine the toil may be avoided and a sufficient acquaintance with science obtained from the study of popular treatises. Works of this nature may do well enough for the mere schoolboy tyro, but are totally inadequate for the education of a scientific-practical man. Scientific knowledge to be available must be based on mathematics and chemistry. We are happy to see that the jealousy which once in no small degree existed between practical and theoretical men, is now fast disappearing. The practical man begins to see that theoretical knowledge is not visionary knowledge, and the theorist finds that his speculations, to produce any beneficial results, must be combined with the experience of practice.

We have a large number of treatises of natural philosophy in our language, but none which handles the subject both mathematically and popularly. In this respect we are far behind our continental neighbours, whose works on science are models of simplicity and elegance. Among the best works on natural philosophy recently published in Germany, is Peschel's Elements of Physics; it is divided into two divisions: the first division treats on the physics of ponderable bodies, the second on the physics of imponderable bodies. The former is the only part as yet translated. The first two sections contain a description of the properties of materials, and of physical forces in general, embracing molecular attraction and gravitation. This part is illustrated by a variety of apposite experiments. The laws of motion and a sketch of the modern doctrines of chemistry follow. The third section is taken up with the properties of solid bodies, including the pendulum, the elements of machinery, and friction. The theorems in this section are clearly and satisfactorily proved, and contain besides a great number of numerical illustrations, which practical men will find very useful. The remaining sections contain the doctrine of non-elastic and elastic fluids, vibrations, and acoustics, all of which are most luminously and perspicuously treated. The translator has shown good judgment in substituting the methods of Baily and Littrow for determining the barometric measurements of altitudes in the place of the author's, which is both long and intricate.

The following extract gives a good general view of a subject most important to the engineer—the strength of materials.

"In consequence of its great tenacity, iron is the most important metal, in a technical point of view. According to Tredgold's and Duleau's experiments, a piece of the best bar iron 1 square inch across the end would bear a weight of about 77,373 lb., while a similar piece of cast-iron would be torn asunder by a weight of from 16,213 to 19,464 lb. It is worthy of remark, that thin iron wires, arranged parallel to each other, and presenting a surface at their extremity of 1 square inch, will carry a mean weight of 126,340 lb.

"All wood of the same name, however, is not of uniform strength; for such trees as grow in mountainous districts are, in this respect, much superior to those which grow in a champaign country; and in the same individual there exists a great difference in the trunk, branches, and roots. A piece of well-dried pine-wood (*Pinus sylvestris*), presenting a section of 1 square inch, is able, according to Eytelwein, to support a weight of from 15,646 lb. to 20,408 lb., whilst a similar piece of oak will carry as much as 25,850 lb.

"Theoretical investigations and actual experiments alike lead to this result, that in a parallelopipedon of uniform thickness, supported on two points and loaded in the middle, *the lateral strength is directly as the product of the breadth into the square of the depth, and inversely as the length.* Let W represent the lateral strength of any material, estimated by the weight, b the breadth, and d the depth of its end, and l the distance between the points of support; then $W = f d^2 b \div l$.

"If the parallelopipedon be fastened only at one end in a horizontal position, and the load be applied at the opposite end, $W' = f d^2 b \div 4l$.

"It is to be observed that the three dimensions, d, b, and l, are to be taken in the same measure, and that b be so great that no lateral curvature arise from the weight; f in each formula represents the lateral strength, which varies in different materials, and which must be learnt experimentally.

"A beam having a rectangular end, whose breadth is two or three times greater than the breadth of another beam, has a power of suspension respectively two or three times greater than it; if the end be two or three times deeper than the end of the other, the suspension power of that which has the greater depth exceeds the suspension power of the other four or nine times: if its length be two or three times greater than the length of another beam, its power of suspension will be $\frac{1}{2}$ or $\frac{1}{3}$ respectively that of the other; provided that in each case the mode of suspension, the position of the weight, and other circumstances be similar. Hence it follows that a beam, one of whose sides tapers, has a greater power of suspension if placed on the slant than on the broad side, and that the powers of suspension in both cases are in the ratio of their sides; so, for instance, a beam, one of whose sides is double the width of the other, will carry twice as much if placed on the narrow side, as it would if laid on the wide one.—Application in the beams of ships' decks, shoring houses, &c.

"In a piece of round timber (a cylinder) the power of suspension is in proportion to the diameters cubed, and inversely as the length; thus, a beam with a diameter two or three times longer than that of another, will carry a weight 8 or 27 times heavier respectively than that whose diameter is unity, the mode of fastening and loading it being similar in both cases.

"The lateral strength of square timber is to that of the tree whence it is hewn as 10 : 16 nearly.

The lateral strength of a beam supported at both ends, whatever be the section it presents, is least when the whole weight acts at the middle, and greatest when placed near the ends; hence the rule that considerable weights are to be placed not in the middle but near the ends of their supports. By an equal distribution of the load over the entire length of the timber, it can be made to bear twice as great a weight as it would have borne had the load been placed in the middle, and four times as much as it could have borne had it been fastened at one end only.

"A considerable advantage is frequently secured by using hollow cylinders instead of solid ones, which, with an equal expenditure of materials, have far greater strength, provided only that the solid part of the cylinder be of a sufficient thickness, and that the workmanship be good, especially that in cast-metal beams the thickness be uniform, and the metal free from flaws. According to Eytelwein, such hollow cylinders are to solid ones of equal weight of metal as 1·212 : 1, when the inner semi-diameter is to the outer as 1 : 2; according to Tredgold as 17 : 10, when the two semi-diameters are to each other as 15 : 25, and as 2 : 1, when they are to each other as 7 : 10.

"An extraordinary method of increasing the suspensive power of timber supported at both ends, a method, however, which has been confirmed by repeated experiments, is, to saw down from $\frac{1}{3}$ to $\frac{1}{2}$ of its depth, and forcibly drive in a wedge of metal or hard wood, until the timber is slightly raised at the middle out of the horizontal line. By experiment it was found that the suspensive power of a beam thus cut $\frac{1}{3}$ of its depth was increased $\frac{1}{19}$th, when cut $\frac{1}{2}$ it was increased $\frac{1}{29}$th, and when cut $\frac{3}{4}$ths through it was increased $\frac{1}{87}$th.

Resistance to pressure is taken into account chiefly when a body, as, *ex. gr.*, a column of stone or wood, has to withstand the pressure of a weight acting in the direction of its longer axis. The consequences of this compression are various as the body is long or short; if the former, the material when overweighted will bend and break; if the latter, the body becomes shorter and thicker, its parts at length separate, the upper pressing through the lower, and by mutual friction reducing the substance to powder.

"The force required to crush a body increases as the section of the body increases; and this quantity being constant, the resistance of the body diminishes as the height increases.

"According to Eytelwein's experiments, the strength of the columns or timbers of rectangular form in resisting compression is, as

"1. The cube of their thickness (the lesser dimension of their section). 2. As the breadth (the greater dimension of their section). 3. Inversely as the square of their length.

Of the Weights required to Crush some of the most Important Materials.
(Eytelwein's Handbuch der Statik fester Korper 2r. Bd.)

1. Metals.		
Cast-iron	115813—177776 lb.	on the square inch.
Brass, fine	164864	"
Copper, molten	117088	"
— hammered	103040	"
Tin, molten	15456	"
Lead, molten	7728	"
2. Woods.		
Oak	3860—5147	"
Pine	1928	"
Pinus sylv.	1606	"
Elm	1284	"
3. Stones.		
Gneiss	4970	"
Sandstone, Rothenburg	25 6	"
Brick, well baked	1092	"

We wish before closing our review to notice a rather serious error at page 24, which, though probably accidental, is very likely to mislead the student. The author is giving illustrations of the method of measuring *moving power* by the product of the mass and velocity, and he says, "A porter carrying a load of 100 lb. with a velocity of 2 feet *must apply a force* of $2 \times 100 = 200$ lb. A horse walking at the rate of 4 feet per second and bearing a load of 250 lb. *puts forth a force* of $4 \times 250 = 1000$ lb." If the reader were to conclude hence that the muscular strength exerted throughout the first experiment was 200 lb. measured statically, and throughout the second experiment 1000 lb. measured statically, he would certainly have a wrong notion. The conclusion ought we think to be this—that the *efficiency* or *work done* is in the first case not 200 lb. but 200 *units of work*, and in the second 1000 units of work, where the unit of work is defined to be one pound moved through one foot per minute.

PROPOSED NEW LAW COURTS.

EVIDENCE BEFORE THE COMMITTEE OF THE HOUSE OF COMMONS.

Evidence of Mr. Barry.—In conducting the building of the New Houses of Parliament, I have had occasion to pay much attention to the present courts of law at Westminster. Speaking the opinion of the public in general, as far as it is interested in the matter, and my own, the present courts of law, are not convenient. In respect of want of space; of want of proper rooms attached to each court for the judges and their clerks; of barristers' rooms, robing rooms, solicitors' rooms, witnesses' rooms, and rooms attached to the law courts for juries to consider their verdicts. This kind of accommodation should, in my opinion, be attached to each of the common law courts, and a considerable portion of it to the equity courts, which is not the case in the present courts.

Is it not possible, in your opinion, to reconstruct the present courts of law so as to provide the required accommodation on the same site?—The space in itself is inadequate to the purpose, and there are difficulties as to the contiguity of the courts with Westminster Hall, and the interference with the light of the Hall, which makes it utterly impossible to reconstruct the courts at Westminster upon a good practical plan.

Proposed Site in Bridge Street inapplicable.

Supposing that the south side of Bridge-street was removed, and that New Palace Yard was converted into a quadrangle, by extending the present clock-tower of the Houses of Parliament along the present site of the south side of Bridge-street, might not accommodation be there found for the courts of law, in connection with the present courts, by extending the buildings already standing along the west side of New Palace Yard, so as to form a complete quadrangle of the whole?—Additional accommodation undoubtedly might be obtained by that means, but not I fear upon any good plan. In consequence of the quadrangular form of the addition that it would be necessary to make for enclosing New Palace Yard, it would not lend itself to a convenient arrangement of the courts as a whole; and therefore I think such an addition to their accommodation would not be advisable. In enclosing New Palace Yard, it is assumed that it would be desirable to make the principal entrance to the new palace at the corner of Bridge-street and St. Margaret-street, facing the north-west. This gateway would render the north side of the proposed quadrangle, enclosing New Palace Yard, unavailable for the purposes of the law courts, inasmuch as it would be cut off by the gateway from all connection with the courts and the proposed addition to them. The available addition, therefore, would be from the north side of the present stone building to the gateway, and as it would be necessary that that portion of the building should not exceed the depth shown upon the plan, namely, 35 feet, such an addition to the law courts would not lend itself to any convenient arrangement of them as a whole; and I question very much whether by such an addition the increase of accommodation which is necessary could even be obtained.

Would not the space admit of the enlargement of the courts? Unquestionably it would, to the extent I have mentioned, namely, to the gateway at the north-west angle of the proposed quadrangle formed by enclosing New Palace Yard.

Would it not be possible to provide sufficient accommodation on the lower story for the counsel, for the witnesses, and for the professional gentlemen of different classes, reserving the upper story (by whatever name you may call the lower one) for the exclusive purposes of the courts of law, and would you not (the whole being nearly upon the same level now) thereby gain more than double the space which you have already in the existing buildings?—Such an arrangement could not be made without blocking out the light from the windows of Westminster Hall, and even then, I do not consider that it would afford to any material extent the convenience and additional accommodation required.

Injury of present Courts to Westminster Hall.

The present courts being nearly upon a level one with the other, and with their respective adjuncts?—The present courts are not much above the level of the ground, with the exception of the Rolls Court, which is in the front of the stone building, on the one-pair floor; but as the courts could not be raised to a higher level without blocking out the light from Westminster Hall, any alteration of their level would be objectionable.

In what way would they affect the light of Westminster Hall, inasmuch as no window exists at present in Westminster Hall at less than about 25 feet from the ground?—Several of the courts are now above the cills of those windows, and if they were raised, the light to the windows on that side of the Hall would be entirely blocked out. The existing front is a building that is very shallow in its depth; that it encloses, as it were, a large area, in which area are obtained all the courts upon a low level. If, therefore, those new courts were to be raised to a level with the external front of the stone building, it would effectually stop out the light from the windows on one side of the Hall, and the story that would thereby be obtained below the courts could not well be lighted. The cills of the windows on the west side of the Hall were originally 21 feet above the ground in New Palace Yard, and were raised to 26 feet above that level when the present law courts were constructed. The floor of the courts is about two feet six inches above the ground, and the roofs of several of them are already above the level of the top of the window cills, on the west side of the Hall. The stone building, towards St. Margaret-street, is about 54 feet high.

Conversion of present Courts into a Record Office.

If the courts were removed from their present site, would you be very much embarrassed as to what purpose to apply the space to?—Certainly not; I conceive that there are many purposes to which it might be very advantageously applied. I would mention amongst others a new Record Office, for which, in my opinion, the site might be made available, and would afford ample and very convenient accommodation. The remainder of the proposed quadrangular addition to the palace might be appropriated either for some of those Government offices which it is not necessary should be immediately connected with others, or for rooms for commissions and other Governmental purposes, or for what is, in my opinion, very much wanted in the new Houses of Parliament, refreshment and other rooms for the convenience of the public.

In your plan of converting the present site of the courts of law into a Record Office, do you mean to place any space between that and Westminster Hall?—I meant to take means of completely isolating the building which is to contain the depositories for records from the Hall.

Improvement of Entrance to the Palace of Westminster.

Is it desirable for the architectural appearance and the convenience of the new Houses of Parliament at Westminster that the courts should be removed, and that an addition should be made to the building upon the site now occupied by them?—Their removal would I think promote very materially the effect of the new Palace at Westminster, as well as its convenience. The elevations towards Old and New Palace Yards and St. Margaret-street will be very defective, owing to the irregularity in plan, the difference in levels, particularly the low level of Westminster Hall, and the necessarily inharmonious character of the design, owing to the incorporation of Westminster Hall in those elevations. This defect would in a great measure be removed by the proposed quadrangle, and by causing Westminster Hall to form a part of it, as was formerly the case in the ancient palace. So that on the whole, I think the gain in the external effect of the building would be very considerable. There is another point also that I might observe upon, which is, that at the present moment there is no principal or striking entrance to the new Palace for the public. The only great entrance is the state entrance to the House of Lords, reserved exclusively for the use of Her Majesty. There is no situation in which a main public entrance could be so convenient, or have so good an effect as at the north-west corner of the proposed quadrangle enclosing New Palace Yard. If the quadrangle were added to the building, it would only be necessary to secure this entrance gateway, in order to render the building more secure from external attack in case of public commotions. The building, as now designed, could be effectually protected towards the river, but it will be very much unprotected on the other sides. It might be as well I should state, that in case the law courts were removed from Westminster, and the site of them were made available for other purposes, the value of it, in my opinion, could not be stated at less than £86,640. I mean that if it were sold for any building purpose it would be worth that money in the market.

Do you mean the committee to understand that that is an element which ought to be taken into their consideration, that, in immediate connection with the New Palace at Westminster, you would allow the space at present occupied by the law courts to be applied to any other than congenial purposes?—Certainly not.

Then will you state how far it can fairly be within your calculation to assume as the marketable value of the site a sum which could not be obtained by any mode which you would recommend, or which you would think consistent with the propriety of the case?—I have said that the site might be made available for a Record Office, which externally might be made to appear as part of the new palace, and the value of it so applied is, in my opinion, what I have stated, 86,640.

Victoria Tower.

Have you not stated on former occasions that the Victoria Tower was the spot to which you proposed to transfer the records of the kingdom, and have you not stated that it was eminently adapted for such purpose; and if not for such purpose, will you state to what purpose it is to be applied?—The original purpose of the Victoria Tower was for the Parliamentary records alone; it has since been considered that it might be made available for the public records of the kingdom. I was therefore consulted as to the accommodation that it would afford for that purpose, and from the best information which was afforded to me at the time as to the accommodation required for the records, I have no hesitation in reporting that the Victoria Tower would be sufficient to accommodate the whole of them. Since that time a very minute survey has been made by the officers of the Record establishment of the whole of those records, and a plan has been proposed by them of a particular mode in which they should be arranged, which plan differs altogether from the plan which I had formerly acted upon, and now causes me to doubt whether the capacity of the Victoria Tower is sufficient for the purpose.

Roofs of New Houses of Parliament.

I had proposed certain accommodation in other parts of the building, such as in the roofs; but that species of accommodation has been discountenanced entirely by the Master of the Rolls, and I believe is now considered as unavailable.

Have you made preparation, either by floors or windows in the roofs, for the reception of the records?—The only preparation I have made is in strengthening the roofs; the dormer windows in them I consider to be necessary for the convenience of the building.

Have you not floors in the roofs adapted for the purpose of the records, and windows opening in such apartments?—There is a fire-proof floor in the roof, which is necessary for the warming and ventilating arrangements of the building; and there are windows also.

Space required for the Records.

According to the arrangements proposed, it is questionable whether the cubic capacity of the Victoria Tower is sufficient for their accommodation; but if the records were to be arranged in the Victoria Tower as closely as possible, I believe the tower itself would be sufficient to hold the whole of them.

At the time when you gave evidence of the sufficient capacity of the Victoria Tower for these purposes some years ago, a previous measurement of the records had been made?—A subsequent measurement of a more minute description has taken place within the last two years.

Upon that re-examination, the quantity of records, and consequently the space required to deposit them in, was found to be much greater than was anticipated at that time?—Taking the quantity of records and the arrangements considered necessary for their location together.

Has the actual bulk of the records been found greater than it had before been estimated to be?—No, it is found to be less; but much larger allowances are now proposed for the arrangement of them and for the annual increase of them; and those allowances make the entire cubic space to be provided much greater.

Of course it would be desirable to provide not merely room for the existing records, but for their gradual increase, and also room for the use of the readers who may desire to consult them?—Yes; taking the allowance that is now proposed for that purpose, and the proposed increase of facilities for searching the records, the cubic quantity of space required is very considerably greater than it was in the first estimate.

I propose that a much larger site should be obtained than is absolutely required for the new law courts, in order that there might be a very considerable return in the shape of ground-rents for chambers, in diminution of the expense of purchasing the site in question. I have gone over the whole of the property which I consider it would be advisable to purchase, with a gentleman whose local knowledge of the property is unquestionable (Mr. Cadogan, who has his office in Pickett-place), and I have every reason to believe that the estimate which that gentleman has formed, and which I have had an opportunity of checking by going over the same ground, may be relied upon. The amount that would be required to purchase the whole site considered necessary to carry into effect the alterations, would amount to £675,074.

It will be bounded on the north by Carey-street, on the east by Chancery-lane, on the south by the Strand and Fleet-street, and on the west by Clement's lane and Plough-court.

The length will be from east to west, about 700 feet; and from north to south about 480 feet.

About 7¾ acres. I should propose to place the law courts in the centre of the site, or nearly so, and the proposed chambers east and west of it.

Law Chambers—Deductions from Costs.

Is there any residue out of the space which you propose to take, and which you have estimated in the calculation of £675,074?—A very considerable residue, which I should propose to appropriate to the purpose of building chambers, as shown upon Plan (B), which exhibits two quadrangles on each side of the law courts, and a row of houses towards Plough-court. The value of the ground-rents that might be obtained for the proposed chambers alone is, in my opinion, worth the sum of £316,500.

Leaving the expense of the actual site for the law courts £358,574.

I have made a calculation to the best of my judgment of such ground-rents as would be obtained for buildings in that locality of the description mentioned, supposing the law courts to be in the centre of them.

Other Deduction.

I should state, as amongst the items of deduction from the expense of the site, that a certain number of public offices attached to the courts of equity would become available for other purposes if the law courts are removed to it, and that the value of those offices, if let for other purposes, would be about £100,350. Those offices are the Accountant General's Office, in Chancery-lane; the Affidavit-office in Symond's Inn, Chancery-lane; the Public office in Southampton Buildings; the Enrolment office in Chancery-lane; the Clerk of Custody of Lunatics' Office in Mitre-court Buildings; the Great Seal Patent office in Quality-court, Chancery-lane; the Lunacy-office, 45, Lincoln's Inn Fields; the Masters in Chancery-Offices, 11 sets of Chambers, &c. in Southampton-buildings; the Patent-office, 13, Searle-street, Lincoln's-Inn; the Presentation office, 4, Old-square, Lincoln's-Inn; the Record and Writ Clerks' Office in Chancery-lane; the Registrars' office in Chancery-lane; the Report-office, Chancery-lane; the Secretary of the Lord Chancellor's Office in Quality-court, and the Taxing Masters' Office in Staples Inn, in addition to the site of the present law courts at Westminster, which I have valued at £86,000. There are also other offices attached to the courts of law which might be let for other purposes, but of which I have no valuation. If the Corporation of the City of London were disposed to enter into the arrangement of central courts upon the site proposed, the present courts in the Guildhall-yard might be let for other purposes.

I believe it to be probable that the proposed building might afford accommodation for all those offices.

In your proposed plan for the courts of law have you included judges' chambers?—Yes; I propose that the judges should be accommodated in the new building. I have not gone so much into detail with the plan of the new building as to say with certainty that such would be the case; but I imagine from the immense size of it, and the number of stories that would be available for offices, that all the offices, and other accommodation which I have mentioned, might be obtained.

Deducing these set-offs from the expense of purchasing the ground, you would make out, the purchase of the ground would not cost above £172,224, exclusive of the value of the offices attached to the courts of law.

If you were to make no deduction for the value of the present site it would be £258,224.

And this includes the formation of new streets immediately contiguous to the site?

And the clearing away of a very unwholesome, unsightly, and disreputable neighbourhood?

Architecture of the New Buildings.

The plan would be very much like that which I proposed some years ago for a building to occupy the centre of Lincoln's-Inn Fields; it would be upon the same principle; the accommodation would be for 12 or 14 courts, each with a judges' room, a clerks' room, and ante-room, barristers' room, and solicitors' room; and in the common law courts, in addition to this accommodation, a room for the jury. It would include also, a room for the grand jury, a law library, consultation rooms, a refreshment room, a great central hall, communicating with the whole of the courts and their appurtenances, for the accommodation of the public; and private lobbies, and communications for the convenience of the judges and the bar. The courts would be arranged around the great central hall, and towards the exterior of the building, surrounding the courts, would be arranged all the private accommodation connected with the court respectively.

The elevations would be much higher than in the plan proposed for Lincoln's-Inn Fields, which was formed on the consideration that it would be desirable to keep the building in that situation as low as possible, in order to obstruct as little as possible the air and ventilation of that neighbourhood, and with that view, the building was designed in a style of architecture which admits of low proportions. The style of architecture that I should propose for the new building would be altogether different from that proposed in the first design. I should say that it would be desirable that it should be in the Mediæval style of architecture, and that the loftier the building is made, provided no practical inconvenience results from the height, the better will be the external effect.

In the exterior of the building I should propose four stories; the centre of the building would be lower, and the great hall and surrounding courts would be lighted entirely from above.

That area with that elevation would supply the means of transferring to that central locality all the public offices now in the Temple, and in other places connected with the administration of the law.—I have every reason to believe, from the information I have at present, that such would be the case. It is most probable that many of those offices would require to be new modelled, and the extent of accommodation is therefore a little uncertain; but I have very little doubt that the size of the building and the power of increasing the number of stories in it, will afford every accommodation that can be required.

It would include also the late Six Clerks' Office, now in Chancery-lane

Cost, Frontage.

I can state, in round numbers, what I believe would be the cost of the new building. It would, I think, be about £300,000. It is impossible for me, however, to give an answer with certainty, inasmuch as I have not gone into the details of the plan.

Does the estimate of £300,000 cover merely the new buildings of the courts, or all the buildings that would stand upon the site that would be cleared?—The courts alone.

Where would you propose the front of this building to be?—The front should be to the Strand and Fleet-street.

Do you contemplate in your plan so widening the Strand as to give easy access to the building?—I propose that the Strand should be widened so that it should not be less than 100 feet.

Temple Bar.

Do you propose to get rid of Temple Bar?—That would not be necessary.

Will you state to the Committee how far Temple Bar could be preserved, consistently with the frontage of the street at that spot, as designed on your plan?—Temple Bar can stand as it is shown upon that plan; it would not be in the centre of the street, or of the area in the front of the building, but it would be attached to one side.

It would be like the arch of Titus?—Yes, in some degree.

Evidence of R. L. Jones, Esq.—You are the Chairman of the Committee for City Improvements?—

Alterations of Temple Bar.

With reference first to the question of Temple Bar, do you believe that the alteration of Temple Bar would form any objection on the part of the City to the plan that Mr. Barry has proposed?—I think they would require boundary gates. I do not think there would be any strong objection against removing the present gates and substituting others; but I think they would insist on boundary gates.

City Improvements.

The City contemplate some improvements in the direction of the inns of court.

It is proposed to commence from the corner of Cheapside, at the west end of Cheapside, and to take down the whole block of building on the north side of St. Paul's, and thence going across the Old Bailey, through the site of the Fleet Prison, crossing Farringdon-street, up to little New-street, and thence up to Fetter-lane, which joins the Rolls estate, taking another diagonal line into the wide part of Holborn, which would be the means of relieving Holborn-hill, as to which a loud complaint has so long been made, because we have ascertained that the aclivities from the point at the west end of St. Paul's Churchyard will be more than Ludgate-street or Fleet, about 1 in 30.

The hill, as marked on this plan, would be as steep as Ludgate-hill.

These plans are now in contemplation.

Several of them will be begun, but which portion I cannot say.

The great call is for another artery, if I may use the expression, east and west.

Where would be the terminus of the proposed street of the left-hand branch?—Up to Fetter-lane on one side, and into the wide part of Holborn on the other.

Accountant General's Office.

Evidence of Mr. S. Parkinson.]—The office was built about 70 years ago; when it was built it was only intended for four clerks in the Accountant General's office, and one division. The whole property was about six millions. Since that time the office has been obliged to be divided into four distinct offices, so as to divide the Alphabet. The consequence is that the rooms have been much cut about, and we do not know where to put the books and papers securely. Last year the property transferred and paid in and out was £19,900,000.

So that an office which was formerly intended for four clerks, has now 26.

Formerly the public got their dividends passed on the ground floor; now they are obliged to clamber up and down a very bad staircase in order to get their drafts passed by the Registrar.

With regard to all those offices, very much increased accommodation is required; the Exchequer business has been removed into the Court of Chancery, and we were obliged to make provision for it within the same walls.

Increase of Business.

When you speak of the great increase of business which has taken place in the different courts lately, what year are you comparing the present with?—I am comparing the year 1775 with the present year. In the year 1775, when the offices were built, the whole of the property in court was £6,000,000, and last year the amount of stock and cash paid and transferred into and out of court, was about £19,000,000; the Railway Bills bringing an immense deal of business.

I can state what it was in 1828. The cash received and paid into court was about £1,000,000. The stock paid in then was about £1 160,000. The cash paid out was £4,359 000, and the stock transferred out was £3,322,000; making a total of about £15,000,000.

What is the amount of property to which those books have reference which are contained in the offices of the Accountant General?—I should think the value would be about £60,000,000, The stock last year was £46,530,577; that included East India stock and Bank stock, and a great number of valuable securities, so that the value of the whole would be nearly £60,000,000.

Petition for Removal of Present Courts.

Evidence of Mr. R. Maughan.—There was a petition to the House of Commons from the solicitors of London and Westminster, signed by 632 different solicitors.

Do they reside in different parts of the metropolis?—In various parts; a large proportion in the City; some at this end of town; and particularly in and about the inns of court.

Including the most considerable solicitors in London.

The signatures to the petitions include almost all the agency houses.

All those persons think it would be a great convenience to themselves, and their clients, if the courts of law were removed from their present position.

The total number of professional men in that department, residing in the metropolis, is I think about 2,500.

About one-fourth of that number have signed the petition in favour of this plan.

Has any one on the part of Messrs. Freshfield, signed?—Two of the Messrs Freshfield have signed, and Mr. Edward Lawford, and Mr. John Lawford.

Of the solicitors at the west end of London, can you specify some of the leading houses?—I observe that Messrs. Clarke and Fynmore have signed; Mr. Clarke is just appointed solicitor to the Ordnance.

Did the clerk call upon any of those three-fourths who have not signed?—He called upon many who did not sign, not being at their offices; he informed me that none he called upon objected to sign.

Did he state that none upon whom he called had refused to sign?—None whatever.

You were rather in a hurry with the petition?—Yes; the time was short.

Gas Works in the Colonies.—The inhabitants of our most distant colonies are becoming alive to the advantages and comfort of gas lighting. A company has been formed for this purpose at Cape Town, Cape of Good Hope, and the contract for the supply of the apparatus has been taken by Messrs. Barlow and Co., the engineers and contractors for gas works of 39, Bucklersbury. The total outlay will not exceed £7,000. Mr. Alex. Wilson, late of the Imperial Gas Company, is engineer, and the designs and arrangement of the work do him great credit.

THE BOOKSELLERS' PROVIDENT RETREAT.

If the Booksellers be, as Johnson said of them, the best patrons of literature—as no doubt they are when its interests happen exactly to coincide with and promote their own—they show themselves to be about the very worst patrons of architecture, for they have just patronized a most wretched design for their Provident Retreat, at Abbot's Langley; the first stone of which was laid on the 3rd of September; the better and more sensible part of the ceremony on the occasion being an early cold dinner, called, for gentility's sake, a breakfast. There was, of course, the usual dose of speeches to be swallowed, as well as eatables and drinkables, yet, somehow or other, nothing was said with respect to the intended building; nor did the Earl of Clarendon, in return for the compliments paid him, venture to compliment the booksellers upon the taste they had shown in their selection of a design. We admit that the matter is not one of any great moment in itself, yet the Booksellers might, for the same outlay as they contemplate, have a building very far superior in architectural quality to many that are very much larger, and which now stand as so many lamentable records of opportunities thrown away. The getting one paltry thing the more may seem a mere trifle, but then it is no trifle to find a number of paltry and ridiculous things stuck up all over the country: the items are insignificant, but the amount is a fearful one. "Take care of the pence" is a very good maxim in architectural matters, as well as in money matters: if we study good taste in our buildings generally, let them belong to whatever class they may, there will be no danger of either bad taste, or want of taste, being shown in our public edifices and monumental structures; whereas, although there is no lack of excitement and talking whenever a competition takes place for something worth scrambling for, as holding an unusually lucrative prize, ordinary competitions are passed over as matters of no interest or concern to any one except the parties actually engaged in them.

People have a right, it will be said, to please themselves; true—yet, even this right must be understood, *cum grano salis*, or it might, in time, be extended to the privilege of pleasing one's-self by putting one's hand into another person's pocket. The right is a qualified and limited one: a man is perfectly at liberty to go into a shop and cull out from the articles offered for his selection one of the very worst patterns of all; but no set of men, let them call themselves what they may, have any right to invite architects to send in drawings to a competition under the pretence of intending to choose the best design—or, if not the very best of all, still, one of real merit, and then select the very worst—or what must be considered such by those who do not know that there was something *still worse* offered. At any rate, it would be merely honest were committees to say to competitors, "We do not pretend to be judges of architecture; we do not pledge ourselves to select the best design that may be sent in; we only want to have the opportunity of rummaging over whatever you shall think fit to show us; and as to choosing a design from them—why, in that we mean to *please ourselves*." Had the Booksellers thus forewarned the competitors, we could have admired their sincerity, if nothing else. But what is the position in which the Booksellers—their committee at least—have placed themselves? Whether it was knowingly, or through sheer ignorance, they have chosen such a despicably maudlin and wretched design, that it proclaims either their injustice and bad faith towards the other competitors, or their own utter incapacity and bad taste. That choice is so far an injury to others who may be known to have engaged in the competition, as the natural, though inconsiderate inference is, that bad as the one chosen may be, not one of the others was *so good*. Even granting for a moment that such really was the case, the only way then left for the committee, if they had a grain of taste in them, was to reject the designs, one and all, as being every one of them far below the mark, and as manifesting complete ignorance of style, and of every architectural quality. We should very much like to know upon what grounds the committee justified to themselves the choice they have made; or are we to suppose that the *selection* was conducted after the manner of a *raffle*, and that they left luck to decide for them? If so, they certainly cannot boast of their good fortune, though the author of the design has no reason to be dissatisfied with his. We should, too, like to know if, after choosing such a design, any one of the committee could dare to look any of the other competitors in the face?

Committees may not be formally responsible to any one for their proceedings, or their decisions, but they ought at least to be made to feel that they are in some measure responsible to public opinion, and should be taught that if they refuse to pay deference to it, they must expect nothing else than its hissings and its hootings. The Booksellers' committee have fairly exposed themselves to derision, because, although they themselves say nothing, the choice they have made proclaims aloud for them—*This is our taste!* We do not pretend to say *why* we have come to such conclusion, but this is, in our opinion, the best and most suitable design among all that were offered us. So long as it satisfies us, we care not who may be dissatisfied; and it is sheer impertinence in other people to inquire into our reasons.

Admitting that the power of acting just as they please, confers on committees and other bodies the right of exercising, *à discretion*, similar power gives public opinion the undoubted *right* of expressing itself without restraint; so that at any rate there is right pitted against right, though on which side *might* lies is not yet decided. Some may think the particular case hardly calls for such animadversion, yet it is precisely owing to the practice of winking at the arbitrary proceedings of committees on ordinary occasions, that the general system of competition has grown up to what it is—a notoriously corrupt one, stamped by chicanery, favoritism, and intrigue, by shameless bad faith towards competitors, and frequently by the most shameless bad taste on the part of judges, who seem to have been appointed on account of their stupidity.

COAL FIELDS IN CHINA.

By R. C. Taylor,

(*From the Journal of the Franklin Institute.*)

In the East Indies various depots of European coal have been established, for the service of the British government steamers. This fuel, for the most part, it is understood, consists of the anthracitous and partially bituminous coals of South Wales, of course obtained at great expense. It appears that 5000 tons of English coal, at a freightage of about 2*l.* per ton, are annually imported into Bombay, for the Company's steamers. Bituminous coals have been derived from much less distant sources; among which the Burdwan coal field, in the vicinity of Calcutta, may be named. Mergui Island, also, in the Bay of Bengal, has lately furnished some steam coal to Singapore. The steam ships on the China seas, during the war with that vast country, were supplied from these various sources.

It is probable that coal was discovered, and was in common use in China, long before it was known in the western world. It is mentioned by a noble traveller of the 13th century, as abounding throughout the whole province of "Cathay," of which Pekin is the capital, "where certain black stones are dug out of the mountains, which stones burn when kindled, and keep alive for a long time, and are used by many persons, notwithstanding the abundance of wood."

Among the people of Pekin, three kinds are in use.

1. That employed by the blacksmiths. It yields more flame than the other qualities; is more fierce, but is subject to decrepitate in the fire; on which account, probably, the blacksmiths use it pounded in minute particles.

2. A harder and stronger coal used for culinary purposes, giving out more flame than the other sorts so employed; it is less quickly consumed, and leaves a residuum of gray ashes. There are several gradations of these. The best are hard to break, of a fine grain, a deep black colour, soiling the hands less than the others. It sometimes is sufficiently siliceous to give the fire with steel. Others have a very coarse grain, are easily broken, and make a bright fire, leaving a reddish ash. Another species crackles, or decrepitates, when first placed on the fire; and falls down, almost entirely, in scales, which close the passage of the air, and stifle the fire.

3. A soft, feebly burning coal, giving out less heat than the 2nd class; consuming more quickly, it breaks with greater facility, and in general is of deeper black than the sorts previously mentioned. It is commonly this description, which, being mixed with coal dust and a fourth part of clay, is employed to form an artificial and economical fuel. This being moulded in the form of bricks and balls are sold in the shops of Pekin. Wagon loads of coal dust are brought to that city for this sole purpose.

Nearly the whole of the properties and applications are now in everyday use in the United States, and are familiar to all. They are, in fact, the natural results suggested by qualities possessed in common by the combustibles of remote parts of the same globe. Even the modern method of warming all the apartments of our dwellings, which we view as the result of superior practical and scientific investigation, was in use with very little deviation, centuries ago, by the Chinese. Many a patented artificial fuel compound, both in Europe and America, has been in practical operation in China, at least a thousand years.

4. Anthracite. Another description of coal abounding about 30 leagues from Pekin, but which was not then in such general use there as the other kinds, is called by the Chinese Che-tan. Che means a stone, but tan is the name they give to wood charcoal. Therefore, according to the genius of the Chinese language, this compound word signifies a substance resembling or having the common properties of stone and charcoal. There can be little difficulty here in recognising the variety of coal which, in our day, has been denominated anthracite, a compound word of similar meaning.

The Chinese *glance coal* forms a remarkable exception to the unfavourable conclusion prevailing against Oriental coal; and, according to more recent authority than those we before cited, deserves to rank at the head of the list, in respect of its purity as a coke; although, in specific gravity, it does not come up to the character of the Pennsylvania or Welsh fuel; neither has it the spongy texture which contributes much to the glowing combustion of the latter.

So late as 1840, a Russian officer has described the coal formations of the interior, as occupying the western mountain range of China, in such abundance that a space of half a league cannot be traversed without meeting with such strata. The art of mining is yet in its infancy among the Chinese; notwithstanding which, coal is thought to be at a moderate price in the capital. Anthracite occurs in the western range of mountains at about a day's journey, or about 30 miles only from Pekin. The coal formation is largely developed, in which thick beds of coal occur. They appear to be of various qualities. Some of this coal occurring in shale beds, is singularly decomposed, and its particles have so little cohesion, that they are almost reduced to a state of powder. Beneath these coal shales are beds of ferruginous sand stone, and below those occur another series, consisting of much richer seams of coal than the upper group.

In this range are seen also both horizontal and vertical beds of conglomerate, accompanied by seams of coal, which have the conglomerate for the roof, and diorite or greenstone for the floor. As might be expected, this coal very much resembles anthracite. It is shining, of compact texture, difficult to ignite, does not flame in burning, or give out any smoke. Its substance is entirely homogeneous. Every thing respecting it leads to the belief that there had been a great development of heat at the period of its formation, or subsequently. The horizontal coal beds are the most important and valuable, and are denominated large; but no greater thickness than three and a half feet is quoted. The blacksmiths and those who work in copper, prefer this coal, on account of the intense heat which it gives out.

Throughout the whole of this mountain range may be continually seen the outcrops of this combustible, where they have never, as yet, been touched by the hand of man.

In those parts of China where wood is very dear, coal is worked on a great scale for the Pekin market; but the process of mining is very little understood by those people, who excel in the preparation of charcoal.

We possess evidence, that extending over large areas in China, are beds of tertiary or brown coal, of cannel coal, a dozen varieties of bituminous coal, of anthracite, glance coal, and graphitic anthracite; all of which, for ages, have been in common use in this remarkable country, and have been there employed for every domestic purpose known to civilized nations of all times, including gas lighting, and the manufacture of iron, copper, and other metals.

Mode of Mining Coal in China.

It might be expected that in China, where most of the practical arts have, from time immemorial, been carried on with all the perseverance of that industrious people, the operations of mining coal would be conducted with some regard to science, in relation to sinking, draining, and extraction. We have, however, good authority, especially in regard to the environs of Pekin, for stating that the process is still in a very imperfect state. Machinery there to lighten labour is unknown. They have not even an idea of the pumps indispensable to draw off the water. If local circumstances allow, they cut drainage galleries; if not, they abandon the work whenever the inundation has gained too far upon them. The mattock and shovel, the pick and the hammer, are the mining instruments—the only ones, in fact, which the Chinese employ in working the coal. The water of the mine is emptied by the slow process of filling small casks, which are brought up to the surface by manual labour. Vertical shafts are not used. In working horizontal coal seams, the timber is expensive, and the materials cost about 2 copecs per poud, = 8 dollars 50 cents per ton, English wood being sold by weight in China.

The coal, when mined, is put into baskets, and drawn upon sledges, which are raised to the surface by manual strength. Each basket contains about three pouds of coal, and one man can raise about eight baskets in a day. This is equivalent to 1032 Russian pounds, or to 12 cwt. English, per day. The miners' wages are at the rate of 30 copecs a basket; which is equal to 240 copecs (copper currency), or 46 cents of United States currency, per day; being 76 cents U. S. per ton.

Prices at Pekin.—At the pit's mouth, this coal is sold for 60 copecs per poud, = 4 dollars 63 cents per ton of 20 cwt. It is then conveyed on the backs of mules through the mountains, and thence on camels to Pekin, where the price is 1½ rouble, = 1½ francs, = 29 cents United States per poud; which, if our calculation be correct, is equal to 11 dollars 60 cents United States, or 2*l.* 8s. 3d. per ton of 2240 pounds English. We perceive, therefore, that the best of fuel is expensive at Pekin, and hence the necessity for resorting to the artificial compounds and substitutes to which we briefly alluded.

There is, however, a kind of coal sold in that city at a much lower price, particularly when it is mixed with one-half of coal dust. This coal, in 1840, sold for one rouble per poud, which is at the rate of 7 dollars 75 cents equal 1*l.* 12s. 3d. per ton. It is of indifferent quality, however; giving out but little heat, and is quickly consumed.

Coal Gas Lighting in China.

Whether, or to what extent, the Chinese artificially produce illuminating gas from bituminous coal, we are uncertain. But it is a fact, that spontaneous jets of gas, derived from boring into coal beds, have for centuries been burning, and turned to that and other economical purposes. If the Chinese are not manufacturers, they are, nevertheless, gas consumers and employers, on a large scale; and have evidently been so, ages before the knowledge of its application was acquired by Europeans. Beds of coal are frequently pierced by the borers for salt water; and the inflammable gas is forced up in jets, twenty or thirty feet in height. From these fountains the vapour has been conveyed to the salt works in pipes, and there used for the boiling and evaporation of the salt: other tubes convey the gas intended for lighting the streets and the larger apartments and kitchens. As there is still more gas than is required, the excess is conducted beyond the limits of the saltworks, and there forms separate chimneys or columns of flame.

One cannot but be struck with the singular counterpart to this employment of natural gas, which may be daily witnessed in the Valley of the Kanawha, in Virginia. The geological origin; the means of supply; the application to all the processes of manufacturing salt, and of the appropriation of the surplus for the purposes of illumination, are remarkably alike, at such distant points as China and the United States. Those who have read, even within the present month, the account of the recent extraordinary additional supply of gas, and the services it is made to perform at the Kanawha saltworks, must be impressed with the coincidence of all the circumstances with those which are very briefly stated in the previous paragraph, in relation to China. In fact, the parallel is complete.

To the coals and combustible minerals of China, I cannot further advert here. But what a conviction irresistibly presses upon the mind, as to the incalculable utility of the *Railroad system*, and coal mining improvements in such an empire! If ever there were concentrated at one point all the circumstances especially and unequivocally favourable to that system, and imperiously calling for improvements of the character suggested, it seems to be presented in the case of the city of Pekin. Here, with its enormous population of 1,500,000 souls, it is situated only at a day's journey—computed at thirty miles—from an immense region of coal, comprising several varieties. Yet its inhabitants cannot purchase the best qualities of this coal, brought from the mountains on the backs of mules and camels, under 11 dollars 60 cents per ton, and the very worst for less than 7 dollars 75 cents per ton.

Borneo, "the largest island in the world," which is only twenty degrees due south of Canton, has lately come into repute for the great quantity of coal which it contains, not only accessible to ships along the coast, but extensively occurring in the mountains of the interior. Much information has also been acquired from the natives; and the facts which are already elicited are regarded as of considerable importance, in respect to the facilitating the steam navigation of the China seas.

[Note.—The prices and admeasurements, which are quoted in the foregoing article, were reduced to the United States and English currencies and measures, from the Russian, as furnished by the Engineer Kovanko; who, in like manner, converted them into the Russian from the Chinese standards. In consequence of this triple conversion of standards, additional care has been taken to avoid error in these calculations.]

TIDAL HARBOURS' COMMISSION.

Analysis of the Evidence.

Improvement of Thames Navigation.

Evidence of J. Walker, C.E.—The Report on the Thames of 1842 states that Barking Shelf is the worst in the river, and might be removed without difficulty: it is to be deplored that so important a measure as the removal of the shoals in the river should, for the want of 60,000*l.*, be left untouched. The Report in 1843 enumerates 14 shoal places in the river, and that all might be removed, and witness has had no reason to alter his opinion, and contemplates an uniform depth of 12 feet at low water springs from London Bridge to Gravesend; dredging may be done at from 9*d.* to 1*s.* a cubic yard. Is of opinion that there should be one superintending power over all harbours to control all operations where navigation is concerned. Considers that local trustees, with proper professional advice, are the most likely persons to be vigilant conservators of their rivers; a general surveillance would be unobjectionable on public grounds. Is of opinion that there ought to be a plan of every harbour in the United Kingdom, but would not interfere with the present efficient system of the hydrographer, in having each port surveyed. There should be efficient conservancy over the harbours, but it will require great caution as to the party entrusted with the exercise of that power. Has reported that the embankments at Southwold Harbour are an evil, but it must not be supposed that in all cases the embanking of land is an evil. The Thames, for instance, was once six times its present width, and many thousand acres of marsh land have been taken from it with advantage, reserving always an adequate breadth for a channel. The evil in Southwold Harbour arises from the tidal estuary having been diminished, so as no longer to contain backwater to scour the harbour. No reason to suppose that the shoals at the mouth of the Thames have increased, or that they will increase. If the Penryn Dock were made, does not apprehend any danger of silting up in Falmouth Harbour. It would be advisable to call upon the parties to give security for the completion of the works, or for their removal. The balance is in favour of good being done by the proposed dock rather than evil. With respect to the improvement of the Thames, is of opinion, that a Commission should be formed, in which the different interests are represented; as the City of London, the Crown Lands, the Admiralty, and the Trinity House, and they should carry out the requisite improvements, while the two former bodies are at law, regarding the right of soil; has reason to believe that this would have been done, except for the change of Ministry. In the mean time the navigation of the Thames is neglected, and its commerce interrupted.

Evidence of Mr. Fisher, Principal Harbour Master of the Port of London.

Has been harbour master 26 years. The dry bank formed by old London Bridge has been removed and a depth of 11 feet water gained. Has lighters generally at work in the centre of the river in order to deepen it to 14 feet; the navigable channel has increased in depth slightly from the action of the steam boats at low water. After the shoal in Limehouse Reach the next considerable obstruction is Ham Shelf, which is a great nuisance to Her Majesty's ships that come up to Woolwich; on account of not having given the proper direction to the set of the tide all attempts to clear Woolwich Reach have hitherto failed; a deposit is also formed in front of the Dockyard, to remedy which, Mr. Walker, in 1842, recommended that Hook Ness should be cut off. Fully concurs in Mr. Walker's recommendations in 1842 to the Port of London Committee; attended that survey with Captain Bullock, and approved of the lines for the side of the river drawn by Mr. Walker. Is aware of irregularities in the bottom of the river above London Bridge, but his duties are strictly confined below bridge. Recommended the Navigation Committee to deepen the river from London Bridge downwards, but is not aware why this plan has not been carried out; it rests with the Committee; has pointed out the obstructions, and advised them to be removed. Formerly people took sand and gravel where they pleased from the river above bridge; in some places they had made holes of 4 foot, in others 5 or 6 feet; this was allowed, under the authority of the Lord Mayor, by the water bailiff. Excavations are now made under special directions of the water bailiff. Since 1842 there has been considerably more water in certain places, but they have not made an uniform depth in the channel. Those who are allowed to dig above bridge are directed by the water bailiff where they are to work. The only difficulties in widening the river would be the expense, and that it would affect many interests in water-side premises. Those at the side of the river should be called upon to pile and defend their property; jetties, barges and craft are now run out from different private landing-places; during two-thirds of the tide these barges are aground, stop the free current of the tide, and cause a deposit. The Navigation Committee recommended the removal of all these nuisances, and objected to the manner in which licence has been irregularly given. No steps have been taken since that report to prevent the accumulations which have taken place; some of the jetties have been removed, but the most objectionable still remain. One of these is at Greenwich, run out from the Garden Stairs. To improve the river effectually all these jetties ought to be removed: is of opinion that others might be run out for public benefit, under proper authority, and of open piles. No representation has been made by witness since the Report of 1842. Witness removed the pier at Greenwich that he complained of as a nuisance, but the Lord Mayor sent him an order to let it remain. The change of Mayors, &c., is very unfavourable to systematic work on the river; a committee of sailors, under one acknowledged authority, would soon carry out the requisite works. Since London Bridge has been removed the tides have risen higher and fallen out lower than before; in spring tides it is occasionally 3 feet higher above the Trinity standard than it used to be. Hardly any mud is now found in the river, the steamers wash it all away. On the Whiting Shoal has raised 100 tons of soil a-day: the hard part, resembling plum pudding stone, is blasted with gunpowder. Trinity dredgers raise 120 tons in 35 minutes. The clay under the gravel offers great impediments to dredging; expense is the only objection to clearing the river as recommended in the Report of 1842; the present irregular system is directly contrary to that Report: the Trinity Board will only take up material that is fit for ballast.

Six more vessels sunk within the last year lie between Northfleet Hope and Sea Reach; two near the edge of the Bligh Sand, where the Duc de Nemours grounded in 1843. No immediate measures are taken to remove vessels, some lie 18 months. The Barking Shelf delayed the royal yacht for two hours on her passage to Woolwich; it is of clay, peat, and gravel. Cold Harbour Point, the shoal in Erith Reach, Dagenham Shelf, Bugby's Hole, and the Middle Grounds between Blackwall and Greenwich, still remain as in 1842. With the machinery at present in use there would be no difficulty in making the Thames of one uniform depth as recommended in the Report of 1842. The mud still fills up in front of Woolwich dockyard. Agrees with Mr. Walker that the only remedy is to cut off Hook Ness. Either shingle for ballast or mud dredged up might easily be deposited on the Isle of Dogs or elsewhere. In Woolwich Reach steamers are obliged to wait two hours at times to pass Ham Shelf. If sufficient depth of water, by judicious dredging, were maintained on the face of the quays both at Greenwich and elsewhere, there would be no necessity for projecting piers of any sort.

Evidence of W. English, Millwright and Contractor for Dredging.

Has been engaged dredging parts of the Thames, and is now at work on the Whiting Shoal, a sort of concrete or plum-pudding stone in Limehouse Reach. Cost of dredging it is 1*s*. a cubic yard; gravel is lifted at 5*d*. per cubic yard, of 26 cwt.; lighterage is a separate charge, varying from 9*d*. to 1*s*. Is not allowed to raise gravel below London Bridge, it is monopolized by the Trinity House for ballast. No directions given by the water bailiff or other person to deepen a channel in the river, only not to go within 100 feet of the shore on each side. There would be no difficulty but the expense in deepening an uniform channel of the river to 6 feet at low water, from London Bridge to Gravesend. His two engines, of 10 h. p. each only, can take up 500 tons daily in 10 hours. Supposing the quantity of soil to be removed from the Thames to be 1¼ million of cubic yards, it could be done in four years, with two engines of 24 h. p. each. The Whiting Shoal is about half a mile long; witness is cutting a channel through it of 50 yards in width; the soil is composed of gravel about 6 inches, then clay 2 feet, then a substance between a clay and stone, and then stone. Permitted to deepen above bridge 10 feet below low water mark, except when near a bridge; formerly has dredged to 27 feet in some parts. No difficulty, if required, in dredging the Thames, from London Bridge up to Wandsworth, or from London Bridge downwards to Gravesend.

Severn Navigation.

Evidence of W. Cubitt, Vice President of Inst. of Civil Engineers.

Enumerates the different harbours and rivers he has examined professionally and reported upon. Knows of no general rule for improvement applicable to rivers. Crookedness of channel and unevenness of depth are the chief obstructions to the propagation of the tide. Depth in rivers is chiefly due to tides as far up as neap tides reach, above that point to freshes. More to be feared for our harbours from silt brought in from the sea than from detritus brought down by freshes. Has improved the Severn upon two principles; first, as a tidal river by embanking and deepening; secondly, above the influence of the tide by making the river into a series of level or ponds connected by locks and weirs. By means of four weirs a constant and uniform depth of six feet has been obtained for 20 miles where formerly were only 18 inches, and navigation entirely at a stop; and the same improved depth is nearly completed for 30 miles in the tideway above Gloucester. If witness were instructed to improve the navigation of the Severn for seagoing vessels he would make a ship canal across the isthmus at Hock Crib with double stop locks at both ends of the cut, leaving the river to go round by Newnham as at present; would also embank many thousand acres of the Nooze Sands just below. If the tide were stopped altogether at Hock Crib it might be better for all the lands above and the navigation below. There are difficulties in controlling the tide; it would be easier to stop it, and pass the flood water over a weir. A depth of 15 to 20 feet of quiet water to Gloucester would be much better than having a roaring furious bore all the way. A weir of 3 inches thick would carry off the heaviest floods, and a perfect navigation might be completed to Stourport, from 60 to 70 miles.

Rye Harbour.

Evidence of Messrs. Hicks, Manser, and Stocks, Chairman, Clerk, and Harbour Master of the Rye Harbour Trust.

The western and eastern groynes at Rye have been run out according to the opinion of the majority of those who happened to be sitting as Commissioners. Mr. Cubitt was consulted as to improvements, but the Commissioners did not concur in his Report, and would not act upon it. There are 48 Commissioners, who attend tolerably well. There are three sluices across the three rivers about a mile above the town, which entirely stop the flow of the tide. If these were removed the tide would flow 10 miles up the Rother and 7 miles up the other rivers. The sluices were erected 50 years ago, and re-erected 10 years since. Scott's Float Sluice was broken down by the tide in 1813, and was down for two years; the effect upon the bed of the river was to deepen it, so that a boat could go up to the town at low water spring tides. The indraught was so great that the flood stream continued to run up the river after the water had fallen two feet at the pier head. Dredging would be a great benefit to the channel, but cannot do it for want of funds. Average revenue about 1,300*l*, last year only 1,050*l*.; amount of debt 1,500*l*.; expenses of management about 400*l*. a-year, leaving 600*l*. to be laid out in improvements. An area of 731 acres of marsh on the banks of the river, below the sluice, has been embanked since 1833, by consent of the Harbour Commissioners. In the event of a railroad crossing the river at a quarter of a mile above the town it would prevent the passage of 112 sailing vessels annually that now go up to Scot's Float Sluice. Barges go 15 miles higher up the Rother to Bodiham Castle. At times great freshes in the Rother. Width of river at low water, at a quarter of a mile above the town, 102 feet; any bridge across would be an impediment to navigation. The eddy tides makes the case more difficult; the tide rises 23 feet in the bay, and 11 feet at springs at the town. The Nook was embanked in 1839 without any authority. It excluded 10 million cubic feet of water on every spring. The Admiralty Commissioner did not report it to the Admiralty, because he thought the Nook without the jurisdiction of the Harbour. Scot's Float Sluice was pulled down by the people, in 1830, as a nuisance, but was rebuilt by Act of Parliament. The Rye Harbour Commissioners were consenting parties to, and received 6,000*l*. for the 731 acres of marsh embanked in 1833. These lands were covered with 3 feet water at high tides, and thus 30 million of cubic feet of water were excluded, and its scour over the bar lost at every spring tide. All the Commissioners who consented to this arrangement were influential proprietors in the neighbourhood.

Clyde Navigation.

Evidence of J. Walker, C.E.

The proposed weir on Clyde is to be placed on the level of the low-water in the river before improvements began. Tide now falls out from 2 to 3 feet lower than formerly. Tide flows feebly 2 miles above the proposed site for weir. Depth of the Clyde at Glasgow does not depend upon the tide, but on the river freshes. Every fresh carries away more soil than it brings down. Rate of tide at Glasgow 1 mile, of a fresh 4½ miles an hour. Practically the weir in the Clyde does not impede improvements of the river. Just below the weir is a gully of 15 feet depth. Before the deepening of the river above bridge by the trustees, its bed was nearly dry. If it could be done, is quite ready to take upon himself professionally the whole responsibility of removing the weir up to Dalmarnock. By this the river near Glasgow would be materially improved; it would form a large basin, and would extend the harbour 2 miles higher up. If the weir were removed the river in a fresh might so scour the banks and bed, as to bring down Rutherglen Bridge. Would wish anything done to increase the flow and ebb of the tide to the utmost, but the opposition would be too strong to attempt to carry such a measure now. Has contemplated a plan for removing the weir, by having a pipe from Dalmarnock to the factories in the city. Cranston Water-works might be united with the Glasgow Water-works. If the change of channel could have been made completely from the north to the south side of Newshot Isle, it might have been desirable to do so, but under the circumstances it was wrong to begin such a work, as the weir could not keep two channels open. Saw the resident engineer on that occasion, but as Rennie, Telford, and Logan, all preferred the north channel, he saw no sufficient reason to change it. Since 1839, has been frequently consulted as to improvements, but not as to the mode of carrying out works. Mr. Logan gave the lines of parallel dykes which have been slightly modified. It would be mischievous to remove the dykes, or to widen to any great extent; Clyde has been more improved than any river in the world; in Smeaton's time, only 3 feet at high water at Glasgow Quay; but by the skill of Golborne, Rennie, and Telford, it has been brought to its present state; if Clyde had been made too wide at first, the present depth would not have been obtained, nor the consequent large revenue; by widening it now to nearly double the former width, great increase of dredging will be required. Depth in upper part of river due to freshes; in the lower to tides; all the lower dykes should be half-tide dykes. Considers it would be waste of money to close the channel north of Newshot Isle, and to open the south side. The gain in distance would be 130 yards in 2 miles. If the section of the south channel made by Mr. Aird be correct, the removal of half a mile of solid rock would cost ten times Mr. Bald's estimate. There is a longitudinal section of the river from Glasgow to Greenock. The removal of the weir at Glasgow Bridge has so deepened the river, that Stockwell Bridge is in danger of falling, and as the deepening is to go on, it seems fair that the river trustees should pay the additional expense, caused by founding the piers so much deeper, and by removing the weir 1100 yards higher up the stream. Sir John M'Neil and witness reported that 8,100*l.* would be a fair sum to be paid for this purpose.

The Glasgow Junction Railway Company purpose to carry a line of rails across the Clyde upon two piers 15 feet wide, to be built in the middle of the river, at 16 yards below Glasgow Bridge; height of middle arch to be 35 feet above high water. The Glasgow Bridge has 6 piers, average 8½ feet wide, taking up 51 feet of the water-way. The railroad might cross a quarter of a mile above Rutherglen Bridge.

Evidence of Gray Turner, Esq., Deputy Chairman, and Mr. Turner, Secretary to the Clyde Trust.

Cannot speak exactly as to increased depth, as the only soundings in the river that the trustees would be responsible for, were taken in 1839. Mr. Bald was instructed by the Committee to deepen the Port Glasgow Bank. Has no knowledge of the Board having forbidden the removal of boulder. It appears from the Minute produced, that Mr. Spreull, the treasurer, did issue such an order, but he had no authority to do so. Many Reports have been received from Mr. Bald, recommending improvements in the upper part of the river. Mr. Walker has been consulted as to improvements within five years, but not as to the plan of carrying them out. It is proposed that the Clyde Trust shall pay 8000*l.* towards erecting the Stockwell Bridge, upon condition of the piers being founded deep enough to admit of deepening Glasgow Harbour. Foundations and weir at Stockwell Bridge strengthened a few years since; it was necessary to do so, as the Water Company complained of losing their water; and it was done by driving a row of piles across the river, under an order of the Court of Session.

Evidence of J. Miller, Engineer to the Glasgow Junction Railway Company.

The proposed railway will cross the Clyde at a height of 39 feet above high water mark, with three arches, resting on two piers 15 feet wide each. The clear water-way of the river here is 430 feet; span of centre arch 180 feet. The objections to taking the line above Glasgow are—1st, The increased distance of six miles; 2ndly, That it would not be a thorough line, and so breaks up the traffic, as in witness's opinion, to be of no public benefit.

Whitehaven and Furness Junction Railroad.

Evidence of G. Stevenson, C.E.

Proposed line goes along the coast from Whitehaven to St. Bees, Ravenglass, and across the Duddon Sands to Furness; the object is to carry the iron-stone. No part of the plan, at present, is to cross Morecambe Bay, but it may be next year. Proposes to cross Duddon Sands by an arched embankment 1¼ mile long. Would probably cut off 5000 acres of the Duddon Sands, at 4 miles below Broughton. Means to make an outlet for the river Duddon, but this is not in the Bill; mode of proceeding would be by piles; then to lay a wooden railway at top 6 feet above high water mark, and drag wagons to and fro loaded with stones to be dropped between the piles, and thus gradually raise all parts above high water. The bed of the river above the embankment will become land, claimed by the Crown and the neighbouring proprietors. If this line were obtained it would be a reason for asking for a line, next year, to cross Morecambe Bay. Complaints against the embankment have come from Broughton, and it is intended to give that place a railroad instead of the present navigation. Would not propose a swing bridge; the current of water would be so strong that no engineer would undertake it. To cross from Shaw Point to Angerton would carry the line a long way round. The present proposal is the only line witness would undertake.

Evidence of H. M. Denham, Commander in the Royal Navy, and F.R.S.

Has been engaged 30 years in the surveying service. Enumerates the coasts and ports he has surveyed either in command or as assistant, among others the river Lune and Morecambe Bay, in Lancashire. Opinion as to the difficulty of maintaining a deep-water entrance to the Lune; discovered deep-water channel from Lune Deep to Poulton Ring, in Morecambe Bay. Proposes to make docks at that place, distant only 2¾ miles from Lancaster; the ground is level, and easily connected by railroad. Far preferable to any attempt at improving the navigation of the Lune. River may be deepened to 16 feet from Glasson Dock to the new bridge. Expense of cutting canal (including breast-work and basins) from Poulton to Lancaster, 130,000*l.* This would give 12 feet of water at pier-heads without deepening; Harbour at Poulton would avoid the delays of navigating the river; has known ships of 17 feet detained six days bound to Glasson. Compared his survey of 1844 with one projected in 1826, is of opinion that the latter could not have represented the features of the banks, from the great dissimilarity of the two. From common report, since 1826, the sands have not advanced. Tide flows up the Kent within half a mile of Leven's Bridge, 12 miles above Poulton; navigable only for flats up to Milnthorpe. The enclosing of the bay would create a large tract of land, and facilitate railroad communication between Lancashire and Cumberland. If such a project were carried out, a harbour at Poulton could not be maintained, unless by the Kent and Keer rivers being brought down on the south side of the bay. Is of opinion that present depth at Poulton Ring depends on the flux and reflux of tidal water. Depth of water at high-water springs, over the top of the sand called Cartmell Wharf, 9 feet, across on the western edge 13, three miles farther 9, then 13 feet below low-water level in the channel; 2 miles farther, 17 at high water. Full 57,000 acres of tidal water would be excluded if project were carried out. Every enclosure of sand would lessen the depth of the bay. Is of opinion that any enclosure would be prejudicial to the outer channel; but inside would embank all bights and sinuosities, and straighten the river course. From time immemorial, there has been deep water off Poulton Ring, ensuring a permanent harbour. If 10,000*l.* were to be expended on the improvement of the Lune, would do so on lights and buoys, and perching the channels and shallows. Is not of opinion that 7000*l.* is sufficient to deepen the river to 16 feet up to Lancaster. Advises a floating light to be placed on the south-west spit of the Fisher Bank Patches, and tidal lights in Sunderland and Chapel Points, or Abbey Scare, by which means vessels could anchor in Sunderland Hole, or proceed over the 4 miles of flats or bars to Glasson by night. Arrangements for lights are local, the Quay Commissioners possess the light of Walney, erected in 1789, paying general toll; it is imperfect in its action; and they have 3 or 4 buoys placed in an irregular way, under the superintendence of a buoy-master. Considers that local trustees should have no control over the navigation beyond the high-water mouth of the river. Walney light ought to be a channel light; it lights vessels from Liverpool to the Solway, and all vessels entering the bay pay toll. It is a very important light; it consists of a tower 80 feet high, with 3 argand lamps and reflectors revolving, obscured every 5 minutes, showing bright but *one* minute. Navigation of river Lune deteriorated within the last 20 years. Is of opinion that dredging would have little effect. System of harrowing better and cheaper, such as was used in Victoria Channel, Liverpool; but is of opinion it could not be used successfully in the Lune. The extension of the sand is the cause of injury to the navigation. Rise of tide at foot of Lune 28 feet; at Glasson Dock, at high spring tides, 24 feet, 21 at ordinary spring tides; at Lancaster Bridge, 11 feet. Depth of water between the present bridge and intended viaduct, 15½ feet at high water ordinary springs, at low water 6½. No possibility of any vessel proceeding above the first buoy at foot of Lune, 11 miles below Lancaster Quay, and 5 below Glasson Dock, without the aid of a pilot, owing to the want of a light, and a proper system of buoyage. Is of opinion that if the whole of such estuaries were placed under proper independent authority on the part of Government, that the navigation might long ago have been benefited. Has observed the same neglect in navigation under other local authorities, particularly seaward of the mouth of the river, and considers that some competent authority, not local bodies, should direct the placing of buoys and other necessary improvements. Harbours would then eventually be much improved, and the dues on shipping not misapplied. Persons at present employed are not supported by the local authorities, and the latter do not possess sufficient knowledge on the subject. Undertook to scour the Victoria Channel, Liverpool, but immediately after resigned a lucrative appointment, owing to the vexatious difficulties that arose. Considers that in the Lune, where the tide rises 18 feet, dykes or walls would be necessary to direct the current. The upper surface of dykes should come 3 feet above high water level. In case the dykes on the Clyde were pulled down to make way for half-tide dykes, it would confine the stream to steam navigation, as it would not be safe for sailing vessels. Is of opinion that banks in the estuary of the Clyde require all the tidal water, but that within the river dykes should be raised above high-water level. The last half of the tide-scour is necessary to keep the channel deep, also as great a flow of the tide upwards as can be got for the sake of the outer banks. Considers that the descending tidal water would not have the effect of keeping the channel clear within the river. For improving the port of Lancaster, recommends abandoning the Lune to its present course *in toto*, and by establishing a harbour at Poulton, to enable a ship to approach within 3 miles of Lancaster at low water. Should an embankment be run across Morecambe Bay, would recommend that the sea reach of the Lune over Sunderland and Cockram Sands be assisted by more buoys, and the interior of the estuary straightened to define the outfall of the river. Various plans for embanking Morecambe Bay have been suggested. Considers the line from Poulton to Point Comfort feasible and advantageous, in stopping present dangerous indraught into the Bay. Does not consider such an embankment would be mischievous. Depth of water at embankment would vary between 6 and 9 feet. States his opinion as to the phenomenon of the Lune Deep, where the depth jumps from 3 to 154 feet; thinks that the mouth of Morecambe Bay, now 8 miles across, was originally only 1½ miles. Lune Deep was then the outlet of all the rivers, but that it is now filling up, as the bay widens, as may be judged by the submarine spits which all point at it. An embankment of pile-framing and rubble-stone might be built from Poulton, across the bay, sufficient to resist the action of the sea, and to carry a railway. Is of opinion that the embankment would not destroy the entrances of the harbours of Lune, Wyre, and Piel.

Surveyed the estuary of the Duddon water, on the coast of Lancashire. A solid embankment across it, would stop vessels that now go to Broughton quarries; but is of opinion that it would be more beneficial than otherwise, as the estuary presents no refuge capacity. At the proposed line, 3 miles below the Burlington slate quarry, there is 20 feet depth in the channel at high-water ordinary spring tides; vessels drawing 6 feet reach 4½ miles higher; open punts go up to Duddon Bridge, and the tide flows ½ of a mile above. Rate of tide at proposed place of embankment, 3 knots on the flood and 3½ on the ebb, which would be stopped by the embankment. Considers that it would cause slight privation of water-carriage to the surrounding country; a railroad is in progress of formation from Kirby Pool to Piel Harbour. This estuary is the outlet for the waters of the Duddon and Kirby Pool, but is not aware of any traffic upon them. Duddon estuary drains the lakes, Kirby Pool, Simpson's Beck, and Salthouse Pool. And the embankment would entirely destroy its navigation. Would exclude about 1300 millions cubic feet of water on every tide. In order to dispose of the waters above the proposed embankment, either sluice gates or a new channel must be made. The seaward side would no longer be navigable. Considers that the railway might be carried out by a circuit of eight miles, and so avoid the embankment, and all interference with navigation. Recommends the crossing to be by an embankment with arches. Depth of sand is nine feet, then clay; piles and rubble-stone wall form the embankment. Contemplates shutting out entirely the flow of the tide, both here and in Morecambe Bay. Considers that owing to the long flat of two miles, extending off shore, it is impossible, either by dredging, buoys, or beacons, to maintain a channel so as to make the Duddon even a limited refuge harbour. Embankment at Salthouse Pool was made in 1830, to redeem 260 acres of marsh, over which the sea ranged two feet at high-water springs, thereby excluding 7½ millions of cubic feet of water. There are several other embankments. A railway might be carried along shore to the southward of Millom Hill. Numerous objections to constructing a railway from Poulton to Cowper Point, to Chapel Island, and thence to the mainland on the north-eastern side of Morecambe Bay. It would shut up ten rivers or streams. With the exception of the proposed pier at Poulton Ring, considers an embankment across Morecambe Bay of public advantage. Is of opinion that the shutting out of so large a body of water would silt up the different channels in the bay; yet would not be injurious to the early tide ports, the Lune, Wyre, and Piel, but destroy all above, with the proposed port at Poulton Ring. Observed several encroachments on the banks of the Duddon and Morecambe Bay. All ebbing waters do not scour a bar, some deposit on it, and increase it. All ebbing waters do keeping open a channel, but as that is kept open the bar works out seaward, rendering the entrance like that of Liverpool. Where a bar has extended to the limit of the velocity of the ebb tide, it will go on accumulating, and is hopeless; if it lie within the range of a rapid ebb stream, artificial means may be useful. Extent of bar depends not so much on depth of water as on reaching the fair channel stream, the Wyre for instance; the Duddon sands will project till they reach the fair set of tide in the Irish Channel. An estuary that presents the form of a prostrate cone, with its base outwards, is hopeless. All estuaries do not present the same features; distinction drawn between the Dee and the Mersey. If the Burbo and East Hoyle Bank between the Mersey and Dee did not exist, the channels of the river would not be kept open. To improve the Lune sea reach it would be necessary to embank Sunderland Point both in its river and sea face. An embankment across Morecambe Bay would have a beneficial effect on the sands at mouth of Lune, by diminishing the scour of the bay, and consequent deposit of sand. If Cartmell Wharf were walled up, the same effect would be produced on the channels of the Kent and Leven as on the Lune. Lune Deep was the original outfall of all the waters of the Lune and Morecambe Bay. Conjectures why it has not been filled up by the sands. In case Morecambe Bay be cut off by an embankment, the sands would immediately break in, and the Lune Deep very slowly fill up.

THE WATER WORKS AT EXETER.

A great and manifest improvement in the supply of water to the city of Exeter is afforded by the water company, a joint-stock corporation, formed under Act of Parliament in 1833; from a large reservoir made by them under the direction of the late William Anderson, Esq., C.E., it may be said that an unlimited supply of this most necessary article of life is afforded. This reservoir, which occupies a spot to the north of the city known by the name of Dane's Castle Field, is now 200 feet square and 17 feet deep, and is supplied with the water of the river Exe, taken from a mill leat, two miles from the city, and above the junction of the Creedy; it is, therefore, in great measure free from any adventitious impurities. The qualities and chemical composition of this water have already been given.

Engine Power.

The first erected engine is worked by a breast-wheel of 23 h.p., with 48 buckets, 13 of which are equal to one stroke of the pump; it has three pumps, each of which gives 18 strokes to a minute. The water thus delivered in this space of time at the reservoir is 37 cubic feet or 438 gallons. The reservoir is 160 feet above high-water mark, but the water could be raised by the stand-pipe, which was 150 feet above the level of the river at Pynes Weir, to the further height of 180 feet. On ordinary occasions, however, the number of strokes in a minute at which these pumps are worked is 11 each, to force the water into the reservoir, and 10 to the higher level of the stand-pipe. It was early found, notwithstanding the great extent of the supply thus afforded, that it was inadequate to the wants of the inhabitants; therefore, in 1841, a new wheel and pumps were added, the reservoir was enlarged to its present capacity, and the stand-pipe considerably elevated. The new wheel is of 17 h. p., and has 40 buckets, of which 11 are equal to one stroke of the pumps. The new pumps are three in number, and each gives 14 strokes in a minute at its usual work. The height of the stand-pipe is now 13½ feet above the level of the water in the reservoir, and its valve is weighted to raise the water 50 feet. The higher pressures are supplied independently of the reservoir. The advantage derived from these additions and improvements will be fully appreciated when it is stated that, on a trial being made by working the new and old pumps together, the water flowing through the safety valve of the stand-pipe and falling into the reservoir, each set of pumps making 11 strokes per minute, the quantity of water delivered into the reservoir by gauge was 23,748 gallons in one hour; on another trial, the water being delivered to the lower level of the reservoir, the new pumps making 17 strokes to the minute, and the old 11½, the quantity of water forced in was 33,122 gallons in one hour; so that the higher level of the stand-pipe decreases the power of the pump by about one-third. By experiments made in different places, it was shown that water could be delivered from the pipes 30 feet above the highest levels of the city. One cause of failure in the old pumps, and which had not been foreseen, was excessive floods "tailing" the wheel, to such an extent as to cause material obstruction. By an experiment on the new and old wheels, during some high floods, it was found that while the old wheel was two feet in tail water, and the pumps making but 10 strokes per minute, the new wheel had only six inches in tail water, and the pumps were making 21 strokes per minute; so that the new wheel will be only affected by severe floods, and then but for a few hours.

Quantity Supplied.

The quantity of water now supplied to the inhabitants of Exeter and its vicinity is 6919 hogsheads daily, (about twelve gallons per head of the population,) the cost of which to the consumers, according to the amount of rents paid, is little more than one farthing per hogshead, and at this trifling price it is supplied to many houses at a considerable elevation. The waste consequent upon this vast consumption is of the greatest service in preserving the health of the city, by cleansing and washing out the sewers, &c. The mode in which the water is distributed over the city is through iron pipes, and from them by leaden supply pipes into cisterns furnished with ball cocks. In some particular cases the cisterns are supplied directly from the mains. Of the 5122 houses of which Exeter is composed the water is supplied to 3400; the number of customers, however, is about 2600, the deficiency of 800 being made up of tenements closely packed together, which are supplied, never from the stand-pipe, but from one common cistern, usually at the landlord's expense, who is charged by the company at the rate of from 2s. to 4s. per annum for each family. This supply is so easy and so generally furnished, that it is only in a few cases the people have recourse to pumps or draw-wells, and in still rarer instances do they beg of distant renters. That this supply is duly appreciated may be learned from the fact that 98 families out of every 100 who consume the water now have it in their houses; in fact, in some of the very poorest there may be seen in the corner of the room a small cask, with ball-cock, to receive the supply, and they invariably speak of it as being the greatest comfort, and as well worth the money it costs them. Notwithstanding this apparently very favourable statement, there is yet much room for improvement; for if we assume, in the absence of any such statement in the census of 1841, that the number of families in Exeter are in the same proportion to the population as they were in 1831, we state them to amount to 7000, so that there are only, of the whole population, about one-third who have it in their houses, and only about half who are consumers of it.—*Second Report of the Health of Towns Commission.*

ON LOCOMOTIVE AND ATMOSPHERIC RAILWAYS.

Sir,—Before proceeding to a consideration of the comparative merits of the Locomotive and Atmospheric system of railways, it may be as well to mention that the chief causes of loss of power in general may be classed under three different forms. The first and most obvious cause, and that which is the most generally known, is friction: the second, loss of heat: and the third, the escape of an elastic air, gas, or vapour from a greater to a less density; the two last causes not being so universally known as the first, and often overlooked. One obvious defect of the Locomotive system is the force which is required to move the engine and tender, which in light trains amounts to a considerable share of the actual duty performed, a defect which cannot be classed under the head of loss of power, but is more properly power employed unprofitably When we compare their merits as regards friction, we shall find the Locomotive system vastly superior: first, there is the friction of the different parts of the engine, which is common to both, but would be found perhaps rather more in the Locomotive than in the Stationary; but, in addition to this, the Atmospheric system has the friction of the air pumps, and last, though not least, the friction of the travelling piston in the long pipe. But the friction of the pumps is proposed to be done away with by the patent plan of Messrs. Nasmyth and May; but when I come to a consideration of the second and third causes, I think I shall be able to prove that their system has defects as great as those it proposes to remedy.

As regards their merits under the second cause, or loss of heat, the Atmospheric system has the advantage, in consequence of our being able to use condensing engines, and thus save a great quantity of heat which in the Locomotive is blown away into the atmosphere in a latent state. But according to Messrs. Nasmyth and May's plan there will be a loss of heat in two ways; first, by having such an extensive surface exposed to the atmosphere, as there would be by having four enormous cylinders 150 feet in height and 10 feet in diameter; certainly they propose to counteract this disadvantage by having the cylinders coated inside and out with wood, which they describe as a very simple affair, but which I am inclined to think would not be so easy in practice but that some of the heat would escape. The other way in which heat is lost is one which I believe has been entirely overlooked, or at least has not been adverted to either by the patentees or any one else that I am aware of, and it is, that when they admit the steam into the cylinder it is full of air at the temperature of the atmosphere; now it is asserted by the patentees that the steam will gradually force out the air, but it appears to me that when the steam comes in contact with air so much colder than itself, instead of forcing it out would be itself condensed, giving to the air its latent heat until it was raised to a temperature corresponding with that of the steam, which, supposing it to be the case, would be no small loss of heat, and consequently of power.

Under the third cause, or the escape of an elastic air, gas, or vapour from a greater to a less density, we shall find that both the systems are subject to defects, the amount of which would not be easy to calculate with exactness, at least until it is understood better than at present. In the Locomotive system it acts by means of contracted steam passages, and the great velocity of the piston, causing the pressure in the cylinder to be less than in the boiler, and the steam that is blowing out of the cylinder to be at a higher pressure than the atmosphere, even when it is worked expansively, and when that is not the case the difference will be still greater. In the Atmospheric system the stationary engine is subject to it in a less degree, but it comes under its influence by the leakage of the long valve; but Messrs. Nasmyth and May propose to remedy that, in a great degree, by means of a large store vacuum, so that when a communication is opened with the pipe it may close the valve at once, and by that means diminish the leakage; but the employment of a store vacuum is attended with a very great loss of power, to prove which I will suppose that it is of the same internal capacity as the pipe which it has to exhaust, then, if the store vacuum be perfect, it will reduce the pressure in the pipe to 7½ lb. per inch; but suppose the store vacuum to be made into the form of a pipe of the same length and diameter as that which it has to exhaust, and that it has an air-tight piston at that end near the pipe to be exhausted, then, when a communication is opened between the two pipes, the piston will be driven onward with a force of 15 lb. per inch at first, which will diminish to 7½ lb. at the last, therefore it follows that there is a loss of power which is sufficient to drive a piston with the above-mentioned forces,—no small matter indeed,—greater I should think than the loss from leakage which it is proposed to remedy.

A Working Mechanic.

Newcastle-on-Tyne, Sept. 26.

DREDGE'S SUSPENSION BRIDGES.

Sir,—Notwithstanding the evident proofs I gave in my last letter of having nothing to do with Mr. Turnbull's treatise, Mr. Bashforth still endeavours to make me responsible for it, and then by specious reasoning on an erroneous proposition in the argument, he concludes my principle is wrong. He has in consequence of Mr. Turnbull's papers voluntarily come forward to attack my invention. But because those papers are not mine, nor the invention a consequent of them, I do object to his reasoning, for it is fallacious; and will not allow sophistry to confuse the object, for as it bears no reference to the subject it would be averse to a fair spirit of scientific enquiry, and only tend to prevert the truth. I beg Mr. Bashforth will therefore at once set aside this treatise, and discuss the subject on its own merits.

To the best of my belief, I have not referred any one for answers to their objections to Mr. Turnbull's papers since they were published, and therefore the charge of making them an authority is unfounded. The letter Mr. Bashforth quotes was I think printed about the same time as the foot note, and *previous* to the publication of the papers, both were announcements that such a work was about to appear, but I do not conceive that either of them makes me responsible for it.*

The oblique direction of the suspending rods necessarily involves much complication in the investigation, but *not* sufficient to place it beyond the resources of analysis.

Mr. Bashforth complains that I unfairly charge him with misquoting,—I gave an example, and placed the full sentence by the side of his quotation; as I read them, they have a distinct meaning, and how can he assume that a portion of the sentence gave my real meaning, if the whole conveyed a different one.

I thought I had set aside the objections which were so distinctly pointed out by disavowing the treatise that contained them; but this does not satisfy Mr. Bashforth, he wishes me to answer objections to propositions manifestly impossible. I can only reply to this by saying they are erroneous; and if the author were really as ignorant as the propositions considered by themselves lead us to suppose, he would deserve the full censure Mr. Bashforth has measured out to me. But in my opinion he was not; and my reason for this is obtained from the 4th page, part of which was quoted in my last letter. I had not any idea of attempting by specious reasoning on this quotation to prove an impossibility, though I did mean to say that in my opinion it clears the author from the charge of such gross ignorance.

What are we to understand when a person tells us that "most unfortunately not one of these writers even *professes* to have any knowledge of mathematics, and consequently all their opinions are worthless," but this —that every opinion except that founded on mathematical experience is worthless? This deduction is perfectly fair and obvious, and how can Mr. Bashforth presume to say that "the authors of the letters could not have had time and opportunities for gaining practical experience." Is he personally acquainted with each?

Mr. Bashforth now alludes to the bridge that has lately fallen in India, and passing in this case the opinion of the mathematician by merely observing it was a laudable desire to ensure success, doubting the express statements which have accompanied all the accounts that have reached England, he comes to the conclusion that there was another weighty reason. I presume he has premises for this opinion; will he state them? This would be a legitimate object of discussion. I can tell him the reason. The parties erecting it did not sufficiently understand what they were about, and if Mr. Bashforth had been contractor, a similar accident would have happened to him, and then no doubt he would have been enabled to appreciate the value of practical experience.

I gave the authority of my statements respecting the Menai bridge; the quantity of iron I should require I obtain by calculation.

I see nothing very surprising in the fact that Telford did not adopt the modification of the oblique bars, nothing very extraordinary in his not perceiving it, but I am astonished at Mr. Bashforth's surprise.

If it be impossible to obtain the solution of a problem without data, Mr. Bashforth's remarks were worthless; for he did think he had written enough "to show the principle was wrong," and with acknowledged insufficiency of data; but, as he says, "I do not see the force of his ergo," let us analyze the construction of his opinion. In a treatise entitled "The Mathematical Principles of Mr. Dredge's Suspension Bridges," a fundamental proposition is erroneous, and such of the argument as depends on that proposition is also erroneous, but Mr. Bashforth carries his reasoning further, and concludes that the principle is wrong. Before by such argument he can do this he must accomplish two impossibilities: first, *he must*

* The first intimation I had of Mr. Turnbull's treatise was in June, 1841, when I received a letter from the author asking me to purchase some papers he had just compiled, which I declined. A few weeks after this he called upon me in London, and told me Mr. Weale would buy them provided he could obtain a drawing and specification of some practical example. He had his MS. with him, but I did not read it, though after a few minutes' conversation I promised to give him what he required, and caused an announcement to be printed at the foot of some of my detached circulating papers. As nearly as I can recollect about the same time I was engaged in controversy with Mr. Fordham, and knowing that Mr. Turnbull was a teacher of mathematics, and had written several tracts illustrating mechanical problems algebraically, I had sufficient confidence in him to refer that gentleman to the work that was about to appear, but had no idea of taking the responsibility of what I had not seen upon myself. Your readers will now be enabled to judge how far Mr. Bashforth will be justified if he continues the argument on these grounds.

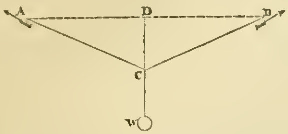
show that the demonstration was mine—which, not being the fact, is impossible; *and then he must prove that the invention was the consequent of it*—which is absurd; failing at either of these and his argument fails, and as both are impossible his remarks, are worthless. If Mr. Bashforth had only intended to undermine the argument, he should not have extended his remarks to the principle.

If I had told you that a pound weight placed upon the table caused a pressure of two pounds, I should have stated a manifest absurdity. Let a weight of 1875 tons be attached to the point B, fig. 1, then there will be 1875 tons of tension in the cord A B, and 1875 tons of passive resistance at the point A. This is an example to which Mr. Bashforth ought to have applied his comparison, and not to that I gave in my previous letter, to which if you refer you will see that I supposed the cord to pass round a pulley C, and a force or weight equal to 1875 tons attached at each end, A and B; there is, therefore, 3750 tons of pressure, 1875 tons of tension in the cord, and 3750 tons of passive resistance.

Fig. 1.

But to take an example which will directly bear upon my first expression. Suppose the point A and B, fig. 2, to be in the same horizontal line, let a wire (void of weight) A C B be suspended from them,

Fig. 2.



and let a weight W be applied at the centre C, $a = \angle$ D A C $= \angle$ D B C, and T = the measure of tension in the wire A C B; then

$$T = \tfrac{1}{2}\, W \cos a.$$

But if W be supported in a projection at an $\angle = a$, the tension excited must be = W cos σ. Let us see if this is not the case. At the point A a resistance must be applied in the direction of the arrow $= \tfrac{1}{2}$ W cos a, and similarly at B a resistance is required $= \tfrac{1}{2}$ W cos a, and the sum of these resistances (which are solely caused by the action of the weight W,) is

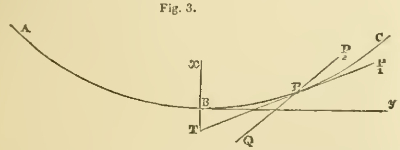
$$\tfrac{1}{2}\, W \cos a + \tfrac{1}{2}\, W \cos a = W \cos a,$$

Consequently *the tension must be* W cos a, *half of it* (or $\tfrac{1}{2}$ W cos a) *acting in each direction.*

I believe I have now fully replied to Mr. Bashforth, and if anything is passed it is an error of omission which does not proceed from a wish to avoid discussion; I have no fear of the ordeal he talks about, and beg to hand you a proposition for his consideration.

Proposition.—Let A B C, fig. 3, be a cord or string void of weight, and

Fig. 3.



suspended freely between two fixed points A and C, take B the origin. Suppose pressures applied to this curve, and let P_2 Q be a line representing the direction of one of these pressures, and $(y_2 - y) = a\,(x_1 - x)$ its equation, where x and y are co-ordinates of the point P through which it passes, draw P_1 T a tangent to the curve at the point P, so that

$$(y_2 - y) = \frac{\frac{dy}{dx} - m}{1 + m\,\frac{dy}{dx}}\,(x_1 - x) \text{ where } \tan^{-1} m = \angle P_1 P P_2.$$

Now I say that the smaller $\tan^{-1} m$ is, the less is the tension beyond the point P; and finally, when $\tan^{-1} m = \tan^{-1} 0$, or $\tan^{-1} a = \tan^{-1} \frac{dy}{dx}$, and the equation becomes $(y_2 - y) = \frac{dy}{dx}(x_1 - x) = (y_1 - y)$, that not any tension at all exists between the point P and the point at which the axis of x intersects the curve, and consequently the segment P B may be removed without at all effecting the equilibrium of the segment P C.

I remain, Sir,
Your obedient servant,
James Dredge.

Banbridge, County Armagh, Ireland, October 4, 1845.

P.S. In your remarks page 307 you observe it can scarcely be supposed but that there is some limit in the reduction of the central bars. There is *no* limit, for in any bridge on my plan, however large, the central link may be *entirely* taken away without affecting the stability of the structure, which is evident from the above proposition; nay more, if the roadway be sufficiently strong to resist the compression, the platform itself may be *divided* in the centre, *thus separating the bridge into two independent brackets*, and it would still be as strong as ever to resist passing loads.

By the sentence "transferred to and distributed, &c.," I do not mean that the tension is lessened, this would be evidently absurd, excepting in as far as the reduction of tension from lessening the weight of the structure is concerned. What I mean by "*transferred*" is this, that the horizontal force, which is a constant quantity in the polygon of pressure, is transferred from the chains to the platform; and by "*distributed*," that the whole section of the roadway is active to resist that tension. These points must necessarily be discussed if a controversy ensue with Mr. Bashforth, and if it do not, then I will give you the particulars in a subsequent number.

J. D.

[We have inserted Mr. Dredge's letter at full length, that he might have no reason to complain of injustice on our part. But we must now beg to remind him that there is a limit beyond which a controversy like the present ceases to have any public interest. The discussion commenced with the avowed object of eliciting the mathematical principles of Mr. Dredge's bridges; but we have now, on the one hand, the expressed opinion of Mr. Bashforth that the problem is not susceptible of an analytical solution; on the other, we have from Mr. Dredge a specimen of mathematics, which, to say the least of it, is totally different from any thing in standard works on Mechanical Philosophy.

The tension referred to in fig. 2 is wrongly determined. The horizontal parts of the tensions of A C, B C respectively are T sin C A D and T sin C B D, and the sum of these forces is 2 T sin a. Consequently

$$T = \frac{W}{2 \sin a}, \text{ instead of "} \tfrac{1}{2} W \cos a. \text{"}$$

This error pervades the subsequent remarks. The expressions "T = $\tfrac{1}{2}$ W cos a" and "the tension must be W cos a" are inconsistent with each other. The notion of half the tension "acting in each direction" is not to be found in any recognized treatise on statics.

The "proposition" of fig 3 seems, as far as we can make any meaning of it, as incorrect as the preceding one. No demonstration of it is given, except what may be supposed to be contained in the words "I say that—."

The most important part of Mr. Dredge's letter is, however, the postscript. It is now put on record, by Mr. Dredge himself, that a bridge on his principle consists of "*two independent brackets*;" that "*the central link may be taken away without affecting the stability of the structure*;" that '*the platform itself may be divided in the centre.*"

It is now, therefore, a question for the practical engineer to decide,—whether the roadway of a bridge can be made sufficiently rigid to act as the arm of a bracket perhaps 200 feet long.

This question we shall leave entirely to the solution of practical experience, for we cannot devote our space to the particular kind of mathematics which Mr. Dredge has originated.]—Ed.

ATMOSPHERIC RAILWAYS.

ABSTRACT OF THE EVIDENCE BEFORE THE COMMITTEE OF THE HOUSE OF COMMONS.

(Continued from page 317.)

Obstructions.—The piston carriage might be constructed so as to remove obstructions from the line—(*Brunel.*)

"In the case of any impediment upon the line, I think the weight of the locomotive engine is an advantage in throwing the impediment over the rails, as compared with the atmospheric train, which is much lighter. I think it would be more than counterbalanced by many other circumstances of safety; and I think it would be very easy to construct the front of the piston-carriage so as to throw any obstruction of that sort on one side, and to diminish very much the chances of its falling immediately in front and being run over. But I should observe that those things are very rare; I only know of one instance on the Great Western Railway where any accident would have resulted, or did result, from running over an animal."

Passing of Trains.—Suggestions as to the mode in which the trains should pass one another on a single line of railway; amount of delay that will be occasioned by this passing—(*Cubitt.*)

"One train can pass another by instructions to the train arriving which is to be passed, by a telegraph for that train to be detained on the platform till the express train has passed it. As soon as the train is in from those instructions, the lever would be turned to bring the coming-in train through the crossing into the other line; it would then pass into the next pipe without coming into contact with the train which is stopped. The train so passed would be delayed only during the time that it would take to get up the vacuum in the next pipe; three or four minutes. And the time that it would require to run through the pipe?—Altogether about eight minutes, perhaps. To what extent would that delay the train beyond its usual time?—Just half that time, four minutes; because one of the operations would have to be done for that train, namely, pumping out. Suppose that the train so passed did not recover its lost ground by greater speed afterwards, it would have the effect of delaying the train it met, would it not?—To that extent; therefore I think the thing is not so well adapted for express trains: except there is sufficient time between the stoppages for the express train to get a considerable distance, not much would be saved on a single line. On a double line it would be necessary to send express trains, and they could overtake and pass other trains."

Peterborough and Northampton Railway.—Arrangements that are made for working this line, being a single line with the exception of five miles; number of trains that might be run in the course of a day—(*Stephenson.*)

"The proposed arrangements are simply these; that an engine is to run from Peterborough to Thrapstone, and back again from Thrapstone to Peterborough. There will consequently be only one engine upon each section of the railway at the same moment, therefore a collision is absolutely impossible. But in addition to that we propose erecting an electric telegraph, which will convey intelligence from station to station as the train passes, and therefore the whole line will be informed of the progress made by the train; and consequently risk from collision, even supposing we worked the engines through, is almost impossible. I conceive that, without the most gross and wilful neglect on the part of the engine-men, it is impossible that any accident can happen. You might work eight trains a day each way, from Northampton to Peterborough. For a traffic of that kind you could safely recommend a single line upon the locomotive principle; but upon a much more extensive traffic, you would not recommend a single line, even though the atmospheric system were adopted?—No; but a single line upon the atmospheric system would have cost as much as the locomotive line has cost; for the Peterborough line has not cost more than 7,000*l.* a mile for the engineering; therefore, taking Mr. Samuda's estimate of 6,000*l.* a mile, it would make it ruinous, the traffic being small: wherever the traffic is small, the application of the atmospheric system must result in ruin to it; it is inevitable. Can you give any estimate of the cost of a single locomotive line on the same principle as Mr. Samuda has adopted in giving the cost of a single line atmospheric, viz., assuming the country to be as level as a bowling-green?—I can; I have taken the Yarmouth and Norwich line; I happened to have all the facts before me in detail; the actual cost of that line, exclusive of the land, which is common to both plans, is 150,000*l.*

Piston.—It is proposed to have an expansive piston on the South Devon line to accommodate itself to the varied size of the tubes—(*Samuda.*)

Power: 1. *Production of Power under the two Systems.*—In an ordinary train the power exerted to move the engine and tender bears a very large proportion to the power to move the train with passengers; explanation in detail showing this fact—(*Stephenson.*)

"I find that a locomotive engine will absorb nearly as much power as about 15 loaded carriages; so that the actual quantity of power expended with an ordinary locomotive train of eight carriages; say in point of power (I am now speaking not of cost, but I am speaking upon the abstract question of power), is equal to the expenditure of power upon 23 carriages; and I find that in the same proportion, take the engine, say at Camden Town, the friction of the rope, and the loss by other circumstances, is very nearly as much, except with light trains. Then the proportion, of course, as you diminish the weight of the train, to the locomotive engine, becomes more and more unfavourable to it, because the resistance of the engine itself still remains constant; if you have only one carriage behind it, it will be the same as though you had 16, though there may be only one beneficially employed."

Calculation showing that though there is more economy in the means of raising power by a stationary engine, there is a greater deduction to be made in consequence of the unemployed intervals; instance of the Dalkey line—(*Stephenson.*)

"On the atmospheric system it is cheaper to move a given number of passengers by a larger number of light trains than by a smaller number of heavy trains. But when I refer to the question of power, and the expense of producing that power, all my answers have reference to the time during which the power is being produced; that is, during the engine is in motion. A stationary engine, under those circumstances, is very much more economically worked than a locomotive (that is, during a certain time, while producing a given quantity of power); but in regard to all stationary power, the loss of fuel, and the loss of money, in fact, during the time it is not in action, is far more than equivalent to the disadvantage which the locomotive engine labours under during its actual motion; and consequently, practically, if you take the question as applied to the whole day, the stationary system becomes the most extravagant. At Dalkey, when I was there, there were 10 trains a day running each way; the consumption of fuel then was upon the train mileage 266 lb. a mile. I understand from the evidence given by Mr. Nicholson, whose papers I had an opportunity of perusing, that the consumption of fuel when 27 trains a day are running is 115 lb. per mile per train, which is less than one-half; that is the consumption of fuel to useful effect. On the Blackwall, where the trains are three times the weight of the Dalkey, and where they run 54 trains a day each way, the consumption of fuel is only 66 lb. per train per mile, which is one-half; therefore, comparing the Dalkey as it was with 10 trains a day with the Blackwall with 54 trains a day, the one is 266 lb. per train per mile, while the other is 66 lb., being fully four times as much per mile of useful effect."

2. *Application of Power on the Atmospheric and on the Locomotive Principle.*—On the atmospheric system the amount of power is always used which is necessary for the work. The power can be adjusted to the load by producing a greater or less vacuum, and consequently a greater or less pressure upon every square inch of the piston—(*Samuda.*)

On the South Devon line it is intended that the engine next ahead of thta immediately in front of the train should be at work at the same time, and that the force of both should operate upon the train—(*Brunel.*)

3. *Loss of Power in each Mode of Traction.*—In the atmospheric system the only loss of power, apart from imperfect machinery, arises from the attenuated air in the tube being heated, and having to be compressed by the air-pump, by which, however, the loss of power is not 10 per cent. Experiments have been tried on the Dalkey and Kingstown line to protect the pipe from the external air, but no such plan would pay—(*Brunel.*)

Resistance offered by the compression of the rarefied warm air in the air-pump previous to its expulsion into the atmosphere; this might be obviated —(*Robinson.*)

"The only difficulty which, theoretically speaking, occurred to any one who thought on the subject, but of which no one had anticipated the full effect, was this, that during the expulsive strokes of the air-pump, that is, when the air that has been drawn from the main is expelled into the atmosphere, a considerable quantity of heat is evolved by the condensation of the rarefied air; the amount of this far surpasses what I at least had anticipated from the existing theories. It increases the elasticity of the air so condensed, and, therefore, increases, beyond what theory would assign, the resistance to the motion of the air piston. Do you contemplate that anything might be done to abate that loss of power by the heat evolved in the condensation of the air?—Unquestionably; modes of exhausting can easily be conceived which would be free from that. Will you state what those modes are?—I am, perhaps, scarcely at liberty to do so, because I derived the idea from the researches of a friend who is engaged upon the subject; I will name the gentleman, the secretary of the Dublin and Kingstown Railway, Mr. Bergin; he showed me the results of his experiments; I therefore do not feel at liberty to mention them. I consider that they are likely to be attended with success."

Deductions to be made from the power of the atmospheric engine; first, on account of the force required to draw the air through the pipe; and, secondly, for the friction of all the valve apparatus—(*Robinson.*)

"The French engineer, M. Mallet, who came over to make experiments, in his report has given the result of the different experiments which he made with the piston carriage; it was at a velocity of 20 miles an hour; he deduces, that he required, to overcome this friction, and also to lift up the valve and seal it again, a force amounting to a total of 35 lb.; that is so small that I did not reduce it to horse power. And I must add to that another, the evidence of which has been established by experiment; one may say in general, the atmospheric system is like drawing by a rope which has no weight, which is perfectly elastic and is capable of transmitting almost an infinite velocity; but the velocity has a certain limitation. It requires a little force when you begin to exhaust the tube to draw the air through it to the pump. In some experiments that were made for the purpose, holding the train by the break, working the engine and having two chronometers carefully compared, looking at the gauges at the ends of the line, and noting at each successive series of 15 seconds the height of the gauge, you got a comparison of the difference of the two gauges, which is the pressure at the two ends of the line, and then the train was allowed to start, and the barometer was still observed. You cannot observe, with that precision, the height of the barometer in the piston carriage, because it goes up and down so much; but still, as far as it could be ascertained, there appeared to be the same difference of about three-quarters of an inch of mercury; an inch of mercury is half a pound; that will be three-eighths of a pound, which was the force required to pump the air through the pipe to the air-pump; then take that three-eighths, and then allow for the friction of the piston, which will be little more than another eighth, and you will have the pressure on the mercury, that will be half a pound on the square inch of the tube's diameter, for the friction of the piston apparatus, and the force required to open the valve, and the friction of the air."

Different kinds of power available for railway purposes are the stationary engine with ropes, applicable to flat or hilly countries; the locomotive system; and, thirdly, the atmospheric. Loss of power under these different systems; in the first case the friction of the rope; in the locomotive the weight of the engine when moving from a level, and the resistance of the air; and in the atmospheric the leakage. Witness made an experiment by which he found that the quantity of power lost by the friction of the rope in the case of the Euston plane, from Euston-square to Camden Town, was as nearly as possible equivalent to the loss on the Dalkey line by leakage. The waste of power on the locomotive and on the atmospheric systems is pretty much the same. On the atmospheric plan there is a loss of power in getting up the vacuum in the tube; on the Dalkey line this is almost entirely lost; this is a loss of the same kind as getting up the steam in the locomotive engines, but not to the same extent—(*Stephenson.*)

"It has been stated that with a vacuum of from 18 to 20, from 60 to 70 per cent. of the power generated by the steam-engine is wasted?—I must say that at present I am not in a position to believe that; I do not think it is so"—(*Cubitt.*)

Rails and Sleepers.—On the atmospheric plan the rails and sleepers may be lighter than in the locomotive lines—(*Samuda.*)

On the Great Western railway the rails are 70 lb. per yard; on the South Devon, 50 lb.; the latter will probably last the longest—(*Brunel.*)

Less deflexion would take place on the rails of an atmospheric line, even if they were considerably lighter; a 50 lb. rail would be much stronger than a 70 lb. rail on a locomotive line—(*Robinson.*)

The engines used on the Dublin and Kingstown railway are as heavy as those used on the long lines in England, with the exception of the Great Western—(*Bergin.*)

Short Lines.—On short lines where the traffic is very large, when the departures of trains are very numerous, and where there is no intermediate traffic to accommodate, the atmospheric would be a very convenient arrangement. It would not be more economical than the Blackwall, and not so convenient where there is intermediate traffic—(*Stephenson.*)

The atmospheric system is particularly applicable to short lines with a large number of passengers—(*Cubitt.*)

Sidings.—At the sidings and points carriages would be equally as liable to get off the rails on the atmospheric as on locomotive lines; there is nothing more to hold them—(*Stephenson.*)

Slips.—Most of the slips on railways are caused by the vibrations of the trains, which is principally due to the locomotive. Slips of embankments will be less likely to occur on an atmospheric than on a locomotive line. In the event of slips the pipe could be easily replaced. Apart from other conditions, a slip is more likely to interrupt traffic upon a single line than upon a double line—(*Brunel.*)

South Devon Railway.—The South Devon railway, a line of 52 miles, is being executed on the atmospheric principle; 20 miles of the South Devon line will be opened in July—(*Samuda.*)

About 20 miles of the Exeter and Plymouth line will be ready to receive the atmospheric apparatus in June or July. The South Devon line has been laid down entirely for a single line of rails, which makes peculiar arrangements necessary at the stations—(*Brunel.*)

Speed attainable on the Atmospheric Principle.—Means of varying the power of the engine and the speed of the trains by working the tube to a higher or lower degree of exhaustion; illustrations of this power—(*Samuda.*)

"Besides adopting as we do in extreme cases a varied size of tubes, we have means of varying our power very considerably, by working to a higher or to a lower degree of exhaustion. We carry this to such an extent, without varying the size of the tube, that on the Dalkey line it is a very common practice for us to run with trains weighing only 16 tons; and we have with the same apparatus run with trains of 75 tons up the incline, which is an average of 1 in 115. We have the means of regulating that by regulating the period at which the steam-engine shall start before the load; that is to say, if we have a very heavy load, and we wished to work with a vacuum of 20 inches upon the piston, we should start the engine sufficiently in advance of the train (it would be a matter of about four or five minutes) to obtain that vacuum before the train arrived at the section at which it was to be propelled by the engine stationed in advance of it: and if on the other hand we were starting a light load, we should start the engine a proportionably less time in advance of the train. This will be regulated by means of the electric telegraph, which is fixed along the line, and which affords a means of communication to every engineman of what vacuum will be required for the ordinary traffic of the day."

All trains would be carried at the same velocity, because the power would be adjusted to the load—(*Samuda.*)

"Under ordinary circumstances, all trains would pass at the same velocity: a heavy train would have an increased vacuum produced for it. Your proposition is to carry all trains at the same velocity?—Yes; I should observe, we do not contemplate carrying those immense luggage trains which they carry on the locomotive plan; on the locomotive plan it is desirable that they should carry them; because they interfere with the passenger traffic, therefore they go very slowly, they stop at the sidings, and they remain there for the quick trains to pass them, and they often remain a considerable time. We propose to subdivide the loads so as to keep our trains, generally speaking, of such a weight that we should be able to send all our trains at the greatest speed, and that would be one of the greatest advantages in point of security which we should have; we should have a continuous chain of trains running on all at equal speeds, and not at variable speeds, as in the locomotive system, in which one train is always approaching to overtake the preceding one. Upon the atmospheric system it is no more expensive to run quickly than slowly."

The speed, excluding stoppages, would be about 48 miles an hour, including stoppages—(*Samuda.*)

The Dalkey line, from its curves, is very unfavourable for an experiment of speed. Fifty-one miles an hour, which is the rate at which they have travelled on the Dalkey line, is more than safety would allow—(*Field.*)

The whole distance from Exeter to Plymouth could be traversed at a speed of 60 miles an hour—(*Brunel.*)

On the atmospheric system it will not cost the railway company more to carry the public at a quick rate than at a slow one; they will have no temptation to limit the speed of travelling within any bounds that ought to satisfy reason. Extraordinary speed was attained by the piston-carriage on the Dalkey line, detached from the train; Mr. Elrington stated it to be at an average speed of 84 miles an hour; on a long line of 200 or 300 miles one or two light trains might be sent each day with letters at the rate of 100 miles an hour—(*Robinson.*)

"Mr. Stephenson lays down in that report an extremely singular criterion of the maximum velocity being arrived at. In that, or in his evidence before the Croydon committee, he states that he is certain the maximum velocity was attained, because the barometer gauge did not rise; now an extreme case will show that that test is incorrect. Suppose the tube were perfectly freed from air—perfectly exhausted, then the piston would sustain on one side the full atmospheric pressure of 15 pounds to the square inch, and no pressure on the other side; it is clear that the motion of the piston and the train would go on accelerating, because there would be nothing to check it. It would go on accelerating as long as the piston was in the tube, until the resistnace of the air to the train balanced the pressure. Now you see that, in this case, the gauge must remain at 30 inches, notwithstanding the extreme acceleration. That will show at once that the stationary condition of the gauge has nothing to say to the velocity. The real criterion of the maximum velocity being attained is, that the difference between the external pressure of the atmophere and the pressure of the air in front, shall be greater than the amount of the resistances to the motion of the train. So long as that is the case, so long the motion will continue to be accelerated, even though the gauge may be sinking. The sole argument by which Mr. Stevenson endeavoured to prove that the maximum velocity was attained, viz. the stationary condition of the gauge, is therefore an evidence that the motion was still accelerating, unless it be also shewn that its height was such as to indicate a pressure equal to the resistance."

In experiments on the Dalkey line witness found the smallest height of mercury in the guage gave the greatest velocity; the maximum velocity was rather under 40 miles an hour; the height of the mercury about 15 or 16 inches. As the vacuum increased there was an increased loss of power and diminution of velocity. Explanation of the difference of opinion existing between Dr. Robinson and witness as to the circumstance stated in witness's report, that the greatest velocity is attained when the position of the barometer becomes uniform—(*Stephenson.*)

"Can you explain the difference of opinion which exists between Dr. Robinson and yourself, as to the circumstance stated in your report, that you had attained the maximum velocity when the position of the barometer became uniform?—I can, and I should be glad of the opportunity of explaining it. Dr. Robinson puts a position, by way of illustrating what he conceives to be an error which I have fallen into; he supposes a perfect vacuum to be made before the piston in the pump; he says, therefore, that it would go on accelerating till the resistance of the atmosphere to the carriage exactly equalled the power of the piston; here, he says, the velocity will depend upon the resistance of the atmosphere, which has nothing to do with the barometer; *ergo*, the barometer can have nothing to do with the velocity. I was perfectly aware of that view, and I will explain to the committee how I endeavoured to guard against any error arising from that circumstance. I quite anticipated, when the experiments were made, the objection which Dr. Robinson has now started; because, if you observe the experiments which I tried, you will see that one or two in the first instance overran the tube; they did not get a steady height of the barometer, they ran much more quickly than we wished; but they ran more quickly merely from this circumstance, that they employed the engine in pumping the vacuum before they allowed it to produce any beneficial effect upon the train; therefore, during the time that the carriage was passing over the Dalkey plane, it was not only receiving the power given by the pumping from the engine during the time it was moving, but it was receiving the result of the previous working; it was receiving the expenditure of the working that had been husbanded before it started. Now if that accumulation of power before the train was allowed to start was so great as not to be exhausted before the carriage gets to the end of the plane, it must go on accelerating, and the barometer of course will not indicate the velocity; but if you take care to generate only so much power before the train starts as will exhaust itself before the carriage reaches the top of the Dalkey plane, then you get the true result, because then you go on accelerating until the resistance equals the power; as soon as the resistance equals the power, the velocity must be uniform, and the barometer must be stationary, because it cannot be stationary unless the velocity is uniform. If the air were drawn away more quickly than the piston could follow it, an acceleration would instantly take place; if it were not drawn away, there would be more compression, and therefore the barometer would fall; therefore, though I do not say that the height of the barometer is actually a test of the velocity, yet I say that it is a test of the uniformity of the train, and the position which Dr. Robinson puts an impossible one; he supposes a perfect vacuum made, which is not the fact, and cannot be the fact."

Relative Speed of the Locomotive and Atmospheric Systems.—Reasons for considering that no greater speed is likely to be attained, as a general rule, upon the atmospheric than upon the locomotive system; cases in which the locomotive would beat the atmospheric—(*Stephenson.*)

"I compared the working of the Dalkey line on the atmospheric system with the working of the Euston Plane from Euston-square to Camden Town, by means of a rope, and I found that the quantity of power lost by the friction of the rope in the one case was, as nearly as possible, equivalent to the loss in the other case by leakage; and that is given in my report at length. I give the amount of duty done by each machine, and the comparative power of each. You stated that at 1 mile in the one case to $1\frac{1}{2}$ in the other?—Yes. At what vacuum was that?—I assumed the vacuum to be from 16 to 18 inches. I made a calculation upon the Dalkey, with trains, which I considered equivalent to the trains upon the Euston Plane; therefore the cases were very nearly the same. At what rate of speed did you calculate the train to be going?—Eighteen to twenty miles an hour; that is the rate in each case. At a rate of from 18 to 20 miles an hour the friction of 1 mile of rope was equal to the leakage of $1\frac{1}{2}$ mile upon the atmospheric line?—

Yes, but the rope at Euston-square is peculiar, it is not a single rope, but an endless rope; therefore it is 2 miles of rope as compared with 1½ mile of pipe. What is the utmost speed you have known to be attained upon a locomotive line? I have not myself gone more than 55 miles an hour; that I have done upon the Great Western and the Northern and Eastern. Upon the Great Western I have gone 53 and 55 miles an hour several times, between Bath and Bristol. In all the experiments I made upon the Dalkey line with very light loads, a greater speed was attained upon that plane than could have been attained by a locomotive engine; but with heavy trains a locomotive engine would have beaten the atmospheric upon that identical plane. What kind of weight do you mean by heavy trains?—The trains I made experiments with were from 27 tons to 64; there was one of 70 tons. And you think, with trains of that nature, a greater speed would be attained by the locomotive engines?—Up that gradient of 1 in 115, most decidedly, because then the atmospheric leakage begins to tell, a train of 64 tons requiring a vacuum of something like about 22 or 24 inches: whenever the vacuum gets to that height, the loss of power by leakage is so great, and the velocity so much diminished, that the locomotive engine exceeds the atmospheric in speed most considerably. I have here a table of the trains which I tried, varying them 27 tons. With light trains, the locomotive would have been at fault; but with heavy trains, it would have been better than the atmospheric.

It is quite possible to go from London to Exeter as fast by the atmospheric as by the locomotive principle. Higher velocities can be acquired and maintained on the atmospheric than on the locomotive system—(*Cubitt.*)

Judging from the reports and from the opinions of those in favour of the atmospheric system, there is no reason to suppose that it has any advantage over the locomotive with regard to the rate of speed—(*Locke.*)

Facility of attaining a high Rate of Speed, and also an Increase of Speed, &c.—Result of experiments as to the speed attainable upon an atmospheric line; the velocity can be determined upon with accuracy—(*Bergin.*)

"Have you made any experiments as to the speed attainable upon an atmospheric line?—I have; I noted a considerable number of trains with great accuracy, and I have selected a few for the purpose of mentioning them to the committee. On the 18th of November 1843, I noted a train which consisted of six passenger-coaches, which were all well filled, being something like 30 tons gross weight; the first quarter of a mile was passed in 44 seconds; the second quarter in 29 seconds; the third in 28¼ seconds; the fourth in 28½ seconds, and the fifth in 22½ seconds. During this journey the greatest speed attained was 45 miles per hour; I may perhaps add that that weight of 30 tons gross, on that inclination, was equivalent to a load of 87 tons on a level. Again, on the 21st of November 1843, (Mr. Brunel was present at the time,) I noted the time of a train consisting of 12 coaches and wagons full of passengers and loaded with iron, the total weight of which was 71 tons 19 cwt., being equivalent to 208 tons on a level; the time occupied by that train in traversing the first quarter of a mile was 88½ seconds, in traversing the second quarter of a mile was 49¾ seconds; the third quarter of a mile 47¼ seconds; the fourth quarter of a mile 50⅗ seconds; the fifth quarter of a mile 48⅗ seconds, and the greatest speed attained was 20 miles per hour up an inclination of 1 in 129. What was the amount of vacuum? I have not the record of that; Mr. Brunel, I believe, took it; I took these speeds for Mr. Brunel, or in company with him, while he noted the vacuum, and I neglected to get a copy of his notes of the exhaustion, but speaking from recollection (and I am pretty sure I am right), it was between 25 and 26 inches. You tried to attain the utmost vacuum?—I think so; it was Mr. Brunel who directed those experiments. We can get 27 inches vacuum on the whole line without much difficulty; but we do not like to get it, because when you get to the degree of exhaustion, it increases the expenditure of engine power very much; but I have raised the exhaustion upon the whole line to 27½ inches frequently. Did you at the same time take any note of the horse power?—No; I had no means of doing so at that time, but that will not make a difference in these figures: it only makes a difference in the original power exerted in obtaining the requisite exhaustion; it takes a proportionally much longer time, in the first instance, to raise the gauge to 27 inches, than to raise it to 20.

The increase of speed is contingent in a very small degree on the pressure upon the piston in the pipe—(*Vignoles.*)

"The velocity in the atmospheric system is due to the proportion between the pipe and the air-pump. The speed of the stationary engine is a constant speed of, we will say, three miles an hour. We will suppose, and in fact it is the case, that the piston of the air-pump moves at that same velocity of three miles an hour. Then the proportion between the area of the pipe and the area of the air-pump is the exponent of the velocity; the velocity of the piston of the air-pump being multiplied by the number of times that the area of the air-pump is greater than the area of the pipe, will give you the velocity of the train theoretically. There is a certain amount of deduction to be made from that, on account of leakage and other matters; but the velocity of the piston regulated entirely by the velocity with which the air is drawn from the tube by the air-pump; that is the reason why the velocity is independent of the load; the velocity being independent of the load, the pressure upon the piston does not form an element of the velocity at all. I lay down this without fear of contradiction, that the load to be carried on the atmospheric railway is as the diameter of the pipe, and the pressure created by the rarefaction of the air; that gives you the load to be drawn. The velocity is as the proportion between the area of the air-pump and the area of the pump, and is totally independent of the load. There is a certain amount of power to be calculated in order to work the air-pump; the number of strokes per minute must be so many, and the duration of them must be for a certain time, in order to get a higher degree of pressure; but that has nothing to do with the question in the way you have put it, as to the increase of pressure upon the piston, because the increase of pressure upon the piston will enable you to carry a larger load; but it is the increase of the size of the air-pump, and the increase of the proportion between the pipe and the air-pump, that regulates the velocity."

Stationary Engines.—1. *Nature of the Stationary Engines; their Operations; Cost; probable Duration.*—On the Croydon line there is a double set of engines, so that one engine may perform the exhaustion before another train can arrive. The same effect is proposed to be produced on the South Devon line by a tank of water, which, on being emptied, leaves a rarefied atmosphere. There will be double sets of engines on the London and Croydon line, which can be brought to bear upon the trains at pleasure—(*Samuda.*)

It is not at all necessary that these fixed engines should be high pressure—(*Field.*)

Those on the Croydon Railway are low-pressure condensing engines, working the steam to 25 lb. upon the inch to commence with—(*Samuda.*)

On the South Devon line one pair of engines will be sufficient to draw the trains 50 or 60 miles an hour. If more power be required, there must be larger engines. Doubtful expediency of increasing the distance between the engines—(*Brunel.*)

"There are advantages in having them numerous as well as disadvantages; by working two engines, one in front of the other, you get all the advantages of double power of engine, and the probabilities of delay and interference are less by having numerous engines, than by having larger ones and fewer in number; and except the mere cost of attending to those engines, I do not think that there would be any material saving."

In the event of an increase of traffic, it would always be practicable to add a stationary engine at each station, to increase the power—(*Samuda.*)

Cost of each pair of steam-engines on the London and Croydon line, including the exhausting pumps, the expansion gear, &c., is £4240. Such engines would continue in good order for 20 or 30 years, as we see in the waterworks—(*Field.*)

2. *Cost of Repairs*—The average annual cost of repairs would not exceed 10*s*. per horse power, or 50*l*. a-year for two engines of 50 horse power. The cost of repairing the engines on the Blackwall Railway has been under this proportion. The ordinary repairs to keep the engines in good working order might be done at night, or in the intervals. The estimate of 10*s*. the horse-power would include the repair of the pumps—(*Field.*)

Number of days the Dalkey line has been stopped during the 11 months previously to 1st March, from fractures to the steam engines; to what these fractures are attributable—(*Bergin.*)

"What was the weight of the heaviest train you ever carried?—Seventy-four tons and a half. I once tried 78 tons 17 cwt, but could not get it more than ,* where it stopped, in the sharp curve of 570 feet. Upon the Dalkey line there were 337 days during which we were at work; we were stopped for eight and a half entire days, from fractures to the steam-engine. The stoppage upon the 28th and the greater part of the 29th of April arose from the pedestal of the fly-wheel shaft of the engine breaking, and it was of course quite impossible to work the engine until that shaft was repaired. And we had to stop again from the 15th to the 19th of August, being five days; we were stopped then in consequence of the great crank having broken, which in its fall damaged the parallel motion and the cylinder cover; it took us five days to repair that accident, during which we could not work the engine. Again, in last December we had another delay of a day and a half, from a different cause; there had been a great deal of rain, and one of the banks fell down, and obstructed the trains for a day and a half; it took that time to remove the materials. We have never, from the running of the first train to the running of the last train upon the line, had any accident to the valve, or any part of its apparatus."

Stations.—Number of stations on the South Devon line—(*Samuda.*)

"There will be a station at Newton, which will be the extreme end of the 20 miles, and we shall have stations at Dawlish, Teignmouth, Saltash, and, I believe, two others, at places the names of which I do not know; there will be, I believe, five stopping stations in the 20 miles."

By the removal of locomotives the complication, extent, and unsightliness of railway stations would be very much reduced. It is proposed to move the carriages and add them to the train by a small capstan, as in the goods shed at Bristol—(*Brunel.*)

(To be continued.)

* So in the original.—Ed.

The city of Paris has voted the sum of 41,600 francs (£1664) for paintings on glass for the churches of St. Germain l'Auxerrois, St. Gervais, St. Eustache and St. Laurent.

THE GREAT BRITAIN.

(Continued from Page 324.)

The Boilers.—The boilers consist of one outside case 34 feet long by 31 feet wide, and 21 feet 8 inches high, and this is divided into three distinct boilers, by means of two longitudinal partitions. They have an apparatus for regulating the discharge of brine, and also a hot-water jacket, around the lower part of the funnel, into which the feed water is pumped and whence it flows into the boilers. In each boiler there are four furnaces at the after, and four at the forward end; therefore there are twenty-four fires in the whole. Each furnace has its own distinct course of flues, terminating in one take-up in the middle.

The total area of the surface of the grate bars is 360 square feet. The total area of furnace surface exposed to the direct action of the fire is 1248 square feet, and the total areas of the flues are—of upper surface 1608 square feet, of side surface 6504 square feet, of bottom surface 1710 square feet.

When the form of the engines was first decided on, it was intended that the cylinders should be 80 inches in diameter; but they were afterwards increased to 88 inches, with the view of working the steam very expansively, and thus obtaining an increase of power at a reduced expenditure of fuel. As far as can be at present judged, this appears to have succeeded, but in consequence of the rough weather on the voyage round, in was not possible to weigh the coal consumed.

Difficulties in getting out of Dock.—When the "Great Britain" was commenced, the city of Bristol had taken up the subject of widening the dock-gates of the port, with other improvements, so warmly, that no doubt was entertained that, before she should be completed, there would be no difficulty in her going out; accordingly she was designed 5 feet 6 inches wider than the existing locks.

Various causes led to the abandonment, for a time, of these improvements, and the ship when ready for sea was not only discovered to be a prisoner, but likely to continue so, in consequence of the personal liability which it was assumed the Dock Company might incur, if, by permitting any disturbance of their works, not provided for by Act of Parliament, any injurious consequences should ensue to the port.

This state of affairs lasted for several months, until at length, by an agreement between the two companies, permission was accorded to remove, first so much of the masonry and gates as would allow the ship to pass from the floating harbour into the outer basin, next to restore these, and then to adopt the same course with the gates and one side of the lock communicating with the river Avon.

Trial Voyage.—The "Great Britain" quitted the port of Bristol for London on the evening of January 23.

During this voyage the engines made 52,773 strokes, consequently the distance described by the screw was 639 knots, and the actual distance traversed by the ship, as computed by Captain Hosken, was 567 knots. The ratio of the speed of the ship, to that of the screw, during the entire voyage, was as ·887 to 1·; or in other terms, the total slip was 12¼ per cent. The time the ship was under weigh, was 59½ hours, so that the average speed was upwards of 9½ knots, and if allowance be made for times when, on account of the bearings becoming warm, the engines went slowly, the average speed may be fairly reckoned at 10 knots per hour. On several occasions the author watched the screw, and he does not think it ever rose one-half of its diameter out of the water, and standing by the engines during the worst of the gale, he could only observe that there was occasionally a slight acceleration, during perhaps half a revolution, but there never was any check to the uniform rate.

Observations.

Mr. Barnes said, that in his original calculations, given to Mr. Guppy, he had erroneously assumed the pitch of the screw to have been 8 feet. He had since calculated the results accurately, and found the mean number of revolutions per minute 32·8, and the mean speed in knots 10 0815.

The results of the indicator were	10·15 lb. per square inch.
Deducting for friction, and more ample allowance than was required for engines in good order, which was not, perhaps, too much for engines which were quite new, and of which all the movements were stiff	1·55
Remains	8·60 = 95·5 h.p. for each engine.

Mr. T. R. Guppy stated, in answer to questions from the President and Members, that during the whole voyage the throttle-valve was only ⅓rd open, and that the steam was cut off at ⅓th of the stroke. It was not possible to take any accurate account of the coals consumed, but he estimated the consumption at about 40 tons in 24 hours.

Captain Sir Charles Napier inquired, whether the "Great Britain" steered well, and whether it was not found she had a tendency to fall off to leeward in a cross sea? He should have supposed that the action of the screw propeller being so entirely in the stern it would act upon the ship like sculling a boat.—Captain Hosken replied that the "Great Britain" steered extremely well; and that there was not any tendency to fall off to leeward. It was evident that the propeller was not easily injured, for since his arrival in the Thames he had found, coiled round the shaft, nearly 9 fathoms of chain cable, which had been apparently torn away from the mooring of a buoy in coming up the river.

Mr. J. Miller said, he had noticed particularly the difference of the speed of the engines, on board the Royal Mail Company's vessels, at the commencement and at the end of a voyage. At starting, with a full complement of fuel, the paddle-wheels were plunged so deep, that the speed of the engines, which ought on an average to be 17 strokes per minute, was reduced to 8 or 9 strokes, and at the end of the voyage the paddle floats had scarcely sufficient hold on the water. A vessel with a screw propeller would not be so affected.

Mr. Guppy said, in answer to questions from members, that, at present, he believed the average speed obtained by vessels with screw-propellers was below that of paddle-wheel steamers. A new screw, of larger diameter and greater area of palms, was being made for the "Great Britain," with a view to increasing the speed. Four chains, weighing together about 7 tons, were employed for communicating the power from the upper drum upon the main shaft to the lower drum upon the shaft of the propeller. They worked smoothly and without noise, and at present had not shown any tendency to wear or to lengthen. From the form of the link, he conceived the chains would only lengthen on the slack side, under any circumstances, and this would not affect their working, as the projecting ends of the links would, on the driving side, always fall into the recesses prepared for them, so that thes- recesses must be much worn, before the chains would ride out of their proe per direction upon the drums.

Mr. R. Stephenson observed, that the chains very nearly resembled those used in the early locomotive engines, and which were discarded on account of their lengthening so much as to render them useless. It was true that the links of the locomotive chains were much smaller, there were many more traversing pins, and the speed at which they travelled was probably greater than the large driving chains of the "Great Britain," which would, therefore, be less liable to injury than those he had mentioned.

Performance of the French screw vessel Napoléon.—Mr. P. Taylor said, that great difference of opinion existed among the officers of the French navy as to the capabilities of the "Napoléon." It had been asserted, that with the peculiar build and great proportion of power to tonnage of that vessel, greater speed should have been attained. Mr. Taylor was not of that opinion, although he fully appreciated the build of M. Normand's vessel, and the excellence of Mr. Barnes' engines. He had paid much attention to the result of the voyages of the "Napoléon," and found them, on an average, more rapid than those of the paddle-wheel vessels on the same station. The screw did not generally make such good way in smooth water, but with a sea or wind sufficient to lay a paddle-wheel ship at all over, the screw gained immensely, and hence its average superiority. After the trial voyages, and the run from Havre to Marseilles, with the cast-iron screw, which had been mentioned at the Institution on a previous occasion, it was found, on putting the "Napoléon" into the graving dock at Toulon, that the outer journal of the propeller-shaft was much worn; and that the cast-iron screw was much affected by galvanic action; a new bronze screw was therefore cast, and was highly polished and varnished before it was fixed. At the same time the bearing areas of both the outer and the inner journals of the shaft were increased, and a jet of cold water was arranged so as to be constantly applied to them. Since these alterations, there had not been any undue wearing of the journals.

Mr. Barnes would not venture to state the relation of power to tonnage on board the "Napoléon," as the methods of measurement of vessels were quite illusory. The engines were 130 h.p. The vessel was 148 feet 6 inches long, and 27 feet 4 inches broad at the water line, drawing 11 feet 10 inches aft, and 7 feet 5 inches forward, and the area of the midship section at that draught was 144 square feet. By the ordinary rules of measurement the tonnage would be 490 tons, and the displacement 365 tons. He had made many engines for vessels built by M. Normand, and he knew their capabilities. He was of opinion that if the feathering paddle-wheels, invented by M. Cavé, had been adapted to the "Napoléon," as good speed would have been attained, as with the screw, in all weathers; but that with the common paddle wheels, such results could not have been arrived at.

Material for the bearings of the propeller-shaft.—Mr. F. P. Smith had found, with reference to the journals of the propeller-shaft, that steel was the best material for the bearing of the toe or extreme end, where the destruction was most rapid, and that the form was that of two hemispheres, working under a constant jet of cold water. The experience upon the 'Rattler' tended to show, that it was advantageous to reduce the bearings as much as possible; for they had always worn down to certain dimensions and then had ceased to wear. On the contrary, however, on board the 'Great Britain' and the 'Napoléon' it appeared, that an increase of the size of the journals had been advantageous. On this practical question, the manner in which the thrust of the propeller-shafts was received in the toe bearing, must be well considered, before any rule could be laid down. From his previous experience of the performances of the 'Rattler,' in smooth water, Mr. Smith had recommended to the Admiralty, that a large propeller should be tried. The recent trials at sea had proved the correctness of the recommendation, which was now being acted upon.

On the accuracy of the log.—Mr. J. G. C. Curtis remarked, that it was necessary to be extremely cautious in using the results of the ordinary log, for although very useful for the common purposes of navigation, he did not think they ought to be allowed to enter into the computation of a vessel's velocity, where the "slip of the screw" was to be determined. The velocity of a ship being determined with the ordinary log, by ascertaining how much of the line, attached to the log, ran out in a given time, it was essential that both the time and the distance should be correctly measured; but that was seldom the case, as the sand in the sand-glass, which measured the time, was affected by every change in the atmosphere, and the line which measured the distance was alternately wet and dry, and being stretched unequally, at different parts, it was impossible that the marks, or knots, could remain at distances which they were intended to indicate. These difficulties, when the vessel was going less than 8 or 9 miles an hour, might be partially surmounted, by counting the requisite number of beats of a good watch, instead of using the sand glass, and by actually measuring the quantity of line which ran out, instead of counting the distance by the knots. But in heaving the log at higher rates, it was difficult to prevent the log from being dragged after the ship, by the friction of the reel, and whether the line was "taken off" or "paid out," there was always a degree of doubt, whether the correct length had been allowed to go off the reel. It was also nearly impossible to measure the time to the requisite degree of accuracy, by the 14 seconds sand glass, which was generally used at high rates. For instance, if a vessel were going 14 knots, the quantity of line representing one mile passed through the hand of the observer in one second of time; and hence, in order to obtain the speed to the eighth part of a mile, it would be necessary to measure the interval to the eighth part of a second. In like manner, to obtain a vessel's speed to the eighth part of a mile, when she was going 10 knots, it would be necessary to measure the interval, to the sixth part of a second. As these small portions of time could not possibly be measured by a sand-glass, persons unacquainted with the subject, would not be surprised to learn, that Mr. Curtis had heard it expressed, as an opinion, by most naval officers, and had found by his own practice, that the rate of a ship, going more than 10 knots, could scarcely be obtained within a mile, under unfavourable circumstances. As Mr. Curtis was convinced, that the difficulty of accurately measuring the speed was one of the greatest causes of the discrepancies which existed in the accounts of the trials of vessels, he ventured to suggest an expedient "for determining a vessel's velocity at any given instant," which he thought would be more accurate than the common log. He proposed, that the time which a vessel took, in passing through her own length, should be measured, from which her velocity per hour could be easily ascertained by proportion. For this purpose he would fit, in convenient places, at a short distance from either end of the vessel, two rods, one vertical and the other horizontal, so that each pair, when seen in coincidence, should point in a line perpendicular to the direction of the vessel's keel. He would also have a buoy painted white and black, or any colours that would show well, when in the water; to this he would attach a line considerably exceeding the length of the vessel. This buoy should be passed forward, with plenty of spare line, to the bowsprit end, the end of the line being made fast abaft, ready to haul it in when done with.

Scudding.—Captain HOSKEN stated, scudding well was a point of great importance, and was entirely a seaman's question. No point required more judicious management, and correct judgment, than as to when a ship could not scud longer with safety, and ought to be "hove to." He had very often, in the 'Great Western,' been scudding past very fine ships of from 500 tons to 1000 tons, not very deep in the water, "laying to," because they could not scud with safety. There were now several steamers longer than the 'Great Western,' and he had never heard, that any difficulty had been experienced with them, on this important point.

Mr. PIM mentioned an advantageous application of the combined power of the screw and sails, which had been practised by his relations, Messrs. Pim of Hull. They had adapted to two fine trading schooners, screw propellers, driven by small engine power. The result of this experiment had proved, that in cases where extreme speed was not an object, but in which regularity was essential, this plan might be advantageously adopted, especially for commercial purposes, in which it was requisite to combine economy and a certain amount of dispatch.

Sir J. RENNIE, President, after expressing to Mr. Guppy the thanks of the meeting, for the communication which had given rise to so interesting a discussion, said the construction of iron sea-going vessels was a subject of peculiar interest to the Institution, as to one of its early members must be ascribed the merit of their first introduction.

The first iron steam vessel that ever went to sea was built in 1820-1 at the Horseley iron works, near Birmingham. It was named the 'Aaron Manby,' after the constructor, and being put together in the Surrey Canal Dock, took in a cargo of rape-seed and iron castings, in the Thames, and landed it at the Pont Royal at Paris without transhipment. This unique voyage was performed under the command of Captain Sir Charles Napier, R.N., who was largely interested in the undertaking, and devoted much time and his usual skill and energy to the enterprise. The engine was put together, and was worked during the voyage, by the present Secretary of the Institution. The propellers were the feathering paddles which were invented by the late Mr. John Oldham. Both the engine and the paddles had been superseded by more perfect machinery, and the boilers had been frequently renewed, but the hull of the vessel had required but little repair, and was still at work upon the Seine, as were several other iron vessels built by Mr. Manby, about the same time, at Horseley, and at his works at Charenton, near Paris.

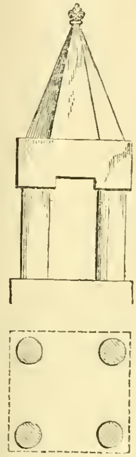
The introduction of iron, as a material for ship-building, was now becoming so general, that the result of the great experiment, the 'Great Britain,' must necessarily be regarded with much interest, and next session, the Institution would look forward to receiving from Mr. Guppy an account of the first few voyages, and, if skill and experience could accomplish them, they might be considered safe in the hands of Captain Hosken, whose success in the 'Great Western' had been so decided.

ARCHITECTURE IN GUERNSEY.

SIR,—Having lately visited Guernsey and observed one or two peculiarities in the church architecture of that island, I take the liberty of sending you a brief description of them, leaving it to you to determine whether or not they are worthy of a place amongst the mass of valuable facts of which your Journal is the medium of communication, and premising that I do not attempt any sort of classification, merely collecting them from notes in a diary.

1. In the town of St. Peters, there is a church of the same name, consisting of nave, north and south aisles, transepts, tower and spire (at their intersection). The southern transept projects considerably further than the other. At the west end of the nave the arches which separate it from the aisles on either side are so low as to be intercepted above their springing by the caps of the piers, the sides of which are then continued to the paving, following the curve of those arches; so that the piers are broader at top than at bottom.

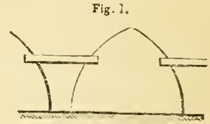
Fig. 2.



Elevation.

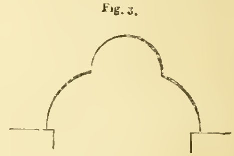
Plan.

Fig. 1.



Level of Paving.

Fig. 3.



2. Somewhere near the centre of the island stands Catel church, consisting of nave, chancel, north transept, north aisle, west porch, tower and spire. What most particulary struck me in this church was the design of the four pinnacles at the base of the spire. They each consist of four small round columns, without cap or base supporting a square mass of stone which forms a base from which to spring the pyramidal part of the pinnacle, octagonal on plan.

3. St. Martin's church is near the eastern coast, about 2 miles from St. Peter's, it consists of nave, chancel, north aisle, south porch, and a tower and spire, situated at the east end of the nave.

There is a peculiarity in the *section* of this church, viz., that the *aisle* is *more lofty* than the *nave*, the chancel being of the same height as the aisle. That the *least* lofty division of the church is indeed the nave is attested by these facts—1. It is in the same line with the chancel—2. The tower and spire are placed over its eastern end—3. The pulpit is situated in it.

The chancel projects no further on plan than the aisle, from which it is separated by a cuspated arch, whose head is not, however, pointed but round.

It will be observed, that both St. Martin's and Catel churches have only one aisle, viz., a north aisle; it may perhaps also be worth noticing, that the *poor boxes* in each are similar and are of a peculiar kind, resembling long narrow boxes turned on one end, so as to stand perhaps about 3 feet in height, the money being admitted through a small aperture in the top.

I remain, Sir, your constant reader,

G. W. R.

October 2, 1845.

STATUES IN THE PALACE AT WESTMINSTER.

The Commissioners on the Fine Arts in their fourth report, just published, state that they have found in the course of inquiry that many situations for statues consist of niches only, which, in accordance with the style of Gothic architecture adopted, are uniformly narrow, not exceeding two feet in width; that there are also situations where insulated statues might be fitly placed; and that, with a view both to convenient inspection and the expediency of affording opportunities for displaying the abilities of the artists, the last-named situations are the most important. Some situations, though not fit for the display of statues, would be well adapted for the reception of busts; and we are of opinion that busts might be considered among the means before referred to of doing honour to eminent men. With respect to monuments in painting of the description indicated, whether such monuments be understood to refer to portraits or to other representations, the report is at present postponed.

It is recommended that six insulated marble statues be placed in St. Stephen's porch, and that 16 such statues be placed in St. Stephen's hall. That statues of Marlborough and Nelson be placed in St Stephen's porch; and that statues of Selden, Hampden, Lord Falkland, Lord Clarendon, Lord Somers, Sir Robert Walpole, Lord Chatham, Lord Mansfield, Burke, Fox, Pitt, and Grattan be placed in St. Stephen's hall.

That the following three artists, viz., William Calder Marshall, John Bell, and John Henry Foley, whose works in the last exhibition in Westminster Hall were considered by us to be entitled to especial commendation, be at once commissioned to prepare models for three of the aforesaid statues, viz., the statues of Hampden, Lord Falkland, and Lord Clarendon, and that the execution of such statues be allotted to the said artists respectively as we may hereafter decide.

That 2,000*l.* of public money be granted on account towards the payment of such works, and we humbly request the sanction of your Majesty to our present report.

Distinguished Persons to whose Memories Statues might be Erected.

The committee appointed to "prepare a general list of distinguished persons of the United Kingdom to whose memory statues might with propriety be erected in or adjoining the new Houses of Parliament," submit two lists; the first (A), of names to which they agreed unanimously; the second (B), of names on which they were not unanimous, but decided by greater or smaller majorities.

The committee express their unanimous opinion, that the attempt to execute any great number of these statues simultaneously would not be conducive to the interests of art.

MAHON. HENRY HALLAM.
T. B. MACAULAY. SAMUEL ROGERS.
ROBERT HARRY INGLIS. THOMAS WYSE.
B. HAWES, JUN.

London, March 11, 1845.

A.

Alfred,	Lord Clive.	Cowper,
Elizabeth,	Lord Heathfield.	Sir Walter Scott.
Robert Bruce.	—	—
—	Lord Howard of Effingham,	Bacon,
Lord Burleigh,	Sir Francis Drake,	Napier,
John Hampden,	Admiral Blake,	Newton,
Earl of Clarendon,	Lord Rodney,	Locke,
Lord Somers.	Lord Howe,	Robert Boyle.
Earl of Chatham,	Lord Duncan,	—
Edmund Burke,	Lord St. Vincent,	Caxton,
C. J. Fox,	Lord Nelson.	Watt,
William Pitt.	—	Herschell,
—	Sir Walter Raleigh,	Cavendish,
Sir Thomas More,	Captain Cook.	—
Sir Edward Coke,	—	Inigo Jones,
John Selden,	Sir Thomas Gresham.	Sir Christopher Wren,
Sir Matthew Hale,	—	Hogarth,
Earl of Mansfield,	Chaucer,	Sir Joshua Reynolds,
Lord Erskine.	Spenser,	Flaxman,
—	Earl of Surrey,	—
Venerable Bede,	Shakspeare,	John Howard,
Richard Hooker.	Milton,	William Wilberforce
—	Addison,	—
Sir William Wallace,	Richardson,	Harvey,
Sir Philip Sidney,	Dr. Johnson,	Jenner.
Duke of Marlborough,		

B.

Richard I., Cœur de Lion,	John Wickliffe,	Ben Jonson,
Edward I.,	John Knox,	John Bunyan,
Edward III.,	Cranmer,	Dryden,
The Black Prince,	Archbishop Usher,	Pope,
Henry V.,	Archbishop Leighton,	Swift,
William III.,	Jeremy Taylor,	Goldsmith,
George III.	Chillingworth,	Burns,
—	Barrow,	Sir William Jones.
Cardinal Langton,	Bishop Butler,	—
William of Wickham,	John Wesley.	Robertson,
Cardinal Wolsey,	—	Hume.
Earl of Strafford,	Sir John Talbot,	—
Lord Falkland,	Sir John Chandos,	Fielding.
Sir William Temple,	Marquis of Montrose,	—
Lord Russell.	Cromwell,	Roger Bacon,
Sir Robert Walpole,	Monk,	Smeaton,
Earl of Hardwicke,	General Wolfe,	Brindley,
Earl Camden,	Sir Eyre Coote,	John Hunter,
Grattan,	Sir Ralph Abercrombie,	Adam Smith.
Warren Hastings.	Sir John Moore.	—
—	—	Purcell,
Speaker Onslow.	Hawke.	—
—	—	Garrick.

Report of Committee respecting the Selection of Persons whose Effigies might be placed in the Niches in the House of Lords.

The selection of the statues for the 18 niches in the House of Lords, which has now been referred to your committee, does not appear to them altogether so free and with so wide a scope as the selection of the 96 figures on painted glass upon which they have lately reported. In this case the very narrow size of the niches, and their Gothic form, seem to limit the choice of the commission to characters drawn from the feudal age, and, as usual, with effigies of that period, presenting little or no variety of attitude.

On a careful consideration of the characters which might be chosen, subject to this condition, your committee have become convinced that no scheme is preferable to that which was first suggested to the commission by his Royal Highness Prince Albert—namely, to fill the niches with the effigies of the principal barons who signed Magna Charta. Your committee subjoin a list of the names which they would recommend for this purpose. They conceive that the difference of character as laymen, or as prelates, would afford a picturesque variety of attire, and that the historical analogy would be most suitably attained by placing side by side in the same house of the Legislature, in windows or in niches, the successive holders of Sovereign power, and the first founders of constitutional freedom:—Stephen Langton, Archbishop of Canterbury; William, Bishop of London; Almeric, Master of Knights Templars; William, Earl of Salisbury; William, Earl of Pembroke; Waryn, Earl of Warren; William, Earl of Arundel; Hubert de Burgh, Earl of Kent; Richard, Earl of Clare; William, Earl of Aumerle; Geoffrey, Earl of Gloucester; Saher, Earl of of Winchester; Henry, Earl of Hereford; Roger, Earl of Norfolk; Robert, Earl of Oxford; Robert Fitzwalter, Eustace de Vesci, William de Mowbray.

Whitehall, May 15, 1845.

Letter from Mr. Hallam.

21, *Wilton Crescent, May* 17, 1845.

My dear Sir,—In compliance with the request of his Royal Highness and the other members of the commission, at our meeting yesterday, I will state the grounds on which the committee appointed to select persons whose effigies might be placed in the 18 niches of the new House of Lords, having first determined that men prominent in obtaining the Great Charter of John shall be chosen, have come to a resolution of recommending the particular names which have been submitted to the commission.

In the text of Magna Charta, inserted in Matthew Paris, the King recites himself to have granted it by the advice of Stephen Langton, Archbishop of Canterbury; the Archbishop of Dublin; seven English bishops; the Master of the Knights Templars in England; with 16 Barons, five of whom had the rank of earls, though only four are mentioned by this author, who has also committed one or two other slight inaccuracies. Roger de Wendover, whose chronicle, lately published by the English Historical Society, is almost wholly copied by Matthew Paris, omits altogether this recital of names in his text of the charter. But in this instance he is certainly wrong, as appears by the incontestable evidence of the charter itself, of which, as is well known, several copies exist. There can, therefore, be no doubt that the personages above mentioned were concerned, in a prominent manner, in the enactment of that great and celebrated law.

But, while it would have been easy to recommend for the 18 niches in the House of Lords the effigies of the archbishop, and some other ecclesiastics, with those 16 barons whom we find recited in the charter, we were checked by the consideration that these, as appears by a preceding passage of Matthew Paris, were all on the King's side in the previous contest, and that it would be a very inadequate commemoration of that event to omit those nobles of England who had in reality the chief share in bringing it about. It is indeed true, that those who had adhered most steadily to King John united with the rest at last to press upon him the necessity of compliance with the demand of a charter of liberties; so that it may be said to have been granted on the unanimous requisition of the baronage; but this affords only a reason for selecting names indiscriminately from both parties, considering them as in fact combined for the purpose of obtaining a legal guarantee for their liberties.

It became, consequently, the duty of the committee to look over the history of the time, in order to fix upon 18 persons who, out of a more considerable number, appeared most worthy of being commemorated on this occasion. The Archbishop of Canterbury, Stephen Langton, independently of his high rank, was, as is well known, one of the most distinguished statesmen of that age, and a strenuous supporter of the charter, though without the Royal banner. The next in station among the prelates is the Archbishop of Dublin; but, as he did not hold an English see, it seemed more desirable to select William, Bishop of London, whose see is next in dignity among those who were present, and whose name may be found in history. Almeric, Master of the Knights Templars in England, was the representative of a renowned and powerful order; and his effigy would furnish some variety of costume. Five earls are recited on the King's side, those of Pembroke, a very eminent man, of Salisbury, of Warren, of Arundel, and lastly, Hubert de Burgh of Kent, afterwards justiciary of England. On the side of the barons we find seven earls, those of Clare, Aumerle, Glocester, Winchester, Hereford, Norfolk, and Oxford. Three names remained to complete the number of 18. No doubt could be felt as to that of Robert Fitzwalter, whom the barons had placed at their head in conducting this enterprise. Eustace de Vesci bore a considerable part on the same side, and has some name in history. One only remained;

and among many noble, but scarcely very historical persons, none appeared more eligible than William de Mowbray, ancestor of the Duke of Norfolk, the oldest peer, and that in the three ranks of duke, earl, and baron, in the existing House of Lords. William de Mowbray is also ancestor, not only of the various noble families which bear the surname of Howard, but of that of Berkeley.

Such, I apprehend, are the reasons which have induced the committee, as they have myself, to recommend the 18 names, of which you possess a list, to be commemorated as having borne a share in obtaining the great charter of John.

I am, my dear Sir, very truly yours,
HENRY HALLAM.

C. L. Eastlake, Esq.

Memorandum respecting Places for Statues in the Palaces at Westminster.

The commissioners having at various times inspected the new Houses of Parliament with a view to ascertain what situations would be adapted for the reception of insulated statues, and having examined the principal localities on the 25th of April last, for the same object, were then of opinion—

That, as the entrance to the Houses of Parliament by St. Stephen's porch will contain statues of distinguished statesmen, warriors, and other eminent subjects, the entrance by the grand staircase, the landing-place, guard-room, Victoria gallery, and lobby to the House of Peers, should contain the statues of sovereigns.

The statues of Egbert, Edgar, Canute, and Edward the Confessor might be fitly placed on the first landing place.

That the principal landing-place should contain the statues of the sovereigns from William the Conqueror to Edward IV. That the statues of Edward V. to Richard III. might be placed in the guard-room.

That in the Victoria-hall the series should be continued, beginning with Henry VII., and ending with Queen Anne.

That the lobby to the House of Lords* should contain the statues of the Sovereign of the House of Brunswick, beginning with George I., and ending with her most gracious Majesty.

In this proposed arrangement it appeared that one pedestal in the lobby to the House of Lords would still remain unoccupied. A resolution was referred to (recorded in the minutes on the 21st of April, 1843), to the effect that a statue of his Royal Highness Prince Albert would be appropriately placed in the Victoria gallery (of which the lobby in question originally formed a part). Thus the situations for statues in the state apartments and the approaches to them would, in the event of the above resolution being confirmed, be entirely occupied.

According to the above proposed distribution, the number of statues on the landing-places and in the guard room would be 22; in the Victoria gallery 12 (William III. and Mary being both represented); in the lobby, including the statue of Her Majesty, seven.

It was considered that the statues in the robing-room might, according to a resolution proposed by Mr. Gally Knight with reference to another locality, consist of allegorical figures.

It was further proposed that the lower waiting hall should contain eight statues of celebrated scientific men; that the upper corresponding hall should contain eight statues of celebrated poets, and that the panels in the latter should be adorned with paintings. The lower hall has no panels available for paintings.

It was further remarked that, if required, statues could be placed in the open air in many of the courts, and that some of the larger corridors or passages on the ground floor would also admit of such decorations.

The consideration of the place for the statue of Alfred, and of precise number and situations of other statues in the central hall, was postponed till that part of the building should be more advanced.

Whitehall, April 26, 1845.

Letter from the Right Hon. the Secretary of State for the Home Department.

Whitehall, 9th May, 1845.

Sir,—I have received Her Majesty's commands to notify to you that Her Majesty has been graciously pleased to approve the report of the Commissioners of the Fine Arts dated the 25th of April, 1845. And Her Majesty has directed the Lords Commissioners of the Treasury to submit to Parliament an estimate for the sum of 2,000*l.* on account, towards the payment of the expense of statues of Hampden, Lord Falkland, and Lord Clarendon.

I have the honour to be, Sir, your obedient servant,
J. R. G. GRAHAM.

C. L. Eastlake, Esq.

Competition in Oil Painting.

The competition in oil-painting which, by an announcement before issued, was to take place in June, 1846, is postponed till June, 1847. All other conditions, expressed in the announcement referred to, remain unaltered.

1. Three premiums of 500*l.* each, three premiums of 300*l.* each, and three premiums of 200*l.* each, will be given to the artists who shall furnish oil paintings which shall be deemed worthy of one or other of the said premiums, by judges to be appointed to decide on the relative merit of the works.

2. The paintings are to be sent in the course of the first week in June, 1847, for exhibition, to Westminster-hall.

3. The commissioners reserve to themselves the right of excluding from public exhibition works which shall be deemed by them not to possess sufficient merit to entitle them to such a privilege.

4. The paintings, not to exceed two in number by each artists, are required to be prepared for the occasion.

5. The subjects are required to come under the general classes of religion, history, or poetry.

6. The dimensions are left to the choice of the artists under the following conditions:—The figures are not to be less than two in number; the size of the nearest figure or figures, in at least one of the specimens by each artist, is to be not less than that of life; but the size of the figures is altogether left to the choice of painters of marine subjects, battle-pieces, and landscapes.

7. The judges appointed to decide on the relative merit of the works may, if they shall think fit, require any artist to whom a premium shall have been awarded to execute, under such conditions as they may think necessary, an additional painting as a specimen of his ability, and in such case the premium awarded to such artist will not be paid unless his second painting shall be approved by the judges.

8. The names of the artists are not required to be concealed.

9. The paintings will remain the property of the respective artists.

10. Paintings which may combine appropriate subjects, with a high degree of merit, shall be considered eligible to be purchased by the nation, in order to be placed in one of the apartments of the Palace of Westminster.

11. Religious, poetical, or allegorical subjects, which by judicious adaptation or treatment may have reference to the history or constitution of the kingdom, may, as well as strictly historical subjects, be eligible to be so purchased.

12. The judges to be hereafter appointed to decide on the relative merit of the works, with a view to the award of premiums, will consist partly of artists.

13. The competition hereby invited is confined to British subjects, including foreigners who may have resided 10 years or upwards in the United Kingdom.

Various applications having been received from artists, candidates for employment as fresco-painters, respecting the mode in which specimens of fresco-painting may hereafter be submitted to the Commissioners on the Fine Arts, without reference to public exhibition. Notice is hereby given, that such specimens may be sent to Westminster-hall for the purpose aforesaid from the 1st of March to the 1st of May next inclusive. The subjects and dimensions are left to the choice of the artists, but those artists who have not before exhibited cartoons in Westminster-hall are required to send specimens of drawing together with their fresco-paintings.

THE CONSTRUCTION OF GAS METERS.

By ALEXANDER ANGUS CROLL, Assoc. Inst C.E.

The use of gas for the purposes of illumination, has now become so general in this country, and involves so much capital in its production and distribution, that any invention, by means of which gas can be more accurately measured than heretofore, becomes of importance. It is well known, that as much as from 30 to 40 per cent. of the whole quantity of gas produced, is sometimes unaccounted for, and this great and positive loss has generally been attributed to leakage. That there is a certain constant amount of leakage through the pores of the metal, of which the mains and pipes are composed, is undeniable. The fact of such leakage is proved by the saturation of the ground in which the mains are imbedded, though it would appear to have been somewhat hastily assumed, that such saturation would furnish a complete explanation of the whole of the known loss. The erroneous character of this opinion can be readily demonstrated by experiment. The most minute jet of gas can be detected by the smell; for instance, any escape of gas which can scarcely be discovered by its igniting upon the application of fire to the spot, is instantly perceived by the offensive odour. In the author's own house a very small escape of gas took place. This was so offensive that its continuance would have rendered the room uninhabitable; but when estimated by the meter it was found to be only one per cent. Further, escapes of gas in the streets have been detected by the smell, which when traced were found to be incredibly small when the nuisance they had occasioned was taken into consideration. These facts show that it is impossible to account for even 5 per cent., instead of upwards of 30 per cent., of the ascertained loss, which is the utmost allowance to be made for loss from bad joints and porous metal in the mains.

The amount of gas daily distributed from the works of the Chartered Gas Company alone may be taken at about 2,700 000 cubic feet; the loss of 30 per cent. upon that quantity would occasion 810,000 cubic feet of carburetted hydrogen to be set free daily in a comparatively limited dis-

* The names of various apartments have been altered and finally determined since the date of this memorandum. The principal landing-place is called the Norman Porch; the Victoria Gallery is called the Royal Gallery; the lobby to the House of Lords is called the Victoria Hall.

trict of the streets of London. It may be objected, that the gas escaping in the soil becomes decomposed, and that therefore no smell is observed; but this hypothesis is inadmissible, as in that case the hydrogen would be formed into water, and the carbon would be deposited in the soil; therefore the quantity, by weight, annually left in the soil, from the supposed escape of 30 per cent would be upwards of 3,000 tons. This is from the works of one company only; and if we consider the enormous additional quantity that would be produced from the other ten metropolitan companies, we cannot avoid pronouncing it to be utterly impossible.

Water Meters.

The ordinary wet meter is necessarily placed in the basement, in order to receive the water which, rising as vapour out of the meter, is condensed in the fittings. The meter is therefore almost always in a dark cellar or an obscure corner, and in some instances fraudulent methods have actually been in existence without detection during the inspection by the company's officers.

It is well known that the water meter invented by Clegg, and improved by Crossley, is substantially the same as that now generally in use. The action of the water gas-meter is generally understood. The gas is introduced at a central opening of the measuring drum, which is sealed with water; the pressure is exerted upon the surface of the water, and the diagonal divisions of the revolving wheel, which is the measuring chamber of the water meter. The revolutions of the wheel, caused by the passing of the gas, are shown by the index. Now the effect of this meter can be easily evaded by various methods. The correctness of its measurement depends entirely upon the water in the meter being kept at the proper height; thus, for instance, if the case of the meter be tilted forward to an angle of from 5° to 13° (according to its construction), and a proportion of the water drawn off, so as to unseal the outlet of the measuring chamber, the gas passes through it without affecting the index, and without being registered at all. During the winter, the water contained in the wet meter is sometimes frozen; and then it is necessary, in order to enable the gas to pass through the fittings, that the meter should be removed. The bad example of avoiding the measurement of the gas, until a fresh meter can be substituted, is thus set by the company itself. The number of new meters required on such occasions is so great, that a considerable period often elapses before the frozen meter can be replaced.

Dry Gas-Meters.

To meet these admitted evils, various kinds of dry meters have been at different times invented; but hitherto they have been open to such serious objections as to prevent the general adoption of them in practice. The first machine of any importance was that of the Dry Meter Company. The material of which the measuring chamber of that meter was formed was leather, which has been found liable to several objections. If the meter is used only occasionally, at intervals, the action of the gas upon the leather produces considerable contraction and causes a registration of an increased proportion against the consumer. On the other hand, when the meter is in constant use the leather is expanded, whereby more gas passes into consumption than is marked by the index. This of course operated unfairly against the manufacturer of gas. These imperfections have therefore rendered this meter obsolete.

The only other dry meter of sufficient importance to be mentioned, is that constructed by Defries. In this instrument, each of the three measuring chambers of which it is composed is separated from the others by a flexible partition formed of leather, partially defended from the chemical action of the gas by metal plates. This flexible partition is expanded by the pressure of the gas, and in the alternate expansion and contraction it forms a cone. Now as a cone is one-third part of a cube, one-third part of the surface only is available to the pressure of the gas. Independently of the loss of power thus occasioned, a further loss arises from the sides of the flexible partition being fixed, and the centre only being moveable, and registering by its motion the gas consumed. Further, if where the leather is attached to the sides of the case there be a play of $\frac{1}{16}$th of an inch between the plates and the line of attachment of the leather, in the backward and forward motion, it passes through $\frac{1}{8}$th of an inch; thus, when by use and exposure to the atmospheric air, the leather has contracted only $\frac{1}{32}$nd of an inch, then in its motion it passes through this $\frac{1}{16}$th part of an inch, the effect of which is, that the measuring chamber is diminished by this $\frac{1}{16}$th of an inch, over the whole diaphragm. Now since it measures merely a conical space, it must be evident that this loss of $\frac{1}{16}$th of an inch over its surface very much lessens the measuring chamber. In cases where the meter has been some time at work, it is stated that it has thus registered, against the consumer, as much as from 8 to 11 per cent The reverse of this occurs when the meter has been some time in use, without any admission of air, and then the manufacturer incurs a loss. Each flexible partition consists of four triangular divisions, each of which is protected by a metal plate, and between each division and all round the outer rim of the partition, where it is attached to the case of the meter, there is necessarily an uncovered surface of the leather, to allow the partition to move freely backwards and forwards; this leather is consequently liable to be acted upon by the gas. This circumstance must be an objection to every meter in which the flexible material forms part of the measuring diaphragm.

Croll and Richards' meter avoids these objections, which have hitherto prevented the general use of dry meters. The machine will be more readily understood by imagining a steam engine measuring its steam, as it really does, in all cases. The steam enters the cylinder, from the boiler, on to the top of the piston, forcing it through a certain space; the supply is cut off, and the action is reversed, the bulk of steam occupying the space through which the piston moves, is thus measured; for presuming the piston to be of a given area, and the distance through which it moves at every stroke, to be constant, it can readily be conceived how the actual quantity of steam employed could be indicated or calculated. The meter in question bears a strong resemblance to a double engine. It consists of a cylinder divided by a plate in the centre into two separate cylindrical departments, which are closed at the opposite ends by metal discs; these metal discs serve the purpose of pistons, and they are kept in their places by a kind of universal joint, adapted to each; the space through which the discs move, and consequently the means of measurement, is governed by metal arms and rods, which space, when once adjusted, cannot vary. To avoid the friction attending a piston working in a cylinder, a band of leather is attached, which acts as a hinge, and folds with the motion of the disc; this band is not instrumental, to any extent, in the measuring, so that if it were to contract or expand, the registering of the meter would not be affected, inasmuch as it would only decrease or increase the capacity of the hinge, the disc still being at liberty to move through the required space; the leather is also distributed in such a manner, being curved, and bending only in one direction, that it prevents any wrinkles or creases from forming, and renders it, therefore, much more durable. The arrangements of the valves and arms are somewhat different to that of a steam engine, although similar in principle.

Meters with Three Chambers.

Mr. Defries said, there were some points of Mr. Croll's paper, with which he could not accord, although he perfectly agreed in the statement of the general deficiencies of the wet meters, and the facilities they afforded for fraud. Being aware of the objections against all meters with only two compartments, as being liable to cause oscillations of the lights, he had, in the construction of his meter, adopted three chambers, in order that its action, like that of a three throw pump, might be continuous. In practice this was found to be the case, and at the Thames Tunnel, the House of Lords, and in many private establishments, where very large meters made by him were used, and their measurements were tested daily, none of the contraction or expansion of the leather hinges, or any alteration in the size of the chambers, had occurred. The leather used was prepared expressly for the purpose, and he believed, that the theoretical objections, both to the use of leather hinges, and to the form of the chambers, were not well-founded; at all events, no ill effects had been found to result from either in a period of seven years, during which time upwards of ten thousand meters had been made. He contended it must be evident, from the form and the arrangement of the chambers of his meter, that it would work correctly under a low pressure; indeed at less, be thought, than if the disc moved bodily forward; but that point could only be ascertained by actual comparative experiments.

Mr. J. Farey said, the meter with three chambers appeared at first sight most likely to keep up an equal flow of gas, and he did not think the dimensions of the chambers would be subject to alter so as materially to affect the capacity. The meters with two chambers were somewhat on the principle of the diaphragm pump, patented by Benjamin Martin nearly a century ago, but which did not succeed in water. The same kind of pump was more extensively used for the "Carcel" lamps, and in oil it was very durable; but he was of opinion, that when working in dry gas, the leather diaphragm would crack, unless it was prepared in a peculiar manner to resist this tendency.

Leakage by the Porosity of the Pipes.

Captain W. S. Moorsom said, that a point of much interest connected with the subject was the leakage of the gas through the metal pipes. He understood the same effect had been observed on the atmospheric railway, where the leakage through that portion of the main which was composed of close pipes was as great in proportion as in that part with the continuous valve.

Mr. J. T. Cooper said, there could not be any doubt of the porosity of the ordinary metal pipes, so that the process of "endosmose and exosmose" occurred to a great extent, particularly with soft iron pipes. This subject had been discussed at length last Session. If harder iron, of a greater density, were used, there would be less porosity. He was astonished to hear the statement relative to the leakage of the air through the metal of the pipes in the main of the atmospheric railway; but with respect to the pipes in the streets, it was not surprising that carburetted hydrogen gas, which was very volatile, should traverse the pores of soft iron. The method of exhibiting the "endosmose and exosmose" process, by means of jars covered with a sheet of India rubber and filled with gases of various density, was well known to chemical students.

Mr. Farey believed, that if the gas pipes were made from better materials they would not be so porous as to be in any way prejudicial; but now, for the sake of a low price, they were cast from any sort of coarse bad iron, and they could scarcely be expected to be sound. Much also depended upon the method of casting them. If they were cast in moulds placed vertically, with fountain jets, the thickness of the pipes would be more uniform, and the metal would be less liable to be spongy.

Mr. Lowe said one source of loss arose from the destruction of the wrought iron service pipes, by oxydation under ground. It had been asserted, that in opening the ground in the streets, it was not uncommon to find, that the whole of the metal of the service pipe, was gone, and that the gas travelled through a tube of metallic oxyde, which had formed a sort of concrete, with the gravel in which the tube had been laid. Many kinds of artificial coating had been tried, for protecting the service pipes from the action of the damp earth, but Mr. Lowe believed, that hitherto nothing effectual had been discovered. The wrought iron service pipes would, at present, last from 3 years to 5 years, after which new ones should be laid down. He was convinced, that more than 5 per cent. should be allowed for the leakage of the main alone, independent of all those other sources of loss which he had enumerated. Mr. Lowe did not think, that any of the meters registered with mathematical accuracy the quantity of gas passing through them; but he was of opinion, that if the water line of the wet meter was correctly maintained, that meter, in its actual improved state, was the most accurate. In very hot, or very cold situations, dry meters were essential, as the evaporation of the water, or its freezing, would equally derange its action. The freezing could be obviated, by dissolving in the water a little common salt, or some caustic potash (soaper's lees); but the evaporation could not be prevented. He thought, that when in good order, the dry meters would work under as light a pressure as the wet meters; but there was a possibility of the leather becoming rigid, if they remained any length of time inactive. The ratio of the amount of the leakage did not appear to follow the same rule, with respect to the diameter of the pipe, as did the quantity of gas passing along pipes of given diameters, under given pressures.

Mr. Croll did not think Mr. Lowe's arguments conclusive, against the position assumed in the paper. The case of the Rothesay gas works had not, alone, been considered, as many gas works accounted for within 8 per cent. of all that was sent out. The Manchester works had a deficiency of only $3\frac{1}{2}$ per cent. In a main of very large pipes, extending from the gas works situated at West Bromwich, to Birmingham, a distance of nearly 7 miles, the amount of leakage was only from 7 to 8 per cent. The gas was sent along the main, under a pressure of about $3\frac{6}{10}$th inches, until it reached Birmingham, which was at about 120 feet higher level than the works at West Bromwich. About 16,000 cubic feet of gas passed through the main per hour. Mr. Croll exhibited the discs and leather packing of his meter, detached from the case, and explained, that from the manner in which the leather was attached to the discs, whatever expansion or contraction occurred, no alteration could take place in the quantity of gas expelled by each forward motion of the disc; for the packing formed a bag all round, in which a certain quantity of gas lay stagnant, and whether that bulk was greater or less, no difference could be produced in the measurement.

NECROLOGY.

Persius.—We learn from the *Morgenblatt* that Persius, the German architect, died lately—some time we conjecture about last June, for no positive date is given—shortly after his return from a visit to Italy. As to his age, it is merely said that he was "in the prime of life;" nor have we as yet been able to gather any particulars respecting him from other sources, for on turning to Nagler's "Kunstler Lexicon," where we fully expected to meet with something, however scanty and brief, we discovered that he is not so much as mentioned at all by that remarkably "industrious" and "accurate" compiler, many of whose omissions and insertions are equally extraordinary. However, after his omitting Barry, we need not be surprised at his leaving out Persius also, except that as a German architect, and one in very high favour with the present King of Prussia, who has employed him on a very great variety of works at Potsdam and its environs, it is rather unaccountable that the latter should have escaped the "indefatigable" Nagler. — Persius, for we no not know even his Christian name, is said to have fathered many of his royal patron's own designs, which may account for the inequality of taste which has been laid to his charge. For displaying fertility of ideas and invention he certainly did not lack for opportunities, since the number of buildings which he erected in and about Potsdam afforded ample scope for variety of design. They consist mostly of villas, garden temples and other ornamental structures in a diversity of styles, which has given occasion to the remark that he has converted the environs of Potsdam into a sort of architectural "pattern-card." But it may with equal justice be said on the other hand, that he bestowed on them the character of embellished landscape enlivened by architecture. If there be, as alleged, somewhat of "*spielerei*," or *toyishness*, in what he there produced, it is at least not so much out of place as to call for censure. It is surely infinitely more prudent to experimentalize and try fancies upon such works than on more important ones; and doubtless something may be learnt from them for other occasions. It is not often that we get *voluntaries* and *fantasias* in architecture. We are unable to point out by name any of the other buildings by Persius, except that called the *Krollsche Wintergarten* at Berlin, in the erection of which extensive edifice he was associated with Knoblauch.

George Basevi, Jun.—Since we wrote the above, a fatal accident has added to the melancholy interest of this article, for we have now to record the death of a countryman of our own—one who has been prematurely and most suddenly cut off, without a moment's warning, just as he was rising into eminence, and beginning to distinguish himself in his profession, by being employed on works of a superior class. Though most of our readers are no doubt already acquainted with the circumstances of Mr. Basevi's death, it may be as well to state that it occurred on the forenoon of Thursday, October 16, when, in the couse of examining some work that had been done in the belfry of Ely cathedral, in company with the dean and another gentleman, he got upon a beam in which were some projecting nails; his foot catching against one of them he fell,—not upon the floor of the belfry, but through a hole or open space in it upon the floor beneath, and was killed upon the spot. The lately erected Conservative Club-house in St. James's Street (an authentic elevation of which was given in the No. of our Journal for March, 1844) is a piece of architecture that has not many rivals in the metropolis. Though he was not the sole architect—Mr. S. Smirke being also employed with him—he was, we believe, the principal one; we cannot, however, pretend to say what was the respective share of each in that joint production. But there is another work, the entire merit of which—and its merit is of no ordinary kind—belongs to Mr. Basevi, namely, the Fitzwilliam Museum at Cambridge, whose façade is distinguished not only by unusual richness as to columniation, but by great originality, picturesqueness, and artist-like treatment as to composition, it being stamped equally by unity and perfect congruity of character, and by variety. Not only is its beauty of a rare kind, but, what is equally rare, there is nothing to mar it,—no ordinary every-day features. The Fitzwilliam edifice tells its purpose at once: it looks like a museum—like a temple of art. Would that poor Basevi had been associated with the other Smirke, to give us a facade for the British Museum! The interior of the Cambridge Museum is not yet finished, but should it be completed according to the architect's designs, it will be in a far nobler style than any other public gallery of art in the kingdom. We shall probably now take an opportunity of describing the building more fully and more architecturally than has hitherto been done. Mr. Basevi was about 44 years of age, and has, we understand, left a family of eight children.

Paris Academy of Sciences.—Sept. 29.—M. Dumas read the first part of a paper on the nature of the milk of different animals. He observes that the milk of herbivorous animals always contains four orders of substances which form part of their food, viz., the albuminous represented by the caseum, the fatty substances represented by butter, the saccharine portion of their food represented by the sugar of milk, and, finally, the salts of different kinds which exists in all the tissues of these animals. In the milk of carnivorous animals there is no sugar, and there are only the albuminous, fatty and saline substances which form the general constituents of meat. If, however, bread be added to the food of these animals, the sugar of milk will be found, although not in large quantities. M. Dumas concluded by stating that his investigations have enabled him to arrive at a perfect analysis of milk.—M. Boussingault made a communication relative to a new ammoniacal manure. Having remarked that magnesia, the basis which has always been regarded as injurious to vegetation, was found in the ashes of all vegetables, and in a proportion in accord with the quantity of phosphorus also found in the ashes, and of that of the azote which enters into the composition of plants, he was led to infer that vegetables must assimilate with ease and advantage the ammoniated-magnesian phosphate. Being desirous of verifying this, he planted on the 1st of May some grains of early maize, which had already germinated, in two series of pots; into the half of which he had poured 15 grammes (about half an ounce) of double phospated salt for each pot. The two series of pots were then placed in the open ground. During the first twenty five days, the vegetation was the same with both series; after that there was a difference in favour of the pots which had been watered with the phosphate. On the 25th of July, the plants in them were double in height those of the other series, and the diameter of the stems was two-thirds thicker. By the 25th of August the proportion had diminished; the height of the plants watered by the phosphate was then only one-third greater, and the size of the stems double. At the moment of their coming to maturity, the phosphated plants bore two sound ears, and one that had failed to come to maturity; the other plants had only two ears each—viz., one complete and one that had failed. This was not all; each grain of the ears of the phosphated plants was double in weight to that of the non-phosphated plants. M. Boussingault concludes therefore that the salt in question may be used with advantage as an artificial manure. M. Bravais communicated some information on halos and parhelions, and on the white rainbow. All these phenomena are due to the same cause,—viz., the refraction of light through water in its different conditions. The ordinary rainbow is due to refraction through an ordinary cloud; halos and parhelions, which are images coloured by the sun dispersed in variable numbers over two circles always placed alike, are due to refraction through crystals of snow.—A paper was received from M. Leverrier on the last passage of Mercury over the disc of the sun. This commenced, in Europe, on the evening of the 8th of May last, and did not come to a termination until a late hour of the night, and was not visible in our hemisphere. This was not the case, however, in America, where the entire phenomenon was visible. M. Carrillion announced that he had invented a machine for polishing looking-glasses with greater effect than is now the case.—There were many medical communications: amongst them was one by M. Sédille, of Strasburg, on the anaplastic treatment in cancer, which he states to have been very successful. M. Vierordt, a physician of Carlsruhe, gives the result of some experiments on the respiration of man, under different circumstances, and at different hours of the day. The writer states that the expirations are increased in the proportion of 1 72 upon 14 per minute after eating. He adds that the proportion of carbonic acid given out by the lungs is almost instantly diminished after drinking spirituous liquors, and that this continues for nearly two hours.

DRAINAGE of ANCHOLME, LINCOLNSHIRE.

By Sir John Rennie, Pres. Inst. C.E.

The level of Ancholme consists of a tract of low land, situated on the south side of the river Humber, about 10 miles below its junction with the river Trent, and contains about 50,000 acres of land, of which only about 17,000 acres are subject to taxation. This district is bounded on the east by an elevated ridge of chalk hills, extending from the Humber, for a distance of nearly 24 miles north and south; about 100,000 acres of the land of this ridge drain into the Ancholme. On the west, there is an inferior ridge of oolite and sandy limestone hills, which divides it from the valley of the Trent; about 50,000 acres of this ridge drain also into the Ancholme. On the south it is bounded by a low ridge of diluvial hills, which divides it from the valley of the Witham, and on the north is situated the river Humber; so that the total quantity of land draining into the Ancholme may be said to be about 200,000 acres.

The river Ancholme takes its rise a little to the north of Lincoln, and after a course of about 35 miles, passing through the centre of the above district, discharges itself into the Humber, about a mile to the west of the village of Ferraby. The valley varies from 1 mile to 3 miles in width. At a place called Bishop's Bridge, about 20 miles from the Humber, and at the southern extremity of the level, the Ancholme is joined by a large brook, called the Rasen, which takes its rise 4 miles north-east of the town of Market Rasen, near the village of Lealby, and brings down considerably more water than the Ancholme.

	Cubic Feet.
The streams on the east side produce . . .	48,014,000
Those on the west side	24,500,000
The Ancholme and the Rasen	36,000,000
Sundry small streams	32,000,000
Total in one day's flood . .	140,514,000

This would cover the whole level about 2¼ inches deep.

This valley, for the most part, lies below the level of high water-mark of spring tides, in the Humber. Near Ferraby, it is 3 feet under high-water ordinary spring tides; at Brigg, it is nine feet below; at Black Dike, 15 miles distant from Ferraby, it is 4 feet 6 inches below; and at Glentham Bridge, 18 miles distant, it is level with high-water spring tides. It is probable, that at no very distant period, it was overflowed by the tide, until by the gradual deposit of the alluvial matter, with which the waters of the Humber and the adjacent coasts abound, it became sufficiently raised above the low-water level, to form a grass or salt marsh, leaving the feeble waters of the Ancholme to force their devious way to the Humber in the best manner they could; but inasmuch as the Ancholme and its tributaries bear no proportion to the Humber, the mouth would frequently be blocked up by the deposit of alluvial matter, and thus the drainage water from the interior would be obstructed, so that, at times, the level would be completely inundated, and even under the most favourable circumstances, would never be properly drained, and necessarily became a vast stagnant marsh, more or less intersected with streams and pools of water, according to the particular state of the season, and the ever varying condition of the adjacent channel of the river Humber, into which it discharges its waters. In that state the tract of land was unfit for tillage, affording but a precarious pasture for cattle, during a few months and, in the winter, it became the resort of innumerable flights of wild fowl.

History of Ancholme.

This valuable district, however, was not altogether lost sight of, for the great Roman road, called Ermin-street, from Lincoln to the Humber, ran along the west side of it, and was partially protected, by banks, from the floods and tides of the Humber, as well as from the Ancholme.

The level also must have been in a flourishing state at an early period subsequent to the Romans, for we find in Dugdale, that Thornholm, or Thornham Priory, was founded for canons of the order of St. Austin by King Stephen, and dedicated to the Holy Virgin, in 1193. The priory is situated in the parish of Appleby, about 5 miles N.W. of Brigg. The style is in the florid Gothic peculiar to the period.

Also the priory of Newstede, or Newstead, near Brigg, founded by King Henry II., 1173, for the canons of the Gilbertine or Semperingham order, and dedicated to the Holy Trinity. Revenue £55 per annum. In the reign of Henry VIII. it was dissolved, and the lands were granted to Robert Heneage; and there is little reason to doubt, but that the monks who possessed all the learning of the times, and were generally alive to improvement, and everything which would augment the revenues of the church, did not lose sight of the valuable tract of the Ancholme level, but that they employed all the resources of the day to drain and cultivate it, to the utmost extent. There is not, however, any specific record of works executed by them, in that district, except the curious old work called Bishop's Bridge, consisting of two Gothic arches, of 12 feet span, erected at the southern extremity of the level, across the Ancholme, and over which the road between Gainsborough and Market Rasen now passes.

According to the plan of the level made by Francis Wilkinson and John Fotherby in 1640, and published in Dugdale, it appears, that the Ancholme was straightened, and drains were cut at right angles to the new channel, and another drain from the main river at Horkstow to the high lands near Elsham.

In the year 1801 the late Mr. Rennie was applied to, for his opinion, as to the best plan for improving and completing the drainage and the navigation of the level.

Invention of "Catch-water" Drains.

These works he estimated at £63,920. These drains, which Mr. Rennie termed "catch-water-drains," involved a very important, and at the same time novel principle; for it should be understood, that according to the old Dutch plan, of simply cutting a series of straight drains, to some convenient point, where the water could be discharged, and then fixing a sluice upon the main drain, or river, all the high-land and low-land waters were mixed together, and the high-land waters, coming from a higher level, necessarily had a greater fall and velocity, and rushing down upon the low lands, forced their way to the outfall, quicker than the less rapid waters which fell upon the level, and which were thus left to stagnate there; the sluices being unable to discharge both the high-land as well as the low-land water, during the period, when the tide in the Humber enabled the doors of the sluices to remain open. It was therefore impossible for the level to be drained by the old system, but by separating the high-land from the low-land-waters, by the catch-water drains, as proposed by Mr. Rennie, each body of water would have been effectually discharged, by an independent sluice, into the Humber, without interfering with the other. The catch-water drains were also well adapted to answer the important purpose of supplying the lands in the level with fresh water; for it must be remarked, that generally speaking, in the management of extensive districts of low-lands, it is not only necessary to have the means of draining them effectually, but also to have the power of supplying them with fresh water, during summer, for the want of which, in dry seasons, the low lands suffer as much as they are injured in winter by the floods. The catch-water drains being laid at a higher level, they would therefore serve to collect and to retain the fresh water, during the summer, so as to admit it into the low-lands during dry seasons, for the purposes of irrigation, stock, or navigation. The great object to be obtained, in managing a district of low-land, is not merely to get rid of the water during the floods; but to have a perfect command of water during all seasons, in order to provide for the drainage, irrigation, and navigation, all of which are equally important; for without effectual drainage, the lands cannot be cultivated; without irrigation, they cannot be occupied to advantage during dry seasons; and without navigation, the produce cannot be well disposed of; neither can the district import the various necessaries, without additional charges, which amount to an additional tax upon the lands occupied. All these grand objects would have been effectually provided for by Mr. Rennie's plan of catch-water drains, which he was then carrying into effect, on a similar, but more extensive district, called the East, West, and Wildmore Fens near Boston. This work was subsequently completed, and now forms the most perfectly drained district in the empire; and it is only to be regretted that these principles have not been acted upon to a greater extent in similar localities.

Much has lately been said about the principle of separating drainage from navigation, and it is stated, that the merit of the invention, if such it can be called, is due to others; their claims are not, however, well founded, for the late Mr. Rennie proposed the plan, on the Witham, near Lincoln, in 1803, and the works were finished by Sir John Rennie in 1827. It was unnecessary, in that case, to preserve the navigation up to Lincoln, and at the same time, to provide for the drainage of an extensive district of low-lands above the city. This was done by making two drains parallel to the Witham, called the North and South Delphs, which discharged their waters into the Witham below the locks at Horsley Deeps, about 6 miles from Lincoln.

The principle is recognised also, to a certain extent, in the catch-water drains, which were proposed by Sir John Rennie, in 1836, for the improvement of the Whittlesea district; by carrying the main drain under the navigation of the old Nene.

The propriety of adopting this principle, depends much upon local circumstances and convenience. Where old navigations exist, it would be both expensive and inconvenient to disturb them, the drainage may therefore be carried on by independent and separate channels; but where an entirely new district is to be drained, if the main drains be made low enough, and catch-water drains are formed, there can be no reason why the drains should not be made navigable, because it saves the cost of double channels, as well as the expense of keeping them open hereafter.

Report by Sir J. Rennie.

In 1824, the complaints of insufficient drainage became universal. The principal proprietors of the level, the Duke of St. Albans, Lords Yarborough and Manson, Sir M. Cholmondeley, Messrs. Corbett, Wynn, Uppleby, Skipworth, and others, determined to apply to Parliament for another Act, to amend their former Acts, to increase and enlarge their powers and to enable them to raise additional funds, for the purpose of carrying into effect the necessary works, required to complete the drainage and the navigation. They accordingly applied to Sir John Rennie for the necessary report, plans and estimates.

His report recommended, that the plans of the catch-water drains, as proposed by the late Mr. Rennie, should be carried out to their full extent. That the main river Ancholme should be straightened, widened, deepened, and enlarged, to double its then capacity; that a new sluice should be constructed at Ferraby, with its cill laid 6 feet lower than the old one, together with a new lock 20 feet wide, so as to serve the double purpose of accommodating larger vessels and of acting as an additional discharge for the drainage waters, during periods of flood. That all old bridges should be removed; as during floods they keep back the waters, and formed serious obstructions to the drainage. That a new lock should be constructed, at a place called Haarlem Hill, about 18 miles above Ferraby sluice.

That as during floods, the Ancholme and the Rasen brought down a considerable quantity of sand from the adjacent hills, so as sometimes to block up the main river and the drains, and thus to prevent them from discharging their waters and causing inundation of the adjacent lands; it was further proposed, to construct a large overfall and weir, with an extensive reservoir on the lower side, to catch all the sand and mud, which was brought down from the upper part of the country, and thus to prevent it from falling into the main river. From the reservoir, the mud and sand would be occasionally removed, at a trifling expense. It was also subsequently recommended, that there should be similar overfalls, weirs, and reservoirs, at all the minor streams, and brooks, where they united with the level.

An Act of Parliament for these objects was obtained, in the year 1825, the works were commenced directly and were completed, so far as regarded the navigation of the main river Ancholme, up to Bishop's Bridge, by the 18th of June 1828. This was with difficulty effected on account of the limited time allowed, and it was of the utmost consequence that this period should not be exceeded, because the time specified by the Act, for the completion of the navigation works, expired within three days afterwards; but as no time was specified, in the Act, for the completion of the drainage works, the Commissioners determined to proceed with them, more leisurely. The next important object, was the west catch-water drain; this, it was determined to carry into effect, only as far as Castlethorp, about 9 miles above Ferraby, and in order to save expense, it was kept within the level skirting the high lands near Appleby.

Works commenced in 1842.

The new sluice was proposed to consist of three openings, each 18 feet in width, having their cills 8 feet below the cill of the old Ferraby sluice, or from 2 feet 6 inches to 3 feet below low water of an average spring tide in the Humber.

The lock was to be 20 feet wide in the clear, and 80 feet long, between the gates, so as to give a clear water way of 74 feet, with an additional fall of 8 feet, which would discharge above four times the quantity of water in the same time that the old sluice could do.

The work, which was directed to be built wholly of the best Yorkshire stone, was commenced in the beginning of March, 1842, by forming two whole-tide coffer-dams of timber, one on the Humber, the other on the Ancholme side, so as to enclose a complete space for the sluice, including also the old sluice, but not the old lock, which was still left open for the navigation. In order to provide for the drainage, in the event of floods, an opening, 16 feet wide, was made through each coffer-dam. Both openings were fitted with lifting doors, working in grooves, to be raised by machinery, whenever it was requisite. The old lock also served as an additional opening for the drainage. The excavation for the foundations of the new lock and sluice, was made in alluvial silt and clay, in which piles from 24 feet to 28 feet long were driven, at intervals of 3 feet from centre to centre; the piles averaged 12 inches diameter, in the middle, and were of beech, elm, or fir timber, with wrought iron hoops and shoes, of sufficient strength to prevent them from splitting whilst being driven; their heads were then cut off and levelled; the earth was excavated 2 feet deep, below the pile-heads, large blocks of chalk were rammed in soundly between them, and the whole was well grouted with lime and sand. Upon the tops of the pile-heads, cap-cills, 12 inches square, of Memel fir, elm, or beech, were then nicely fitted, both in the longitudinal and transverse directions, and were firmly spiked down with jagged spikes; the spaces between the cills were then solidly filled up with brickwork, set and well grouted with the best Roman cement, and the whole was then covered with a flooring of Baltic fir plank, 3 inches thick, closely jointed and well spiked down to the cills below, with jagged wrought iron spikes 9 inches long. This flooring was also well bedded in lime, pozzolana, and sand, in the proportion of two parts of lime, three of sand, and one of pozzolana, well ground together. Upon the top of this platform, inverted arches of stone were laid, of solid masonry, 18 inches deep at the crown. The quoins, where the gates shut against, were 2 feet 6 inches deep, and were made perfectly water-tight. The piers were then carried up of solid masonry, set in pozzolana mortar, with the beds, faces, and joints finely dressed and set. When the piers were carried up to the requisite height, they were covered with elliptical stone arches to form the roadway.

Draw-doors for regulating the Navigation Level.

Each opening of the sluice was provided with double gates; one pair on the land-side, with draw-doors which lifted in a water-tight groove, by means of wrought iron pinions, working in screws attached to vertical rods. These draw-doors were for the purpose of regulating the navigation level, which is 13 feet 8 inches above the cill, and so as to enable a depth of 8 feet 9 inches to be preserved at Brigg, which is 9 miles distant, and 6 feet 6 inches at Haarlem Hill lock, which is 18 miles above the sluice. On the outer, or Humber side, there were also gates to prevent the tide from entering the level. These gates were self-acting, shutting by the force of the tide, and opening by the head of fresh water, as soon as the tide had fallen below the level of the water inside; they rested against stone mitred cills, carried down through the solid invert, and faced with segments of cast iron, run in with lead. At the top, the gates abutted against stone mitred arches, projecting from the face of the work, immediately below the elliptical arches which form the roadway. The stones forming these mitred arches, consisted of large blocks finely dressed, and bonded into the main body of the work. The usual mode of effecting this, is to make a framing of wood, above the gates, against which they abut. The wood, however, is subject to decay, and is not so strong as stone.

After the sluice was considerably advanced, it was considered advisable to make a communication with the west drain, by means of a side cut, in order to give to the district draining by the old west sluice the advantage of the increased fall of the new sluice. For this purpose it was decided to separate the western opening of the new sluice from the other openings, by means of a draw-door, which could be raised and lowered at pleasure, either for the purpose of turning the whole of the river Ancholme through the three openings, or only through two, as might be deemed advisable. Another door, or gate, was constructed on the opening, between the west drain and the river Ancholme, to be raised or lowered according to circumstances. The opening, between the two drains, was formed by an inverted arch, resting upon piles, cills, and planking, in a similar manner to that described for the rest of the work, and the gates, which were nicely balanced, were lifted by means of double purchase crabs, with racks and pinions. Over the opening between the Ancholme and the west drain, a stone arch served for a roadway to communicate with the west bank of the Ancholme.

Thus the principle of the west catch-water drain was still preserved, and the extra width and depth of the new sluice and cill was rendered sufficient to drain the level. The whole of the sluice was covered by elliptical stone arches, 18 feet wide, rising 4 feet 6 inches, and surmounted by a simple cornice and plain block parapet, 3 feet 7 inches high, perfectly level from one end to the other.

Lock-gates.

The lock, which was 20 feet wide in the clear, and 77 feet long, between the points of the gates, with a lift of 10 feet at high water, was provided with four pairs of gates; two pairs of which pointed seawards, and were high enough to exclude the highest tides; the other two pair, pointing landwards, were high enough to regulate the navigation level. These gates were wholly constructed of the best English oak, well fitted together with wrought iron straps and bolts. The lock was filled and emptied by means of side culverts in the piers and abutments, which were constructed of solid and finely-worked masonry, set in pozzolana cement, perfectly impervious to water. They were provided with cast iron sluices, working upon brass faces, and were raised and lowered by wrought iron pinions and screws. The whole of the lock was constructed of solid masonry, of the best description.

New Bridges.

Nearly all the old bridges, which were built chiefly of wood, with several small openings, the piles of which materially obstructed the passage of the water, particularly during floods, were removed, and were replaced by others, spanning the river with one opening. Commencing at the lower end, a new suspension bridge was built at Horkstow, one mile above the new sluice; the span was 130 feet, with stone piers. At Saxby, three miles higher, a wooden bridge was placed, consisting of a series of circular ribs bolted together, forming an arch 96 feet 6 inches span, with a versed sine, or rise, of 10 feet 4 inches. The roadway, which was also of wood, and curved 2 feet, was supported by a series of diagonal braces resting upon the arch below. Both arches rested against stone abutments. The roadway was 12 feet 4 inches wide, and the whole was very substantial.

Three other bridges, of corresponding construction, were placed at Cadney, 76 feet span, and 9 feet 3 inches in rise; at Hibaldstow, 74 feet span, and 9 feet rise; and at Minutes Farm, 74 feet span, and 8 feet 9 inches rise. At Bondby there was another bridge also of wood, but of a different construction, being framed in the form of a truss, the outer part being 7 feet in the middle.

At Brigg another bridge was built, consisting of a single stone arch, the segment of a circle, whose radius was 63 feet span, and the versed sine, or rise, was 11 feet. At Brandy Wharf was a cast iron bridge of a single arch, the segment of a circle, 55 feet span, with a versed sine, or rise, of 5 feet; with stone wing walls and abutments. The bridges of the west catch-water drain varied from 15 feet to 26 feet span, all of semi-elliptical arches, with a rise one-fourth of the span, and built of brickwork.

The whole of these works, which were completed on the 22nd of May, 1807, were opened, with considerable ceremony, by the Duke of St. Albans, the Earl of Yarborough, Mr. Uppleby, the Chairman, Mr. Skipworth, Mr. Corbett, and a large body of the Commissioners.

Thus, after a lapse of 43 years, since the late Mr. Rennie's report, and 556 years since the drainage commenced, these works have been finally completed, and the whole of this valuable and extensive district now receives the benefit of a perfect, natural drainage, without the adventitious aid of mechanical power. The sure principles of drainage,—catch-water drains for the highland waters, and improved rivers and drains for the lowland or fen waters,—have been established, and the whole of the Ancholme level is now converted into a rich arable district, capable of producing the finest crops of every kind.

The whole of the works have been completed under the direction of Sir John Rennie, the principal engineer, assisted by the able co-operation of Adam Smith (M. Inst. C. E.), the resident engineer, whose great experience, unwearied zeal, and perseverance, accompanied by no ordinary ability, entitle him to great praise. The late indefatigable clerk, Mr. Nicholson, and his successor, Mr. Hett, deserve also particular mention.

OBSERVATIONS.

Sir JOHN RENNIE, *President*, said, it would be observed, that in the paper he had brought prominently forward some leading principles of drainage, which he thought were very important.

There were, 1st, The formation of 'catch-water' drains, which separated the highland from the lowland waters, and conveyed each to independent sluices, at the lowest practicable outfalls. This system was, he believed, first practised by the late Mr. Rennie, about the year 1801, in the Witham drainage.

2nd, The straightening, deepening, and general improvement of the main river, separating, as much as possible, the navigation from the drainage; and—

3rd, The formation of over-fall weirs and reservoirs, for arresting the sand and mud, and preventing the drains from being choked.

The advantages of these plans must be evident, particularly for a flat district, surrounded by high lands. He was opinion, that the defects, complained of in the Bedford level, might be attributed, in a great degree, to the neglect of these principles, and the continuance of the old Dutch plan, of simply cutting a series of straight drains to the nearest point in the river, without sufficient regard to the outfall, where only as much of the water was discharged as was allowed by the time the sluice gates could be permitted, on account of the tide, to remain open. This plan alone was, he believed, still pursued in Holland. The attempts to drain the Pontine Marshes, under Pius VII., had been conducted on that principle, and even M. Prony, who was sent to Italy by Napoléon, for the purpose of reporting on the drainage of those marshes, made no other suggestion.

It had been asserted, that the Carr Dyke, which was constructed at the foot of the high lands between Peterborough and Lincoln, had been intended, by the Romans, for a 'catch water' drain and for a canal; but there was not any distinct evidence of the fact.

The works of the Nene Outfall, which were executed under Mr. Telford and Sir John Rennie, had cost about £160,000. By that great work, the low-water mark had been lowered 10 feet 6 inches, and in conjunction with the North Lever drainage works, which were executed under Mr. Telford, nearly 200,000 acres of land were most effectually drained, which, previously to that time, had been almost without cultivation. A further example of the effect of drainage might be given, in the Thorney estate, of 20,000 acres, belonging to the Duke of Bedford. It was stated, that at times, previous to the drainage, scarcely any rent had been paid; but now, in consequence of the improvement of the land, from the system of drainage, towards which his Grace had contributed about £100,000, an annual rental of nearly £25,000 was paid. The navigation of the Nene up to Wisbeach was also so much improved, that large vessels now arrived there, and the trade had been nearly trebled. At Sutton Bridge, about 8 miles below Wisbeach, where previously only moderate-sized colliers could arrive, even at spring tides, vessels of nearly 700 tons burthen could now be brought up, at ordinary spring tides. The flow of the tide, which formerly seldom exceeded between 11 feet and 12 feet, now attained a height of upwards of 21 feet, besides securing at low water a depth of between 5 feet and 6 feet in the channel down to the sea.

Mr. R. STEPHENSON said, that the system of 'catch-water' drains would not be generally applicable in Holland, on account of the flatness of the country, there being little high land, except near Utrecht.

Sir JOHN RENNIE, *President*, thought the Dutch, with all their talent and patient industry, had been somewhat too strongly attached to their old plans. In his opinion, if they had done more by warping on their coasts, they would have succeeded better, and would have saved much expense of embanking.

Overfall Weirs.

Mr. J. SMITH (*Deanston*) said, that possibly the farmers were satisfied, because the present state of the district was so much superior to its former condition; but if the level of the water was reduced still more, they might perhaps be better satisfied. With respect to the overfall weirs and reservoirs for arresting the sand and mud, there was no doubt of their actual utility, and every district would be improved by their introduction. In the present system of surface drainage, large quantities of the lighter particles of the soil were carried by the water, along the open furrows, into the drains; thus filling them up, and at the same time depriving the fields of their soil. This would, however, be in a great degree prevented, when subsoil drainage was more extensively introduced. The surface of the land would then be so arranged, that the rain would filter through into the drains, and it was now found, that even in very rainy seasons, the water from subsoil drains was but little charged with sand, or earthly particles, and that it could be used for many purposes, for which the drainage water had previously been unfit.

Mr. GILES must contend, that there was no necessity for placing the cill of the outlet sluice lower than 2 feet below low-water mark. It was not possible to drain to below that point, by natural means; and no extra amount of discharge would be obtained by going deeper. But, on the other hand, there would be a considerable deposit of silt against a cill placed deeper than 2 feet, and the gates would be prevented from shutting accurately.

Mr. J. WALKER said, although it was true that natural drainage could not be carried below low-water mark, yet in order to drain down to that level, the cill of the outlet sluice should be placed as much lower as was practicable. It should be recollected, that the gates only remained open for a short time, during which period it was desirable to discharge as much water as possible; then as the quantity, passing through the gates, could be appreciated by multiplying the depth of 2 feet down to the cill, into the width of the opening, and by the time the gates remained open, it was evident that if the cill was fixed at 6 feet or 8 feet below low-water mark, the greater depth, multiplied into the same width, would give a greater sectional area, for the passage of the water, in the same time. The friction of the water would also be less when flowing in a mass of good depth, than when it ran in a comparatively thin stream over the cill.

Drainage near Scarborough.

Sir George Cayley observed, that he had been for more than thirty years one of the directors for carrying out the provisions of the Muston Drainage Act, including about 10,000 acres of land near Scarborough. This drainage was effected under the direction of the late Mr. William Chapman, of Newcastle-upon-Tyne, who had great experience in such matters. The drains appeared to combine in their just and most economical proportions the two adverse principles at issue in the previously expressed opinions. In that extensive and gently rising marsh, the dead level principle was adopted from the lowest outfall, till the surface of the water in the drain, at ordinary times, was within about four feet of that of the soil, which level was found sufficient for the purpose of draining the adjacent lands. From this point, the drains took the average rise of the marsh, and continued it for several miles; thus furnishing, at the cheapest possible rate, a very useful and efficient drainage, to all the lands under the Act. Had the dead level been continued throughout the whole length, the expense would have been enormous, without rendering the drainage more complete, and had the dead level not been brought up to the point named, many hundred acres of the lower portion of the swamp would not have received any benefit.

The general plan of the Muston drainage might be thus stated. The small rivers Hartford and Derwent, with several brooks, held their courses through an extensive marsh, and in times of heavy rain, they overflowed their banks and flooded the land to a great extent. No expense whatever was incurred, for cutting channels, deep enough to convey away the flood waters of these rivers, or brooks, but they were allowed to keep their ancient levels, and embankments were made near them, on each side, by cutting deep back drains, for carrying the dead water from the lands, and casting up the soil excavated from them, on to the sides next the rivers or brooks. By this process, all the great body of water was conveyed, in times of flood, within these embankments to the lowest outfalls, and the deep cutting, which he considered the "sinè quâ non" of an efficient drainage, and the expensive part of it, was entirely confined to such moderate sized drains, as were sufficient merely to convey the dead water from the land. Another practical advantage, of the deep back drains being contiguous to the embankments, was, that when they received any injury from cracking, after long droughts, or the burrowing of moles and water rats, and thus permitted the flood-water to pass in some degree through them, the back drains interrupted it, and preserved the land from injury.

The original cost of this drainage was about £40,000; and the annual repairs averaged about £800. The improved rent was obtained at about four or five years' purchase.

The expense of this drainage had been much increased by local circumstances, and which could scarcely be supposed to occur in any other cases; and therefore it was unnecessary to detail them; but these circumstances took place at a distance from the marsh land, and in no way invalidated the state of the case.

Sir John Rennie, *President*, said, that Mr. Telford, in his drainage works, had as nearly as possible acted upon an uniform system, similar to that which had been described; but that, in particular cases, it was necessary to adopt peculiar methods. It was certain, however, that in all cases, it was essential to commence the drainage at the lowest point of outfall, and to work inwards, towards the head of the marsh. In the Bedford Level that system had been neglected, and to that circumstance Sir John Rennie attributed much of the difficulty that had been experienced.

It was always a point of importance to restore the rivers to their natural state, of main drains for the country. At Boston, in the year 1826, he recollected seeing the bed of the river nearly dry, at the time of what ought to have been high water. Since then, the outfall below Boston had been improved, by making a cut across Burton's Marsh, and improving the channel of the river upwards, upon a plan proposed by him; the effect of these works had been such, that vessels, drawing upwards of 14 feet of water, now arrived at Boston.

The Academy of Sciences of St. Petersburgh is preparing an edition of the works of Euler more complete than any hitherto published, for it will contain several tracts deposited in MS. in the library of the University of Dorpat which have never yet been printed, besides others preserved in various libraries of Germany. The edition will form thirty volumes.

TABLE OF BRITISH AND FOREIGN STEAM VESSELS, WITH THEIR PRINCIPAL DIMENSIONS.

For the following table we are indebted to a young friend, who has collated it with great labour from all the published lists, with numerous additions, obtained by personal enquiry. Every effort has been made to ensure its completeness and accuracy, ti will be found to be fuller than any yet published.

ABBREVIATIONS.—O, Peninsular and Oriental Company.—G. Government.—E. I. C. East India Company.—E. I. C. East India Company War Steamers.—W. I. M. West India Mail Company.—Tug or T. Tug Boats.—S. Screw.—R. River Boats.—C. A. or C. A. M. Cunard's American Mail Steamers.—W. War Steamer belonging to a foreign country.—Q. Y. Queen's Yacht.—A. Y. Admiralty Yacht.—H.P. Horse Power.

Name.	Builder.	Engineer.	Launch.	Material	Tonnage	Length over all.	Length of keel.	Between Perpendiculars.	Extreme Breadth	Depth.	Mean Depth.	H.P	Diameter of Cylinder	Length of Stroke.	Diameter of Wheel.
						Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.		In.	Ft. In.	Ft. In.
Acteon ..	Robert Duncan	Caird and Co.	1837	wood	552			171 0	25 10	17 3	10 0	290	62	5 9	24 6
African, G. ..	Admiralty	Maudslay	1826	wood	320			109 10	24 10	20 0	9 4	90			14 7
Atna ..	Admiralty	Fawcett	1828	wood	306				22 6		11 0	120	46	4 3	17 2
Alban, O. ..	Deptford Yard	Boulton, Watt & Co.	1827	wood	293	109 8	91 11⅝	106 9	41 8	11 0	11 0½	80	35½	3 6	13 0
Agir ..	Fairbairn	Fairbairn	1841	iron	254½	150 6		145 0	19 0	10 1	5 8	80	36¾	3 0	16 0
Acbar, E. I. C. ..		Robert Napier	1843	wood	1100							350			
Albert, G. ..	Laird	Forrester	1840	iron	440	136 0		130 0	27 0	10 0	5 9	70			
Albion ..	Evans	Boulton and Watt	1830	wood	315	133 9	115 3	130 5	41 4	11 3	5 2	80	35½	3 6	13 6
Atburkah, G. ..	Laird		1832	iron	56			70 0	13 0	6 6	4 0	16			
Alecto, G. ..	Admiralty	Seaward	1838	wood								200	53	4 6	26 0
Alice, Tug ..		Davonport	1839	iron	170			95 0	20 0	9 0	4 6	60	31	3 3	14 0
Amsterdam ..	Foreign	Boulton, Watt & Co.		wood	170	107 0	93 11	105 0	33 10	11 0	7 0	60	31½	3 0	
Antelope ..	Pitcher	Boulton, Watt & Co.	1843	wood	123½		90 5	100 0	16 0	9 6	7 3	40	26¾	2 6	
Arrow, A. ..	American			wood		160 0			21 0		4 3		31	11 0	22 0
Arrow ..	Evans	Boulton, Watt & Co.	1821	wood	130	96 5	82 2	92 2	33 0	10 3	5 11	40	26¾	2 6	10 0
Arcadis, C. A. ..	J. Wood	Robert Napier	1840	wood	1200	228 0		206 0	34 6	22 6	4 3	420	72	6 10	28 0
Archimedes, S. ..	Winshurst	Rennies	1838	wood	237	125 0		107 0	22 6	19 0	9 4	84	36	3 0	5 9
Avon, W. I. M. ..	Acraman	Acraman	1841	wood	1354	238 0		213 0	36 6	30 6	17 6	450	75	7 0	30 8
Avenger, G. ..	Admiralty	Maudslay	1844	wood	1444			210 0	39 0	25 6		650			
Atmospheric, R. ..	Ditchburn	Seaward	1843	iron	365			150 0	18 0	9 9	4 8				
Anti, J. Scott Russell	Beale	Beale	1843	iron				53 0	6 0	3 3			14		
Aurora ..	Connell	Irish	1838	wood	453	170 0			23 0			240			
Bearer, G. ..	Admiralty	Maudslay		wood	128			102 2	16 0	10 0	6 0	62			
Bentinck, O. ..	Wilson	Fawcett	1840	wood	1600	250 0	220 0		39 0	31 6		520	78½	8 0	
Bernice, E. I. C. ..	J. Wood	Robert Napier	1836	wood	646		148 5	164 10	28 8	20 0	13 0	240	56	5 6	23 0
Black Eagle, G. ..	Admiralty	Penn		wood	496		136 9½	155 0	26 1	14 10	10 6	270	62	4 6	23 0
Blackwall, R. ..	Ditchburn	Miller	1842	iron	258½			145 0	19 1	9 10	5 0	90	55	3 0	15 6
Britannia, C. A. M. ..	J. Wood	Robert Napier	1840	wood	1200	228 0		206 0	34 6	22 6	16 6	450			28 0
Britannia ..		Gladstone	1825	wood	90				24 6		11 0	20	46	4 0	
Brunswick, R. ..	Ditchburn	Seaward	1842	iron	258½	150 0		145 0	19 1	9 10	5 6	90			
British Queen, W. ..	Curling and Young	Robert Napier	1838	wood	1862	275 0	223 0	240 0	40 0	27 6	17 0	500	77½	7 0	30 6
Braganza ..		Scott and Sinclair		wood								288	62	5 6	24 0
Belle, A. ..	New York	New York	1838	wood		190 0			26 0		4 6		50		11 0
Caledonia, C. A. M. ..	John Wood	Robert Napier	1840	wood	1200			206 0	34 6	22 6	16 6	450			28 0
Caledonia ..	C. Wood	Boulton and Watt	1817	wood	95	92 0	70 10	94 0	27 8	9 0	4 3	28	23	2 6	13 0
Cambridge ..		Girdwood		wood									55½	5 0	
Carron, G. ..	Admiralty	Boulton and Watt	1827	wood	293	109 8	91 11½	106 9	46 0	11 0	11 6½	100	39½	3 6	13 6
City of Aberdeen ..		Scott and Sinclair		wood									62	5 6	
City of Canterbury R.		Boulton and Watt		wood								122	43½	3 6	16 6
City of Edinburgh ..	Wigram	Boulton and Watt	1821	wood	400	142 10	116 0	134 7	25 0	14 6	8 6	80	35½	3 6	18 0
City of Glasgow ..	John Wood	Robert Napier	1836	wood	550			155 0	24 0	16 0	10 6	150			21 0
City of London ..	Robert Napier	Robert Napier	1844	iron	1119	230 0	195 0	215 0	32 0	19 4		400	71	6 6	
City of Dublin ..		Fawcett	1828	wood	300				22 4		11 0	130	45	3 6	
Cinderella ..	Wigram	Boulton and Watt	1823	wood	234	119 9	101 4	116 6	37 10	12 6	8 9	80	35½	3 6	13 2
Clyde, W. I. M. ..	Robert Duncan	Caird and Co	1841	wood	1354	238 0		215 0	36 6	23 6	12 6	450	74½	7 6	30 6
Colchis (Russian) ..	Fletcher	Butterly & Co.	1837	wood	430½			156 0	24 6	13 6	9 6	125	42	4 6	17 0
Colereigne ..	John Wood	Robert Napier	1835	wood	380			133 0	24 6	11 6	9 0	150			18 0
Columbia (lost) ..	John Ward	Robert Napier	1840	wood	1200			206 0	34 6	22 6	16 6	450			28 0
Columbus ..	Liverpool		1839	wood	330		145 0		21 6	13 6		110	40½	3 6	17 6
Comet, G. ..	Admiralty		1822	wood	237	118 0	101 2	115 0	40 3	11 10	7 9½	80	35½	3 6	12 6
Comet ..		Maudslay	1825	wood	380				22 6			150	46½	4 6	
Cormorant, G. ..	Admiralty	Fairbairn	1843	wood	1100	210 0		180 0	36 0	21 0		300	65½	5 3	26 0
Concordia ..	Fairbairn	Fairbairn	1839	iron	119	112 8		108 3	15 0	8 3	3 6	36			10 2
Congress, A. ..	Ward, Stillman & Co.	Ward, Stillman & Co.	1843	wood	671	160 0			30 8	14 6	8 6		42½	4 7	18 0
Coquette ..	Fairbairn	Fairbairn	1840	iron	163½	150 0		145 0	15 0	8 0	3 7	50			14 6
Courier ..	Ditchburn	Penn and Son	1840	iron	310				20 3	9 0	1 4	70	34	3 0	15 0
Cyclops, O. ..	Admiralty	Seaward	1839	wood	1195	216 6		190 0	36 6	13 0	15 6	350		5 0	26 0
Cumberland ..	Graham	Boulton and Watt	1826	wood	288	133 8	117 3	128 0	38 6	15 6	8 2	80	64¾	3 6	13 6
Dart, R. ..				iron	48			81 0	14 0	7 0	2 3	22	20	2 0	11 0
Dart ..	Evans	Boulton and Watt	1825	wood	262	118 8	101 9	115 0	40 3	12 3	5 10	100	39½	3 6	14 0
Dather ..	Evans	Boulton and Watt	1821	wood	134	88 0	74 0	86 6	34 3	10 6	6 1	40	26¾	2 6	13 0
Dee, W. I. M. C. ..	Scott	Scott and Sinclair	1841	wood	1354		207 0	213 0	36 0	30 6	17 6	450	73	7 0	28 6
Dee, G. ..	Admiralty	Maudslay	1827	wood	700	180 0			31 0	18 0	10 0	200			20 0
Devastation, G. ..	Admiralty	Maudslay	1841	wood	1100	210 0		180 0	36 0	21 0		400	54½	6 0	27 0
Dolphin ..	Fairbairn	Fairbairn	1839	iron	107			110 0	14 0	7 6	2 3	50	28	2 0	10 4
Dolphin ..	Graham	Boulton and Watt	1826	wood	140	142 8	121 0	136 0	44 5	14 9	10 6	327	45	4 6	17 0
Don Juan, O.	Fletcher and Co.	Girdwood	1836	wood	775½	200 0	180 0		29 4	19 0	12 9	350	68	6 0	
Dover, G. ..	Laird	Fawcett		iron	230			110 0	21 0	11 0	6 0	80			
Duchess of Sutherland	C. Wood	Robert Napier	1835	wood	380			150 0	20 6	15 6	10 0	200			21 0
Dundalk ..	Robert Napier	Robert Napier	1834	iron	560	180 0		17 0	26 0	16 0	10 6	280	61	5 6	24 9
Dundee ..	T. Wood	Robert Napier	1834	wood	650			170 0	28 0	17 5	11 6	250	58	5 6	24 0
Driver, G. ..	Admiralty	Seaward	1840	wood	1100	210 0		185 0	36 0	21 0		280	62	5 3	26 0
Dwarf, G. ..	Ditchburn	Rennie	1844	iron	164			130 0	16 6	9 0		90	37	2 8	a. 5 8
Duchess of Lancaster				wood	238			120 0	20 0		6 0	90	40	3 0	
Dragon, G. ..	Admiralty	Fairbairn		wood								580	87½	5 9	27 0
Dragon ..	Graham	Boulton and Watt	1820	wood	237		102 9	117 4	38 0	12 6	7 9	80	35½	3 6	13 6
Diana, R. ..	Evans	Boulton and Watt	1827	wood	59	87 6	77 9	85 0	23 1	7 3	2 3	15	19½	2 0	10 0
Eagle ..	Fairbairn	Fairbairn	1842	iron	303			180 0	18 6	9 4	4 9	100			
Eclipse, R. ..	D. Napier	D. Napier	1840	iron	277⅜			156 0	19 0	11 0	5 6	100	54½	4 0	16 6
Eclipse, R. ..				iron	78			95 0	13 0	7 0	2 3	27			11 0
Elterfeld (lost) ..	Ditchburn	Miller	1843	iron	383			176 0	21 0	11 6	2 8	110			
Enterprise, T. ..	Fairbairn	Fairbairn	1839	iron	92			76 6	16 0	8 0	3 9	40	27½	2 6	12 6
Era, R. ..	Spiller	Spiller		iron	60			85 0	12 0	5 11	2 5	24	29	1 8	10 4
Erie, A. ..	American	American		wood					27 0		5 6		44	10 0	22 0
Enterprise, T. ..	P. Borrie	P. Borrie	1839	iron	300		116 0		21 0	9 0	2 6	70			
Eclair, G. ..	Admiralty	Miller	1843	wood	1100	210 0		180 0	36 0	21 0		300	65	5 0	26 0
Empire, A. ..	American	American	1845	wood	1220	260 0						600			
Erin ..		Fawcett		wood	400				25 0		10 0	150	46½	4 9	20 6
Emerald Isle ..		Fawcett		wood	400				23 0		12 0	150	46½	4 0	
Escape ..	Graham	Boulton and Watt	1826	wood	237	119 0	102 9	117 6	38 0	12 6	8 4½	80	35½	3 6	13 6
Eagle ..	Brockelbank	Boulton and Watt	1821	wood	174	92 9	75 0	89 0	36 4	9 6	4 5	40	26¾	2 6	14 0
Eclipse ..	Evans	Boulton and Watt	1819	wood	230	113 5	98 3	110 10	37 2	11 1	4 8	60	31½	3 0	16 0
Eridano ..	Foreign	Boulton and Watt	1828	wood	154	103 6	89 4	100 0	30 0	9 0	4 10	40	: 6¾	2 6	11 0
Fairy, Q. Y. ..	Ditchburn	Penn and Son	1845	iron	260	145 0			21 0	10 6	5 0	105	42	3 0	a. 5 4
Father Thames, R. ..	Ditchburn	Penn and Son	1840	iron	247			140 0	19 0	10 0	4 0	75	35	3 6	18 6
Fire King ..	R. Napier	Robert Napier	1839	iron	663			175 6	28 0	16 8		230			
Forth, W. I. M. P. ..	Menzies	Bury and Co.	1841	wood	1350	245 0			36 2	30 3	17 6	450			

Name.	Builder.	Engineer.	Launch.	Material	Tonnage	Length over all.	Length of keel.	Between Perpendiculars.	Breadth.	Depth.	Mean Draught	H.P	Diameter of Cylinder	Length of Stroke.	Diameter of Wheel.
						Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.		In.	Ft. In.	Ft. In.
Fulton, W. ..	American	Kemble		wood	875	130 0			34 6		10 0	400	50	9 0	22 5
Fury, G. ..	Admiralty		1845	wood	1123	212 0		190 0	36 0	21 0					
Fly ..	Wallis	Boulton and Watt	1830	wood	74		77 0	85 0				20	1½	2 0	
Fury ..	Graham	Boulton and Watt	1824	wood	106	91 6	76 10	88 0	20 8	9 9	6 4	40	26½	2 6	10 0
Favourite ..	Evans	Boulton and Watt	1818	wood	121	94 6	70 0	90 0	23 0	9 2	21 6	40	26½	2 6	13 4
Firebrand, G. ..	Admiralty	Seaward	1843	wood								400			25 0
Firefly ..	Butterly and Co.	Butterly and Co.		iron								138	43½	4 6	17 6
Glow-worm ..	Laird	Forrester	1838	iron	361			153 6	22 0	12 0	6 6				
Gorgon, G. ..	Admiralty	Seaward	1838	wood	1150		152 3	178 0	37 6	23 0	15 8	320			25 10
Grappler, G. ..	Fairbairn	Maudslay	1845	iron	557			165 0	26 6	17 0	10 0	220	40	4 6	21 0
Great Britain ..	Gt. W. St. Ship Co.	Gt. W. St. Ship Co.	1844	iron	3443	322 0	289 0	286 0	50 6	32 6	16 0	1000	88	6 0	s. 15 6
Great Liverpool, O...	Wilson	Forrester	1837	wood	1140	240 0	209 5	233 0	30 10	19 5	16 0	460	75	7 0	28 5
Great Northern S. ..	Coppin and Co.	Miller	1842	wood	1430	247 0		221 0	37 0	26 0	18 0	325	64	4 6	s. 11 0
Great Western ..	Company	Maudslay	1838	wood	1321	236 0		212 0	35 4	23 3	16 0	440	73½	7 0	28 3
Guadaloupe, W. ..	Laird			iron	800	201 0			30 0	17 0	9 0	360			
Gipsy Queen ..	Samuda	Samuda	1844	iron	436	197 6		175 0	21 0			249			
Gladiator, G. ..	Admiralty	Miller	1845	wood	1190		178 5	203 6	37 6			430	78½	5 9	
Germ, A. ..	American	Lieutenant Hunter	1841	wood		50 0			11 0			7			
Geyser, G. ..	Admiralty	Seaward	1839	wood								268	62	5 3	26 0
George, R. ..	Fletcher	Seaward	1830	wood	320		127 0	140 0		11 0	5 10	120	42½	4 0	
George, St. ..		Fawcett		wood	300				22 4		11 0	120	42	3 6	17 0
Hamlet ..	Fairbairn	Fairbairn	1842	iron	130			96 0	17 0	9 6	5 6	40	27½	2 3	11 0
Helen MacGregor ..	Laird	Forrester	1843	iron	593	175 0		180 0	26 0	16 0	11 0	220	42	4 6	23 6
Herne, R. ..	Ditchburn	Boulton and Watt	1844	iron	355			155 6	21 6	10 0	8 2	120	43½	3 6	18 6
Hibernia, C. A. ..	R. Steele	Robert Napier	1844	wood	1350		218 0	218 0	36 0	24 0		500	77½	7 6	17 6
Hindostan, O. ..	Wilson	Fawcett	1842	wood	1600	250 0	220 0		39 0	30 6		520			
Her Majesty ..	Todd & M'Gregor	Tod and M'Gregor		iron	600							300			
Hecla, G. ..	Admiralty	Scott and Sinclair		wood								280			
Hecate, G. ..	Admiralty	Scott and Sinclair		wood								280	60	5 9	
Hawk ..	Wallis	Boulton and Watt	1826	wood	133	96 6	84 2	93 6	31 9	9 6	5 2	40	26½	2 6	11 0
Hibernia, C. D. S. P. ..		Fawcett	1825	wood	400				22 6			150	45	4 0	14 0
Hoogley ..	East Indies	Boulton and Watt	1827	wood	302	130 0	112 3	125 9	41 10	14 6	9 7	120	42	4 0	
Hero ..	Bancham	Boulton and Watt	1827	wood	255	116 9¼	100 0	113 0	43 2	12 4	6 8	100	39½	3 6	13 8
India ..	Scott and Sinclair	Scott and Sinclair		wood	1000		189 0	202 0	32 9	28 0		325	63	5 9	26 6
Invincible ..	Tod and M'Gregor	Tod and M'Gregor	1844	iron			125 0		17 3	8 0		85	49	4 2	16 0
Iron Duke ..	Fairbairn	Fairbairn	1840	iron	110			100 0	15 0	7 9	5 6	24			10 0
Iron Duke ..	Wilson	Fawcett		iron	683				28 0	17 0	3 4	350			
Iron Prince ..	Hodgson			iron	168			108 0	18 0	9 6	10 0	26			s. 5 6
Isis, W. I. M. C. ..	Pitcher	Miller and Co.	1841	wood	1298			215 0	36 0	23 0	17 3	450	74½	7 0	29 3
Ironsides ..	Jackson		1838	iron	271		96 0		24 6	13 10	8 5				
James Watt, G. S. N.	C. Wood	Boulton and Watt	1821	wood	448	150 7	126 3	141 9	25 8	15 0	10 0	100	39½	3 6	18 0
Janus, G. ..	Admiralty	Earl Dundonald	1841	wood	761½	210 0	159 1	180 0	30 0	19 1	11 6	208			21 0
Jason ..	Fletcher	Butterly and Co.	1837	wood	433½			156 0	24 0	13 6	9 6	125			17 0
Kamschatka, W. ..	American	Schuyler, N. Y.	1841	wood	1500		210 0		36 0	24 6	18 0	600			
King of Netherlands	Wigram	Boulton and Watt	1823	wood	180	110 10	94 3	107 6	33 0	9 1	5 9	60	31½	3 0	12 0
Kent ..	Bancham	Seaward	1829	wood	179	106 6	94 4½	105 9		10 8	5 8	90			
Lady Burgoyne ..	Fairbairn	Fairbairn	1843	iron		130 0		126 0	17 6	9 6	4 9	85	30	3 0	15 3
Lightning, R. ..		Penn and Son	1842	iron	55			85 0	11 0	6 0	2 0	24			10 4
Little Western, R. ..	Acraman	Acraman and Morgan	1841	iron	721	216 0	194 0	200 0	27 0	17 6	11 0	180	51	4 0	
Lpool Screw ..	Grantham	Grantham	1843	iron	50			65 0	12 6	7 0	3 3	20	13	1 6	s. 5 4
Locomotive, R. ..	Ditchburn	Braithwaite	1841	iron	70			105 0	11 6	6 6	2 6		12	1 6	11 4
Loudon ..	John Ward	Robert Napier	1837	wood	650			170 0	28 0	17 6	11 6	150			24 0
Ladoga ..	Fairbairn	Fairbairn	1838	iron	215½	140 0			18 0	9 0	3 8	80			
Ludwig ..	Fairbairn	Fairbairn	1836	iron	176½	120 0			17 0	8 0		40			
L'Hirondelle ..	Fairbairn	Fairbairn	1835	iron	171	116 0			18 0	8 0	3 3	60			
Lord Yarborough ..		Yates	1825	wood					13 0		5 9	30	24	2 8	11 0
London, R. ..	Boulton and Watt	Laforte	1824	wood	56	83 0	73 0	80 0	22 11	8 4	3 0	20	19½	2 0	
Lord Melville ..	Butterly and Co.	Fletcher	1830	wood	205	108 7	92 0	106 6	40 0	11 6	7 6	80			
Liman ..	Boulton and Watt	Foreign		wood	269	123 0	104 9	118 0	38 6	10 0	4 4	60	31½	3 0	
Lee ..	Fawcett		1825	wood	300				22 0		10 6	120	43	4 0	18 6
Leeds, C. D. S. P. ..	Fawcett		1825	wood	300				25 0		10 0	120	45	4 0	18 6
Liverpool ..	Fawcett		1834	wood	300				22 6		11 0	130	45	3 6	
Lord Blayney ..	Clegg		1824	wood	300				22 0		10 6	120	42	4 0	18 0
Massachusets, A. ..	American	American		wood		200 0			29 5	13 0	8 6		44	8 0	22 0
Magician, G. S. N...	Ditchburn	Penn and Son	1843	iron	360	155 0		146 0	21 6	10 0	5 6	110		3 6	17 9
Medea, G. ..	Admiralty	Maudslay	1843	wood	870	210 0		179 4	31 11	20 0	14 0	220	55½	5 0	24 6
Medina, W. I. M. C.	White (?)	Bury and Co.	1841	wood	1354			213 0	36 6	23 0	17 6	450			
Medway, W.I.M.C.	Pitcher	Maudslay	1841	wood	1300		193 8	215 0	36 0	23 0	17 6	450			
Megara, G. ..	Fairbairn	Fairbairn	1845	iron	1298			195 0	37 6	22 0	15 0				
Meteor, R. ..	Miller and Co.	Miller and Co.	1844	iron				170 0	18 0		4 0	80	37	3 9	15 9
Memnon, W. I. C...	Fletcher	Maudslay		wood	1100							400			26 0
Minerva, R. ..		London	1837	wood	65			100 0	11 0	6 6	2 3	24			11 6
Mississippi, Missouri	American	American		wood		228 9	206 9		40 0	23 6		600			28 9
Monarch, G. S. N...	Wigram		1833	wood		208 0	180 0		32 0	18 4	10 6	200			21 0
Mongibello, W. ..	Wigram	Maudslay	1843	wood	590			156 0	26 0	17 0		200	39	4 3	
Manchester ..	Fairbairn	Fairbairn	1832	iron	70	76 0			15 0	8 0		30			
Magnet, G. S. N. ..	Tillet	Boulton and Watt	1827	wood	315	133 1	111 3	126 0	44 6	12 6	6 3	120	42	4 0	15 6
Meteor, G. ..	Daptford Yard	Boulton and Watt	1824	wood	296	131 0	111 9½	126 0	44 0	13 8	9 2	100	39½	3 6	13 6
Moerdyke ..	Colthorp	Boulton and Watt	1822	wood	84	82 1	71 3	80 0	27 2	7 6	3 4	16	24½	2 0	10 0
Mersey, C. D. S. P...		Fawcett	1824	wood	300				21 0		9 0	90	44	3 6	15 0
Mona ..		Fawcett	1825	wood	250				20 6		11 6	110	40	4 0	15 8
Manchester ..		Gladstone and Co.	1824	wood					25 0		11 0		46	4 3	19 0
Meteor, G. ..	Laforte	Boulton and Watt	1821	wood	185	104 6	88 5	103 0	37 0	11 6	7 2	60	31½	3 0	12 0
Narragansett, A. ..	American	American		wood		210 0			26 0	10 7	5 6		50	12 0	25 0
Nemesis, E. I. C. ..	Laird	Forrester	1840	iron	660	184 0		165 0	29 0	11 0	6 0	120			17 6
Nerka ..	Fairbairn	Fairbairn	1838	iron	231½	150 3		145 3	18 0	10 0	4 0	7			15 6
New York ..	Wilson	Fawcett and Co.	1840	wood	1300	235 0			36 6	22 0	15 6	420			24 6
Nile, W. ..		Boulton and Watt		wood	911	190 0			33 6	20 6	13 6	260	60	5 2	22 0
Nimrod ..	Vernon and Co.	Bury, Curtis and Co.	1843	iron	591		175 0	180 0	26 0	16 0	11 0	300	66	5 3	24 6
Northern Lights Y...	Fairbairn	Penn and Son	1845	iron	303½	148 9		142 0	21 0	12 9	6 0	150	47	4 3	19 0
Napoleon, W. ..	French Government	Barnes	1842	wood				155 8	27 8		19 0	130	45	3 6	
Neptune, A. ..	New York	American	1841	wood					25 0		7 0		50	11 0	25 0
New York, A. ..	New York	American	1841	wood					22 0		4 0		50	10 0	24 0
Neufchatel ..	Foreign	Boulton and Watt	1827	wood	166	94 0	81 3	93 0	31 7	7 11	2 9	28	23	2 0	
New Eclipse ..	Wallis	Boulton and Watt	1829	wood	176	114 9½	94 11	107 9	31 7	9 9	5 6	76	35½	3 0	12 6
North America, A...	New York	Stevens		wood					84 10				44½	8 0	21 0
Orion ..	Read	Lloyd and Easter	1840	iron	347				22 3	10 6	4 9	100	38½	3 6	
Ondine, W. ..	Miller and Ravenhill	Miller and Ravenhill	1845	iron								100	42	3 0	
Oriental, O. ..	Wilson	Fawcett	1839	wood	1670	235 0			36 6	22 0		450	73½		
Osceola, R. ..	New York	Hall	1830	wood										11 0	28 8
Odin, G. ..	Admiralty	Fairbairn		wood								560	87½	5 9	26 6
Pelke Sigareter ..	Fletcher	Miller and Co.	1843	wood	568			168 0	26 6	16 6	10 0	180			
Il Petero ..	Pitcher	Boulton and Watt	1843	wood	252			130 0	20 2½	11 2		100	39½	3 6	15 6
Penelope, G. ..	Admiralty	Seaward	1842	wood	1630			216 0	40 0	25 0		620	92	7 0	30 0
Phlegethon, O. ..	Laird	Forrester	1840	iron	500			157 6	26 0	16 0		100			
Precursor, O. ..	J. Wood	Robert Napier	1841	wood	1476	244 0		225 0	37 0	25 0	17 0	520	80	7 0	28 0
Perth ..	J. Wood	Robert Napier	1834	wood				170 0	28 0	17 6	11 6	250			24 0
Princeton, W. ..	American		1844	wood	700			164 0	30 0	22 6	17 6	260			s. 6 0
Promethus, G. ..	Admiralty	Seaward	1839	wood	797		141 6	170 0	32 6	18 7	12 6	200	53	4 6	2. 6

Name.	Builder.	Engineer.	Launch.	Material	Tonnage	Length over all.	Length of keel.	Between Perpendiculars.	Breadth.	Depth.	Mean Draught	H.P	Diameter of Cylinder	Length of Stroke.	Diameter of Wheel.
						Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.		In.	Ft. In.	Ft. In.
President (lost) ..	Curling and Young	Fawcett and Co.	1840	wood	1840	265 0	220 0		41 0	30 0	17 0	535	80	7 6	31 0
Prince Albert, R. ..	Coutts	Braithwaite		iron	300			155 0	19 6	9 6	4 6	100	40	3 4	17 6
Prince of Wales ..	Tod and M'Gregor	Tod and M'Gregor	1842	iron	585			160 0	26 6	15 6	7 9	270	61	5 0	25 0
Prince of Wales, R...	Miller	Miller	1843	iron	430		180 0		22 0	10 6		140			18 4
Princess Royal ..	Tod and M'Gregor	Tod and M'Gregor	1841	iron	800	206 0	185 0		28 0	17 0	10 0	410	73	6 3	28 6
Princess Alice, G. ..	Ditchburn	Maudslay	1843	iron	260	145 0		120 0	20 0	10 6	6 6	120	48	3 6	19 3
Princess Mary ..	Ditchburn	Maudslay	1844	iron				143 0	20 6		6 3	120			
Princess Maude ..	Ditchburn	Maudslay	1844	iron											
Peru ..	Curling and Young	Miller	1840	wood	700							90			
Prussian Eagle ..	Fairbairn	Fairbairn	1838	iron	100¼	129 6			14 0	6 6	2 4	50			
Pradpriatic ..	Fairbairn	Fairbairn	1839	iron	91¼			79 0	16 0	8 0	3 4	40			
Proserpine, E.I.C...	Ditchburn	Maudslay	1840	iron	470							90			
Polyphemus, G. ..	Admiralty	Seaward		wood								200	53	4 6	26 0
Pearl, R. ..	Fletcher	Seaward	1829	wood							5 6	65½			
Patrick, St. ..		Clegg	1825	wood	300				22 0			120	42	4 0	18 0
Queen, R. ..	Rennies	Rennies	1844	iron	217⅓			160 0	16 6	8 9	4 3	90	29	4 5	16 6
Queen, E. I. C. ..	Curling and Young	Seaward	1839	wood	767			173 0	31 0	19 6	14 0	220			22 0
Queen Victoria, R...		Penn and Son	1840	wood											
Queen of Netherlands	Wigram	Boulton and Watt	1824	wood	164	109 9	94 3	105 0	32 1	10 6	5 11½	40	26¾	2 6	10 0
Queen of the French	Ditchburn	Maudslay	1845	iron				145 0	22 0		6 0	120			
Queen ..	Laird	Forrester	1844	iron				110 0	22 0			60			
Queen of the East ..	Holmes		1838	iron	2618¾	310 0		270 0	45 0	30 0		600	84	9 0	14 0
Quorra, G. ..	Admiralty	Seaward	1832	wood				112 0	16 0	8 0	6 0	40			
Robert Napier .	J. Wood	Robert Napier		wood	207		138 9		22 0	14 11		180			
Rattler, G. ..	Admiralty	Maudslay	1844	wood	800½	195 0	137 9½	176 0	32 8½	18 8	11 3	200	40	4 0	s. 9 0
Retribution, G. ..	Admiralty	Maudslay	1844	wood	1641		192 10	220 0	40 6	26 4	18 0	800	72	8 0	34 0
Railway, R. ..	Ditchburn	Penn	1842	iron	258½	155 0		145 0	19 1	9 10	5 3	90	39½	3 0	15 6
Rainbow, G. S. N...	Laird	Forrester	1837	iron	581	200 0		190 0	25 0	12 0	6 0	180	50	4 6	21 0
Red Rover, R. ..	Fletcher	Boulton and Watt	1835	wood	377			154 0	22 4	10 6	5 6	120			16 6
Rhenus ..	Fairbairn	French	1842	iron				145 0	18 0	8 0	2 0	150			17 9
Roberto ..	Pitcher	Maudslay	1843	wood	1056			190 0	34 0	19 0	14 0	300			
Rochester, A. ..	American	America		wood				195 0	24 0	8 6	2 0		43	10 0	24 0
Rocket, G. ..	Fairbairn	Fairbairn	1842	iron	70⅓			90 0	12 8	7 4	0 6	20	19	2 0	9 8
Roncline ..	Pitcher	Boulton and Watt	1843	wood	123		90 5	100 0	16 0	9 6	6 6	40	26¾	2 6	
Rose ..	Fairbairn	Fairbairn	1840	iron	306			148 0	20 6	11 6	6 6	100	40½	3 6	17 0
Royal Tar, O. ..	Duffus and Co.	Duffus and Co.	1832	wood	700		155 0	160 0	27 10	19 0	11 0	260			
Ruby, R. ..	Wallis	Seaward	1836	wood	272¼		141 9½	155 0	19 0	10 2	4 6	100	40	3 6	17 6
Robert Stocktoo, A.	American	American		iron				70 0	10 0			50	16	1 6	
Regent ..	Ward, Stillman & Co.	Ward, Stillman & Co.	1843	wood	671			148 0	30 8	14 6	8 6		42½	4 7	18 0
Royal Sovereign ..	Laforte	Boulton and Watt	1820	wood	205	108 7	92 0	106 0	39 8	11 6	7 6	80	35½	3 6	13 0
Rose ..	Wallis	Boulton and Watt		wood			97 4	107 0							
Rhadamanthus, G...	Admiralty	Maudslay		wood								224	55½	5 0	21 0
Samson, G. ..	Sir W. Symonds	Maudslay	1845	wood								500	80½	5 10	27 0
Scourge, G. ..	Sir W. Symonds	Maudslay	1845	wood							15 6	440	54	6 0	
Severn, W. I. M. ..	Acraman and Morgan	American	1841	wood	1354			213 0	36 6	30 6	17 6	450	75	7 0	30 0
Solway, W. I. M. ..	M'Millan	Scott and Sinclair	1841	wood	1300		193 8	215 0	36 0	30 0	17 6	450			
Soudan, G. ..	Laird	Forrester	1840	iron	250				22 0	8 6	4 0	35			
Spitfire, G. ..	Admiralty		1845	wood	432		130 0		25 0	14 6		200			
Stromboli, G. ..	Admiralty	Robert Napier	1839	wood	966			180 0	34 4	21 0	15 0	280	63	6 0	26 6
Styx, G. ..	Admiralty	Seaward	1839	wood	1057	210 0		185 0	36 2	21 0	14 9	280	62	5 3	22 0
Swallow, G. ..	Admiralty			wood	133			107 6	16 8	16 6	5 0	70			
Swallow ..	New York	American		wood				233 0	22 0		3 9		46		24 0
South America ..	New York	New York	1844	wood				266 0	26 0	9 0	4 5		54	11 0	31 0
Soho, G. S. N. ..	Wigram	Boulton and Watt	1823	wood	510	158 10	131 7	151 3	46 0	17 5	10 1	120	42	4 0	15 8
Swiftsure ..	Wallis	Boulton and Watt	1821	wood	105	89 3	77 6	87 0	30 6	9 0	4 6	30	23¾	2 0	12 0
Spitfire ..	Graham	Boulton and Watt	1824	wood	106	91 6	76 10	88 0	30 8	9 9	6 4	40	26¾	2 6	10 0
Solway ..	Graham	Boulton and Watt	1825	wood	288	133 4	117 3	128 0	38 6	15 6	9 7	80	35½	3 6	
Shamrock, C. D. S. P.		Fawcett	1825	wood	310				24 0		10 6	90	37	3 6	15 0
Shannon, C. D. S. P.	Fletcher	Boulton and Watt	1826	wood	512	160 6	132 1	151 0	49 4	15 6	9 6½	160	47½	4 6	17 0
Sons of Commerce ..	Laforte	Boulton and Watt	1820	wood	77	86 0	75 6	85 0	25 3	8 1	3 5¼	20	26¾	2 6	10 0
St. Patrick ..		Clegg	1825	wood	300				22 0			120	42	4 0	18 0
St. George, C. D. S. P.		Fawcett	1825	wood	300				22 4		11 0	120	42	3 6	17 0
Sapphire, R. ..		Seaward		wood								100	47	3 0	16 0
Seahorse ..		Borrie		wood								204	53	5 0	
Tagus, O. ..	J. Scott	Scott and Sinclair	1837	wood	710		186 0		28 1	17 4		290	62½	5 9	
Tay, W. I. M. ..	C. Wood	Caird and Co	1841	wood	1354		270 0	213 0	36 6	30 6	17 6	450	74½	7 6	30 0
Temperador ..	Fletcher	Miller		wood	418			151 0	24 0	14 0	9 9	140			
Termagant, G. ..	O Lang	Maudslay	1845	wood	1529			208 0	40 0	24 0	9 0				
Terrible, G. ..	O. Lang	Maudslay	1845	wood	1847		196 10	226 0	42 6	27 0	10 2	800	72		34 0
Telegraph ..	Fairbairn	Fairbairn	1840	iron	236			129 10	18 0	8 3	2 8	45			12 3
Teviot, W. I. M. ..	Robert Duncan	Caird and Co	1841	wood	1345	240 0	207 0	213 0	36 6	30 6		450	74½	7 6	
Thames, W. I. M...	Pitcher	Maudslay	1841	wood	1300		207 0	215 0	36 0	30 0		450	74¼	7 0	
Thistle ..	Fairbairn	Fairbairn	1840	iron	306	160 6		148 0	20 6	11 6	6 6	100			17 0
Thunderbolt, G. ..	Admiralty	Robert Napier	1842	wood		210 0		180 0	36 0	21 0	14 6	325	67	5 0	26 0
Trent, W. I. M. ..	Pitcher	Miller	1841	wood	1300		207 0	215 0	36 0	30 0	17 0	430	74	7 0	29 0
Trident ..	Wigram		1841	wood	1000	195 0			31 0	19 0	14 0	380			
Tweed, W. I. M. ..	Thompson	Caird and Co	1841	wood	1350	240 0	267 0	213 0	36 6	30 6	17 6	450	74½	7 6	30 0
Thetis ..	Graham	Boulton and Watt		wood	1825	131 2	111 9	127 0	44 5	14 9	10 2	140	45	4 6	15 6
Thames ..	Fletcher	Boulton and Watt		wood	1827	160 6	132 1	151 0	49 4	15 6	9 5	160	47½	4 6	17 0
Tigar ..		Bury and Co	1837	wood								248	56¾	6 0	
Urgent ..	Robert Duncan	Caird and Co	1837	wood	562½			172 1	26 0	17 5	10 6	290	62	5 9	24 6
Vandalia ..	Canadian		1843	wood	140			90 0	20 2	9 0	5 0		12		s. 4 6
Vernon, (aux.) ..	Green	Seaward	1841	wood	1000			170 0	36 0	22 0	15 6	56	30	3 0	14 0
Vesper, R. ..	Fletcher	Miller	1836	wood	250			153 0	18 0	10 6	5 0	90			
Victoria and Albert..	Admiralty	Maudslay	1843	wood	1034	225 0	178 6	200 0	33 0	22 0		430			31 0
Volcano, G. ..	Admiralty	Seaward		wood	720½		128 8	150 8	32 9	18 0	8 6	140			26 0
Vanguard ..	Robert Napier	Robert Napier	1843	iron	670	200 0			27 0	16 6	5 1	280			24 9
Vulcan, G. ..	Laird	Forrester	1845	iron	1490			210 0	37 0	23 0		480			
Virago, G. ..	Sir W. Symonds	Boulton and Watt	1843	wood	994	210 0	156 0	180 0	36 0	21 0		300	64¾	5 8	26 0
Vulture, G. ..	Sir W. Symonds	Fairbairn	1844	wood								476	80⅝	5 9	26 6
Vesuvius, G. ..	Admiralty	Robert Napier		wood								280	63	6 0	26 6
Venus ..	Laforte	Boulton and Watt	1821	wood	269	114 10	97 4	111 0	41 0	11 3	4 8	60	31½	3 0	16 0
Vixen, G. ..	Deptford Yard	Boulton and Watt	1822	wood		109 2	93 3	107 6	36 0	12 0	8 4	80	35½	3 6	13 0
Utica, A. ..	New York	American		wood		200 0			21 0		3 6		39	10 0	22 0
Virgil ..	Foreign	Boulton and Watt	1828	wood	170	113 6	98 10	110 0	30 0	8 1	3 3	36	25½	2 6*	11 0
Victoria ..	J. Wood	D. Napier		wood								320	64	6 4	25 0
Warrington ..	At Warrington		1840	iron	200	110 0			19 0	9 6	3 0	70			15 0
Waterman, No. 9 ..	David Napier	David Napier	1843	iron	117			107 0	15 0	7 2	3 0	35			
Waterwitch, R. ..	Caird and Co.	Caird and Co		iron			123 0		16 4	5 6	2 9	33	22	4 0	10 0
Waterlily, S. ..	Ditchburn	Maudslay	1844	iron	170			132 0	16 6				29½	1 2	s. 8 0
Wm. Wilberforce ..	Curling and Young	Hall	1840	iron	650	200 0			27 0	17 0	10 0	280	60	6 0	24 0
Wilberforce, G. ..	Laird	Forrester	1838	iron	440	146 0		130 0	27 0	10 0	5 9	70			
William Adam ..	Menzies	Menzies		wood	166			190 0	20 0	8 4	5 4	59			12 9
Wonder ..	Ditchburn	Seaward	1844	iron				160 0	22 0	12 9	6 6	150	53	5 6	20 0
Woronzow ..	Fairbairn	Fairbairn	1839	iron	91¼	86 0			16 0	8 0	3 4	40			
Wizard ..	Graham	Boulton and Watt	1826	wood	237	119 0	102 9	117 4	38 0	12 6	8 5½	80	35½	3 6	13 6
Watersprite ..	Graham	Boulton and Watt	1826	wood	162	108 7	91 0	103 10	34 8	11 6	7 6½	60	31½	3 0	12 0
William Fawcett ..		Fawcett		wood								130	43½	4 6	
Widgeon, G. ..	Admiralty	Seaward	1837	wood	162			108 0	17 10	8 0		90			14 6

ENGLISH AND FOREIGN GOTHIC ARCHITECTURE COMPARED.

BY SIR JOHN AUDLEY.*

Mr. Rickman has attributed more pure simplicity and boldness of composition to Gothic architecture in England than elsewhere. My acquaintance with Continental models is (I regret to say) very slight; but I think I can see that he is right, and can point out one or two leading points in which our architecture is more pure, and one or two external circumstances which, though they could not create the genius or the taste, might leave them more free to work out the unadulterated result of their own principles. I do not speak of the Romanesque period, during which our Norman architects were probably, both in art and in time, behind their countrymen on the Continent; nor (on account of my own ignorance of the Flamboyant) of the latest period, when I must think that architecture, however increasingly subservient to use and luxury, after the day of Wykeham, was on the decline as an Æsthetic art. For the peculiar principles I only refer to the Master of Trinity, in whose observations on Rickman I shall strictly concur when, but not before, I have added to them, that it was himself who inspired with a living soul the nascent body produced by the patient and acute inductions of Rickman, and which has since advanced so far towards adolescence.

The favouring circumstances which strike me are, first, the comparative freedom from private war and local disorder, and, secondly, the comparative want of Roman works. Private war and local disorder would have far greater tendency than public, even though they were civil conflicts, to waste and destroy local monuments, and consequently, to cause that sense of insecurity, which will prevent their frequent and familiar construction: hence, to prevent the art from becoming inbred in the minds, and apparently indigenous in the soil of the country. One who twenty years ago had the early thin edition of Rickman in his pocket wherever he travelled, has a right to say that every little village church, which has been spared by time and churchwardens, proves such to be the case in England.

The same insecurity which would prevent the frequent construction, would thwart that construction when it took place. Protection would be necessary, even to the detriment of their architectural ends. This requires no proof, but I imagine it to be illustrated in passing along the high road through Herefordshire and Western Shropshire—borders countries, where, I fancy, I see more than their proportion of rude and naked bulk in early English and early-decorated towers; but where, when the victories of Edward I. had given free scope to the arts of peace, I certainly observe more than I have myself been elsewhere used to of the prevalence of quiet and humble structures of the decorated style.

It may be objected that the turbulent reign of Henry III. was that which produced the glory of our native art, the early English, so preeminently, if not quite peculiarly our own. The reign of Henry III. was turbulent; but not so much so as it appears to posterity, in whose eye its half century appears as a unit by the side of shorter reigns. Nor were its wars private, whatever human intermixture of private violence they may have involved. They were wars of public principle. A weak reign afforded the opportunity, whilst it succeeded to one whose united weakness and violence called forth the necessity of claiming that increased public liberty, for which the social improvement of the nation was ripening it. The age of Magna Charta is no less appropriately the age of early English art, than the matured excellence of decorations coincides with the settlement of our Parliamentary constitution under Edward I.

The student of Hallam and Fortescue, the best concise expositors of our laws and liberties, and our consequent national greatness, will probably, with me, divide the actual production of our happier state of things between Norma prerogative and Saxon liberty—the superincumbent pressure of the crown having prevented the well-compacted social economy of the humbler frames from being broken up as elsewhere (if elsewhere it existed) by the all-pervading violence of the military tenants. It being important to me to assume the fact, I may be excused in thus digressing to account for it, in order to make it credible to those impressed with a general idea of the lawlessness of that age.

The favourable effect of the absence of Roman works of art will be twofold. The eye will be less distracted by a beauty depending not only on different but on antagonist principles; and the architect will not be tempted, or required by his employers to impair the free and full development of his own style, by the use of materials (particularly old columns) too precious to be rejected, yet difficult to be adapted.

These two drawbacks have effectually prevented the formation in Italy (except, perhaps, at Naples) of a school, though there was long a fashion of pointed Gothic architecture in that country. This is conclusively shown by the splendid work of Gally Knight, the more conclusively, as it was not his object to draw the conclusion. I must not be considered as undervaluing, except in the single particular of the purity of Gothic art, the edifices of other countries. I can tolerate those who may consider the French or German, who make nearer approaches to purity than the Italians, as on the whole our superiors in great edifices; and even in Italy I can admire sometimes even more than my judgment can approve; and I may both approve and admire a work not Gothic, but *sui generis*. The matchless splendour of Milan pleases a cultivated taste the less because it is manifestly intended to be, what yet it is not, purely Gothic. That gem the Capella della Spina, at Pisa, wants in its outlines the truthfulness of Gothic art; but he must be such a master of language as I am not, who can find words adequately, yet soberly, to extol the cathedral of Florence. It is neither classical, nor Romanesque, nor modern Roman, nor Gothic; but, with much of the breadth and expansion upon earth of the school founded on classic art, it carries the eye and the mind up to heaven, and onwards towards the unseen, in the truest spirit of the romantic. We scarcely need be told that its wonderful cupola is the first, in order to look upon it as the most admirable of its kind which the country produced. Yet we must come home to Salisbury, Beverley, Westminster, Tintern, Lincoln, York, and Winchester. I place them in the chronological order of the style to which (of the many which most of them contain) I attribute in each the leading effect,—Early English pure—Early English, with all the later styles admirably harmonized to it—Early English, verging on Decorated—Early English, passing into Decorated, Decorated and Perpendicular.

I must not be supposed to be laying down rules without exceptions, that what I have been impressed with on the prevalent taste ought to be admitted by others to be so. I have not time, nor indeed materials to prove—perhaps I may be wrong, but if I am not, it is still a chance—whether their recollections of objects seen without any such idea having been suggested to them, will bear me out, or whether if my observations should be honoured with a place in their recollection, they will be confirmed by their future experience. In English Gothic we have scarcely any where but at Canterbury the column substituted for the pier. Now, in every one's eye and mind, whether he have expressed it in words or not, the pier is subordinate to the arch, but the column cannot be made subordinate to the intercolumniation. The column, where it exists, is always the thing dwelt upon, and the intercolumniation, be it arched or not, dwindles into the mere form which the column does not fill. This is contrary to the primary canon that Gothic is the architecture of interiors, in which the supporting parts are subordinate to the contained space.

In the eastern apse which our pointed architects scarcely ever constructed except at Westminster, or even adorned except at Tewkesbury, I am inclined to admit that where it does not lead to narrow and wire-drawn proportions, our continental neighbours have an advantage over us; but in the long west window, so comparatively rare in the French west fronts, we have an immeasurable advantage—it makes our great front more one, more ascending, more indicative of the contained nave than the window either circular or in which the circle is the prominent object.

Some of the most admired French fronts have also a great prevalence of horizontal lines carried through the two towers. Notre Dame is a known instance, as far as I recollect. Amiens, Abbeville, Troyes, Sens, and many others may be referred to, to show the prevalence of the taste. I am by no means disposed to treat as a fault the almost Grecian ground-plan of many of these buildings, but it certainly tends to produce a form in the profile of which horizontal lines shall be conspicuous. Now in the great breadth of the west front of York, though some may disapprove the low pitched roof, or others the general proportion, yet the lines of buttress and window preclude any such effect. Salisbury, though without towers, is in some degree open to it. Lincoln is worse than any French building, but the fault is in the Norman work.

In richness and depth of moulding, and in the progress of roof tracery, I believe that foreign buildings are oftener behind what would be suitable to the general advance of enrichment than English. Canterbury has much which I do not think English in character.

If a horizontal effect has been often directly given to French fronts, an opposite cause has in some admirable German buildings impaired the effect of the division into bays vertically divided. The office of the buttress with pinnacles not only to be the truthful index to the essential support of a Gothic building, but to carry up the eye according to its enclosed parts, as admirably arranged on the north aisle at Winchester, cannot be overrated. But such is its office, and if from its too great projective proximity, and want of set-off, the line of buttress form to the eye the outline of the building, as occurs in the glorious Cathedral of Cologne, it veils instead of exhibiting the form and character of the contained spaces.

The great height, and consequent relative narrowness, of the parts of this structure, has much tended to this effect; but where there is much flat wall often full of highly enriched parts, but still one wall with many enrichments instead of a series of bays grouped into one harmonizing whole. This often, with a narrow strip of window, too insignificant in breadth to give individual character to the several bays, is, I believe, seen to prevail in the architecture of Nurenberg. It is more necessary to be guarded against, as it is the very fault into which many of our recent attempts have fallen. They have walls pierced with windows, they have sometimes three windows under one gable, which never can satisfy the eye, though it may not know the nature of the objection.

I must regard the ostentatious disproportion of the most celebrated steeples of Germany to the rest of the building as a fault. I can hardly regret that Ulm has never been carried up, yet who can object to Freyburg, completely as it overpowers the church.

Yet more questionable is the gorgeous open-work of Strasburg, and others of these structures. A pinnacle, which is an excrescence, may be open, but not a leading member of the edifice itself, which ought to resist the weather and shoot off the rain; and there is a further objection where the tower is crowned with a spire—a spire, whose silent finger points to heaven, has that silence broken over by the beautiful addition of crockets.

* Read at the late Winchester Meeting.

How much more by a surface broken up in all its parts. I believe in all these points the prevalent taste in English architecture has the advantage in purity. It is no part of my object to attempt any comparison in point of positive excellence.

SEWERS OF WESTMINSTER AND PART OF MIDDLESEX.

AVERAGE DISCHARGE OF SEWAGE.*

Sewers' Office, October 3rd, 1845.

In compliance with the Order of Court of 6th October, 1843, to report "on the average discharge of sewage from the following outlets, viz.—Church-lane and Smith-street, Chelsea; Ranelagh, King's Scholars' Pond, Grosvenor, Horseferry-road, Wood-street. King-street, Northumberland-street, Durham-yard, Norfolk-street, and Essex-street, under ordinary and extraordinary circumstances,"—I beg leave to present the accompanying tabulated results of some experiments at the above-mentioned outlets, made during the months of May, June, and July of the last year.

The Plan of the district of this Commission shows the comparative surface drained by each of the above outlets; their total area being about 7000 acres, of which nearly one-half may be considered urban. As the observations were made during fine weather, the results will only indicate the discharge under ordinary circumstances.

The general conclusions deducible from these experiments are,—

1st.—That the mean discharge per acre, taking the whole surface drained, urban and suburban, is about 256 cubic feet in twenty-four hours.

2nd.—Considering the dryness of the weather during these observations, the above quantity of sewage may be assumed as solely derived from artificial sources and due to house drainage; supposing therefore the entire surface to be urban, we have 540 cubic feet as the mean daily discharge per acre. If, however, the average be taken of the first eight outlets, viz., from Essex-street to Grosvenor-wharf inclusive, which drain a surface wholly urban, the result is 1260 cubic feet per acre in the twenty-four hours. This excess may be attributed to the number of manufactories and the densely populated nature of the locality drained; but, as indicative of the general amount of sewage due to ordinary urban districts, the former ought perhaps to be considered the fairer average.

3rd.—Assuming, (as regards the relative proportion of urban and suburban,) the district to which the accompanying observations refer to be a fair type of that included within the whole of the Metropolitan Commissions of Sewers, and taking the extent of the active jurisdictions of those on the North side of the River Thames at 43 square miles, and the jurisdiction of the Surrey Commission at 15 square miles, the ordinary daily amount of sewage discharged into the river on the North side would be 7,045,120 cubic feet, and on the South side 2,457,600 cubic feet, making a total of 9,502,720 cubic feet, or a quantity equivalent to a surface of more than 36 acres in extent and 6 feet in depth.

(Signed) GEORGE HAWKINS, Assistant Surveyor.

Discharge from the Principal Outlets in the Westminster Commission of Sewers, being the Mean of Seven Observations taken during the Summer of 1844.

No.	Names.	Mean discharge per 24 hours.	Number of Acres drained.			Urban or Suburban.	General Remarks.
		Cubic feet.	A.	R.	P.	Urban (about)	
1	Essex-street ..	52081 }	100	3	28 }	The whole	A portion of the Holborn and Finsbury District is drained into this line of Sewer, containing 30 acres.
4	Norfolk-street ..	42189 }	30	0	0 }		
7	Durham-yard ..	23402	31	2	14	ditto	
20	Northumberland-street	692382	337 8	0 0	35 0 }	ditto	A portion of the Holborn and Finsbury District is drained into this line of Sewer, containing 8 acres.
27	King-street ..	3049	27	3	13	ditto	
28	Wood-street ..	13245	92	3	8	ditto	
29	Horseferry-road ..	15935	21	3	14	ditto	
30	Grosvenor-wharf ..	15691	28	2	6	ditto	
21	King's Scholars'-pond	511626	1753	1	19	Four-fifths	
34	Ranelagh ..	384480	4227	2	12	A quarter	
35	Smith-street ..	20037	161	0	27	Four-fifths	
43	Church-lane ..	23977	186	0	12	A quarter	
		1798094	7006	3	28	3313 3 4	acres urban, (about)

* Printed by order of the Court.

ASPHALTED BRICKWORK.—The New River Company, under the superintendence of W. S. Mylne, Esq., their engineer, are constructing a large reservoir upon Highgate-hill; the interior will be built of *Seyssel asphalted* brickwork, for the purpose of rendering the reservoir perfectly water-tight. It is expected that this important work will be completed in about two months' time. Messrs. Mansfield and Sons are the contractors.

PROBLEMS IN SURVEYING.

SIR,—The last number of your Journal has just been put into my hands, in which I see some Trigonometrical Problems by "Professor Oliver Byrne, Mathematician."

The principle from which the professor deduces the solution was first employed by me for that purpose in 1829, when all the cases of the problem were resolved exactly in the same manner as in your Journal, together with the several cases of the kindred problem proposed by Mr. Townley, and which is so well known to marine surveyors for its great use in fixing the positions of places at sea. The problems, with their solutions, appeared in one of the earliest numbers of "Colburn's United Service Journal," but, being without signature, the author's name was unknown to the public.

The problem was proposed to me by Capt. John Hobbs, of the Royal Engineers, while he was superintending the Ordnance Survey in Ayrshire in 1820-1. The solution I then gave was geometrical, with which Capt. Hobbs was so well pleased that he gave me an order for ten pounds on the Ayr Bank, and at the same time recommended me to the consideration of Col. Coleby, if I should ever happen to visit London, which at that time was very far from my thoughts.

I was in the employment of Messrs. Cottam and Hallen when I drew up the Analytical Solution for Mr. Colburn's Journal. My mind was then directed to the subject by an obscure and neglected proposition in Emerson's Trigonometry, from which I was aware that a very concise method of finding the angles could be derived without the intervention of the given distance, and thence the several required distances became known with very little trouble. The same principle was afterwards adopted by Dr. O. Gregory, in the third volume of Dr. Hutton's Course; but, without any acknowledgment of the source from whence it was obtained, it has since been adopted under similar circumstances by several individuals who have written on Surveying and Engineering, amongst whom are *Castles*, *Bourn*, and *Byrne*,—the last of whom having produced the article referred to in your Journal. Now, you will understand that I do not mean to quarrel with Mr. Byrne for what he has done, I only regret that he has not carried the subject a little farther, and rendered the solution more complete, for it is a most beautiful and important problem when taken in all its generality.

I am, Sir, yours truly,
WILLIAM TURNBULL.

NOTE ON DREDGE'S SUSPENSION BRIDGES.

We have just received a letter from Mr. Dredge from which we make the following extract.

"Will you please alter a little expression in the reply to Mr. Bashforth which will appear next month; it is this—instead of printing 'The oblique direction of the suspending rods necessarily involves, &c.,' put 'The *varying* obliquity of the suspending rods, &c.' For it is the variation in the obliquity which causes the intricacy of investigation."

Mr. Dredge requests us also to state that Mr. Turnbull, of whom he had not heard for several years, has sent him a letter stating that his Treatise on Suspension Bridges "was the production of five days, and that too under severe illness when he was obliged to be propped up in bed." This circumstance does not prove his treatise accurate, but it certainly accounts satisfactorily for its inaccuracy. We regret to say, also, that Mr. Turnbull's present letter appears to have been written under most painful circumstances; they are of too private a nature to be made public, but we can assure the reader that they entirely preclude any further strictures on Mr. Turnbull's past productions.

MOTION OF LOCOMOTIVE ENGINES.

SIR,—You say in your note appended to my last communication that my experiment is not analogous to the case in point, because it was a muscular force from without, and that if the experiment is repeated while sitting in the carriage, what then will be the result? Most assuredly, it will then move as a Locomotive engine, urged by steam; and it is a very beautiful illustration of the truth of my conclusions, that in all such cases of = and opposite reaction, which occasion opposite, but not = effects, that motion is produced in the direction of the greatest effect. Suppose, a person sitting in a Manumotive carriage pulls on a crank with a certain force, a corresponding reaction must take place on the body of the carriage, for if not the experimenter would be drawn to the crank, and not the crank in the direction towards him. This = reaction has, as before observed, either a greater or less leverage from the point of contact of the wheel and rail, as the position of the crank in its revolution may determine, and the greater effect of the two forces causes the motion of the Manumotive carriage. On referring to the diagram in my first letter, (page 293), and for the action of the steam on the piston, and the reaction on the cylinder cover, substituting the muscular action, and reaction used in this case, good reason will be seen why the = and opposite internal forces cause (on account of leverage), not = effects and motion is produced, continually in one direction.—Again you say, "The lowest point of a driving wheel surely must not be considered the fulcrum of a lever, for then the centre of the whole would move in the arc of a circle, whereas its motion is rectilineal."—Now as the wheel is only a continuous lever, your stricture seems to me to have more plausibility than weight, for the centre of the wheel could only tend to move in the arc of a circle, the wheel's rotation continually bearing it up, so as to move in a right line.

I am, Sir,
Your obedient servant.
J. G. S.

In his first letter our correspondent proposed certain views on the theory of Locomotive engines, from which we dissented, stating our reasons. But, says our correspondent, in a second letter, I have repeatedly made such and such an experiment which exactly proves my case. To this we replied, by showing where we thought the experiment failed in analogy. In the present letter this want of analogy is acknowledged, and at the same time stated to be

Are we to suppose the theory of that compliant nature, that both analogy and the want of analogy in the illustrations alike confirm it?

The usual method of considering the centre of the wheel the fulcrum of the lever seems the most simple and satisfactory. If the lowest point of the wheel be considered the axis about which the moments of the forces on the spoke are to be equated, the reactions on the centre of the wheel must be taken into account; and these, we should think, would so complicate the problem as to render it incapable of solution. Of course if the solution be correct the result must be the same for either method of investigation.

RAILWAY ROUND PARIS.

The *Journal des Chemins de Fer* gives a long account of the project to encircle Paris by a railway, crossing and connecting all the existing lines which radiate from the French metropolis. We translate some of the principal passages of the description.

The necessity of an encircling line round Paris has been long felt; the loss of time occasioned in passing from one station to another, the expense of carrying and warehousing goods, and the duties demanded *octroi* for in entering Paris, render this railway indispensable.

Three projects have been proposed: the first passes between the circuit-wall of the *octroi* and the continuous circuit of the fortifications; the second between the continuous circuit of fortification and the detached forts; the third is exterior to the forts.

Examined on their strategic merits, there is little difference between these lines. A line connecting the detached forts would be of no more service than one interior to the line of circumvallation. It would be very expensive, moreover, to carry the railway over heights, such as Mont Valerien, Romainville, &c., and long tunnels and inclined planes would be required.

The railway will not require a locomotive department, since it can be supplied with engines by the lines which it unites; and as it will generally serve for mere conveyance from one line to another—from the Northern line, for instance, to that of Lyon—the traffic will be carried on by the locomotives and carriages which arrive from the Northern line. The establishment of the railway round Paris will consist only in the construction of the road and laying down the rails.

Examining the three projects which have been proposed, economically, we have—

First—An encircling line, connecting all the existing and projected railways, and passing from the Batignolles station of the Rouen line to the Orleans line in the commune of Ivry, opposite Bercy, continuing thence to Versailles railway, on the left bank of the Seine, and crossing the valley of the Bievre, and finally rejoining the Rouen railway, crossing the Seine at Point-du-Jour, and passing the Bois de Bologne. Length 19¾ miles; cost, £720,000.

Second—By the line passing by the forts would be 37 miles; cost £1,040,000.

Thirdly—The line beyond the forts—length 47 miles; cost £920,000.

The second and third lines, though they make use of parts of existing railways, would require a length of new line to be much greater than that of the line interior to fortifications. Moreover, supposing either of the two exterior lines adopted, it will be necessary to travel a certain distance along the existing railway, which would be a source of constant accidents. The traffic on these railways being always very great, there would be great danger in using them for an additional line of traffic. In laying down the interior line, it has been made a point that it should merely cross the old lines. The object has been to connect the depots of merchandize. We proceed to describe the manner in which this object is effected.

The new line branches off from the Rouen railway by means of a curve of 1,300 feet radius opposite the workshops of the St. Germain line, and crosses the site appropriated to the goods-depot of the Rouen line; it passes beside the *abattoir* of Batignolles, and goes over the district road number 14, from Paris to Clichy, at a short distance from the curtain 44—43 of the fortifications.

The line next crosses on a level the district road number 13, from Paris to St. Owen, and turns round the declivities at the base of Montmartre, with an ascending gradient, which brings it to the level of the Belgic railway. The royal road number 1, is crossed also on the level, about 250 feet from La Chapelle.

Continuing its course within 800 feet of the circuit wall, the line proceeds to the right-hand bridge of the royal road number 2, from Paris to Hamburgh on the Canal St. Denis, which it crosses on a level. The canal St. Onrcy will be crossed by a moveable bridge. There will be a tunnel under Belleville 7,920 feet long to the road to Charonne. Again crossing the district road 23, the line next reaches the Avenue de Vincennes. After passing over the Avenue de Bel-Air, the line reaches Fecamp, meets the Seine at the Quai de Bercy, and recrosses the river to rejoin the Orleans line.

REGISTER OF NEW PATENTS.

(Under this head are given abstracts of the specifications of all the most important patents as they are enrolled. Any additional information required as to any patent, may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

MANUFACTURE OF SUGAR.

Augustus William Gadesden, of Woburn-square, in the county of Middlesex, gentleman, for "*Improvements in the manufacture of Sugar.*"—Granted Jan. 16, 1845; Enrolled July 1845.

The object of this invention is to effect the evaporation of syrups, at a low temperature, by causing cylinders to revolve in the syrups while being evaporated; which cylinders do not communicate any heat to the syrups, but being partially immersed therein, by simply revolving they carry up the syrup out of the general body of the liquid contained in the evaporating vessels, and thus facilitate the evaporation. The cylinder is mounted on a shaft, which turns in bearings at the ends of the evaporating vessel, and receives motion from a steam engine, or other first mover. In cases where it is desired to remove the steam from the apartment which contains the evaporating vessels, a cover may be placed over the top of each vessel and cylinder, with a pipe leading from it to a chimney or other outlet; care being taken to maintain such a draft as will cause the heated vapours to be quickly removed from the evaporating vessels.

MANUFACTURE OF CHLORINE.

Robert Oxland, of Plymouth, in the county of Devon, chemist, for "*Improvements in the manufacture of Chlorine.*"—Granted Feb. 20, 1845; Enrolled Aug. 1845.

This invention is for a method of manufacturing chlorine by the decomposition of hydrochloric acid by atmospheric air. The hydrochloric acid gas and atmospheric air are mixed in the proportion of one measure of the former to two of the latter; and the mixture passed through an air-tight furnace kept at a bright red heat. The hydrochloric acid is preferred to be obtained by decomposing common salt by sulphuric acid, in a furnace or retort, so heated that the products of combustion do not mix with the acid gas evolved; and the acid gas should be dried (previous to mixing it with the air), by passing it through a vessel filled with pieces of fire-brick, over which a small stream of sulphuric acid is constantly flowing. The requisite supply of atmospheric air is kept up, by pumping it into an iron reservoir, furnished with a stop-cock or valve, for regulating the discharge of the air. The decomposing furnace, through which the mixture of hydrochloric acid and air is passed, resembles an ordinary reverberatory furnace in form; but it is so constructed as to admit of the fire passing over the arch and under the bed; by which means the furnace is heated without the fire passing into it. The furnace is filled with pieces of porous pumice-stone; and the gas and air enter at the end farthest from the fire, and pass out at the other end, through a pipe at the upper part of the furnace. That part of the furnace nearest the fire should be kept at a bright red heat, by a fire acting externally; the smoke passing through flues, over the furnace into the chimney.

The products resulting from the admission of hydrochloric acid and atmospheric air into the decomposing furnace consist of chlorine, associated with undecomposed muriatic acid, and any excess of atmospheric air and nitrogen. This mixture is cooled, by passing it through a series of earthenware tubes surrounded by water; after which the hydrochloric acid is effectually separated, by passing the mixture through water; and, finally, the chlorine is obtained, and chloride of lime produced, by passing the residuary mixture into the ordinary lime condenser, where the chlorine is absorbed, and the nitrogen and atmospheric air remaining are allowed to pass into the atmosphere.

The patentee does not confine himself to the above details, so long as the peculiar character of his invention be retained; but he claims the mode of manufacturing chlorine, by decomposing hydrochloric acid by atmospheric air.

ARTIFICIAL FUEL.

Frank Hills, of Deptford, in the County of Kent, Manufacturing Chemist, for "*Certain improved means of producing or manufacturing Artificial Coal or Fuel, and other useful products connected therewith.*—Granted February 17; Enrolled August, 1845.

The invention consists in an improved method of manufacturing artificial coal or fuel from peat, peat moss, or peat bog, and also in producing or obtaining from those substances naphtha or pyroligneous spirit, and acetic or pyroligneous acid in the following manner:—

Dried peat, either pressed or unpressed, is put into cylinders or retorts, similar to those used in the distillation of wood, connected with a refrigerating apparatus. These cylinders are kept at a heat a little below redness by fires lighted under them, and after they are charged with peat the doors are luted up, and the distillation of the peat is carried on, and in the course of the process the volatile products of the peat are driven off, and the peat charcoal is left in the cylinders. The volatile products, consisting principally of weak pyroligneous or acetic acid, naphtha or pyroligneous spirit, and tar, are condensed in the refrigeratory apparatus in the same manner as though wood were employed, which is a well-known process, and the naphtha and acetic acid are then rectified by distillation in the usual way. The tar is distilled or concentrated, until it becomes pitch; and whilst in a hot state, is drawn from the still into a shallow iron vessel (perferably kept hot by a fire underneath,) and there mixed with it the peat charcoal, either with or without small coal. The charcoal, if not sufficiently small, must be ground or crushed, and as much of it mixed with the pitch as will combine with it. It may then be taken out of the vessel with a shovel and be put in lumps to cool, when it will become dry and brittle. Coal tar, made into pitch, may be added whilst hot to the peat pitch, if desired. The claim is first for the manufacture of artificial coal or fuel, by the mixture of charcoal obtained from distillation of peat in cylinders or retorts, with pitch obtained from the same material, with or without the addition of mineral pitch or of small coal; secondly, the manufacture of pyroligneous or acetic acid, and of naphtha or pyroligneous spirit, by the distillation of peat or bog earth.

PAPER TO PREVENT FRAUD.

Arthur Varnham, of No. 61, Strand, stationer, for "*Improvements in the manufacture of Paper in order to prevent Fraud, which I intend to call 'Safety and Protective Paper.*'"—Granted February 4; Enrolled August, 1845.

This invention consists of a coluured or test sheet of paper, covered with a white sheet or surface, or a delicate coloured sheet or surface, on one or both sides, as follows:—The rags for the coloured test, having been reduced into half stuff, and, if necessary, bleached, is then filled into the beating engine, which should have steel or brass bars and fittings, according to the colour required for the coloured test, or middle sheet. When the engine is half beat, colouring matter, as hereinafter set forth, is to be added. The engine is then reduced to pulp, and emptied into chest called No. 2. The colouring matter for the cloured test, or middle sheet, mnst be prepared with the utmost care; vessels only of glass or earthenware must be employed in order to prevent the delicacy of the colour being impaired. The colouring consists of any matter usually employed for colouring paper, and also of all others susceptible of change from chemical action. The rags for the outer sheets are of a more tender kind; having been reduced into half stuff, and, if necessary, bleached. They are filled in the beating engine, and if the paper be required engine-sized, a resinous size is added to the pulp, together with a small qantity of alum. When reduced to pulp, the engine is emptied into chest called No. 1, and if the outside sheets are to be of a delicate calour, then add the colour. It is necessary that two vats be simultaneously employed in the manufacture of this paper, Vat called No. 1, is to be furnished with stuff from a chest called No. 1. Vat No. 2, is to be furnished with stuff from a chest called No. 2. The vatman will first make a white, or delicate-coloured sheet on a mould of the usual form employed, from No. 1, and deliver the same to the coucher, who will couch the same on the first or bottom felt. The vatman will then make a coloured sheet, on a mould of the same size and form, from vat called No. 2 (the colour vat) and deliver the same to the coucher, who will couch the same on the white, or delicate-coloured sheet or surface, made from vat called No. 1. The coucher will then place a felt upon the table thus made. But should the test or coloured sheet be required to have another white or delicate-coloured sheet or surface, the vatman will then make a sheet or surface on the first mould from vat called No. 1 and No. 2. thereby placing the coloured or test sheet in the centre of two white or delicate-coloured sheets or surfaces. The coucher will then place a felt upon the paper thus made. The vatman and coucher will then continue to complete the post of felts in the same manner. The post having been well pressed, the pack pressing, parting, drying, sizeing (if necessary) is to be performed in the usual manner, and with the modes of sizeing usually employed with coloured paper.

The pulp intended for the test sheet, and outside sheet, having been prepared in the manner described, are both caused to flow from the chests into the sewers; thence on to the wires attached to them, thence to the marking dandy, and then in the usual manner to the couch rolls, where the test or coloured sheet, with one or more white or delicate sheets, surface or surfaces, now unite in a compact body. The sheet of paper thus united and formed, then passes on to the felt, and is pressed, dried, and finished in the usual manner.

The object of the invention is, to protect the test or coloured sheet from being tampered with by chemical agents employee to obliterate writings; and to prevent the using of any sharp instrument or rubbers for scraping or erasing writing. As, should any chemical agent be employed, the test or colourod sheet would be so changed as to alter conspicuously the former appearance of the paper; and the white, or delicate sheet would be likewise imbued with a stain or colour pruduced by the action of those chemical agents on, and thence from, the colour of the test shee,. The result. therefore, would destroy the appearance of both, viz., the outer white or delicate-coloured sheet, and the test or coloured sheet. This being done, it would be impossible to make the said Safety and Protective Paper assume its original appearance; for, if it be attempted to whiten or renew the delicate colour of the outer sheet or sheets, surface or surfaces, it would thereby completely destroy the appearance of the test or coloured sheet; and if attempted to colour the test sheet, it would likewise produce a darker colour on the white or delicate outer sheet. The one is a protection to the other.

IMPROVEMENTS IN MATHEMATICAL INSTRUMENTS.

William Peter Piggott, of No. 11, Wardrobe-place, Doctors' Commons, in the city of London, mathematical instrument maker, for "*Improvements in mathematical, optical and astronomical instruments, and in the mode of manufacturing dials and other graduated plates.*"—Granted April 17; Enrolled October 17, 1845.

The specification is as follows:—These improvements in the construction of mathematical, nautical, optical and astronomical instruments, and in the mode of manufacturing dials and other graduated plates, consist in the application of the electrotype process, whereby I am enabled to produce certain parts of such instruments hereinafter described in a more expeditious and economical manner than by the ordinary process. Before describing the particulars of my invention it may be well to state that the present mode of manufacturing or producing graduated plates such as those employed or used for barometers, thermometers, quadrants, compass sun dials, clocks, and such like instruments requiring plates accurately divided or graduated, is by the ordinary process of engraving or dividing, or dividing and engraving, and by which process it is very probable that after having produced two or more similar plates that on close inspection a material difference in some of the graduations may be detected, and as it is of great importance that graduated plates or scales such as those employed in reducing and laying down mechanical drawings, and also the scale of chains used for surveying purposes, together with those already named should be correctly divided, and moreover that the several divisions or graduations should in each and every plate or scale be the same one to another, it is desirable to employ some other process than that at present practised, in order that each and every plate or scale produced may be a perfect fac-simile of the original, which may be effected by the improvement that constitutes the first part of my invention, which is as follows—that is to say, in order to produce graduated plates such as those already named, I, in the first place, prepare a plate of suitable size for the purpose intended, and engrave upon its surface such graduations and figures or designs as may be necessary to render the same useful and ornamental: this process, as there is never but one of each sort required, should be done in the first style of art and as correctly as possible, especially as regards the divisions and subdivisions; having done this, I next obtain a matrix or mould in a composition of wax, and from this mould I obtain by means of the electrotype process, which is well understood and need not therefore be described, any number of similar plates in copper or other suitable metal capable of being deposited by means of the electrotype process; or in place of obtaining a mould in wax or other suitable composition, the same may be made in copper from the original engraved plate by the aforesaid electrotype process, which will be more durable, and from which mould almost any number of plates may with care be obtained. After the plates have been produced in the manner hereinbefore described, I afterwards finish them in the ordinary manner by silvering, which may also be done by the electrotype process, but I prefer the ordinary process of silvering as it may be effected with less expense. It will, therefore, be observed that by the application of the electrotype process I obtain the following important result, namely, that each and every plate so produced must necessarily be fac-similes of the original, and therefore correct, if proper attention has been paid to the production of the first plate, which I always preserve for the purpose of obtaining the mould or moulds from which I afterwards obtain the plates, in the manner and for the purpose hereinbefore described, and I may here add that by this mode of manufacturing dials and other graduated plates, the same may be produced at considerably less expense and more correct, than by the mode hitherto practised of engraving and dividing or dividing and engaving. Having thus described the first part of my invention, and the manner in which the same is to be performed, I would have it understood that I lay no claim to any part of the apparatus known by the name of voltaic or galvanic battery, neither do I claim the electrotype process, unless the same be employed for the purpose hereinbefore described, but what I claim with regard to this the first part of my invention is the production of graduated plates for mathematical, nautical, optical and astronomical instruments by means of the electrotype process, instead of the ordinary process of engraving or dividing as heretofore.

The second part of my invention which relates to improvements in mathematical, nautical, optical and astronomical instruments consists in a new mode of manufacturing the compass box or case containing the magnetic needle. I would also observe with regard to this part of my invention that the objections to the present mode of manufacturing compass boxes, or cases containing the magnetic needle, arises from local attraction, caused in most cases by small particles of iron, which in the present mode of casting or manufacturing such boxes, become amalgamated and unequally distributed, which have the effect of causing a variation in the needle. In some instances I have observed the needle to vary from one to four or more degrees, in consequence of small particles of iron having been contained in the metal from which the compass box or case has been constructed; under such circumstances it is necessary to drill a small hole or holes in that part of the case supposed to contain the particle or particles of iron in order to remove the same, which hole or holes are afterwards to be plugged up and finished off so as to form a perfect box or case, the object of this part of my invention is therefore to obviate the above process, which is not only expensive but attended with uncertainty, by the application of the electrotype process, whereby I am enabled to obtain a compass box or case of pure and unalloyed metal free from any particles which may have a tendency to attract the magnetic needle. These boxes or cases I produce by the electrotype process in the following manner—that is. I prepare a mould of the required size of wax or other suitable composition and deposit upon it by means of the electrotype process copper or other suitable metal capable of being deposited, until I have obtained the required strengh and thickness, which case is afterwards to be finished in the ordinary manner of making such cases or otherwise. I would here remark that I sometimes make such cases by first depositing pure copper in the form of a shot or block and afterwards work the same into the form required, my object being to obtain a compass box or case of metal free from any magnetic attraction, which I do in the manner hereinbefore described.

Having thus described the nature of my invention, and the manner in which the same is to be performed, I would have it understood that I do not confine myself to the precise details herein mentioned so long as the peculiar character of my invention be retained, but what I claim as my invention is, the application of the electrotype process for the purpose of producing certain parts of mathematical, nautical, optical and astronomical instruments as hereinbefore described.

MANUFACTURE OF NAPHTHA.

Thomas Drew, of St. Austell, Cornwall, chemist, and Edward Stocker, of the same place, merchant, for "*Certain improvements in the production and manufacture of Naphtha, pyroligneous acid, or other inflammable matter.*"—Granted March 18, 1845; Enrolled Sept. 1845.

The improvements consist in obtaining the above matters by distillation of peat, peat moss, or bog earth, previously dried, or deprived of the greater portion of its moisture, in iron, stone, fire-brick, or clay retorts. Each being connected by a short pipe, with a series of pipes, which form the apparatus employed for condensing the volatile products driven off from the retorts. The heat applied may vary from a low dull red to a bright red. In the refrigeratory apparatus, the patentees preferred, where locality will allow, not to pass the volatile products from all the retorts into one pipe, but to conduct them separately through one line of pipes, having at certain intervals (commencing at about ten feet from the retort), descending pipes, through which the condensed products may pass into a receiver beneath. Each line of pipes should be placed in "shutes," about two inches wider and two inches deeper than the diameter of the pipe at the joint; the pipes should have a fall of about one inch in five feet, in the direction from the retort towards the end of the condenser; the shutes should have an inclination to the same extent in the opposite direction; by this arrangement, on cold water being caused to run through the shutes, it will meet with the coolest part of the pipes first, and will therefore be most advantageously employed for absorbing the heat. The product of this distillation will consist of water mixed with naptha or pyroxolic spirit, acetic, or pyroligneous acid, ammonia, tar, oil, charcoal, and an incondensable inflammable gas; these matters may be separated from each other as in the treatment of the like products of the destructive distillation of wood. The patentees do not claim the distillation of peat generally; but they claim the manufacture of naphtha or pyroxolic spirit, acetic or pyroligneous acid, ammonia, and the other inflammable matters, by distilling peat, peat moss, or bog earth, in retorts or vessels made of stone, or iron, or of fire-brick, or clay.

IMPROVEMENTS IN PRESERVING SUBSTANCES FROM DECAY.

Giacomo Silvestri, of Naples, physician, for "*certain Improvements in preserving animal and vegetable substances from decay.*"—Granted, April 7; Enrolled October 7, 1845.

The object of this invention is to preserve human bodies, so as to give them the appearance of marble, which is effected by immersing such bodies, or insects, fish or reptiles, for a certain time in a solution composed of the following ingredients: that is, 100 parts of bichloride of mercury (corrosive sublimate), 100 parts of powdered silex, 100 partr of subcarbonate of lime, 25 parts of hydrochlorate of ammonia, 17 parts of chloride of lead, and 17 parts of chloride of zinc; these ingredients, after being well pounded, are to be passed through a silken sieve, after which they are to be put into a basin, or other suitable vessel, and a sufficient quantity of water added to form them into a syrup; the body intended to be operated upon is to be placed into this bath, care being taken that the body is always covered with the solution, for which purpose it will be necessary occasionally to add a little water to supply the place of that evaporated during the operation. The inventor here observes that the vessel made use of should be lined with platinum enamelled, or made of strongly varnished earthenware, so as not to be acted upon by the above substances. In order to obtain a more complete mixture of the above substances, the same may be slightly heated, which may afterwards be left to the atmospherical influence according to the progress of the operation. The effervescence of the bath may be increased occasionally by adding a few drops of sulphuric acid. The time required for the operation will vary according to the size, nature, and essence of the bodies, as some will absorb the conservative matters with greater facility than others; thus those bodies which contain grease are more disposed for absorption, and the human body will also require more time than an insect, therefore, if 5 or 6 months which are generally required to obtain a general solidification of the first, as many days will be sufficient to obtain the same result on the latter; 15 days are required for fish, one month for mollusques, and 2 months for reptiles.

To preserve the natural shape of a fish the inventor introduces into its interior some solid substonce in powder, such as sulphate of lime or other like substance with which the conservative liquor is disposed to enter into combination.

Another mixture consists of 50 parts of hydrochlorate of soda, 50 parts of phosphate of soda, 100 parts of pounded silex, to which may be added some salt of alum to prevent the fatty matters of the body passing through the skin, and in order to prevent discolouration of the bodies some cinnabar or other colouring matter may be introduced into the first or second bath hereinefore described.

RESISTANCE TO SUSTAIN BANKS OF EARTH.

Sir,—In page 242 of the August number of the Journal, there is given a construction and an equation for finding the resistance to sustain banks of earth. As the construction is without a demonstration, would the inventor, or one of your correspondents, give one?

A Young Engineer.

Dublin, October 20, 1845.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Session 1845-46.—Ordinary Meetings.

Chair to be taken at Eight o'clock on the following Monday evenings.—

1845	November	..	3	17	1846	March	..	..	9		23
	December	..	1	15		April	..	..			20
1846	January	..	12	26		May	..	..	*4	11	25
	February	..	9	23		June	..	..	8		22

* Annual General meeting of Members only.

The town of Montband is about to erect a bronze statue to Buffon.

The King of Naples and the sovereigns of Northern Italy are actively encouraging the spread of railway communication through their respective dominions. It is expected that ere long all Italy, except the States of the Church, will be covered by a network of railways, but no one line is allowed to cross the hallowed frontier. The most strenuous endeavours have failed to overcome the Pope's resistance to the railway system.

Important Railway Amalgamation.—An amalgamation of the London and Birmingham Railway Company with that of the Grand Junction, has just been concluded. On a calculation of the respective interests of the parties, it appeared, that while the London and Birmingham line yielded the full dividend of 10 per cent., the Grand Junction was in a condition to pay 12 per cent., so that the equalization of the two properties, for equal dividends in future, required that the Grand Junction shares should be "written up" 20*l.* per share; and it was therefore agreed that new shares of 20*l.* each should be created, free of cost, to be added to the original shares, and the whole formed into common stock, entitled to common dividends from the 1st of October inst. It has been determined, also, we understand, that on the London and Birmingham line the company will now commence being their own carriers, and that a considerable reduction will at once be made in the charges for the conveyance both of goods and passengers, so as to render the calculations upon which any project of competing lines may be based extremely unpromising. By arrangements in progress, the consolidated company will proceed to establish what has long been considered a desideratum,—a complete system of trunk lines from London to Glasgow (via the Carlisle and the Caledonian), and from London to Holyhead, and across Ireland; and they have decided to encourage in every way the formation, into such trunk lines, of the most direct lines subserving the trade of the country.

Experiments in Woolwich Marshes, Oct. 24.—Experiments were made on a newly-erected one-gun battery, constructed, under the superintendence of Lieut.-Col Barney, on a principle suggested by Col. Abbett. The battery was made 17 feet in thickness, by about 21 feet in front, and 8 feet high, with the embrasure faced with stone inside, into which was fixed an iron bolt attaching a traversing platform 16 feet long, on which an 8-inch gun on a ship or garrison carriage was mounted. The base of the embrasure is very high, on Col. Abbott's principle, being within half an inch of the under part o, the gun when run out for firing, and directed against an object about six feet high at 250 yards' range. The firing took place with hollow 8-inch shells, weighing 48lb. and 56lb., and the charges of powder were in the first instances 8lb., and afterwards 10lb. to each round, and the last shell fired burst from the effect of the large charge, although it did not contain any explosive materials inside the metal of which it was formed: 17 rounds were fired into the mound, and the shortest recoil of the gun and carriage on the platform was 6 feet 1 inch, the whole giving an average recoil of 7 feet 6½ inches. The masonry of the embrasure appeared to answer very well and proved very secure. The wheels of the traversing platform are supported on circular pieces of iron screwed down upon wood imbedded in the earth, similar to railway sleepers and about the same dimensions. The other parts of the ground are left in the usual state with a small quantity of sand and gravel packed upon it to render it dry.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM SEPTEMBER 25, TO OCTOBER 24, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Alexander Bain, of Hanover-street, Edinburgh, engineer, for "Improvements in electric clocks and telegraphs, part of which improvements are applicable for other purposes." —Sealed September 25.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "certain Improvements in machinery for manufacturing screws." (A communication.)—Sept. 25.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "certain Improvements in machinery for manufacturing metal pipes or tubes." (A communication.) —September 25.

John Reed Hill, of 28, Stamford-street, Lambeth, civil engineer, for "certain Improvements in atmospheric propulsion applicable to water as well as land carriage." (A communication.)—October 2.

George Roberts, of Well-street, Cripplegate, miner, for "certain Improvements in the construction of lamps for illuminations."—October 2.

John Kershaw Ramsbottom, of Lancaster cotton-spinner, for "certain Improvements in machinery or apparatus used in the preparation of cotton or other fibrous substances for spinning."—October 2.

Frederic Rosenberg, of Kingston-upon-Hull, gentleman, and John Malam, of the same place, gas manufacturer, for "certain Improvements in, or apparatus for watering, manuring, and drying trees, plants, seeds, and roots, and for accelerating and improving the growth and produce of trees, plants, seeds, and roots."—October 2.

Alfred Hall, of Coxsackie, America, brick-maker, for "certain Improvements in machinery or apparatus for making, moulding, or manufacturing bricks, tiles, and other articles from earthy or plastic materials."—October 2.

George Daniel Bishopp, of Edgbaston, Warwick, civil engineer, for "Improvements in certain engines or machines used for obtaining mechanical power, and for raising and impelling fluids."—October 2.

Robert Clark, of Newburgh, ship-painter, and Alexander Pirnie, of the same place, ship's-smith, for "certain Improvements in steering vessels."—October 2.

John Simpson, of Langton Rectory, York, clerk, for "certain Improvements in obtaining and applying motive power."—October 2.

John Hale, of Leicester-square, Middlesex, esq., for "certain Improvements in guns." —October 2.

Graziana Conté, of Regent-street, Middlesex, merchant, for "Improvements in machinery for cutting, carving, and sculpturing marble, stone, wood, and other like substances." (A communication.)—October 3.

Moses Poole, of the Patent Bill Office, London, gentleman, for "Improvements in rails for railways." (A communication)—October 6.

Gabriel Hippolyte Moreau, residing at No. 18, Boulevard Bonne Nouvelle, Paris, gentleman, for "an improved steam carriage."—October 6.

Augustus Julien Van Oost, of Genbruge, near Ghent, but now of Osnaburgh-street, Regent's-park, "Improvements in treating seed, and in preparing materials used for fertilizing land and for aiding vegetation."—October 6.

Thomas Russell Crampton, of Southwark-square, Surrey, engineer, for "Improvements in locomotive engines and railways."—October 6.

Thomas Howard, of the King and Queen Iron Works, Rotherhithe, Surrey, Iron Manufacturer, for "Improvements in rolling iron bars for suspension bridges and other purposes."—October 6.

Joseph Quick, of Summer-street, Southwark, engineer, for "Improvements in steam-engines."—October 9.

John Lake, of Apsley, Herts, civil engineer, for "certain Improvements in propelling." —October 9.

Isaac Hartes, of Rosedale Abbey, York, farmer, for "certain Improvements in machines or machinery for rowing, sowing, and manuring land."—October 9.

Edmund Morewood, of Thorubridge, Derby, merchant, and George Rogers, of Stearndale, gentleman, for "Improvements in the manufacture of iron into sheets, plates, or other forms, in coating iron, and in preparing iron for coating, and other purposes."—October 9.

Alexander Parkes, of Birmingham, artist, for "Improvements in coating or covering certain metals with other metals and metallic alloys, and for ornamenting the surfaces of various metallic articles."—October 9.

Thomas Wood Gray, of Workworth-terrace, Commercial-road, plumber, for "Improvements in ports, and apparatus for opening and closing ports of ships or other vessels, also applicable in opening and closing windows, and other instruments having the like movements."—October 9.

Henry Francis, of Wardour-street, civil engineer, for "Improvements in the manufacture of gas."—October 9.

Edmund Morgan, of Tenby, Pembroke, gentleman, for "an Improved envelope for letters."—October 9.

Edward Patrick Emerson, of the City of Dublin, doctor of medicine, for "Improvements in the manufacture of paints, pigments, cements, and other plastic compositions and in the machinery or apparatus to be used in such manufacture, parts of which improvements are also applicable to the manufacture of artificial stone and marble."—Oct. 9.

Thomas Hollingsworth, of Birmingham, cigar merchant, for "a certain Improvement or certain improvements in the construction of cases for holding cigars."—October 9.

Joseph Edward Judson, of Ashton-under Lyne, Lancaster, saddler, and Edward Banton, of Walsall, Stafford, commercial traveller, for "A certain improvement or certain improvements in covering rollers used in spinning cotton and other threads, also in covering mill straps."—Oct. 9.

David Wilkinson, of Potters-pury, near Stony-Stratford, gentleman, for "Improvements in obtaining motive power."—Oct. 10.

Edward Lesley Walker, of Foley-place, professor of music, for "Improvements in piano-fortes."—Oct. 10.

Joseph Clisild Daniell, of Tiverton Mills, near Bath, clothier, for "Improvements in dressing and finishing woollen and other cloths."—Oct. 10.

George Fergusson Wilson, of Belmont, Vauxhall, gentleman, George Gwynne, of Putney, gentleman, and James Pillans Wilson, of Belmont, aforesaid, gentleman, for "Improvements in the manufacture of soap."—Oct. 10.

Alexander Jamieson, and John Frederick Lundholm, of Tothill-street, Westminster, manufacturing chemists, for "Improvements in dressing ores requiring washing."—October 10.

John Whitehead, of Leeds, for "Improvements in machinery for combing, hackling and straightening wool, flax, tow, and other fibrous substances."—Oct. 10.

Frederick Harlow, of Paradise-street, Rotherhithe, carpenter, for "Improvements in atmospheric railways."—October 10.

Charles Nossiter, of Lyndon End, near Birmingham, for "Improvements in the manufacture of leather."—Oct. 10.

James Hardcastle, of Firwood, Bolton-le-Moors, Lancaster, Esq., for "certain Improvements in the method of conveying water."—October 10.

Charles Hanson, of Huddersfield, watch-maker, for "certain Improvements in clocks watches, or time-keepers."—October 10.

James Knowles, junior, of Bolton-le-Moors, coal-merchant, and Alonzo Buonaparte, Woodcock, of Manchester, engineer, for "certain Improvements in machinery or apparatus to be employed for raising coal, or other matters from mines, which improvements are also applicable to raising or lowering men or animals, or other similar purposes."—October 10.

William Hodgson Gratrix, of Nuneaton, Warwickshire, ribbon-weaver, for "certain Improvements in looms for weaving ribbons and other fabrics."—Oct. 10.

James Taylor, of Lochwinnoch, Renfrew, carpet and rug manufacturer, for "certain Improvements in the manufacture of carpets, rugs, and piled fabrics."—Oct. 10.

Edmund Parker, of Tring, Herts, decorative painter, for "certain Improvements in graining and decorating in oil, distemper, and other colors, and in imitating marbles, granites, fancy and other woods, and in the apparatus and instruments to be used therein."—Oct. 11.

Benjamin West, of Saint James' Walk, Clerkenwell, bookbinder, for "certain Improvements in covering or stoppering the tops of bottles, jars, pots, and other similar vessels." —Oct. 16.

Stephen Reed, of the town and county of Newcastle-upon-Tyne, gentleman, for "certain Improvements in railway rails and chairs."—Oct. 16, 1845

William Elliott, of Birmingham, button manufacturer, for "Improvements in the manufacture of buttons."—Oct. 16.

John Barsham, of Long Melford, Suffolk, manufacturer of bitumen, for "Improvements in the manufacture of mattresses, cushions, brushes, and brooms, and in machinery for preparing certain materials applicable to such purposes."—Oct. 16.

John Marshall, of Southampton-street, Strand, tea-dealer, for "Improvements in preparing cocoa and chocolate."—Oct. 16.

William Betts, of Smithfield-bars, distiller, for "Improvements in the manufacture of brandy, gin, and rum, and other British spirits and compounds."—Oct. 16.

James Webster Hall, of Fitzroy-square, gentleman, for "Improvements in machinery for cleaning or freeing wool, and certain other fibrous materials, of burrs, and other extraneous substances."—Oct. 16.

Hippolyte Pierre Francois Desranges, of No. 1, Skinner's-place, Size-lane, City of London, gentleman, "for an Improvement or improvements in the mode of manufacturing corks." (A communication.)—Oct. 17.

William Henry Stevenson, the of town and county of Nottingham, merchant, for "certain Improvements in machinery, or apparatus to be used in dyeing or staining."—Oct. 17.

Joseph Orzi, of Pimlico, gentleman, for "Improvements in sleepers, or blocks, for supporting railways."—October 23.

Thomas Taylor, of Manchester, cabinet maker, for "certain Improvements applicable to machinery or apparatus employed for sawing timber."—Oct. 23.

Thomas Worsdell, jun., of Stratford, Essex, railway-carriage builder, for "certain Improvements in apparatus to be attached to and employed in connexion with railway carriages."—October 23.

Arthur Smith, of St. Helen's, manufacturing chemist, for "certain Improvements in the manufacture of soda ash."—Oct. 23.

William Coles Fuller, of Brownlow-street, Holborn, cabinet maker, for "Improvements in the construction of carriages for railways."—October 23.

William Thomas, of the City of London, merchant, for "certain Improvements in the construction of umbrellas and parasols."—Oct. 23.

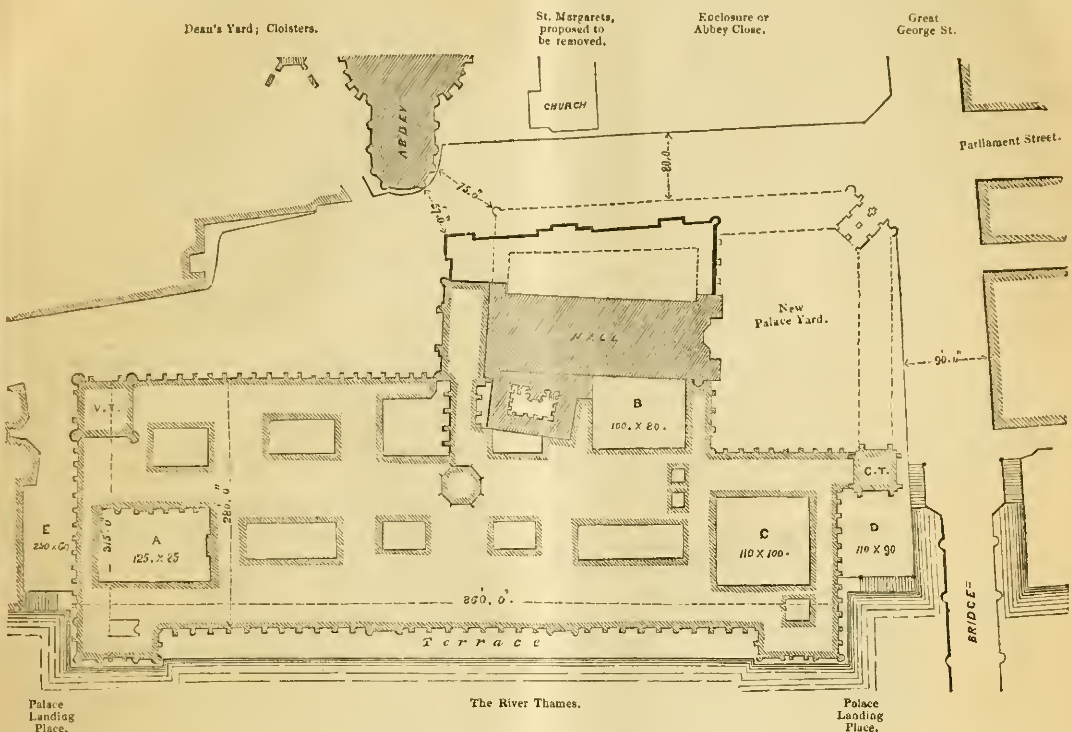
TO CORRESPONDENTS.

E. H.—We will endeavour to avail ourselves next month, of the courteous offer respecting the communication sent to us.

M.—The principal works of Mr. Basevi besides the Fitzwilliam Museum were Stockport Church, Belgrave Square, St. Saviour's Chelsea, Pelham Crescent, Sydney Place, and Thurloe Square.

ERRATUM.—In page 352, col. 12, for "mean depth" read "mean draught."

PLAN OF THE PROPOSED ADDITIONS TO THE NEW HOUSES OF PARLIAMENT.



The Additional Buildings proposed are defined by a broken line, thus — — — — — — —.

REFERENCES.—A. Royal Court.—B. Star Chamber Court.—C. Speaker's Court.—D. Palace Landing Place.—E. Palace Landing Place.—V. Victoria Tower.—C. T. Clock Tower.

PROPOSED NEW LAW COURTS.

In our last number we gave an analysis of the evidence before the Committee of the House of Commons, appointed to examine as to the propriety of removing the Law Courts adjacent to Westminster Hall and building others affording increased accommodation. Great complaints have from time to time been made respecting the inconveniencies experienced by those whose avocations require their constant attendance at Westminster Hall. The site of the present courts, never too large, even when comparatively uninteresting cases are tried, is found totally inadequate for the sittings at Nisi Prius, and during trials of general interest. They only who are frequently present on these occasions can have an adequate idea of the inconvenience and confusion arising from the excessive crowding and from the deficient arrangements of the building. The heat is frequently intolerable, from the defective ventilation, those present are constantly re-breathing a vitiated atmosphere, and even where attempts have been made to remove this evil, it is only by producing strong draughts or currents of air, which are even still more prejudicial to health.

Another great and apparently irremediable defect of the present Courts is the imprrfect manner in which they are lighted. Never were Sir John Soane's peculiar notions as to lighting buildings displayed more characteristically than in the present case. There are sky-lights and lanthorn-lights of every conceivable form, borrowed lights stuck into all sorts of out of the way corners, odd little panes of ground glass stuck into still older places, but with all this contrivance the present Courts are over-wrapped in Cimmerian gloom even when the sun is shining most brilliantly out of doors. There is one of the principal passages, in particular, which leads to the Court of Queen's Bench, in which, to a person entering from the street, every thing is indistinguishable till the eye becomes accustomed to the obscurity, and as this passage has two or three steps in it, it is a general recreation of the "briefless" to watch persons coming in from the street, as, unless among the initiated, they are sure to stumble and afford great amusement by their rapid descent. We heard not long ago a barrister plead in court, as an excuse for not attending to a certain notice, that it was hung up in this passage, and was therefore unreadable. In the lower offices of the building there are no windows at all, and lamps are kept burning the whole day.

The lover of architecture will consider it no unimportant argument for the removal of the present Courts, that they block up and disfigure the finest hall in the world—Westminster Hall. In consequence of their proximity, the upper windows of one side of the Hall have their lower halves blocked up, and consequently no more than half the light they were originally intended to give.

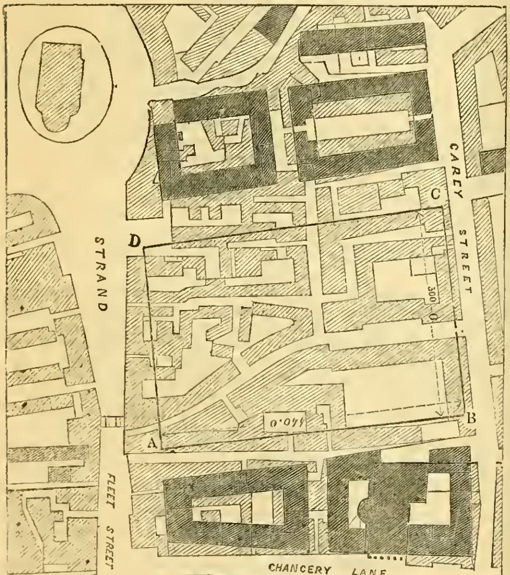
In Mr. Barry's design, given above, New Palace Yard is converted into a Quadrangle, by a range of buildings nearly parallel to Bridge Street, and another range nearly at right angles. These buildings, he proposes, shall be depositaries for the Record Office, as the Victoria Tower is found too small to hold the Records, or rather to hold them, "taking the allowance proposed for additions, and the proposed increased facilities for searching the Records."

It may perhaps be doubted whether we should be justified in incurring so great an additional expense as that required for the building of the New Quadrangle, after so much money has been devoted to the building of the Victoria Tower, for the purpose of holding the Records. The arrangement also of the entrance to the corner of the

Quadrangle seems also very ungraceful. It will be observed also that the new buildings do not make the Court a parallelogram, the side next the Abbey being drawn parallel to the palisading on the opposite side of the road, instead of being at right angles to the side in which is the entrance to Westminster Hall.

The plan involves the removal of all the houses on one side of Bridge-street, and also of St. Margaret's Church. Of the latter proposition we shall have something to say hereafter, but as it does not immediately concern us at present, it is better that it should be considered by itself. Mr. Barry states, that in forming New Palace Yard into a Quadrangle, he is adopting a plan suggested by the form of the ancient Palace, in which he states that the same area was enclosed by buildings. We have examined a great number of very old and very scarce engravings in the British Museum, particularly one by Hollar, and find ranges of buildings in a line with the front of Westminster Hall, apparently of Perpendicular architecture, but have not been able to find any representation of a Quadrangle, such as that proposed. Mr. Barry is, however, doubtless the best authority we can have on the subject to which he has devoted so much study.

The situation proposed for the New Law Courts is an area, bounded by the Strand, Fleet-street, Chancery-lane, Carey-street, and Shire-lane. The rectangular marked A, B, C, D, in the engraving below, shows the position of the Courts themselves, the deeply shaded parts immediately below the line A, B, and above the line C, D, denote the situation of the Law Chambers, and other accessory buildings. Temple Bar is a little above, and to the right of the letter A. By the increase of the street to nearly double the present width, the Bar would be left on one side of the street, which would amount to virtual abandonment of the Palladium of the City of London. For if the Sovereign were at any time to pay an unexpected visit to the city, it would be easy enough to slip round by the side of the barrier without the ceremony of knocking at the portal, so sedulously guarded by the civic corporation.



The removal of the old crowded tenements adjoining Shire Lane would be a great advantge in a sanatory point of view. It will be seen by reference to the Plan that Carey Street and Chancery Lane would be widened; this would be a great convenience, not only to the attendants on the Law Courts, but to the public generally. From the analysis of the evidence already given, it will be seen that Mr. Barry anticipates a deduction from the cost of the improvements on account of the rental derivable from the Law Chambers.

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXVII.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Chambers' Journal presumes upon the ignorance of its readers somewhat too impudently, when, speaking of the Clubhouses about Pall Mall, it tells them that those buildings exhibit "every order of architecture, from the severest Doric to the most florid Composite," and that a stranger might mistake some of them for "restored Grecian temples," the mistake being in fact entirely on the part of the writer, unless Scotch second-sight has enabled him to discern that very striking and illusive Dromio sort of resemblance to Grecian temples, which seems to strike him, but which no one who is not equally gifted can possibly detect. Even when he comes to matter of fact, he is hardly less imaginative, for he characterizes the Athenæum Clubhouse as "gorgeous," and singles out its staircase for especial notice, although there is nothing for notice about it except its extreme plainness. With similar judgment and accuracy, he describes the Hall of the "Conservative" as "a circle (broken only by the staircase and gallery) surmounted by a cupola"!—He therefore literally *mutat quadrata rotundis*, and turns a square apartment into a round one. It is true, the large opening in the ceiling of the lower hall and the floor of the upper one is circular, but that no more converts the hall itself into such shape than a round table placed in the centre of it would do. As to "temples," though in accordance with a very common license, he speaks of them in the plural number, perhaps he means only the one in Pall Mall East, viz., the Tempte of Esculapius, *alias* the Cottage of Physicians, which though not exactly a clubhouse itself, is linked with one in architectural matrimony, namely, with the "Union;" now exhibiting with bitter facetiousness the union of black and white, the fair and better half of it belonging to the Club, and the grave and dismal portion of it to the Doctors, of whose trade as purveyors for the undertakers, its complexion is epigrammatically expressive.—As to the *temple* part of the affair, it will not bear contemplating at all: the very columns looking ashamed at being tacked as a portico to such a piece of dowdiness.—And *a propos* to porticoes, as if we had not quite enow of them before, considering what humdrum sort of things they for the most part are, one of the weekly papers has just bestowed a portico, or rather a couple of porticoes, on Sir Robert Taylor's "Stone Buildings" in Lincoln's Inn,—another instance of the accuracy and *nous* displayed in architectural description, by those who employ at random the few terms they have picked up, as innocently unconscious all the while of blundering as Mrs. Malaprop herself.

II. The mention of porticoes leads me to observe that one of the very best we have in regard to its being a specimen of the Grecian Doric *style*, and not merely of the order—of its columns and entablature alone, is precisely the one which is never quoted at all as an example of it, is that of the Colosseum in the Regent's Park, not only on account of its scale, but also of being free from any admixture of those incongruous features which, notwithstanding that they almost always occur in modern examples—even where they might be avoided, are incompatible with, and therefore detract greatly from the classicality aimed at, or at least affected by the external elevation of the portico itself. Now that the interior of the Colosseum has been converted into a "*Glyptotheca*,"—and a most charming Sculpture-gallery it is, the exterior might be made to express the present purpose of the building very significantly, by the portico—that is, the metopes of the frieze and the tympanum of the pediment being enriched with sculpture. We have as yet not a single instance of a Grecian Doric so embellished. All our modern examples of that style, even those which are otherwise unexceptionable—and they are but very few—exhibit it only in its undress, though it might be supposed that even for the sake of a little variety and of some degree of character to distinguish one design of the kind from another, Doric decoration would sometimes be adopted.—Happily the mania for Grecian Doric, and for "Pæstan columns six feet high," has subsided, since of all the ancient orders that is the most obstinate and unmanageable,—the one which requires a severity and dignity of manner that frequently unfit it for general purposes. It is so expressly adapted to the simple temple form, and to columniation merely, that fenestration is fatal to it. It rejects all alliance with *modernism;* yet nevertheless has, with singular perversity, been applied by us to buildings of every class, and some of them of the most ordinary and vulgar kind; and accordingly the most *outré* and tasteless combinations have produced,—even such vile monstrosities as bird-cage-looking verandas, supported by Doric columns as Athenian as Stuart's "Athens" could supply them. Wilkins was guilty of some absurdities from which it might be supposed that his reverence for classical antiquity, if not his judgment and his taste, would have withheld him. The house built by him at Oxberton, for Mr. Foljambe, is a striking instance of utter disparity of character between the building and the portico attached to it, the former being a moderate-sized house of the plainest description externally, without even dressings to the windows, while the other is a Grecian Doric tetrastyle, of which the columns are 4 ft. in diameter, therefore as thick as the windows are wide. So far from bestowing dignity on the house, such a portico causes it to look all the more insignificant by comparison; and on the other hand, the house quite destroys the dignity of the portico. Instead of composing together, they display two quite distinct modes of building, and the most antithetical taste. Artistic *proportion* was there completely violated; and mere mechanical proportion as to separate parts avails nothing, if the respective parts be not proportioned to each other, and appear to be expressly adapted to each other, so as to constitute a well-proportioned whole, and that whole withal of consistent, if not perfectly uniform character. It would have been taken for granted that the author of the work on "Magna Græcia" could *draw* a Doric portico, without his erecting one as an example of the *order*, betraying at the same time how little he understood, or else how completely he disregarded the genius and spirit of the Grecian Doric style. Oxberton, however, seems to have had its admirers, for it forms one of the subjects in Richardson's Vitruvius Britannicus, where it was, no doubt, introduced on account of its *pure Grecianism*, since, the portico excepted, or rather the portico also included, there is nothing whatever of design, nor a single idea in the elevation.—Neither is the portico of Covent Garden Theatre by any means a very satisfactory or dignified specimen of the style, notwithstanding that in regard to mere dimensions the order is upon a more than usually noble scale. Considering the purpose of the building, sculpture both within the pediment and in the metopes of the frieze, would have seemed almost matter of course, more especially as some sculptural decoration is bestowed on other parts of the façade; nor would the addition of it to the portico have been a very expensive matter, as that is only a tetrastyle; consequently, as the intercolumniation is *monotriglyphic*, there are only six metopes in front. Still, even such decoration would have helped little—perhaps would only have rendered, in contrast with such classicality, the interior of the portico all the more at variance with its external elevation. Being merely *monoprostyle*, the portico neither does nor appears to afford sufficient shelter at the entrance into a theatre, for it is both short and shallow, whereas could it have been recessed also within the general line of front, so as to render it twice as deep as it is at present, besides the greater convenience that would have been so obtained, by being set further back, the inner elevation (which is cut up by doors and windows of very anti-Doric physiognomy) would not have been so observable; and at the same time the whole façade would have been greatly relieved by both depth of shadow, and the appearance of something like spaciousness within the portico.—To return to the Colosseum,—though its portico be only monoprostyle, it does not consist merely of a single range of columns, but forms a boldly projecting mass of which the depth is about three-fourths of its width in front; which circumstance and the absence of windows render the portico and the exterior of the Colosseum generally almost unique among modern examples. In character, if not in material and construction, that edifice may be termed "monumental;" while some that have been built for durability, and which derive their merit from the stonemason, more than from the architect, are so *unendurable* in the taste which they display, that it would be a satisfaction to know they were only of lath and plaster.

III. Sir Robert Inglis must surely have meant to relieve the drudgery of "committee work" by a little facetiousness, when he asked Mr. Barry if Temple Bar would be like the Arch of Titus, when the whole of the present line of houses on the north side of Fleet-street and the Strand, between Chancery-lane and Clement's Inn, come to be pulled down and set back.—Very like the Arch of Titus, indeed!—Though Barry does not care to raise a hubbub among the citizens by formally declaring war against the Bar, which might spirit them up to resist his invasion, and fight manfully for the preservation of that architectural Palladium, he is no doubt perfectly satisfied that as soon as his new Law Courts are built *up*, the Bar will have to come *down*. Were it to be left standing, jutting out just mid-way into the street, which will then be double its present breadth, it would cut a most ridiculous figure indeed, for its own ugliness would only enhance the absurdity of suffering it to remain to block up and disfigure the street on that side. However, Barry will willingly enough erect another barrier—a Bar in somewhat less *bar-barous* taste than the present one.

IV. Professor Hosking's estimate of Palladio is more just than flattering. "His porticoes may be Vitruvian," he says, "but certainly not classic. His columns upon columns, his attached and clustered columns, his stilted, post-like columns, his broken entablatures, his numberless pilasters, straggling and unequal intercolumniations, inappropriate and inelegant ornaments, circular pediments and the like, are blemishes too numerous and too great to be passed over, because of occasional elegance of proportion, and beauty of detail." Such is the great master, whose works have been cried up and extolled as hardly less than the *ne plus ultra* of art, and not only by the *οι πολλοι* of tourists and bookmakers, but by Gœthe, Forsyth, Beckford and others, capable, it may be thought, of judging and thinking for themselves. But that they really did so, may very strongly be doubted, because their laudations have always been general, or even when they have been in raptures about particular buildings, they have never explained their particular merits. What is not least strange of all is, that such ultra-admirers of Palladio should not ever have taken the slightest notice of any of the works of his modern imitator Calderari, which, save that they are somewhat better, might very well pass for being by Palladio himself. In fact, "the sublime genius" of Palladio is the merest cant and twaddle that ever was uttered.

SUPPLEMENT TO THE PENNY CYCLOPÆDIA.

Vol. I. London: Knight and Co. 1845.

A contemporary has dispatched its notice of this volume of 676 closely printed pages in columns, with equal facetiousness and brevity—brevity being the soul of wit,—for all that he said about it was that "Abati" was the first article, and "Gyrosteus" the last, the former of them being an Italian painter, and the other a fossil fish. As to all that lies between, it may be questioned if the hasty "railway" critic ever looked at a line of it. He certainly paid a very poor compliment to his readers in supposing that they did not care to learn any thing further about the publication, notwithstanding that it differs from preceding works, in consisting almost entirely of fresh matter that has accumulated or arisen not only since the publication of former cyclopædias, but during that of the Penny Cyclopædia itself. However well executed a work of the kind may be, it must inevitably require additions to be made to it from time to time, more especially in an age when fresh discoveries and inventions are taking place almost daily. Accordingly so far from the present Supplement being superfluous, another will be required some ten years hence, if not sooner. Many who have taken in the Cyclopædia, may not choose the Supplement, yet we think that quite as extensive a sale, or even a greater, may be looked to for the additional volumes, because though intended expressly to match with the original series, they are in a manner independent of it, inasmuch as their contents are equally supplementary to any other work of the kind, and also of interest and value to those who possess no work of the kind at all.

It will not be expected that we should enter into an examination of the work generally,—for that would be a most preposterous attempt on our part. *Ne sutor ultra crepidam*—we accordingly confine our notice to the architectural articles, which, as may be supposed, are chiefly biographical ones; and some of them might in fact have been given in the "Cyclopædia." They are nearly all, however, of comparatively recent date, and only one or two—and those of English architects—have found their way into English biographical works. Among them are—Bonomi, Bonsignore, Cagnola, Calderari, Cantoni, Carr, Colonna, Dance, (father and son), Delorme, Duraud, Fischer, Foschini, Foulston, Gaertner (father of the present eminent Munich architect), Gandon, and Gasse (Luigi and Stefano);—all of which appear to have been carefully drawn up, and by no means mere ordinary compilation, for instead of a jejune recital of facts, they are occasionally enlivened by critical and other remarks. In the article on Colonna, for instance, the writer has noticed Professor Cockerell's exuberant commendation of that very singular production the "Polifilo"—remarkable enough as a literary curiosity, but a mere *galimatias* in regard to architecture. The article on Delorme, again, *corrects* in a very emphatic manner the opinion that has hitherto passed current in regard to that "worthy," by informing us that so far from possessing the superior talent hitherto ascribed to him, he was in reality little more than an audacious quack, who with equal meanness and baseness, robbed his own brother, taking to himself all the credit of works in which the latter had had by far the greater share. The infamy, therefore, which must henceforth attach to the name of such an impostor, ought to be in full proportion to his former celebrity? Foulston, who is spoken of at considerable length, is estimated more justly than flatteringly; and to say the truth he was more of a builder than an architect, scarcely any one of his works rising above dull and decent mediocrity. Yet even if he should be thought to have obtained an undue share of notice, the article itself is interesting on account of the observations it contains.

The architectural articles of a different class, consist only of such as had been passed over in the "Cyclopædia," which in the earlier volumes was not quite so full, in respect to them, as it afterwards became. Those now introduced are: *Aizani* (a city in Asia Minor, of which the temples and other monuments have become known to us through Texier's work), — *Chimney-piece*,—*Clubhouse*,—*Cologne* Cathedral, and the works now in progress for its completion,—*Cottage* Architecture,—*Door*,—*Elizabethan* Architecture,—and *Gallery*, all of them perfectly new subjects in a Cyclopædia, and which are touched upon very briefly, and drily also, even in architectural treatises and other publications of that stamp. Those who are acquainted with the articles Portico, Staircase, Theatre, Window, &c., in the Penny Cyclopædia, some of which we noticed at the time, will deem it sufficient recommendation when we say that those in the Supplement are treated in the same full and interesting manner,—though when we say "full" we mean comparatively, for notwithstanding that they are as long as can reasonably be expected in a work of this nature, we could wish that they had been further extended, as they probably would have been, had the author of them been left to treat them entirely according to his own views and inclination, without regard to the space they would occupy. There is, however, one article of the kind,—or rather one architectural article of a different kind, viz., that on *Exchange* (the new Royal)—which plainly enough discovers itself to be by another pen. Not only is it little more than mere dry compilation, but poorly put together: as to the peculiar character of the portico, nothing is said; to make amends for which, however, the Encaustic painting within the arcades is spoken of as producing a very novel, rich, and agreeable effect; yet those decorations are certainly in too light and fanciful a taste, to suit either the architecture or the place.

The index to each letter shows at once what articles belonging to it are given, and among these which come under D, the omission of Daguerrotype is rather a singular one, the subject being one of considerable interest as regards both science and art. Ecclesiology—which now forms a particular study, might also have furnished matter for an article unknown to other Cyclopædias, although it is not as yet so formally recognized as a distinct pursuit that the passing it over amounts to an omission. Let us, therefore, be thankful for such a valuable accession to the stores of popular information as this Supplement provides, and we only have to express the hope that it will not be hurried on in the last letters of the alphabet, should it be found impossible else to complete it within the compass originally contemplated.

AMALGAMATION AND LEASING OF RAILWAYS.

In your excellent periodical for October 1845, you did me the favour to insert a few remarks on this most important subject, wherein were shown the opinions expressed by the Railways Companies, the Board of Trade, and the Houses of Parliament, in which an account is given also of the lines which had ceased to exist as independent undertakings. I now, with your permission, intend to continue the subject, and will endeavour to show as briefly as I can the present position of affairs, and the effect produced by the new undertaking of the Session of 1845, in continuation of the amount of amalgamation previously noticed.

The *Great Western* propose (but one offer has been repudiated by shareholders of the Exeter line) to lease the Bristol and Exeter in a capital of 1,080,000*l.* and after January 1, 1849, on two millions at 6 per cent. or 5¾ if a narrow gauge line is sanctioned by Parliament between London and Exeter.

The *London* and *Birmingham* and *Grand Junction* have agreed to join stocks, under title "Great London and Liverpool," the latter Company to increase their shares 20 per cent of the common fund; the increase is 100,000*l.* for 18 weeks, as compared with last year.

The *Brighton* and *Croydon* line amalgamated, and the shares are to be consolidated into stock, the former at 50*l.* and the latter at 18*l.* 10s. per share.

The *Dundee* and *Perth* have leased the Dundee and Newtyle at 1 per cent. on 115,000*l.*, and propose a new line, the Dundee and Strathmore Junction.

The *Eastern Counties* and *Northern* and *Eastern* have amalgamated with the proposed Cambridge and Lincoln, and have also proposed to unite with the intended London and York, but the latter at present decline to accede.

The *Edinburgh* and *Glasgow* have amalgamated with the Ballochney railway and the Scottish Central Lines.

The *Glasgow* and *Greenock* have arranged to work the Glasgow, Barrhead and Neilston Direct.

The *Chester* and *Holyhead* have united with the North Wales.

The *Bristol* and *Exeter* with the Exeter and Crediton.

The *South Western* with the Guildford, Chichester and Portsmouth.

The *Great Western* with the South Wales.

The *Sheffield* and *Manchester* with the Great Grimsby.

The *Manchester* and *Leeds* with the Liverpool and Bury.

The *Great North of England* with the Middlesborough and Redcar.

The *Newcastle* and *Darlington* have offered to purchase the Pontop and South Shields at par, and the Durham and Sunderland at 3*l.* 10s. per share, but both arrangements are as yet incomplete, although the Durham and Sunderland have consented.

The *Caledonian* have amalgamated with the Clydesdale Junction, and guaranteed 6 per cent. to the latter, including 120,000*l.* paid for the Pollock and Govan Railway, and are to participate in the profits above 6 per cent. on the united stock.

The *North Wales* with Chester and Holyhead.

The *Oxford* and *Rugby* with the Great Western, as also the Monmouth and Hereford.

The only remnants of the new infusion of last Session which are left with any degree of independence, are—the Kendal and Windermere, the Cockermouth and Workington, the Newport and Pontypool, the Wear Valley, the Southampton and Dorchester, the Richmond (Surrey), the Leeds and Thirsk, the Shrewsbury, Oswestry and Chester, the Lynn and Dereham, Lynn and Ely, Ely and Huntingdon, the three latter having a common source and interest.

The lines of the Session of 1845 for Ireland are, Irish Great Western, Londonderry and Coleraine, Belfast and Ballymena, Dublin and Belfast Junction, Dundalk and Enniskillen, Cork and Bandon, Great Southern and Western, Waterford and Limerick, Newry and Enniskillen. These being unexecuted have remained comparatively independent, although attempts have been made to form alliances of the Dublin and Belfast with the proposed Great County Down Company, the Dundalk and Enniskillen with the proposed Irish North Midland and Belfast Junction and Dublin and Drogheda line, the Great Southern and Western with the proposed Irish Great Western (Dublin to Galway), Wexford, Carlow and Dublin Junction, Killarney Junction, and numerous other projects in embryo. The Ulster takes an interest in proposed Newry, Banbridge and Belfast Junction.

The lines of Session of 1845 for Scotland were, the Caledonian and Scottish Central, Aberdeen, Clydesdale Junction, Edinburgh and Northern, Glasgow, Barrhead and Neilston Direct, Scottish Midland Junction, Dundee and Perth, Edinburgh and Hawick, Glasgow, Paisley, Kilmarnock and Ayr, many of which were promoted by old companies, and have since come into the combination, which is yet in progress, as the Caledonian propose to purchase the Glasgow and Garnkirk, to lease the Caledonian and Dumbarton Junction to amalgamate with the Clydesdale Junction and Pollock and Govan Railway. By a reference to my former remarks in the previous paper, it will be seen that the views of the different Chairmen have been more than carried out, and to an extent that could not then have been conceived to be at all possible. The opinion of the Board of Trade against the amalgamation of the Liverpool and Manchester, although overruled by Parliament, is shown to have been dictated by sound sense, and the passing of the Act to restrict the powers of selling or leasing, contained in some of the railway bills, is a matter of imperative necessity; and now that the Lords of the Council are to act for themselves, and not to leave this most important affair to those who are leagued with the interest in which they have to adjudicate, may have a very different effect than is anticipated by the new chairman of the Eastern Counties, when he exclaimed, "thank God that we have a House of Peers." The reason of the one member who voted for the London and York line may not yet be futile, "that one individual possessed the control of 600 miles of railway."

The spirit of combination has also affected the new projects, and many have united their interests. This union is not always for good, but serves to cover the retreat from abortive schemes. The following are some of the new alliances:—the West Riding composed of Leeds and West Riding Junction, West Yorkshire and Huddersfield, Halifax and Bradford Union, to become stock of Manchester and Leeds if the Act be obtained. The West Lancashire amalgamates with Southport and Euxton Junction—the Boston, Newark and Sheffield with Nottingham and Mansfield; the Evesham Valley with Warwick and Cheltenham Junction; the Birkenhead, Manchester and Cheshire with Birkenhead, Lancashire and Cheshire Junction; the Leicester, Tamworth, Coventry, Birmingham and Trent Valley Junction is composed of the late Leicester and Birmingham and Leicester and Tamworth; the Northumberland and Lancashire Junction is composed of the late Newcastle, Durham and Lancashire, and Manchester, Liverpool and Great North of England Union, Newcastle-upon-Tyne, Edinburgh and Direct Glasgow Junction are amalgamated or composed of the late Newcastle-upon-Tyne, Hawick, Edinburgh and Glasgow Junction, and Newcastle and Carlisle and North Tyne Junction; the Cheltenham, Oxford and Brighton Junction amalgamated with the Cheltenham and Oxford; the Scottish Western and Scottish Grand Junction have coalesced, the former to receive 10*s.* per share premium, or option of remaining in the united company; the Glamorgan Central, late Daffryn, Llysar and Port Cawl unite with the South Wales.

In reference to the position of the established companies previous to the year 1840, when the first act of combination took place by the sale of the Chester and Crewe line to the Grand Junction, it is to be observed, that they were content with arrangement of a less permanent character, which simply consisted of two classes, viz., toll-paying and toll-receiving; the latter was adopted by the Grand Junction, London and Croydon, Manchester and Birmingham, North Union, and Bolton and Preston, and the former by the London and Brighton, London and Croydon, Manchester and Leeds, Manchester and Birmingham, Sheffield and Manchester, and South Eastern. These arrangements continue in practice yet, and are in my opinion much preferable for the public and the shareholders than the present extensive fever for amalgamation, and issues of new stock for the benefit of the directors and large capitalists, at the expense of the small holders. I have no doubt but that the inhabitants of Caledonia have shown their usual caution in entering into arrangements less permanent than amalgamation. In the case of the Glasgow, Barrhead and Neilston Direct, the Glasgow and Greenock work the line, and the Glasgow, Kilmarnock and Ardrossan are to pay toll.

The position of the railways at present has been compared to the Houses of York and Lancaster, in the battles of the Red and White Roses, and indeed there may be said to exist only two companies, the East and West Coast Lines. The capital expended on lines open is 70,327,264*l.*, and south of the parallel of London we have the South Western, 95 miles, 4,853,000*l.*; South Eastern, 92 miles, 9,000,000*l.* nearly; London and Brighton, 41 miles, 3,000,000*l.* nearly; North of London, the London and Birmingham, 370 miles, 14¼,000,000*l.*; the Great Western, 95 miles, 5,000,000*l.*; Eastern Counties, 136 miles, 6,000,000*l.*; Midland, 403 miles, 10¾,000,000*l.*; the Manchester and Leeds, 70½ miles, 3,000,000*l.*; the Sheffield and Manchester, 40½ miles, 1¼,000,000*l.*, and the residue is made up from the following, Chester and Birkenhead, Stockton and Darlington, Newcastle and Carlisle, Maryport and Carlisle, Lancaster and Carlisle, Preston and Wyre, Norfolk, Taff Vale, Glasgow, Paisley, Kilmarnock and Ayr, Edinburgh and Glasgow, Glasgow, Paisley and Greenock, Dundee and Arbroath, Arbroath and Forfar, Dublin and Kingston, Ulster, Dublin and Drogheda.

The following old lines may be said to be out of the market for speculation, being guaranteed dividends by other lines, Northern and Eastern (London and Greenwich); Bristol and Exeter; Bristol and Birmingham; Great North of England; Hull and Selby; Lancaster and Preston. There is another class of line to which the old contribute a portion of the capital, the Lancaster and Carlisle; Caledonian; Trent Valley; Manchester and Buxton; Manchester, Bury, and Rossendale; South Devon; Chester and Holyhead; Newcastle and Berwick. As to the effect produced by the new lines of 1845, it has only drawn the old combination into closer alliance. The territory of the South Eastern is apportioned, the Great Western and South Western have their limits assigned. The Midland and the Manchester and Leeds have agreed to an armed neutrality. The Great London and Liverpool, with a capital paid up of 15,000,000*l.* nearly, has been formed out of discordant elements. The pugnacious Trunk Line (the Croydon) has been swallowed up in victory over its more extensive neighbour the Brighton. These changes have not been effected without some instances of special injustice; and the chairman of the Eastern Counties says, "he was not afraid of the monetary system of the country: money merely passed from hand to hand; but the system was one which tended to the ruin of the little and exaltation of the great." What think you of this, after the cool proposal for the abrogation of "The Eastern Counties PERPETUAL Five per cent. Stock?" It is a great pity that no directors have as yet moved for an equal division of what was in hand, and allowed the shareholders to seek their remedy, they (the directors) retreating through the loop-hole of resignation, or ceasing to be qualified, having parted with their shares. Among the instances of injustice that now occur to my mind are the Midland Counties 20*l.* shares, or amalgamation with the North Midland being cut down to 2*l.* shares, after being guaranteed 6 per cent. But the "crowning mercy" of Worcester field was the return of the deposit by the Birmingham and Gloucester Railway, after a guarantee of 5 per cent.; and we may exclaim with Shakspere, "What's in a name?" when we find this example really called "The Worcester Deviation Line." The directors, on being remonstrated with, reply, "there was no alternative." Amongst the other means of annoyance to the small holders of shares, are those with preference or guaranteed dividends on the quarter shares in Taff Vale, 3 per cent stock. The Glasgow, Paisley, and Greenock; London and Croydon, thirds; Midland, fifths; Preston and Wyre, halves; and the Clarence "Government preferential loan shares." The above are a preference class of shares in each company. Those wherein the whole shares of a company are guaranteed by another have been previously noticed. Another source of annoyance is the consolidation of shares, after being issued into a lower nominal amount, as in the London, Brighton and London, South Western, and London and Croydon companies. In conclusion, one of the effects of the great number of new companies of the session of 1845 is to cause the old companies to create shares with deferred interest and deferred calls, as the Manchester and Birmingham, and Manchester and Leeds, and Great Western, to issue shoals of scrip for extension, as the South Eastern 289,000 in one lot. In fact, policy, not honesty, is the present order, and what can a shareholder do in an account of 15,000,000*l*, as ascertaining whether a dividend is *bonâ fide* or not. The playing off directors or shareholders against each other, as in the London and York case, is injurious to both, and will probably end as did the fight of the famous Kilkenny cats.

O. T.

ATMOSPHERIC RAILWAYS.

SIR—There is one part of the Evidence given before the Parliamentary Committee on Atmospheric Railways, which I wish to notice; I mean the contradictory opinions of Dr. Robertson (710), and Mr. Stephenson (1588), on the maximum velocity question. Recent experiments seem to show that a greater velocity than Mr. Stephenson expected has been obtained, but of that I shall not at present say anything, I merely wish to show that both Mr. Stephenson's evidence and Dr. Robinson's are partially true, in respect to their theoretical views, and that Dr. Robinson is quite right in his principles, but has led Mr. Stephenson wrong by taking a most unfortunate example.

Let f be the accelerating force on the train of which the mass is M.

P=the pressure of the atmosphere on the area of the piston.

p=the pressure of the air in the partially exhausted tube on the same area.

R_1=that part of the resistance which is independent of velocity.

R_2=that part of the resistance which does depend on velocity.

The reason for this separation of the resistance into two parts will appear directly.

Then we have $Mf=P-p-R_1-R_2$.

When the velocity is a maximum $Mf=0$, and R_2 is a constant, (because the velocity is constant),

$$\therefore P-R_1-R_2=p.$$

And therefore p must be constant, or the gauge is stationary.

Therefore *when the velocity is constant, the gauge is stationary.*

Mr. Stephenson says—"*when the gauge is stationary, the velocity is constant;* but this, the converse of the preceding deduction, is not true; and he was led into error by supposing the proposition to be convertible; for if p be constant, $Mf=P-p-R_1-R_2=$ a constant $-R_2$, and here, where R_2 is a function of the velocity, we know that it by no means follows, as a necessary consequence, that the velocity is uniform—*e. gr.* the equation of motion of a body falling in air is

$$M\frac{d^2z}{dt^2}=g-K\left(\frac{dz}{dt}\right)^2 \text{ or } Mf=\text{a constant}-K\,(\text{velocity})^2$$

And in this case we know the motion is accelerated up to a certain point.

Mr. Stephenson then is wrong in concluding from a stationary gauge that the velocity of the train is at its maximum, though he was quite right in expecting that when the velocity was maximum, the gauge would be stationary; it being evident that the gauge *may* be stationary when the velocity is increasing—but it *must* be so when the velocity is greatest.

Dr. Robinson stated what was perfectly true, but unfortunately took an *unpractical* case, (he supposed $p=0$), and this Mr. Stephenson did not fail to notice; but if he had said—suppose the air in the tube to be kept constantly at such a pressure that the gauge indicates 25 inches—then it is clear that the train will be accelerated till the opposing resistance, which increases with the velocity is such as to be equal to the remaining part of the effective forward pressure, and therefore while the train is being thus accelerated, the gauge will have been stationary.

If you think this worth insertion in your valuable Journal, I shall be very glad. It is a plain instance of a case where the mere turning the reasoning into the form of an algebraic equation and applying the most simple principles of dynamics, we are enabled to see clearly the reasons of disagreement between two such distinguished men as Dr. Robinson and Mr. Stephenson.

I remain, your obedient servant,

M. Cowie.

College for Civil Engineers, Putney, Oct. 29.

THE DECADENCE OF CLASSIC ARCHITECTURE.

Humano capiti cervicem pictor equinam
Jungere si velit, et varias inducere plumas,
Undique collatis membris, ut turpiter atrum
Desinat in piscem mulier formosa superne,
Spectatum admissi risum teneatis amici?

No one who has observed the modern history of architecture in this country can have failed to notice the growing preference in popular estimation of the mediæval to the classic styles, whereas in the last age all great public buildings were erected, or were professed to be erected, after the Grecian or Roman models. At the present time, those forms of construction are perpetually supplanted by pointed architecture, and seem in a fair way to fall into desuetude. It will form by no means an unprofitable inquiry to examine how this change in the public taste has been brought about, and to consider whether the effects which it promises will be advantageous or disadvantageous to the true interest of architecture.

The Georgian era had one leading characteristic, which marked alike the literature, fine arts, politics, manners, and even religion of that age. That distinguishing feature was a hideous, unmeaning formality. The same feeling that produced the rythmic precision of Pope, the polished heartlessness of Chesterfield the *sesquipedalia verba* of Johnson exhibits itself with equal distinctness in the artificial, ungraceful extravagancies of court costume, the polished inanity of court sermons, the cold, unfeeling despotism of court politics, and the studied and laboured barbarism of court architecture.

In an age like the present, not only unmarked by this state-formalility, but avowedly and distinctly opposed to it, it is not to be wondered at that architectural taste has been affected by the great and general change in the "spirit of the times." What a clear, unambiguous reflex of this spirit of the times is uniformly exhibited by its architecture! The severe effective lines of Norman architecture—the simple majesty of the lancet style adding to the boldness of the preceding style the graces of more laboured ornament—the polished and perfected beauty of the Decorated Period—and the over refinement of the Perpendicular, in which art, losing the freshness of youth, lapsed into formalism—what are these mutations but exact transcripts of the genius of the successive generations that produced them? They are, so to speak, of so many chapters of monumental history, written in stone, the mason and cunning artificer being the faithful chroniclers.

In like manner do we trace the successive changes of the feelings of the Greeks in the successive changes of their modes of construction. The pages of Aristophanes do not give a clearer insight into the Grecian mind than do the Temple of Theseus and the Parthenon. The imperfect imitation of the Greek styles by the Romans again is exactly characteristic of a less refined and intellectual people. The monolithic structures—the cromlechs and cairns of the Druids, the eternal pyramids of Egypt, the fantastic minarets of St. Sophia, the idol-caverns of Elephanta, the aboriginal temples of Yucatan, all tend to confirm the same principle, that the pervading genius of nations finds an exact and trustworthy exemplar in the spirit of their architecture.

It is unnecessary to multiply proofs of this; they will naturally suggest themselves to every careful observer; and besides, it is very easy to find reasons for the national feeling being thus typified by the national architecture. There will therefore be no difficulty in conceding that the principle is universally true; and if so, it will operate in our time as much as at any other. This being granted, the truth is no longer merely speculative and theoretical, but assumes the greatest practical importance—it becomes a matter of the highest and most direct interest to the architect to ascertain *what* change is likely to be produced in architecture by the change of popular feeling. For if we have succeeded in convincing the reader that the premises here assumed are something more than mere fine-spun theories, and actually contain practical and homely truth, it will be seen that the permanent fame of the architect really and truly depends on applying the theory to existing circumstances; for if his taste run one way, while the public spirit is inevitably moving in the opposite direction, he may be quite sure that his fame, if he get any, is transitory, and will certainly soon be forgotten.

Take, for instance, the works of Sir John Soane. The adulation of academies, the compliments of kings, the popular plaudits, have now ceased. The people cannot now discover that excelling beauty in a style that entranced the preceding generation. Admiration has lapsed into indifference, and then sunk in contempt, and the works of Soane, at the very moment we write, are exemplifying the principle we have assumed, and are being destroyed, to make way for (it is hoped) a better, because a purer, architecture.

The change of feeling which has produced this disregard for the works of Soane had only begun to operate in his day; it has acquired more strength in ours, and will, it may be predicted, gain still more hereafter. The progress of education among the people has given them a purer and more definite taste, a greater love of philosophical accuracy than they have heretofore possessed. As far as men can judge of their own times, we may say that the present age is by far the most generally reflective and intellectual that has hitherto been known in the world. There is now a widely spread knowledge of accurate science, or at least a love of it, and withal there is a strong feeling of poetry, a love of the beautiful. The present age is not a merely utilitarian one—there is, on the contrary, a general reverence for the fine arts—only the advancement of science has taught people to apply severer tests to all the arts, including architecture, than they have hitherto done, and to demand that they be *philosophically accurate*.

Now, both Grecian and Christian architecture possess (when exhibited in their purity) this philosophical accuracy. Neither, therefore, is it in itself disqualified from gratifying the taste of the present age on this score. The other great popular feeling which we have mentioned (love of beauty) is also satisfied by both styles alike, so that we may safely conclude that neither intrinsically contains anything repugnant to the spirit of the age. But if we can show that one of them, at least, has never been philosophically treated in this country, that the attempts made to impress on the Grecian the characteristics of the mediæval modes are essentially *unphilosophical*, we shall have at once assigned a perfectly satisfactory reason for the decadence of classic architecture.

The distinction between the two styles of architecture recognized in modern Europe is marked with sufficient clearness. The one soars to a great height, and abounds in lofty vertical lines; the other attains but an inferior altitude, and abounds in prolonged horizontal lines. The one loves the complexity and combination of dissimilar parts, the other, simplicity, symmetry, and unity of outline. The one exhibits itself by deep shadows, the other by strong lights.* The one is essentially picturesque (in the artistic sense of the word), the other is statuesque. The one is the offspring of a wild and fertile fancy, the other is the production of disciplined and scholarlike art. The one is imaginative, the other intellectual; the uncontrolled sweetness of Shakspere's versification, and the studied perfection of Milton's metre, do not differ more than do the modes of expression in Christian and classic architecture.

In all these characteristics (and the professional reader will suggest many more) the spirits of the two styles are widely different; but they are something more than different—they are antithetical—directly opposed to each other. The Pointed architecture is the exact antithesis of the Grecian. We must therefore, if we have succeeded in convincing the reader thus

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* It is not here meant to be denied that the Greeks produced effects by alternations of light and shadow, but their alternations were not nearly so great or so frequent as those of the Christian architects. They have no projecting transepts with dark angles, no huge buttresses—their mouldings and the capitals of their columns are convex, and never have the deeply-cut recesses of our own styles. Their alternations of light and shadow are not abrupt, they avoid rapid transitions, sudden contrasts, bold projections, and salient angles; the shadows melt away into light by softened and delicate shading.—Respecting the characteristic distinctions of mouldings, it might have been added in the text, that vertical mouldings are almost (perhaps entirely) unknown in true Grecian architecture, whereas in Gothic they greatly predominate, and the horizontal, where they occur, take their character and form from the vertical.

far, bring him to this important practical conclusion, that any attempt to impress on the one style the characteristic features of the other is inconsistent with what we have termed philosophical accuracy in architecture, and therefore is not calculated for the taste of the present age. If a building is to be characterised by its prolonged horizontal lines, its vertical lines must be, so to speak, subdued; both cannot predominate. Again, if a building is to be distinguished by strong contrasts of light and shade, by deep recesses, and a dim religious light, it is certain that we cannot impress upon it the features of a style in which none of these characters exist. So also, if we determine on producing effect by combination of varied parts, by the complicate groupings of numerous towers and transepts and buttresses and pinnacles, by the composition of architectural members of different sizes and form, we must give up all idea of producing edifices distinguished by simplicity, unity, and perfect congruity of design—the expression, as it were, of one single idea, developed by itself, distinctly, separately, and completely. And this is what we meant by calling gothic architecture picturesque, and Grecian archicture statuesque.

On these grounds, it seems incontrovertible that the Italian style, and that known by the name of Louis XIV., whatever other merit they possess, do not claim that of philosophical accuracy. In them we discern an attempt to do that which is, in the very nature of things, impossible—to give to one of the two great styles of architecture the characteristic beauties of the other. Now this attempt arises from the natural idea, that if we combine the beauties of both styles, we produce a result more beautiful than either; and if it had happened that the two species of beauty were only different, and not absolutely antagonistic, then, indeed, it might perhaps have been possible to succeed in the attempt; but as it is, it seems literally beyond all human power, because it requires the combination of principles which are essentially discrepant.

Another reason which may be assigned for the comparative failure of the modern semblances of classic architecture, and which may likewise be attributed to the want of philosophical accuracy, is the employment of archictural members for services which, it is evident from their forms, they were never intended. The slightest examination of a Grecian pediment shows at once its original purpose—that of forming the gable-end of the roof. It is obvious from every feature of the pediment that that was the purpose for which it was designed. It is admirably and perfectly adapted for this use and no other. And did there exist a doubt as to the accuracy of this opinion, it would be at once cleared up by the fact, that the original inventors of the Grecian pediment (who might be supposed better acquainted than ourselves with the true design of their invention) uniformly used it for the purpose alluded to, and for no other; so that we are irresistibly brought to this conclusion, that if a pediment be stuck upon the flat square front of a building, or if anything be built *upon* the pediment, or by the side of it, to destroy the idea of its being the end of the main roof, or, if it be used merely to cover a single door or window, it is applied to a purpose for which it was never intended.

Again, we see, from the form of the column, that it was intended by the designers to support and bear up a building from the ground. Its base seems clearly made for the purpose of effective support upon the earth, and its capital to bear safely and conveniently the parts resting on it. The whole form is exactly suited for *strength* and SUPPORT, so that if a column be employed as window-moulding, or if it be hoisted on to the first floor of a building, we at once see that it is *not* a main and essential support of the edifice, and is, therefore, totally out of place; or if it be used to support a pigmy statue at a great height in the air, we see that it is applied to a purpose for which its strength and dimensions are ridiculously disproportioned.

The quotation by which the present article is headed, though very trite, is chosen as accurately expressive of the main object which we have now in view. If, says the motto, the human head were united to the neck of a horse, and the plumage and members of all sorts of animals were collected to form one figure, the result would be a ludicrous absurdity. The application of the quotation to the subject before us seems perfectly apposite.

An anatomist will tell you that the human leg is an admirable contrivance for the use to which it is applied—the support of the body. There are an infinite number of beautiful contrivances to render it perfectly adequate for this purpose, but its beauty wholly depends on its fitness for the place it occupies. If the human arms and legs were to change places, if the former grew from the hips, the latter from the shoulders, they would have lost, we imagine, all claims to admiration; and yet, surely, we are guilty of equally great absurdities, when we place columns, which ought to be the main supports of edifices, in situations where they cannot discharge that office. The building up of a huge column to support a little statue seems no less an absurdity than would be the supporting the human head on a huge leg, the other members being got rid of. A gigantic column standing by itself, appears no less ridiculous than the building of an architectural leg in the air, and the sticking of a pigmy column on the front of a building, midway between the roof and the ground, seems as philosophical as the attachment of a dwarf resemblance of a leg to the breast or back.

If these views be correct, and they are not hastily adopted, we must come to the conclusion, that much of what we call our classic architecture more resembles the distorted fancies of a feverish dream, than the coherent thoughts of a healthy mind. To say that we are in a position to do as the Camden Society have done, to condemn the classic styles *in toto*, is ridiculous, for the great majority of the people of this country have never yet seen a *pure* specimen of Grecian architecture. We do not suppose, for instance, that any one will assert that there exists such a specimen in London. To do so, he must be prepared to assert one of these two things—either that there is some building in London of classic architecture, in which the pediment is obviously the gable end of the roof, and in which the roof is supported from the ground by the columns—or else that the building is to be pronounced Grecian, if particular members of that style be employed irrespectively of their proper uses.

There never was a fallacy more injurious to architecture than the sophism—"*De gustibus non est disputandum.*" There may be, indeed, a wide range and liberty allowed in matters of taste, but there must be a limit somewhere. Where can that limit be better placed than as a barrier to overstepping all reasonable analogy, and the "modesty of nature." The great mass of the people may not, perhaps, judge of architecture by the abstract principles which we have here feebly attempted to express, but the impressions produced on their minds, though independent of logical deduction, will be adverse to all architecture in which antagonistic effects are combined, and individual members are applied to purposes for which they were never intended. There is in us all an universal admiration of fitness, consistency, and order, which arises from the contemplation of the works of nature; and this inherent faculty will, when the trammels of usage are overcome, be applied to the examination of works of art. The criticism will be applied by the great mass of the people instructively, unconsciously almost, and independently of all set rules; but, being based on the natural faculties of the mind, will lead to conclusions, which, as far as they extend, will be as incontrovertible as those of the profoundest and most mature judgment.

The practical conclusion of the whole argument is this—that if we would restore classic architecture to its first purity, we must adopt from the Greeks, not only their forms, but their modes of applying them. An edifice made up of members heaped together in utter defiance of their original purpose, is no better than a monstrous abortion—an architectural Frankenstein. The combining, or rather confounding, together of columns, pilasters, cornices, pediments, windows, and balustrades, to *make up an elevation*, is a method with which we may be familiar, but the Greeks knew no such indiscriminate process. Such construction may produce a gorgeous, but is incapable of *pure* effect. And, as we have said, it is only by purity of effect that we can hope to re-establish a national taste for classic architecture.

We again repeat boldly, that this purity has not been hitherto attained in our own country. The lover of architecture who looks for the first time on the Madeleine, at Paris, feels at once that he has found what he hitherto sought in vain—a pure speciman of Grecian art. There is an indefinable sensation—we know not what name to give it—a certain admixture of awe and admiration, which is always produced in a refined mind at the first sight of an edifice of perfect architecture. That impression is infallibly produced by the first sight of the Madeleine. The chastened simplicity of the design, and the perfect congruity of the parts produce that feeling of unmixed pleasure which in our own country is afforded by mediæval architecture alone. We have, indeed, buildings, of pseudo-classic architecture, (that is, buildings in which certain features of classic architecture are mingled together irrespectively of the proper application,) which, by their magnitude and elaborate confusion, produce a certain feeling of amazement; and, coupling with this feeling the prejudices of custom, and the rather vague architectural notions of our fathers, we come to persuade ourselves that such buildings are beautiful, or, at least, we profess as much, for the sake of orthodoxy. After the Madeleine, the edifices which perhaps come nearest to the Greek form are the

Walhalla, at Ratisbon; and in our own country the Town-hall, at Birmingham. But in both these buildings the disproportionate magnitude of the sub-structures on which they are raised, or rather *hoisted*, shows that they were built rather in *imitation* of Grecian art than from generous sympathy with its real spirit.

If we would rival the Grecian architects, (and why should we not not hope to rival them?) we must do it, not by servile copying of individual forms—not by slavish adherence to precedent, but by becoming thoroughly imbued with the very essence and feeling of Greek art. We must *think* and *feel* as felt and thought the architects of the Acropolis. We must make our designs as simple and uncomplicated as were theirs (leaving the effects of beautiful complexity to mediæval art). We must put back our columns and pediments into their right places; above all, we must make our knowledge systematic and exact—we must reduce our practice to the accuracy of a science by first learning, and afterwards exemplifying, the PHILOSOPHY OF CLASSIC ARCHITECTURE.

THE NEGLECTED FOUNDER OF THE RAILWAY SYSTEM.

(*From the Railway Review.*)

In our last number, we published a letter from a highly intelligent cor-correspondent, on the subject of the neglect with which Thomas Gray, the founder—the great genius, who not only originated the railway system, but pointed out the mode by which it might attain perfectibility, has been treated. In consequence of the appearance of that letter, we have received sundry communications, together with the pamphlet above referred to; each and all proposing certain steps to be taken, with the laudable object of rescuing from undeserved indigence, and from the still more depressive feeling of neglected desert, the declining years of a man, the bold and vigorous conceptions of whose genius have been the source of wealth to thousands; of employment to millions; and who has laid the foundation of a new scheme of industrial prosperity, not only in this country, but in every other region of the civilized globe.

We have been much struck by the perusal of these communications, and give them in their original shape; but, from a conviction that as their authors wrote with a greater degree of knowledge of Mr. Gray's claims than is shared by the railway public, we fear their somewhat indignant reclamations would have an effect the reverse of what they intended. Nay, must we confess it? We ourselves, though, in the dim vista of past years, remembering the name of Thomas Grey, as the pioneer of the railway movement, were until lately wholly unaware that he was not only unrewarded, but that he added one more melancholy example to the long list of men of genius, whose prophetic spirit meets with contumely and neglect in their own day, and whose transcendant talent is only appreciated when a life of poverty has closed in a premature grave.

Too often does it happen, that "the dull cold ear of death" is for ever shut to those praises which, if early bestowed, might have stimulated the energies, not merely of luckless inventors, but of hundreds of others, who now, from prudential motives, avoid a divergence from the beaten commonplace tracks of life, lest they also share the fate of those predecessors to whom monuments of marble have been awarded when dead, though bread has been denied them when living. But, whilst we admit this to be a lamentable truth, we at the same time deny that there is any want of liberality or generosity in the British public. It is true, many a man of original genius has seen fortunes reaped from his ideas, whilst he himself has gone wholly unrewarded; but it has generally arisen from the circumstance, that he has not possessed the mechanical or commercial ability practically to carry out those ideas, and adapt them to the existing state of society. This latter qualification, in the eye of the historian and of the reflective man, will necessarily be of inferior merit; but, in the eye of contemporaries, it is obvious that it contains within itself the elements which command business and pecuniary success. Each qualification deserves its reward, and an ample reward; and it is not altogether fair that the creative power, which gave the impulse to all, should he left to perish without its proportionate return either in fame or in pecuniary recompense. In these days, all is accomplished by a subdivion of labour; and were the claims of Thomas Gray fairly known, we are sure that no mean petty jealousy on the part of engineers or projectors of railways would interfere between his deserved claims and their long-protracted remuneration. The British public is essentially noble in its impulses; liberal and generous to the last degree in its actions; though properly cautious and prudent in forming its decisions. We submit the claim of Thomas Gray as it is submitted to us; if it will not bear strict scrutiny, we shall be the first to protest against it; but if it will—if it be, what we believe it to be, undeniable—then are we sure that the railway public, who have hitherto shown themselves the most liberal and generous of the various sections of the British commercial community, will not suffer the great founder of railways to close his eyes in poverty, leaving his family to those rough chances of life from which the genius of their projector should fairly have rescued them.

To our brethren of the press we appeal, to assist our efforts in making Mr. Gray's case known. Neither of Mr. Gray, nor of Mr. Wilson, of Haarlem (the writer of the pamphlet), have we the slightest personal knowledge. The pamphlet of the latter bears intrinsic evidence, however, as highly favourable to the heart of the author, as it is complimentary to the genius of its subject, Mr. Gray.

The author of the pamphlet has spent the greater part of his life abroad; and in Germany, Holland, and Belgium, finding the name of Gray quoted as a high authority on the continent, naturally, on revisiting England, after a lapse of some twenty-six years, expected to find that Gray, if he had not made a fortune, was at least looked up to as a consummate railroad authority. On the contrary, he finds him in the position which he thus describes. With great difficulty Mr. Gray was traced to Exeter. "There," says Mr. Wilson, I find him still writing upon railroads, although he can no longer afford to publish. *The author, inventor, of the railway system is actually condemned to waste his invaluable capacity, his energies and information, on the uncertain, scarcely compatible, occupation of dealing in glass on commission, and trading with glaziers.* His good wife may, probably, have often had occasion to repeat the queries she formerly addressed to him, when so deeply and exclusively occupied with his railway cogitations, "What good will result to *you* from your scheme for travelling by steam, with the civilisation of the world, and the benefit of human kind, which are to be the consequence?"

After giving a variety of details, which alike confirm our view of Mr. Gray's comprehensive and prophetic genius, and of the ability and judgment with which he digested all the details of his vast plan, and which only make us regret that he had not consulted some practical man of business to introduce them earlier and more effectually into action, the pamphleteer thus concludes his remarks:—

"I learn, with deep regret, from himself, and so I think will the public, that a man such as I have briefly described, a man of whom it may be said in railway science, as of Sir Christopher Wren in architectural,—

"Monumentum si quæras circumspice;"

that such a man is left to vegetate how and as best he may, in obscurity, and with means no less precarious than scanty, in the midst of those magnificent works which have arisen, and are still rising. all around him, and of which no man living, I believe, can truly say but himself, I am the creator of all. Independently of the great railway system, of which he is the author and inventor, of the years painfully spent in bringing it to perfection, he expended years more as a railway teacher, writer, lecturer, in his own country, informing the public mind, combating public prejudices, achieving public convictions, and enlisting public sympathies in favour of the railway system and railways; and all this unaided, and at his own cost of time and means. He has laboured incessantly for more than a score of years, but what has he gained? As I have before observed, he has sowed, but others have reaped profit, honour, and all. At least I shall have the satisfaction, as this pamphlet sees the light, of vindicating his rightful possession of the honour; but how, where, by whom, is he to be reimbursed what should have been the lion's share of the profit? In my conviction, it is the bounden duty of the government, of which you, sir, are the worthy head, to repair its own neglect, and the wrongs of fortune, to a subject whose name and fame are public property, and will be claimed as such by posterity if the present generation remain passive. I think, moreover, that the obligation upon railway companies and their proprietaries is no less stringent. Every pound invested, and every dividend received, bears the coinage of Thomas Gray. The railway mine is his discovery, and they but the workers, who should be too glad to pay toll and seigniorage.

Mr. Rowland Hill has been rewarded munificently for his Penny Postage scheme. The public gained a million, but the revenue lost so much, by this reform. With all its advantages, the policy of the reform is still a question, though I need not discuss it. But what are the advantages of penny postage, in comparison to the railway system?—but as the mole hill to the mountain. The latter creates millions upon millions, and gives bread and employment to hundreds of thousands directly, indirectly to as many more. It assists revenue instead of discounting it. It accelerates the march of mind, no less than of industry. It is the creator of wealth, whilst it economises its use. It tends to equalise conditions, to redress the overbearing ascendancy of great capital and capitalists; to raise the humble and the labourer in the social scale, whilst from rank and station it detracts none of their due. Of agriculture, commerce, manufactures, it is already become the corner-stone of the economical fabric;—of national safety and defence, the right arm.

Roman Remains.—The remains of a Roman villa, of considerable extent, have been recently discovered near Wheatley, Oxfordshire, and some excavations have been made under the direction of Dr. Bromet, a member of the Committee of the Archæological Institute. All that has yet been made out is a hypocaust and a bath. Drawings of these have been made by Mr. Jewitt for the institute. These remains are distant about a mile and a half from the Bishop of Oxford, at Cuddesden; his lordship has taken much interest in the excavations, and has requested Dr. Buckland to superintend the continuance of them.

TABLE OF COLLEGIATE AND OTHER HALLS.

In some of the various notices of the New Dining Hall of Lincoln's Inn which have lately appeared, one or two other structures of the kind have been referred to by way of comparison, and for the purpose of thereby affording a better idea of its magnitude, and showing what rank it is entitled to hold on that account alone, independently of its architectural merits. We have endeavoured to improve upon the hint so thrown out, by drawing up a tolerably full list or table of the principal "Halls," with the addition of one or two that are now in ruins, and also a few modern banquetting or other public apartments, which rival or approach the others in spaciousness. We have given them precedence, not according to chronology, but according to their respective *lengths*, as being the simplest and most convenient arrangement. Their united dimensions, (length and breadth), or areas in square feet, are exhibited in the fourth column of the table. These areas, it should be observed, include the space behind the screen (where there happens to be one,) at the lower end of the hall, but is exclusive of oriels.

The third column is incomplete, for we have not been able to state the height of the hall in every instance: neither is it just now in our power to fill up the last column of particulars, as could be wished. Probably some of the readers and correspondents of the Journal will aid in supplying deficiencies, or will correct such inaccuracies as they may happen to discover, for, though we have been at no small pains to ensure exactness, errors, though unimportant ones, there may nevertheless be; or, should they be able to furnish information as to the examples here omitted, the communication of it will be a favour.

This Table might be considerably extended, not only by other home examples, but by several foreign ones also. We give, however, only one or two of the latter, as deserving notice, on account of their extraordinary vastness as single rooms when roofs are not supported by any columns.

W. H. L.

	Length.	Breadth.	Height.	Area in square feet.	Remarks.
Westminster Hall	238	68	83	16184	Fine timber roof, large window at N. and S. end, and windows on sides.
Christ's Hospital	187	51	47	9537	A flattish ceiling, with arched timber beams. Windows (nine) only on south side. Screen at east end.
St. George's, Windsor Castle	180	32	30	5760	A flattish arch ceiling, (nine) windows on south side.
Guildhall, London	153	48	55	6846	Partly modernized. Large window at E. and W. ends.
Lincoln's Inn, New Hall	120	45	62	5400	Fine timber roof. Two oriels, E. and W., at N. end.
Christ Church, Oxford	115	40	50	4600	Fine timber roof. Oriel. Two fire-places.
Arundel Castle	115	35		4025	
Trinity College, Cambridge	110	40	50	4400	Timber roof. Two oriels.
Hampton Court	106	40	60	4240	Fine timber roof. (Five) windows on N. and S. sides, and oriel at S. E. angle. Screen at W. end.
Middle Temple	100	44	50	4400	Rich timber roof, in Elizabethan style. Oriel on N. and S. sides, at W. end. Screen at E. end.
Lambeth Palace (now the Library)	98	38		3594	Timber roof. Oriel on W. side.
Waterloo Hall, or Gallery, Windsor	95	46	40	4370	Style partaking of Elizabethan. Clerestory.
Raby Castle	90	36		3240	
Wadham College, Oxford	82	35	37	2870	
New College, Oxford	78	35	40	2730	
Lincoln's Inn, Old Hall	71	32		2272	Timber roof.
Gray's Inn	68				Oriel on N. side.
Crosby Hall	69	27	38	1863	Restored.
Warwick Castle	62	35	25	2170	
Bishop's Palace, Wells	115	59	34	6785	See Pugin's Gothic Examples. Second Series.
DESTROYED OR IN RUINS.					
Eltham	101	36	52	3636	Fine timber (chesnut) roof. Two oriels, N. and S. at West end, and five other windows on N. and S. sides.
Richmond Palace	100	40		4000	
Ragland Castle	64	28	42	1792	See Pugin's Gothic Examples, Second Series.
Croydon Palace	38	56	47	2128	Timber roof with plain arches.
MODERN HALLS.					
St. George's Hall, Liverpool	161	75	75	12075	Lighted by lunettes over the entablature.
Birmingham Town Hall	140	65	65	9100	Corinthian order in pilasters, with eleven windows between them on each side.
Exeter Hall, Strand	138	60	48	8280	
York Great Assembly Room	110	40	42	4400	Corinthian, in two orders; lower one forming a peristyle of 44 columns, with 17 intercolumns on each side, and five at each end,—upper one in pilasters between the windows of the clerestory.
Whitehall Banquetting Room, now Chapel	110	55	57	6050	
Victoria Hall or Gallery, New Palace of Westminster	100	45		4500	
Freemasons' Hall	92	43	60	3956	Eight Corinthian columns on N. and S. sides.
Egyptian Hall, Mansion House	90	59	60	5310	
Banquetting Hall, Goldsmiths' Hall	70	40	30	2800	The Gallery over screen at S. end increases the length to 80 feet. See Plan, &c., "Civil Engineer," Aug. 1844.
Moscow, Great Exercise House	544	162		88128	
St. Petersburg, Riding House	335	88		29480	
Padua, Salone di Ragione	240	80		19200	

ST. SAVIOUR'S CHURCH, LEEDS.

We copy from the *Leeds Intelligencer* an account of the new church recently erected in Leeds: we have, however, made one or two omissions in the extract. The original abounds in scriptural allusions, makes a vast parade of the piety and humility of the founder, and contains a redundant description of the window paintings. These passages are superfluous in an architectural notice, and need not be reprinted. The language in which they are couched certainly tends to confirm a suspicion that the founders of the new edifice had in view the propagation, not of the doctrines of the church simply, but of a particular form of them, and that form too which is least acceptable to the great majority of the members of the church. With this opinion, whether accurate or inaccurate, we ourselves have little to do except in examining how far the motives of the founders have tended to the introduction of architectural features which are not required by architectural propriety of the institutions of the rubric.

St. Saviour's Church, Leeds, of which the foundation was laid on the 14th of September, 1842, was consecrated on Tuesday, Oct. 28, the Feast of St. Simon and St. Jude, by the Lord Bishop of Ripon.

The style chosen is that which is acknowledged to be the most perfect form of Gothic architecture—the decorated style. The plan is uniform. The chancel is 42 feet long by 16 wide. The nave is 60 feet in length, by 20 feet in width. In the centre are four piers, from which will spring, when the church is completed, a central tower surmounted by a spire, rising to the height of 280 feet. The transepts are short, in order to bring the whole of the congregation as much as possible within compass of the voice of the reader. There is a lofty porch on the north side, which contains the font. Besides this entrance, there is a western door, and a door to each of the transepts, and the small priest's door, giving access to the chancel. The chancel is separated from the rest of the church by a carved oak screen of most elaborate workmanship. There is an ascent of one step from the body of the church into the chancel, and the altar is reached by three more steps. On the elevated part, are inserted in the wall, on the south side, the *sedilia* and *piscina*, of carved stone of most chaste and elegant workmanship. The details of the former are principally chosen from the Percy shrine, in Beverley Minster. The piers of the nave, dividing it into five bays or compartments, are plain, but exceedingly light and elegant. Above them is a clerestory, with five triple windows. The roof is of plaister coved—and consists of five compartments. The whole of the internal carving is not finished. The stone blocks are left, which will allow the church to receive the subsequent enrichment. The same may be said of the exterior, which presents at present rather a naked appearance, from the absence of pinnacles, and the long corbel tables left in plain blocks. On the gables of the chancel and transepts are three beautiful floriated crosses; and the western end is surmounted by a bell gable, with very elaborate details, which has been finished as a specimen of what the whole of this kind of work throughout the church will be when the design is completed. The object of the founder, it is understood, was, as far as the limited means allowed, to do well what was able to be done, leaving the work purposely unfinished, to be completed either by himself, if God should give him the means, or perhaps by another generation. The doors are of massive oak. The pulpit is of the same material, and the prayers and lessons are read from an elegant lectern, bearing upon it the emblems of the Four Evangelists. The seats are of deal, stained and varnished, and are all in the form of moveable open benches. They are secured in their places by large pieces of cork let into the feet of the bench, which by friction prevents any pushing of the bench from its position without the application of considerable force. It is intended that all the windows shall be filled with stained glass of the richest description.

The chief merit of the church consists in its proportion and general effect, which, though it is not of very large dimensions, give a grandeur to it totally different from the effect produced in so many modern churches, which have great pretensions to beauty, but are rather pretty models of churches than noble and imposing edifices. It reflects the highest credit on the architect, J. M. Derick, Esq., of Oxford. The painted glass was executed by Mr. O'Connor, late of Bristol, now of London; and the screen is the work of Mr. Vincent, of London.

Respecting the architecture of the edifice, not having seen it, nor possessing any information materially more explicit than that given above, we can offer no decisive criticism. One or two points may however be noticed. In the first place, it is clear that the object of the architect has been the construction of a building in exact imitation of the ancient Christian model. To this feeling only can be attributed the introduction of the *piscina* and *sedilia*, members nowhere mentioned in the rubric, as far as we are aware, *used* in our churches, and of which most churches are deficient without any perceptible difficulty in the due performance of the liturgy. And yet with this, to say the least, unnecessary adherence to precedent, we have *stained and varnished deal imitation-oak seats* and *plaister ceilings*, two of the vilest disfigurements which could possibly exist in an edifice professedly of Pointed architecture. These sham deceptive materials, these tricks of architectural "shabby gentility," are strangely inconsistent with the anxiety about "*sedilia*," "*piscina*," "lecterns," "floriated crosses," and "moveable open benches."

A local paper states that 260 clergymen in white surplices attended at the consecration. The following is from the *Standard*:—"The church itself was to have been named "The Church of the Holy Cross;" but the Bishop refused his consent. It was built in the form of a cross. The chancel, in which the Communion Service is separated from the rest of the church by "a carved oak screen of the most elaborate workmanship;" the people being thus shut out from one part of the service. "The altar is raised on three steps." "In the wall on the south side are the sedilia and piscina, of carved stone, of the most chaste and elegant workmanship." The windows alone are to cost 7,000*l*., a sum which would have sufficed to build another church!"

IRON AND WOOD STEAMERS.

Within the last few days some interesting experiments have been made on the Thames, tending to elucidate the question of the comparative merits of iron and wood steam-vessels.

We lately noticed the experimental trips of the iron steam-ship Vigilante, built at Blackwall by Miller, Ravenhill and Co., for the Spanish government, and intended to be employed as a *guarda costa*. Since then a wood steam-vessel, of the same dimensions, and designed as a sister ship, called the Alerta, has been launched from the yard of Mr. Wigram, and fitted by Miller, Ravenhill and Co., with a pair of oscillating engines of 120-horse power. The Vigilante having been sent to Cadiz, the Alerta, in the recent trials, could not be laid alongside of her, but she was pitted against the Madrid, a fine new iron steam-ship, built and fitted with beam-engines of 140-horse power, by Miller, Ravenhill and Co., for the Peninsular and Oriental Steam Navigation Company. The latter performed, in still water, at the rate of nearly thirteen miles an hour; the Alerta, though a beautiful vessel, and made up with great care, was considerably slower; in fact, slower by fully a mile and a-half in an hour. But the most interesting fact developed by these experiments is, that the speed of the iron sister ship, the Vigilante, having the same quality and amount of engine power, and intended for the same service, is from two and a-half to three miles an hour greater than that of the Alerta. This is mainly attributable to the difference of material, iron and wood; but in part also, doubtless, to the superior form and proportions of the Vigilante, which is one of the noblest ships of her class that ever left the Thames. Supposing it possible to augment the power of the Alerta, without addition of weight, so as to give her the same speed as the Vigilante had when tried under similar circumstances in the river, it would require an addition of at least one hundred and fifty horse nominal power. This shows, at all events, the great superiority of iron over wood for river vessels of right form and proportions. With regard to sea-going vessels up to a certain tonnage, it is the opinion of practical men that iron can be made in all respects as seaworthy as wood, and we think so too; but as we have said before, we have our doubts as regards heavily-armed ships of the largest class.

The Madrid, as our readers have been already informed, will be placed by the great and interprising company to which she belongs upon the station between Ceylon and Hong-Kong, for which she is admirably adapted. She is a splendid vessel in every sense of the word—in form, strength, fittings, and embellishments. Her burden is 441 tons builders' tonnage, O. M.; her length over all is 170 feet; between the perpendiculars, 160 feet; breadth at the paddle-boxes, 24 feet; extreme breadth, 28 feet; depth of hold, 15 feet; draught of water, 10 feet. Perhaps it may be regretted that her power is not greater; we think she should have had 160 instead of 140; nevertheless, we are persuaded, after a close inspection, that she will perform the work her owners intend her for, and add to the well-earned reputation of her contractors.

In speaking of this vessel it is only an act of justice to remark, in conclusion, that it is an additional proof, after the many others afforded by the Meteor, the Prince of Wales, the Ondine, the Elberfeld, Vigilante, &c., of the correct perception as to form, and the good taste and mature judgment of Mr. Pasco, who designed the whole of these noble vessels, and who is one of those who are silently but materially contributing to the improvement of naval architecture. This is a class of men who make no parade of their services, but yet are valuable promoters of science, and render the most important services to their country and the world.—*Railway Director.*

ATMOSPHERIC RAILWAYS.

ABSTRACT OF THE EVIDENCE BEFORE THE COMMITTEE OF THE HOUSE OF COMMONS.

(Continued from page 342.)

Stoppages.—On the Great Western line five minutes are lost by stopping at a station, besides the time during which the train is stationary. Instead of a delay of five minutes, a stoppage on an atmospheric line would not amount to more than a minute and a half. The difference between the fast and the stopping trains on the Great Western Railway consists not so much in the actual speed as in the loss of time and speedy stoppages—(*Brunel.*)

Immense delay which would be caused by stoppages on a long atmospheric line, running frequent trains, with a single line of tube. A double set of engines would go far to meet the difficulty, *a double line of tube would remove witness's objection altogether.* Average length of the stoppages at the first-class stations on the London and Birmingham line—(*Stephenson.*)

"At the first-class stations upon the Birmingham line, the average loss of time in stopping is about five minutes; that is, not that the actual stoppage is five minutes, but the time lost in stopping, and also in gaining the velocity again, is five minutes. To take two engines, one running by a station without stopping, and the other stopping, they would be five minutes apart at the end of their journey; the practical effect of every stoppage is a loss of about five minutes."

Upon the atmospheric principle the speed is recovered more rapidly than the locomotive, after stopping, if the vacuum be raised—(*Stephenson.*)

Each train must stop a short time at every crossing station, to allow the vacuum to be made—(*Cubitt.*)

Stopping of Trains.—On the atmospheric plan, if a train overshoot the station it can be brought back by a small capstan. Experiments were made in pulling up a train rapidly and within a short distance; it can be effected more readily than with a locomotive train—(*Samuda.*)

In the case in which the piston carriage on the Dalkey line started without the others by accident; it was stopped by the break—(*Gibbons.*)

Traffic.—On the London and Birmingham line about 2,000 tons are carried daily; on a single atmospheric line over the same ground 7,900 tons could be carried—(*Samuda.*)

On the Dublin and Kingstown line, the result of a greater frequency of trains has been a greatly increased number of passengers. While the number of passengers has doubled, the expenses have only increased one-fourth—(*Bergin.*)

The atmospheric system could not be adapted to a railway of considerable traffic, say the London and Birmingham line; main objections to such application of the system—(*Bidder.*)

"Mr. Samada commences by taking the cost of working 15 trains per day; now upon the London and Birmingham the number of passenger trains is 14 trains at this moment, and there are three goods trains besides, therefore there are 17 trains a day, of which three consist of goods; and on the London and Birmingham the passenger trains take 120 tons, and the average of the goods trains is 160 tons. One hundred and twenty tons useful weight?—That is the weight of the carriages and passengers, not including the engine; I would observe that that is the weight of the passenger trains, but there are large goods trains which have to be provided for. On the opening of parliament the traffic is almost all towards London; the traffic is all coming in one direction, and the balance is therefore destroyed. The same takes place when Parliament is adjourned; the traffic all travels in the opposite direction; the consequence is that they have frequently to send up 50 or 60 empty wagons to establish the balance. Or during the Doncaster races?—Yes; but here Mr. Samuda assumes that 15 trains will only do the work, and those trains are to work night and day, and only one man to a train. Now one man to large trains is not sufficient; nor do I think it would be sufficient on the atmospheric principle for an ordinary train, because one man, having no assistance from the engine to stop the train at the station, or in case of obstruction upon the line, could not stop the train in all cases by means of the break. I know a case in point: when I was at Dalkey they used three breaks, with the rails in the very best condition for stopping the train, and when the vacuum was applied the train was all but starting off; it moved once or twice and then stopped again; and to suppose that under the circumstances you could send a train with one man, and ensure the stoppage of that train in case of emergency, is an opinion which I am sure no person practically acquainted with railways would entertain; therefore I should treble that number to commence with. Then Mr. Samuda takes the consumption of coal for the 30 trains, 1¾ tons a day. As I stated before, on the Dalkey Railway itself, the consumption for the day trains was 1½. Now, as regards the London and Birmingham line, you could not carry on the traffic of that railway by day only, you must have night trains inevitably; therefore, instead of 1½*d.* per train per mile, you shall assume the consumption of the engine at three tons per engine. If you take it, without adding anything for extra expenditure, at three tons per engine per diem for 39 engines, that makes a consumption per annum of 40,000 tons instead of 18,000; and I say that that must be the consumption of coal in respect of the multiplicity of trains. Then Mr. Samuda takes his coals at 9*s.* a ton. Now where is he to get his coal at 9*s.* a ton I do not know. That company pay 24*s.* for coke; whereas, if they could get coal at 9*s.*, they could make their coke at 16*s.* Therefore, if you take 9*s.* as the price at which they can get coal, you ought to give the company credit for coke at 16*s.* But if you take it at that which I consider is the price of coal, and you take my quantity of coal, you will find, that instead of 8,000*l.*, the cost of fuel upon the London and Birmingham will be 28,000*l.* per annum. Then this estimate is based altogether, so far as I can comprehend it, upon the assumption that on the London and Birmingham, engines of the same power as those on the Dalkey would work the traffic of the line. Now I think I can show that that is quite out of the question; if you run 15 trains a day, whether you run them every hour, or at whatever interval you run them, you must be subject to the same inequality of trains that you are now subject to, and you must therefore have a power adequate to convey between London and Birmingham the heaviest trains that you may have to convey, combined with the worst state of circumstances, that is, a high wind. Now, assuming that you must provide for passenger trains of 120 tons weight, you must be able to take that 120 tons weight up the steepest incline on the line, and be adequate to meet the resistance from wind. From the experiments which I have tried myself, I have ascertained that the resistance may be increased upon the London and Birmingham Railway to 40lb. per ton, that the engines have had to overcome that; if you take 40lb. per ton, and take the gross load as 120 tons, you must have a tractive power equal to 4,800lb. Now assuming that you had the power to raise the vacuum to 21 inches, and will require a tube of 22 inches diameter, instead of 15, and require an engine of 500-horse power, that is, 250 commercial power, instead of 80 or 90, and with less power than that you never can carry on the traffic of the London and Birmingham line; but the moment you increase the engines, and increase the tubes, you increase the fixed charges; you increase all the fixed working expenses to a certain extent commensurately. And if you were to make any addition commensurate with the scale of working expenses, you would find, even taking this as the basis, that that would make the actual current expenses of the London and Birmingham altogether, upon the lowest calculation upon the atmospheric system, very much exceeding what they are now paying for their whole locomotive establishment. But the question has been mooted of carrying the enormous traffic of the London and Birmingham Railway upon a single line. Now I have considered that; in fact I have had it before me for the last 12 months, and the conclusion that I have arrived at is, that no person acquainted with the nature of that traffic, with all the circumstances attending it, would entertain that opinion for a moment, for this reason, they have 14 passenger trains per diem, and the amount of the goods traffic is about 800 tons per diem. They have just commenced a new system; they have now arranged to carry coals at 1*d.* a ton per mile, and they expect 500 tons a day from one colliery only; they have effected a great reduction in their traffic, not only as regards passengers (which it may be reasonably anticipated, and in fact they do anticipate, will produce a corresponding increase in their traffic), but they have also reduced their tariff for goods, and any system which will provide for a less tonnage than 2,000 tons per diem upon the London and Birmingham, would, I think, be altogether admissible. You have then to consider that you have to provide for 2,000 tons a day, in addition to 14 or 15 passenger trains a day. Then again they are going to open new branches. The Northampton and Peterborough is about to be opened. The Leamington branch is just opened. The Trent Valley Railway is to come in at Rugby, and another will come in at Coventry, and there is a branch coming in at Hampton. The London and Birmingham line will therefore have five or six railways working into it, all of them bringing in traffic of different sorts requiring different treatment, and all that traffic would have to be arranged upon a single line of railway. It would be impossible in this place to point out how all those trains would clash with each other; but if you took any time table and endeavoured to work it out, you would find that you could not carry on this traffic without every train upon a single line making 10 or 12, or 20 stoppages, and the consequence would be, that you would make the London and Birmingham, instead of a fast railwaw, one of the slowest in this country, besides which, the question of collision would come into the account. It is perfectly true that I see no difficulty in having the trains to meet where the stations are, but there is no means that one can contrive, there is no means that it is possible for human ingenuity to contrive (if it is a self-acting apparatus, so much the worse), but which must depend at last upon the train arriving at a particular moment, and at that moment in its right position. Now that regularity has never yet been attained on any railway in this country."

Trains.—It is the direct interest of the owners of an atmospheric line to run frequent trains, as nearly all the expenses are the same whether they do so or not—(*Samuda.*)

The number of carriages to each train would be reduced, rather than the number of trains, to suit the traffic. Trains might be run on the South Devon line conveniently each way every half-hour—(*Brunel.*)

On the London and Croydon line trains will be started every half-hour—(*Cubitt.*)

Tubes.—The diameter of the tube on the South Devon line is 13 inches. Upon the London and Epsom the diameter is 15 inches. On the South Devon line the tubes vary in size and the engines in power, according to the nature of the country—(*Samuda.*)

Means by which a train could pass at full speed from one part of a tube to another of a different diameter—(*Brunel.*)

Detailed statement of the length, diameter, and cubical contents of the main tube and branch—(*Bergin.*)

Contract and present prices of the iron tube. Length and weight of each pipe. Mode of supporting and fixing the tube—(*Samuda.*)

"The contract prices we entered into for the Croydon Railway were 7*l.* 15*s.* per ton for the pipe. The length of each separate pipe is ten feet in the clear; it weighs 1 cwt. a foot. A foot is cast on the pipe, underneath the socket, and that is laid on the same transverse sleeper which supports the chairs of the rail at the spicket end of the pipe; the pipe is turned, and is fixed into the board part of the next socket, so that the pipe is supported every 10 feet."

The distance of the engine from the tube on the Dalkey line is a great disadvantage. It is more prudent, perhaps, to begin with sections of three miles, but the alternate engine at six miles could do the work. If the leakage could be prevented there would be no loss of power in a section of six miles, but more time would be expended in producing a vacuum."

Vacuum.—Economical vacuum to work at is at a pressure of 7lb. to the square inch—(*Gibbons.*)

Explanation of the process by which it is proposed to produce a half-vacum in the pipe by means of a large tank rapidly emptied. There would be no danger of the tank falling in from the pressure of the atmospheric—(*Brunel.*)

"I propose to build, in masonry, an air reservoir, about equal to the contents of the whole section of the pipe, and to pump the water up into that reservoir by the engine power, which I have, and then allowing that reservoir to empty itself with a head of 20 or 25 feet of water, will, of course, exhaust the pipe at once to half-vacuum, or seven pounds upon the inch, and that will enable me to fill the pipes more quickly, and will save a great deal of the first leakage; it will enable me to fill the pipe more quickly, and will also enable me, if I wish to work it again at the same time as the engine, to exhaust with twice the rapidity that I could do with the engine alone. If the reservoir were equal to the size of the pipe, the emptying of the reservoir would produce what is commonly called half-vacuum, supposing there were no leakage. I should make the reservoir a little larger. I propose making the reservoir a third larger than the pipe. A reservoir of about 25,000 cubic feet. Of very rough materials; the sides of rough masonry, and the top of brick work. There will be no danger, from the pressure of the atmosphere, of its falling in; that pressure is equal at the most to 30 feet of water, and there will be no difficulty in making a reservoir that will stand a pressure of 30 feet outside of it. I think it is an affair of 300*l.* or 400*l.* All the engines upon the Plymouth line have also small auxiliary engines, of 10-horse power; our engines consisting, in fact, of a pair of 40 and a pair of 10; all those 10-horse engines might be at work constantly, both pumping the water for the boilers and pumping the water up into the reservoir, and doing the ordinary work at the station."

Witness found his objections to the asmospheric system from the fact of the power required to obtain a higher vacuum increasing in a much greater ratio than the vacuum produced—(*Stephenson.*)

Have you drawn up any table upon that subject?—The number representing the power would be 4 ½-horse power upon the piston. What horse power on the engine?—The pressure would be in proportion to the horse power; when the barometer stands at 9 inches the mean resistance upon the air pump is 4 ½ pounds; I may state that that is not a theoretical calculation, but one made from actual experiments; therefore there is no hypothesis involved in this. From practical experiments we are told that 57-horse power is necessary to produce that result; viz. to raise the vacuum 9 inches?—It is very probable. Take 18 inches, what is the resistance in that case?—There the average mean pressure is 6·3, therefore the horse power will be in the ratio of 4·5 to 6·3. Eighty-seven is the horse power that is put down in the table which has been given in, therefore you double your power without doubling your horse power?—Yes, up to that point. There is no loss there; on the contrary there is a gain. If you go on to 20 inches; the resistance of the air-pump is 9 7. There again you have acquired a greater result with a less proportional exertion of power?—Yes, that is the exertion of power upon the pump, and so you go on till you get near the end of the scale; you gain in point of power, so far as the mere working of the pump is concerned, but the power expended in the pump is not the power given out to the train, and that brings me back to the same position which I took originally; this is not the quantity of power that is given out to propel the piston in the tube which draws the train along, this is merely a representation of the quantity of power necessary to drive the pump; but the second question follows, what proportion of that power is given out to the train, and that is the whole question, upon which I believe I differ essentially from other engineers. I think the difference arises from confounding the power generated with the power given out. By the power given out you mean the power usefully exerted?—Yes, the proportion between the power necessary to work the pump and the proportion of that power applied to the train gets worse and worse as you go on increasing your vacuum. Between the vacuum pump and the train all the leakage exists, and there it is that I differ from those who maintain that they get all the power generated for the propelling of the train; it is perfectly clear that, if there be any leakage at all, the power represented by the air-pump does not give you any true representation of the power given out to the train, because the whole length of the valve exists between the one and the other. The 18 inch vacuum will carry double the load that the nine inch vacuum would?—That is the difficulty. If the pipe lying along the railway were hermetically sealed, and the train put alongside of it, and no leakage took place, that position would be perfectly clear; but inasmuch as between the power exerted by the engine, that is, the air-pump, and the power given out to the train, there is a valve, which is the prominent imperfection of the system; however beautifully in theory it may be overcome, still there it stands as the prominent imperfection, and one which affects all calculations made upon this; and any opinion therefore based upon the power given out by the pump must be fallacious, because it takes no account of the leakage. Supposing the valve to be propped open just before the train, the pump would require the same power to work it, and the train would not move at all; the same power, therefore, would be exerted upon the pump, and the train would not move an inch. Supposing you had a train 10 tons weight, and a 9-inch vacuum was sufficient to carry that train forward at the rate of 10 miles an hour, if you increased the weight to 20 tons and obtained a vacuum of 18 inches, would not the sustained vacuum of 18 inches continue to carry forward that train at the same speed per hour?—If you sustain the vacuum at 18 inches it would, but the difficulty is in sustaining that vacuum, because as the vacuum rises the leakage is increased. When the barometer is standing at 9 inches the leakage is a small amount, but when you get it up to 24 or 25 it requires the full power of the engine to maintain that vacuum; it requires 1000 per cent. more than it requires at a smaller vacuum. According to this scale it requires 56-horse power to produce and maintain nine inches of vacuum, and it requires 87-horse power to produce and maintain 18 inches of vacuum; you have there double power produced in spite of the leakage of the valve, without a doubling of the horse power being requisite?—Yes, but that double power would not produce the same velocity, because the leakage has increased. Though the same amount of power is expended in the air-pump it is not given out to the train; for as you increase the vacuum, you, as it were, sever the connexion between the pump and the train. You mean to say this, that if you can maintain in the atmospheric main a vacuum measured by 18 inches of mercury, that gives double the power to the train that you have when the gauge stands at nine inches?—Clearly. But you say that that increased vacuum cannot be maintained without an exercise of more than double the power, in consequence of the increased leakage?—Precisely. The leakage, as I understand, remains the same; that is, the number of cubic feet of air that you get into the main in a certain time remains constant?—As the density of the atmosphere. But owing to that air expanding you have a loss of power from a certain quantity of air of the atmospheric density entering into the main, which quantity rapidly increases as the mercury rises in the gauge?—That is precisely my view. As I understand, the main objection which you have to the economical working of the atmospheric power is this, that when the vacuum was at that degree of height which is necessary for moving large trains, the expenditure of power would be so great that the system would become very expensive?—Just so. Otherwise, the power applied very directly to the work to be done, and is economically and usefully exerted?—At low vacuums it is."

It is difficult to say at what vacuum it is most economical to work an atmospheric line; it is not yet exactly known—(*Cubitt.*)

Valves.—Statement of the dimensions and of the outlet valve in the engine on the Dalkey line—(*Bergin.*)

In consequence of the large size of the outlet valves, when there is any degree of exhaustion within the pump they are composed to so much pressure from the external atmosphere, that their edges are forced into very close contact with the plate of leather on which they drop, the effect of which is, to require a force equal to about 1 ½ lb. on every square inch of the air-pump piston to lift these valves, in addition to the force necessary to drive the air out; the final result is, that a force of about 8 ½ horse steam-engine power is absorbed in opening those valves alone, in addition to the power necessary to expel the air. In the Dalkey pumps there are two very large valves, 20 inches in diameter, opening by a hinge at one side, which must be forced up a considerable distance to let the air out; the Croydon valves are several in number; I do not know how many, but they are small valves, seated in the covers of the air-pump; they have to rise but a small space, and when down form a completely smooth surface, both above and below; they have not an edge resting on a plate of leather, to which they would adhere; they are simply conical valves, seated in the air-pump cover, counterpoised, so that I expect they will present only a portion of the resistance of which I have spoken. So that two or three horse power, instead of eight, will overcome that resistance?—Probably; certainly much less than in the Dalkey pump. There is another evil accompanying those large valves, arising from their great magnitude; they shut with enormous violence, so great, that upon the very first evening we started, some of them were broken within three or four strokes, and they shut with such violence as to shake the whole mass of the pump and its framework, which weighs several tons. Either Mr. Clegg, or Mr. Samuda, or both, were present at the time, and saw this effect, and they added an ingenious apparatus at the back of the valve, which has diminished the violence of the shock, at the same time that it has increased somewhat the resistance of which I have spoken. The valves which were originally constructed, we have been obliged to replace by others two or three times, and subsequently we have removed them altogether, and put very much stronger, made of Iron. Those valves we have now worked for five or six months without any inconvenience. The steam-engine which is now working, is that which is known as a high pressure expansive and condensing engine, without a beam; the steam piston acts directly on a crank affixed at one end of the fly-wheel shaft. At the other end of the shaft is another crank, which works the air-pump. The dimensions of the engine are a 34¼ inch cylinder, 5½ feet stroke; the area of the piston is therefore 921⅓ square inches; the mean speed of the engine is 22½ double strokes per minute; the steam is intended to enter at 40lb. pressure above the atmosphere, and it is cut off at a variable length from one-fifth to nearly one third of the stroke, according to circumstances; it is cut off at a fourth on a mean of all its workings."

Weight of Trains.—Allusion to the statement made by Mr. Stephenson, that the velocity decreased very rapidly on the atmospheric system upon the increase of the weight of the train—(*Cubitt.*)

"Have you seen Mr. Pilbrow's application of the atmospheric plan?—No; I am aware of the principle of it. I did not go to see it, because I did not think that I could derive any practical information from it. I was not desirous of being seen there, lest I should be made use of to puff off the invention. Mr. Stephenson stated yesterday, that the velocity increased very rapidly on the atmospheric system upon the increase of the weight of the train, and he gave the committee many details on the subject; have you any statement to make on that point?—The heavier we make a train, the more power it takes to move it. If you attempt to move a large train with the same power as a light one, of course it will be retarded. That you can overcome?—Yes, if we take a locomotive engine and a double-sized train, we must fire the engine and water it very differently to what we should do otherwise; it is just the same in either case; a train twice as long as ordinary will take a greater force to move it. With a locomotive engine you can keep increasing the train till the engine cannot move it; the wheels will run round, and not move over the road at all; you must then put on more power to take off some of the load, and having done so you will get on. When you require increased power from a locomotive engine, do you increase the expense of that power as much as upon the atmospheric principle?—Quite, and I think rather more, because it can go up any incline; it must be remembered too, that you have to add all the power necessary to propel the engine itself, besides the load which it has to draw behind it. That never happens upon the atmospheric system; whether it is up or down the moving force continues the same; while the moving force in the locomotive varies according to the inclination, and the power actually may be all absorbed in moving the engine up an incline, and no moving force may be left to draw the train; whereas in the other case the moving force will always keep the same, and you may increas the power to any extent you please. That is a very difficult thing to define; but the moving force which moves the train, and the power which impels it, are two entirely different things. With respect to the estimates that have been delivered in, what do you think would be the cost per mile of the buildings which are required for the housing of locomotive engines?—I take 1,000*l.* per mile for workshops and tools, and 2,000*l.* per mile per plant; that is what I estimate for the London and York; 3,000*l* in all."

Wooden Rails.—Supposing the price of iron to keep up, witness would be induced to put down the wooden rails; they would be perfectly applicable to the atmospheric system—(*Cubitt.*)

Yarmouth and Norwich Railway—Calculation showing the much greater expense that would be incurred in working this line upon the atmospheric principle—(*Stephenson.*)

"The working of this line, the Yarmouth and Norwich, is let to a contractor for the amount of 7,000*l.* per annum: those are the whole of the expenses. I will take off from that 7,000*l.* such items of the expense as I know he must incur: for instance, the government duty amounted to 800*l.* a year; that has been actually paid. Then there is maintenance of road, I assume that at 70*l.* per mile, that amounts to 1,400*l.*; the salaries of the clerks amount to 800*l.*; the working of the carriages is let to Mr. Wright, the coach builder, who maintains them at so much per mile; I believe he has ⅜*d.* per carriage per mile; that would be 600*l.*; those are all the expenses which I assume the contractor is obliged to incur, and which he does in fact incur, and that amounts to 3,600*l.*; therefore that leaves for the costs of the locomotives 3,400*l.* a year, and his profit; but I will assume that he gets no profit at all; he has to do the working of this railroad, 20 miles in length, for 3,400*l.* a year. If you divide 3,400*l.* by 20 miles, it amounts to 170*l.* a mile for working the line by locomotive engines: now this line is through country as flat as a bowling-green all the way; there is one cutting of sand near Reigham, and that is all, and that was made because we wanted ballast; therefore the whole 20 miles may be considered as level as this table, being land reclaimed from the sea chiefly; the cost of working that traffic is 170*l.* per mile. The works would not have been reduced 1*d* if it had been constructed in the first instance for an atmospheric line; it was laid down upon the surface of the country all the way; therefore assuming the cost of an atmospheric line at 6,000*l.* a mile, or at 5,000*l.*, the simple interest of that money, at 5 per cent., is 250*l.* a mile, without the expense of working the line at all: now the cost of working the locomotive line is 170*l.* a mile; therefore, there would be the loss, if you worked the atmospheric system, of the difference between 250*l.* and 170*l.*"

In making the calculation of the expense of adopting the atmospheric system, witness did not take a tube of any particular diameter. On a line of this description, and with the same amount of traffic, a tube of six or seven inches would be quite sufficient—(*Stephenson.*)

EXPLOSION OF FIRE DAMP.

Chemical Society, Nov. 3.—"A Report on the Fire-Damp of Coal Mines, and the Means of preventing Accidents from its Explosion," was read by Professor Graham. The author had some years ago examined the gas of these mines, with the same result as Davy, namely, that it contains no other combustible ingredient than light carburetted hydrogen. But the analysis of the gas of the coal mines of Germany, subsequently published, showing the presence of other gases, particularly of olefiant gas, rendered a new examination of the gas of the English mines desirable. The gases were, (1) from a seam named the Five-Quarter seam, in the Gateshead Colliery, where the gas is collected as it issues, and used for lighting the mine; (2) the gas of Hepburn Colliery, which issues from a bore let down into the Bensham seam—a seam of coal which is highly charged with gas, and has been the cause of many accidents; and (3) gas from Killingworth Colliery, in the neighbourhood of Jarrow, where the last great explosion occurred. This last gas issues from a fissure in a stratum of sandstone, and has been kept uninterruptedly burning, as the means of lighting the horse-road in the mine, for upwards of ten years, without any sensible diminution in its quantity. The gases were collected personally by Mr. J. Hutchinson, with every requisite precaution to insure their purity, and prevent admixture of atmospheric air. The usual eudiometrical process of firing the gases with oxygen was sufficient to prove that they all consisted of light carburetted hydrogen, with the exception of a few per cent. It was observed that phosphorus remains strongly luminous in these gases, mixed with a light air, while the addition of one four-hundredth part of olefiant gas, or even a smaller proportion of the volatile hydro-carbon vapours, destroyed this property. Olefiant gas itself, and all the allied hydro-carbons, were thus excluded. Another property of pure light carburetted hydrogen, observed by Mr. Graham, enabled him to exclude other combustible gases, namely, that the former gas is capable of entirely resisting the oxidating action of platinum black, and yet permits other gases to be oxidated which are mixed with it even in the smallest proportion, such as carbonic oxide and hydrogen, the first slowly and the last very rapidly; air, or oxygen gas, being, of course, also present in the mixture. Now platinum black had not the smallest action on a mixture of the gas from the mines with air. The gas was also inodorous, and clearly contained no appreciable quantity of any other combustible gas than light carburetted hydrogen. The only additional matters present were nitrogen and oxygen, or air; the specimen collected in the most favourable circumstances for the exclusion of atmospheric air, namely, that from the Bensham seam, still containing 0·6 per cent. of oxygen. The gases also contained no carbonic acid. Attention was directed to the result that nothing oxidable at the temperature of the air was found in a volatile state associated with the perfect coal of the Newcastle beds. The remarkable absence of oxidability in light carburetted hydrogen appears to have preserved that alone of all the combustible gases originally evolved in the formation of coal, and which are still found accompanying the imperfect lignite coal of Germany, of which the gas has been examined. This fact is of geological interest, as it proves that almost indefinitely protracted oxidating action of the air must be taken into account in the formation of coal; air finding a gradual access through the thickest beds of super-imposed strata, whether these strata be in a dry state or humid. In regard to measures for preventing the explosion of the gas in coal mines, and of mitigating the effects of such accidents, Mr. Graham confined himself to two suggestions. The first has reference to the length of time which the fire-damp, from its lightness, continues near the roof, without mixing uniformly with the air circulating through the workings. He found that a glass jar, of six inches in length and one inch in diameter, filled with fire-damp, and left open with its mouth downwards, continued to retain an explosive mixture for twenty minutes. Now it is very desirable that the fire-damp should be mixed as soon as possible with the whole circulating stream of air, as beyond a certain degree of dilution it ceases to be explosive. Mr. Buddle has stated, "that immediately to the leeward of a blower, though for a considerable way the current may be highly explosive, it often happens that after it has travelled a greater distance in the air-course, it becomes perfectly blended and mixed with the air, so that we can go into it with candles; hence, before we had the use of the Davy lamp, we intentionally make 'long runs,' for the purpose of mixing the air." It was recommended that means be taken to promote an early intermixture of the fire damp and air; the smallest force is sufficient for this purpose; as a downward velocity of a few inches in the second will bring the light gas from the roof to the floor. The circulating stream might be agitated most easily by a light portable wheel, with vanes, turned by a boy, and so placed as to impel the air in the direction of the ventilation, and not to impede the draft. The gas at the roof undoubtedly often acts as an explosive train, conveying the combustion to a great distance through the mine, while its continuity would be broken by such mixing, and an explosion, when it occurred, be confined within narrower limits. Secondly, no effective means exist for succouring the miners after the occurrence of an explosion, although a large proportion of the deaths is not occasioned by fire, or injuries from the force of the explosion, but from suffocation by the after-damp, or carbonic acid gas, which afterwards diffuses itself through all parts of the mine. It was suggested that a cast-iron pipe, from eight to twelve inches in diameter, be permanently fixed in every shaft, with blowing apparatus above, by which air could be thrown down, and the shaft itself immediately ventilated after the occurrence of an explosion.

It is also desirable that, by means of fixed or flexible tubes this auxiliary circulation should be further extended, and carried as far as practicable into the workings.

DURATION OF RAILWAY IRON.*

There has been a great deal of discussion and speculation during the last two years, as to the probable duration of railroad iron when exposed to a heavy traffic; and there are few subjects on which the opinions of practical men have differed more.

We have, however, at last, the means of forming a very safe estimate of the durability of a 56 lb. to the yard edge rail, when well laid, on an even and well-adjusted track.

The first ten miles of the second track of the Lowell road was first brought into use in 1838, after the "fish-belly rail" had been found inadequate. The new rail was of the H pattern—the form now most generally approved.

The following Table shows the number of tons which passed over the road, in each year, from 1838, when this rail was first used, until July 1845, when the company commenced making extensive repairs:

In 1838, about	60,000 tons.
1839,	70,000 ,,
1840,	73,000 ,,
1841,	86,000 ,,
1842,	91,000 ,,
1843,	115,000 ,,
1844,	150,000 ,,
1845, (to July,)	75,000 ,,
Total freight,	720,000
In addition to this quantity, there has been transported, annually, about 16,000 tons of passengers and baggage, or in seven and a half years	120,000
Which makes the aggregate tonnage about	840,000

One *half* of this quantity only has passed over the second track, which, up to this time, therefore, has sustained 420,000 tons. The question is now, what effect has this tonnage produced? Is the rail visibly injured by it?

The company have relieved us of the necessity of all speculation on this point, by taking up several considerable stretches of this rail in 1144; and they are *now* making still further changes—one about *a mile long*, near the three-mile stone, and the other about *half a mile*, near South-Woburn. They will be compelled to make additional renewals this year, and probably to change the iron on the whole of this ten miles in the next year. The durability of this rail may, therefore, be set down at 500,000 tons. The lowest estimate we have ever seen of the power of a good edge rail, is 1,000,000 tons.

In 1841 and 1842, the Lowell company took up 26 miles of the "fish-belly" rail, and laid down a new iron of about 56 lb. per yard; some portion of it was 60 lb., and that which they are now using is 63 lb. iron per yard. This change of iron cost 121,559 dollars, after deducting the proceeds of the old iron, or about 4700 dollars per mile.

The new iron was heavier than the old, which, of course, increased the cost of making the change; but, on the other hand, the new iron was purchased while railroad iron was admitted free of duty, which *reduced* the cost.

If we make the proper allowance for these two circumstances, we will find that the cost of taking up one track of 56 lb. iron, and replacing it by a new track of the same weight, is very nearly 5,000 dollars per mile.

If we then divide this sum by 500,000 tons, the amount of trade which will have destroyed it, we shall obtain *one cent per ton per mile* for the value of the wear of iron on this road. This is a larger result than we should have looked for; but as the company receive more than *five cents per mile per ton* for all the freight they carry, they can afford to renew their iron and still make reasonable profits.

* From the Boston (U. S.) Courier.

CONNECTION OF LIGHT AND ELECTRICITY.—Mr. Faraday, has announced at a meeting of the Council of the Royal Institution a very remarkable discovery; which appears to connect the imponderable agencies yet closer together, it it does not indeed prove that Light, Heat and Electricity are merely modifications of one great universal principle. This discovery is, that a beam of polarized light is deflected by the electric current, so that it may be made to rotate between the poles of a magnet; and, as we understand, the converse of this, that electro-magnetic rotations may be produced by the agency of light. Thus the problem, which has disturbed science for a long period as to the power of magnetising iron by the sun's rays, as stated by Mrs. Somerville, Morrichini and others, receives satisfactory elucidation from the indefatigable industry of Mr. Faraday. Already has he proved the identity of machine, chemical, magnetic, and animal electricity; and now, advancing a step higher in the inquiry, he finds the most ethereal principle with which we are acquainted capable of producing phenomena which have hitherto been regarded as the exclusive property of ponderable bodies only. Light, the sublime agent of vision, the source of all the beauty of colour, is now shown to have some close relation with electricity.

FLAXMAN, CANOVA, AND THORWALDSEN.*

Flaxman in England, and Canova in Italy, carried Sculpture on in the direction it now has taken; and their example has exercised a most beneficial influence. Both enthusiastic admirers of the *antique*, and both educated in the study of its beautiful remains, their works are utterly distinct in character, expression, and treatment. In some respects, Canova judged more independently for himself than Flaxman; but no modern sculptor has entered so deeply into the spirit of Ancient Art as our countrymen. His style was founded upon its principles, combined with the simplicity of the revivers of the art in the thirteenth and fourteenth centuries. Canova adopted the antique in a modified form, but he also looked out upon Nature. It may be doubted whether Canova's standard of beauty was sufficiently pure to combine thoroughly with the more simple and severe excellence of Greek sculpture. It has been objected, and not without reason, that there is a fantastic and somewhat meretricious character about his sculpture, which is not quite consistent with true, beautiful Art. Canova delighted in execution; and no artist has surpassed him in richness and luxuriousness of workmanship. Among this master's productions, the 'Theseus,' some of the Danzatrici, and especially his monuments of the Popes Ganganelli, Rezzonico, and Braschi, exhibit feeling, grace, fancy, knowledge of form, and exquisite execution, and establish Canova's claim to be classed among the truly great artists who have made Sculpture their study.

The works of Flaxman have gained for him an European reputation. His illustrations in outline from the Greek poets, and from Dante, taking them as a whole, place him beyond comparison with any designer, ancient or modern. His greatest historical work in sculpture is a colossal group in marble of "St. Michael subduing Satan;" and Mr. Westmacott said he believed he should be borne out by the best judges of Art in declaring it to be the finest historical group of any modern sculptor; grand in perception—simple, yet skilfully arranged, in its composition—marked in character—choice in its forms—it realizes all the requirements, all the *ideal* qualities appropriate to one of the most sublime subjects upon which the art could be exercised. Flaxman was also a most accomplished master in the different classes of relievo. Some of his works of this kind are pre-eminent for treatment of subject as well as for technical skill. Among the productions of Flaxman, so distinguished, his illustrations of the Lord's Prayer, in Micheldevor Church; some of his monumental subjects in Chichester Cathedral, and other churches; and, in the classical style, his well-known 'Shield of Achilles,' and his exquisite composition of 'Mercury bringing Pandora to Earth,' were particularly described. Casts of some of these were exhibited. The lecturer observed, that the successful treatment of relievo was one of the most difficult achievements in Sculpture. Flaxman was a master in this department of the art: Canova eminently failed in it: Flaxman, too, often neglected the executive part. In his admiration of the beautiful and expressive in sentiment, he seems to have overlooked, or perhaps underrated, the advantage—and, indeed, it may be said the propriety and necessity in Sculpture, of expressing beautiful sentiments by forms of corresponding quality.

Among the great names which will always be honourably identified with the history of Sculpture, is that of Thorwaldsen, a native of Iceland. His works are characterized by a firm, energetic style. They are totally free from affectation in point of taste; and his sculpture always clearly defines its purpose. Thorwaldsen's practice extended over a wide field. One of his first works was a statue of Jason, in which he showed a pure feeling for the simple expression and grand forms of the Greek school. His statue of Mercury is also conceived in the true spirit of ancient Art. His celebrated relievo of the 'Triumph of Alexander' abounds with excellences of a high order. The human figure and animals are well grouped, and the style of form and the treatment show a thorough acquaintance with the best models. There are few who are not acquainted with his charming compositions of 'Day' and 'Night.' Among his larger works, the series of figures for a church in Copenhagen are particularly deserving of notice. They consist of Christ and the Apostles. The statue of our Saviour, of larger dimensions than the other figures, is marked by all the qualities appropriate to the sublime subject. Dignity in the *pose* of the figure, an affecting calmness of expression, a grand style of form, great breadth of treatment, and well-managed contrasts between the naked and the drapery, stamp this as one of the triumphs of Sculpture. The Apostles are remarkable for appropriate character, dignity, and a happy disposition of drapery. The influence of these three artists has been very great. That of Canova seems to be the least securely established; while the style which characterizes the works of Flaxman and Thorwaldsen is gaining ground. Much of Canova's excellence and charm arose out of his own individual taste, which cannot be communicated, his mode of treating his subjects, and his perfect mastery in execution, in which latter he is unequalled. Flaxman and Thorwaldsen have restored Sculpture to its true principles, and have shown in their own practice that those principles are catholic, universal, and equally applicable to deeply-felt subjects of *modern* interest as they were when employed in illustrating ancient mythology.

(* From Mr. Westmacott's Lectures at the Royal Institution.)

ANTIQUARIAN DISCOVERIES AT LEWES.

Strange, indeed, are the changes wrought by time and man's ingenuity; for these relics of nearly eight centuries since have been upturned in a work peculiar to our own times—the construction of a railway; and this by a circumstance purely accidental, and but for which the relics might have rested for many more centuries. The projected line of railway from Brighton to Hastings, it may be necessary to state, runs through a portion of the town of Lewes, or rather through the grounds of the ancient Priory of St. Pancras; and, although it will not materially disturb the walls, there will yet be a cutting 40 feet wide by about 12 feet deep, traversing in a north-eastern direction from the western boundary to the north-eastern wall adjoining the Mount Field.

Nearly upon this spot, workman had, for some time, been removing the earth from the side banks of the western ruins of the Priory, without discovering anything of interest; but, on Monday week, they commenced clearing a driftway on the bank of the west side of the remains of the Priory chapel, on the high ground. During the day, the workmen found a leaden coffin, 5 ft. 4 in. long, containing the remains of a female skeleton, and portions of cere cloth: the coffin was surrounded with Caen stone, and the lead was much decayed. Still, there was nothing to aid the identifying of these remains; and their discovery was chiefly interesting as a good presage of what might be expected. Accordingly, on Tuesday morning, the workmen exposed a leaden cist, or coffer, surrounded by a few Caen stones.) After clearing away the soil, the cist was carefully removed, and, on being opened, was found to contain human bones, proved to be the remains of Gundreda, daughter of William the Conqueror, the name "GVNDREDA," as it is spelt, being cut upon the lid. The size of the cist is about 3 feet in length, a foot in width, and 9 inches in depth: the lid, sides, and ends, are in excellent preservation, but the bottom is much corroded. The lead is ornamentally cast in beaded compartments of the lozenge form, 5 inches by 3; and the lid fits on, or rather laps over the sides. Soon after the finding of this cist, and at a short distance from it, the workmen found a second cist, precisely similar in form, character, and material; being, however, slightly longer: the bottom is much decayed, and on the lid is inscribed "WILLMs," an old but usual way of writing Gulielmus. This has been readily interpreted into the name of William of Warren; by this means establishing the fact that these cists contain the remains of Gundreda, the founder of the Priory, and of her lord, the first Earl of Warren and Surrey. Ancient records prove that Gundreda died in 1085, and that both were interred in the Chapter House of Lewes Priory; the latter being, as it is stated, "buried in the Chapter House, in a tomb adjoining that in which his Countess was laid. The cists were found lying about 2½ feet below the surface in two square compartments, formed, apparently, by the foundation-walls, or under the floor of what is presumed to have been the Chapter House.

Thus far the circumstances of the discovery of the relics. The ground is the site of the great Cluniac Priory of St Pancras, in Southover; the origin of which is traceable to the piety of the Earl of Warren and his lady Gundreda, who, in the year 1076, set out on a pilgrimage to Rome; and receiving great kindness from the prior and monks of St. Per, at Cluny, they were induced to entertain a greater regard for that order and house than any other which they had seen. Being already determined, by the persuasion of Archbishop Lanfranc, to erect a religious house for the pardon of their sins and the saving of their souls, they requested of the abbot at Cluny three or four monks for the intended monastery. The abbot consented, and the grateful baron returned home to carry into effect his holy project. In about six years, the work was completed; the brethren took possession of their magnificent residence, and grants and benefactions, to an almost incredible extent, enriched the increasing fraternity. Some idea of the extensive scale of the monastery may be formed from the well-ascertained fact, that its walls embraced an area of more than 32 acres. The great church was rebuilt in the reign of Henry II. Its length was 150 feet; its height, 60 feet: it was supported by 32 pillars, 8 of which were not less than 42 feet high, 18 feet thick, and 45 feet in circumference; the remaining 24 were 10 feet thick, 25 feet in circumference, and 18 feet in height. The roof before the great altar had an elevation of 93 feet. The Chapter House and the Church were by far the most splendid parts of this stately pile: in the former were interred the remains of the founder of the monastery and his Countess (as we have explained), several of his successors in the barony, and some distinguished nobles: the latter was richly adorned by the painter and sculptor, and was distinguished by the magnificence of the funeral monuments, with which it appears to have been crowded. We quote these details from Mr. Baxter's forthcoming "Guide to Lewes."

We should add, from the *Sussex Express*, that, in 1828 and 1829, workmen were employed to level the ground about the standing walls, when the turf was taken off from a great portion of the land, and the foundations of many walls were exposed. A plan of them was made by Mr. W. E. Baxter, the publisher, in whose possession it now is. In 1836, the frontage to the north of the Priory grounds was laid out for building a crescent and row of houses. To the south-west of the ruins stood, till lately, a portion of the immense pigeon house belonging to the fraternity; it was built in the form of a cross, and contained recesses for more than 3,000 pair of doves. A mansion of the Dorset family, which was destroyed by fire about 150 years ago, stood adjoining the churchyard, and has given the name of Lord's place to the site.

On our late visit, the spot was crowded with wonder-stricken inquirers. We there learned that, on the discovery of the relics, they were carefully preserved by Mr. Acton, the chief officer of the Lewes and Hastings Railway Police, who had them removed to his own house, and the greater part of them from thence to the Church of Saint John the Baptist, at Southover. The urn, with its leaden case, and a few small relics, were left at Mr. Acton's: the case, in form, resembles a kitchen boiler, and has a projection from the lower part resembling a tap.

Nearly in the centre of the west end of the nave is the memorial, or coffin-lid, of Gundreda. It is a slab of black Norman marble, sculptured with foliage in a fine early style, and bearing around its edge, and up the middle, the following inscription, with slight conjectural supplements, in Anglo-Norman characters:—

"Stirps Gundreda Ducum, decus evi, nobile germen,
Intulit Ecclesiis Anglorum balsama morum,
Martha fuit miseris, fuit ex pietate Maria;
Pars obiit Marthe, superest pars magna Marie.
O pie Pancrati, testis pietatis et equi,
Te fecit heredem, tu clemens suscipe matr
Sexta kalendarum Junii lux obvia carni
Ifregit alabastrum."

The following observations on the discovery, communicated to the *Sussex Express*, by Mr. Blaauw, one of the committee, are entitled to special attention:—

"It is obvious, from the length of these receptacles, that the bones of the Earl and Countess have been transferred to them from some previous tombs; and it is not difficult to suppose that the Chapter House, not being built at the time of their deaths, the founders were buried elsewhere until its completion; and that the bodies were then found so decayed, that their bones only remained for removal to a more distinguished situation, and were on that occasion placed in these very leaden chests. A rebuilding of the Priory Church was begun on the anniversary of William the founder's death in 1243, and from the antique form of the letters G and M, the inscriptions cannot be fixed at a later period. The characters, indeed, more resemble the form used in the 12th century. Of the genuine antiquity of these relics there cannot be the slightest doubt."

SOUTHOVER CHURCH,

wherein the relics are deposited, is an heterogeneous but interesting structure, built upon the northern verge of the Priory grounds; and the discovery of great quantities of bones near this spot, a few years since, led to the inference that it was the cemetery of the church of the monastery.

Still, the present church of Southover is, in part, ancient. It consists of a square brick tower, in which is the principal entrance doorway, lately restored in good taste. You pass beneath, or through, the tower, into the nave, which is separated from the only aisle (south) by arches, three of which are circular, supported by cylindrical columns, whilst the remaining arches are of about the 16th century. The edifice was originally of much greater length than at present; for it terminates with the chancel midway in one of the arches of the later period. The stone window-frames, of various design, some of them very fine, are stated to have been brought from the Priory ruins, but the original bases of the cylindrical columns carry us to the Norman age. The interior has lately been repaired; and in the windows are some good examples of old stained glass, a few fine specimens of yesterday; the emblem of the Trinity, in one of the northern windows, for instance. We are happy to learn that the chancel is shortly to be restored, and its large altar window to be displaced by one of appropriate design. Above the altar is a painting of the Last Supper, by Mortimer, who was a native of Eastbourne; and high above this, filling the gable of the roof, hangs a large but ill-executed painting of St. John the Baptist, to whom the church is dedicated. The roof of the nave, too, has open timber-work. There is a gallery at the west end, with a small organ; and in the south-west corner is an unsightly wooden inclosure, lighted by one window, and used as a vestry-room. Here we saw the remains of the woollen gown of a monk, and a portion of his shoes, the materials of both readily crumbled at the touch.

The tower of the church was built early in the last century, in place of the tower and steeple, which fell down in 1698. The former bears the date 1714; in its west face is sculptured in stone the shields of the Earls of Warren; in the south, a rose and ducal crown; and on the north, in Anglo-Saxon characters, T. A. D. E. (Theobaldus Archiepiscopus Dedicavit Ecclesiam), commemorating the dedication of the church by Theobald, Archbishop of Canterbury, who was translated to the see. A. D. 1138. In the ground, at the eastern end of the church, are some massive remains of columns and arches, which may bespeak the original extent of the fine old castle.

The relics have been preserved by these means. The land on which the Priory stood, and through which the railway passes, belongs to a lady named Jackson, and who stipulated with the contractor for the railway works, Mr. Wythes, through her solicitor, Mr. Hoper, of Lewes, that all relics which might be discovered should be reserved for her. Accordingly, they have been saved from falling into the hands of persons who might have been unable to appreciate their real interest, but who might have caused them to minister to their cupidity.—*Illustrated London News.*

THE BROAD AND NARROW GAUGE COMMISSION.

Evidence of Nicholas Wood, Esq. Mr. Wood stated that he is engineer of the Newcastle and Carlisle Railway, and had given much attention to the construction of locomotive engines, and familiar with the improvements which have been made in them. In the year 1838 he reported on the Great Western, with reference to the comparative merits of the gauge. Great inconvenience would arise from changing the passengers from one carriage to another, which ought to be avoided. It would be impossible to have carriages adapted to the trucks. The transfer of passengers and goods would be inconvenient and expensive. It would occasion a great loss of time. It would take from five to six hours to transfer a load of goods, which would also be mixed. Goods at present were carried for a penny a mile, which could not be continued with a break of gauge. He estimated the cost of loading at 3d. per ton, and 3d. per ton for unloading goods, which would be equivalent to their carriage at the present rate for six miles. That would not be very material on a long line. That estimate would apply to general goods. In the case of minerals, the parties themselves effected the transfer. The cost of loading and unloading he estimated at from 2d. to 3d. per ton. He had seen the apparatus at the Great Western station for transhipment; but he did not consider it applicable. The loose box system could not be carried out. There was a great objection to using them for the transport of agricultural produce, and the transhipment of coals, was very objectionable, from the loss which was occasioned by breakage. The small coals sold for eight shillings a ton, while the other coals sold for 20 shillings. It exposed them to this loss, besides the additional labour which it necessitated. The transhipment of 40 or 50 wagons caused expense and loss of time. The transfer of timber would be very difficult. It was now carried at a low rate, which would not continue to be the case if it was subjected to the process of transhipment. The effect would be either to drive the timber traffic entirely off the line, or greatly to enhance the charge for carriage. There would be also great inconvenience in transhipping cattle, which were often restless and difficult to remove, from one pen to another. They carried 1200 head of cattle weekly on the Newcastle and Carlisle Railway. With a break of gauge they would have to remove passengers, minerals, and timber. The loose box system would not suit them. They had tried it in the north, and found it so difficult to get the boxes to fit the trucks that they abandoned it. In the coal pits they had different gauges, because they had not space in the cuttings for the large wagons. The wheels of the smaller carriages were 12 inches, and those of the larger 2 feet 4 inches. In the large collieries, where they had the command of capital, they found it their interest to reconstruct all the wagons with an intermediate sized wheel, in order to avoid the transfer of the coals, and they found, by adopting this plan, that they saved from one-fourth to one-third of the original. The size of the intermediate wheel is fifteen inches. He could supply a detailed account of this saving, which had been made by reference to the report of the viewer. The bodies of the small trucks were carried on the larger ones. Respecting the breakage of coals by transhipment, and the depreciation per cent. on that account, the estimate on the transhipment to London was 7 per cent. That was the transhipment into the ship and out again in London. If a break of gauge was inevitable, it would be better, with regard to the transhipment of minerals, to lift them by machinery altogether than to adopt the loose box systemi With regard to other minerals—such as iron, for instance, the objections would be the same. The dead weight is a great disadvantage. He saw no particular advantage in 4ft. 8½ in. There would be no peculiar advantage in the half inch. That gauge was taken by Mr. Stephenson from the Killington line, probably because he lived in the neighbourhood, and that it was the one he saw in operation. He adopted it for the Stockton and Darlington. In the lines of the Marquis of Londonderry and the Earl of Durham, they had different gauges, but they made them uniform; the difference was about 12 inches. The length of that line was about 20 miles; they were all now on the 4 feet 8½ inch gauge; both were changed. The greatest distance the coal wagons travel on the railway is to York, about sixty miles. The length of of the colliery lines was about 24 miles. Looking to the different gauges which were contemplated by projected lines, he considered that any intervention of gauges would be most inconvenient. It would not be advisable to change in such a case the broad gauge to the narrow, nor the narrow to the broad, but he thought a line of demarcation should be drawn for either gauge. The coal wagons went as far as York. They sometimes go as far as Scarborough; in fact, they go as far as the coals are carried. They would go through the whole line. As to the interlacing of railways to the west and south, between Southampton and Plymouth, there would be shifts of gauge, without giving an opinion that one gauge is so superior to the other. He thought they must now retain the broad gauge. The narrow gauge on the whole was preferable. He would not, however, change the broad gauge lines to a narrow gauge, but he was of opinion that a line of demarcation should be drawn, and that it should be fixed where there was the minimum of labour. He could not undertake to say where that ought to be. It was an important question, and too difficult: with the limited information be possessed on the subject, he would not offer an opinion. It had been suggested, in order to adapt the carriages of the small gauge to the broad, that they might use loose wheels. They had tried them, but they found that they ran off the rail. The wheel should be fixed to the axle without turning. He accounted for carriages with loose wheels running off the rail in this way, that any alteration which diminished the firmness of the wheel on the axle, had a tendency to turn above the ledge. If both wheels were loose, it would be worse. Deeper flanges would prevent that, but would be objectionable in other respects. He would state the advantages and disadvantages, comparatively, of the two gauges, first, with regard to safety: he had given great attention to that point, when he made his observations and experiments on the Great Western in 1848. He got instruments made, so contrived as to register the motion of the carriages. It appeared to him that the motion might be regarded as threefold—the rocking, the pitching, and the oscillating motions. The witness then described, with the help of a diagram, the instruments which he used for the purpose of precisely defining these motions, and also exhibited a drawing of the marks which these instruments registered on paper disposed for the purpose of being marked. Mercury in tubes, adapted in each case to the object to be attained, was the moving agent used to cause the several registrations of the motion indicated on the paper. The result of these experiments was to satisfy the witness that the motion was altogether irrespective of the width of gauge. The only difference indicated was in the horizontal oscillatory motion. That depended on the adjustment of the wheels. He made an exact register every quarter of a mile. He found when they went slow, the oscillation was less. He considered that the oscillation depended on the velocity. When they went at the rate of nine or ten miles an hour, the oscillations were from 13 to 14; and when they went at the rate of 30 miles, the oscillations were from 40 to 50. The oscillation arose from the speed. At a high speed the cone of the wheel did not adjust itself to a straight line, and it was to that cause he attributed it. He observed a sinuous motion, but he had not measured it. It arose from the play between the flangs and the rail. Regarding the effect of the motion produced by shortening the carriage, the farther the wheel was from the centre of motion, the greater was the sinuous motion. The length of the carriage diminished it. He considered the long carriage better as regarded safety. He considered both gauges equally safe with respect to the oscillatory motion. If there was a rocking motion on the broad gauge, as there was a wider base, there would be more safety; but that is not the case; there is no difference in the motion on either gauge. He thought that on the broad gauge there was a greater tendency to jump the rail. To make an exact comparison between the gauges both should have longitudinal bearers. He had made his observations since they had adopted piling on the Great Western. He had gone on the Great North of England Railway at the rate of 60 miles an hour. He thought the motion smoother on the narrow gauge. That was with transverse sleepers. The gradients are favourable on that line. The trip was from Darlington to York. They could run on the narrow gauge up to 60 miles an hour; but he thought that 45 miles an hour was the highest speed which ought to be used. The narrow gauge was as safe at a high speed as any other. The engine on that trip was one constructed by Mr. Hawthorn, with outside cylinders. The diameter was 3 feet 7 inches. The length of the boiler, 11 feet 6 inches, and that of the fire box was 39 inches, and 42 inches high. It was mounted with 6 wheels. The driving wheel was 6 feet 7 inches. It was better than a 7 foot wheel It was a new engine, and had sufficient space for the gear for a high velocity. The improvements which had been made in engines rendered the gearing simple. Outside cylinders were more economical; inside cylinders he considered perfectly adapted to a rate of speed of 45 miles an hour. He thought there was a little more oscillation with the outside cylinders. The safety was the same with both at a rate of 45 or of 60 miles. The safety was equal on both lines. A high speed was not expedient—the public did not like it.—*Iron Times.*

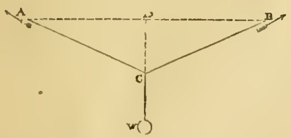
THE LIVERPOOL ASSIZE COURTS.—The work continues still to make a very slow progress. The sound of the hammer and chisel is to be heard at every angle; and we have no doubt, from what we saw and learned on our visits, although the walls are bare, and the building itself is neither roofed nor floored, that a very considerable portion of the preparatory part of the workmanship has been accomplished. The twenty-four granite columns which are to adorn St. George's-hall have arrived from Aberdeen. The columns will have an extremely grand and imposing effect, the granite being of the richest vein we ever before had the opportunity of inspecting. The only other columns in the kingdom which bear any comparison to them are the four in the British Museum in London. There the columns are each hewn from the one block, and present to the eye of a beholder a very elegant appearance. Here, in order to save expense, each column will consist of five or six different pieces, and the joinings must necessarily detract to some extent from the general effect. Still, viewed from either end of the magnificent hall, which will be 199 feet in length, the grandeur and massiveness of the sight will be unequalled. The columns for the front entrance are also nearly completed, and so are the sixteen Corinthian capitals. The capitals are from the design of Mr. S. C. Kelsey, of London, who has been superintending their execution; and some idea of their massiveness will be gathered from the fact that each of the circular ones weighs 9 tons, and each of the square ones 11 tons. Many of the internal embellishments, though not yet fixed in their respective places, are either completed or in a state of great forwardness; and we may add, as a proof that Mr. Elmes, the architect, is availing himself of the present fine weather, that he has at present 170 workmen daily employed. There appears to be very little difference of opinion, however, on this important point,—that it will take from two to three years, at the very least, to finish the building. But, however distant the period of its completion may be, it will, when finished, be such an ornament to Liverpool as no other town in the kingdom can boast of possessing. Its extreme length will be 498 feet. The length of the hall, as we have said, will be 199 feet; its width 72 feet 9 inches; its height 87 feet 6 inches. The length of the courts will be 69 feet 9 inches; their width 50 feet 6 inches; their height about 30 feet. The concert-room will be 70 feet square by about 40 feet high.—'Liverpool Albion.'

DREDGE'S SUSPENSION BRIDGES.

We have to direct attention to the following Correspondence.

Sir,—In publishing my father's reply to Mr. Bashforth, in the November number of your Journal, you have made a very ridiculous error, which is the more to be regretted in consequence of the remarks appended to the letter. I say you made the error, because in the original draft of the letter it does not occur; and as I myself made the copy that went to press, and took particular care that it should be correct, I feel convinced that it is not in that. The part I allude *is written*, and *should have been printed* thus: "Suppose the points A and B fig. 2 to be in the same horizontal line, let a wire (void of weight) A C B be suspended from them,

Fig. 1.



and let a weight W be applied at the centre C, $a = \angle$ D A C $= \angle$ B C D and T = the measure of tension in the wire A C B; then

$$T = \tfrac{1}{2} W \text{ cose } a.*$$

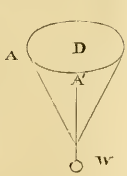
But if W be supported in a projection at an $\angle = a$, the tension excited must be = W cose a. Let us see if this is not the case. At the point A a resistance must be applied in the direction of the arrow $= \tfrac{1}{2}$ W cose a, and similarly at B a resistance is required $= \tfrac{1}{2}$ W cose a, and the sum of these resistances (which are solely caused by the action of the weight W,) is

$$\tfrac{1}{2} W \text{ cose } a + \tfrac{1}{2} W \text{ cose } a = W \text{ cose } a,$$

Consequently *the tension must be* W cose a, *half of it* (or $\tfrac{1}{2}$ W cose a) *acting in each direction*."

The first part of this proposition is to be met with in every treatise on statics; the latter part is self-evident, and is quite distinct from the principle of action and reaction. If you doubt it, take a more general example.

Fig. 2.



From the periphery of the circle A B' B A' let an infinite number of lines descend at the same angle (a), all converging in one point, C. From this point let the weight W be suspended, then will the tension in each line be represented by cose a. dW; but to obtain the full force excited by the weight, W, we must integrate this expression, when we shall have the amount of tension due to the action of the weight, W,

$$[= \text{cose } a \int d\, W = W \text{ cose } a$$

which is the same as we obtain by the above proposition. Therefore as a general rule (which cannot be disputed), multiply the weight suspended by the cosecant of the angle of suspension, and the product will give the whole amount of tension excited; and if this be divided by the number of sustaining lines the quotient will give the tension in each.[1]

This is strictly in accordance with accurate mechanics, and with my father's proposition. If it does not agree with your pre-conceived notion I cannot help it.

If you refer to the differential and integral calculus, by the Rev. T. G. Hall, third edition, pages 113 and 96, you will find that the pure mathematics of the proposition fig. 3 is perfectly correct; its application to the mechanical problem under consideration is equally demonstrable, but that was left for Mr. Bashforth to dispute.

You will find it on record many times before the 1st of November that "*if the roadway be sufficiently strong to resist the compression*, the platform, &c. The words I have put in italics are omitted in your remarks.

I deny the correctness of Mr. Bashforth's opinion, and corroborate my father's statement, for "the problem is susceptible of analytical solution." *I have done it, and have my MSS. by me* [2]

As this is an advertisement, for which the bearer will pay you, I request you will insert it without any remarks. I have forwarded a copy to Mr. Bashforth, that that gentleman might not be able to take advantage of the typographical error so opportunely laid before him.[3]

Yours, &c. &c.

William Dredge, Civil Engineer.

Bath, November 7th, 1845.

* Cose (cosecant) $= \frac{\text{rad}}{\sin}$ If rad = 1, then cose $= \frac{1}{\sin}$; consequently $\tfrac{1}{2}$ W cose a $= \frac{W}{2 \sin a}$

The above letter was accompanied by the following:—

Sir,—I can perfectly understand the reason why the alteration in my father's letter was made—but cannot admire the imprudence of risking an exposure. I request that the accompanying advertisement be inserted *without any remarks* in the body of the Civil Engineer and Architect's Journal, and the bearer will satisfy your demand for it. An announcement that this advertisement is to appear, is sent to the Mechanic's Magazine, and, I have no doubt, printed in that journal of to-day. You will see I have communicated with Mr. Bashforth on that subject, so that he cannot take advantage of the blunder.[4]

I have the honour, &c. &c.

W. Dredge.

To the Editor of the Civil Engineer and Architect's Journal.

P. S. This letter is not intended to be published, *unless you please*, and *not* then as an advertisement.

Bath, November 8th, 1845.

(Copy of Answer.)

No. 10, *Fludyer-street, Whitehall, Nov.* 16, 1845.

The Civil Engineer and Architect's Journal.

The Editor begs to inform Mr. Dredge that his paper shall appear in the ensuing number of the Civil Engineer and Architect's Journal, with all the correspondence relating to it, and that a proof sheet shall be sent to Mr. Dredge for his correction. As the paper cannot appear as an advertisement, the money sent in payment is returned. The editor reserves to himself the right of reply, and of explaining what appears to Mr. Dredge an intentional typographical error.

W. Dredge, Esq.

The following letter was sent with the corrected proof sheets:—

Herbert's Hotel, New Palace Yard, Nov. 22, 1845.

Sir,—I thank your courtesy for sending me a proof of my letter, which was only put into my hand this morning, just as I was sitting down to dinner. In order that no time might be lost, I called upon the editor in Fludyer-street, that I might show the errors you have again committed. You will, of course, understand my object for calling upon him personally was, that no time might be lost in conveying an answer which you wished to have by return of post. What I had to communicate, I therefore send you in writing.

I sent it to appear as an advertisement,—you have published it as a letter; you will therefore please insert these short remarks, which are referred to in the proof. The letter at the foot of the proof was private; I have not any objection to its being published, it was not written unadvisedly, nor in a hurry.

Yours, &c.

W. Dredge.

I had written the letter in London, but neglected posting it. If you have occasion to write to me, address, Bath.

Corrections:

The typographical errors are pointed out in the proof; where I want inserted, in addition, is as follows:

[1] The steps of this deduction would have been sent at length, but for the limits of advertisement, which it was intended to be.

[2] Your expression of Mr. Bashforth's opinion would have been farther remarked upon but for the same reason.

[3] No possible objection can be made to any remarks you please, provided you give an opportunity for reply.

[4] This letter was private, but is published by your choice; I have not the least objection to it. W. D.

The typographical error which forms the subject of the above letters we readily acknowledge. It arises, we find, on referring to Mr. Dredge's manuscript of his former communication, from his having written the word *cosecant* "cose," whereas it is, we believe, uniformly expressed in mathematical books by the letters "cosec," or "cosect." It was therefore concluded that in Mr. Dredge's paper the word "cosine," or its usual abbreviation "cos," was intended; and what we now find to be an "e" was taken to be no more than a mere mark after the "s." This, we think, satisfactorily explains the matter, without any supposition of intentional alteration on the part of the compositor, or dishonesty on the part of the editor.

Allowing Mr. Dredge the full benefit of this acknowledgment (which we here most explicitly do), there still remains enough to warrant us in retaining our opinion of his mathematical knowledge. In his letter now before us, the printer's proof of which has been corrected by himself, he says,—let "T = the measure of the tension in the wire A C B; then T = $\tfrac{1}{2}$ W cose a," and in the same sentence he says, "consequently, the tension must be W cose a." Now, one of these assertions must be incorrect, for otherwise we must conclude that a thing may be equal to the half of itself—ere is no need to tell the mathematical reader that the former of the assertions is the correct one.

In the case referred to in fig. (2) the tension is said to be "cose α d W." This assertion is not accompanied with any proof. It is incapable of one, for this simple reason—that there can be but six equations for the equilibrium of a system (three of translation, and three of rotation), and in the present case there are an infinite number of tensions to be determined. We *presume* that Mr. Dredge knows that simultaneous equations are soluble only when their number equals that of the unknown quantities. The problem is, in fact, an indeterminate one.

Mr. Dredge next refers to the "pure mathematics of the proposition fig. 3," in our last number. Now, as we said before, we can discover no demonstration whatever of the proposition, except that which may be supposed to be contained in the words, "I say that." This *ipse dixit* appears to be the only argument employed; for, as far as we can make out, it is not even professed, that any use or application is made of the pure mathematics here written down. It may be very true that the differential expression for a tangent is correctly copied from Hall's "Differential Calculus," but here no use seems to be made of it. The "proposition" expressed in intelligible language, freed from analytical symbols which have nothing to do with it, seems to be this—that if a chain hang in a curve between two points, and be acted upon by any forces applied at different points, that then, if one of these forces be tangential, the tension of the chain is zero between the point of tangency and the lowest point of the curve. This is not true. It certainly *may* happen for a particular case, where certain relations hold between the amounts and directions of the pressures, that the tension in question becomes zero. But Mr. Dredge asserts this as a general and necessary proposition, which it most decidedly is not.

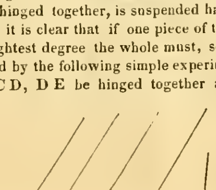
It was also stated in the former paper that "the horizontal force is a constant quantity in the polygon of pressure." It seems scarcely too severe to characterise this as perfect nonsense; and it may almost be suspected that here mathematical phrases are used without any apprehension of their meaning.

On these mathematical points we certainly think further discussion unprofitable. If Mr. Dredge *will* reply to what has just been said, we suppose he must be allowed to do so: but he must excuse our giving any further answer to his mathematical observations.

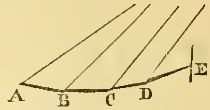
We follow Mr. Bashforth in this determination of giving up further argument, and nothing will induce us to alter our resolve, unless Mr. Dredge can bring the written declaration of some really competent mathematician, explicitly confirming his mathematical notions.

Let it not, however, be concluded hence, that, because we condemn Mr. Dredge's mathematics, we consider his invention a useless one; on the contrary, there is one part of it which we consider very valuable, and that is, the varying thickness of the main chain. We will briefly state our reason for this. When a heavy chain hangs in a curve between two points, the tension is greatest at these points; and the less the inclination of the chain to the horizontal, the less the tension. Consequently, the lowest point of the chain is the point of least tension, and therefore less strength of the material is required at this point than at any other. The same remark holds good where the chain is equally loaded throughout—that is, where the weight of the platform is distributed equally, and at equal horizontal distances along the chain.

Unfortunately, however, Mr. Dredge, like all other inventors, has carried his principle too far. Because the lowest point of chain is the point of least tension, he concludes that it may be arranged that there shall be no tension at all at that point: that the chain may actually be severed there without danger, and that the two parts of the platform will stand as two independent brackets, if sufficiently strong to resist compression. He lays great stress on the words "if the railway be strong enough to resist the compression;" but the fact is, the railway must, if the bridge be cut into two, be strong enough to resist not only compression, but the slightest bending also. For if it be conceived that a bracket, composed of several parts hinged together, is suspended half across a river by chains from the bank, it is clear that if one piece of the flexible bracket be displaced in the slightest degree the whole must, so to speak, *collapse*. This may be illustrated by the following simple experiment; let a number of beams A B, B C, C D, D E be hinged together at B, C & D, and



let them be made to stand out from the wall at E, being also suspended by oblique strings as in the diagram. Now if this fragile structure be in the slightest degree disturbed so as to present the following arrangement,



the whole must fall together. In fact, the structure is no securer than a child's house of cards.

It is very true, that if the platform be made *perfectly rigid* it can never assume the position of the second diagram. But then if it have this rigidity it becomes a *girder*-bridge, and the increased strength of the main chain requisite to support the increased weight of the girder would be so great, that it would be better to dispense with the chains altogether, to unite the two independent girders which we suppose hanging over the river, and when they are connected at the centre, to let the whole rest upon abutments on either bank.

The only bridges which we have of Mr. Dredge's, those in the Regent's Park, certainly have not the rigidity of girder bridges: they have quite sufficient flexibility to produce the effect explained above, supposing they were divided at the centre. We do not think that any one who has seen them, except, perhaps, the inventor, would like to stand on them while the experiment was being made.

It is to be remembered, that the bridge at Calcutta gave way by breaking at the centre.

On the whole, therefore, it seems clear, that Mr. Dredge's system of lessening the thickness at the chain at the centre has a limit. We are convinced that no practical engineer of reputation would consent to construct a suspension bridge without a very ample provision in this respect.

The other distinguishing feature of Mr. Dredge's invention is the obliquity of the suspending rods. On this point we will not speak positively, but our present impression is, that this arrangement does not permit any saving of material in the main chain. On the contrary, it seems that the obliquity of the suspending rods demands a greater strength in the main chain than would otherwise be required. Our reason for this opinion is as follows, though it is to be understood that we do not in this place speak with abslute certainty.

It is clear that with either arrangement the vertical parts of the tension of the main chain must be together equal to the weight of the platform (neglecting the weight of the suspending rods)—that, is the upward force exerted by the main chain must, on the whole, be equal to the downward force exerted by the weight of the platform, however it may be suspended. We know that if a man raise a weight attached to two strings, he must use the same exertion, whether the strings be parallel or converge to a point. If, then, the upward parts of the tensions of a main chain of a given curvature must be the same for both Mr. Dredge's and the old plan, it seems to follow that the strength of material must be at least as great in his plan as the other. And when we add to this the consideration that the obliquity of the chain necessitates an increased amount of the horizontal part of the strength of the chain, and also that the platform must be made stronger to resist the horizontal parts of the action of the oblique rods, it seems that we have two items to add to the account in estimating the requisite strength of material, which would not appear if the rods were supposed vertical.

We have thus, as well as we were able, stated what appeared the merits and defects of Mr. Dredge's plan. It were much to be regretted that any remarks here made should impede the introduction into general practice of the valuable part of the invention. We again repeat, that the diminution of the thickness of the main chain towards its centre is a most useful and philosophical method of reducing its necessary weight; but we must couple with our commendation the opinion that Mr. Dredge has carried this principle beyond its just limits.

One point more we have to allude to before quitting the subject. Mr. Dredge commences one of his letters by saying "I can perfectly understand why the alteration in my father's letter was made." This, if it mean anything, implies intentional dishonesty on the part of the editor. Surely so grave a charge ought not to have been made without some reason, however trifling, being alleged in confirmation. So severe an allegation might well provoke an angry retort; but a scientific journal is not the proper medium of expressing personal feeling, however justly it may have been aroused. The discourtesy is not only gratuitous, but excessively ungenerous: for, throughout the discussion, we have treated Mr. Dredge with every consideration—we have allowed him ample room and verge enough for the discussion of points of comparatively personal interest—we have publicly acknowledged his candour and readiness in supplying us with information—we refrained from any expression of opinion till compelled by the extraordinary nature of his doctrines—and we have the satisfaction of thinking that even in the present reply, himself will be unable to discern any traces of vindictive feeling.

RAILWAY RETAINING WALLS.

[The following extracts are taken from a valuable paper by Mr. Dempsey, just published among the papers on subjects connected with the duties of the corps of royal engineers. The author has honoured us by frequent quotations from the Civil Engineer and Architect's Journal, which, of course, are here omitted.]

The only cases in which artificial retaining walls appear desirable are those in which it is actually or nearly impossible to interfere with the surface, which would otherwise be required, in order to substitute cutting or embankment at the natural slope of the material of which they may be composed. Many instances are recorded of the failure of these structures, which has commonly resulted from the saturation and consequent swelling of the earth behind them; and these effects have occurred frequently despite the most judiciously selected forms and materials, and the best attainable system of back drainage. Indeed, unless the material be adapted to stand by itself, be thoroughly impervious to water, or so completely drained that very little reaches the back of the wall, it is certain that this uncontrollable agent will make its way through the work, and produce sooner or later the disastrous consequences which have already marred the designs of railway engineers.

As applicable to cuttings, artificial retaining walls, unless they can be constructed under the most favourable circumstances, are best secured by arches thrown between them, or by other intermediate resistances, which are required to act as abutments between the two walls, and prevent their forward movement towards each other. With this addition, it is evident that the structure becomes a bridge, or nearly assimilates to one, and is palpably inapplicable to very long walls, except at a tremendous cost.

As applied to the feet of embankments, where the material is of that cohesive but slippery nature that a simultaneous movement of the entire mass may be apprehended, low and strong retaining walls are useful, and present frequently a judicious expedient, though in many cases less advisable than piling or wattling. As protections against the sea, retaining walls to cover the lower or entire face of the embankment, the stability of the work; but in such and other cases, if any thing more than a mere breakwater or rude collection of heavy stones, the wall, sloping back to the embankment, becomes rather a facing of masonry than an independent construction, and contributes to the stability of the work only by its artificial cohesiveness and greater weight. Applied to the height of embankments formed to a steeper slope than that at which they would stand independently, retaining walls may be considered never advisable, and would be infinitely better abandoned for a cheap construction of viaduct.

When their adoption, however, becomes imperative, the stability of retaining walls will depend upon the nature of the soil behind them, and the means taken for its drainage; and upon the form of wall adopted, and the manner and materials of its construction.

The amount and kind of pressure of the earth against the wall which retains it are evidently affected by the angle of repose, or natural slope of the earth; also by the quantity of moisture it will imbibe, the proportion of this which it will retain, the extent to which its absorption of water will cause expansion of the mass, and by other circumstances.

The natural slopes of some kinds of earth have been observed experimentally, and are thus recorded:

1. Fine dry sand	35° 30′
2. Gravel (dry ?)	37°
3. Loose shingle, perfectly dry	39°
4. Common earth, pulverized and dry	46° 50′
5. ditto, slightly damp	54°
6. Earth, the most dense and compact	55°

Of these results, No. 1 is the mean of experiments recorded by Rondelet, Barlow, and Hope; No. 2 is on the authority of Lieut. Hope; No. 3 is recorded by General Pasley; Nos. 4 and 5 by Rondelet; and No. 6 by Barlow.

According to the specific gravity of these substances, it appears that the weight of the triangular section (one foot thick), which is bounded by the vertical back of a wall 10 feet high, a horizontal line level with the top of it, and the natural slope of the material, will be about as follows:

1. Sand	6800 lb.
2. Gravel	6350
3. Shingle	8600
4. Earth, dry,	4800
5. Ditto, damp	3700
6. Ditto, dense	3580

The mere weight of earth to be sustained thus appears to vary very widely according to its constitution and state of dryness or moisture; but this comparison of weights, forming only one element of the calculation, does not furnish any estimate of the actual resistance which the wall is required to exert. This will evidently be reduced by the cohesion of the moving mass, and by the friction between this mass and the natural slope of that portion which would remain stationary in the absence of the wall; but, on the other hand, it is increased in a great degree by the action of water within not only this moving mass, but also the otherwise quiescent mass beneath it.

In a state of perfect dryness, and disregarding the withholding effect of cohesion and friction, the maximum power required in the wall would be represented by the actual weight of the retained earth, supposing this weight to act against the vertical plane of the wall with the same force that it would exert upon a horizontal plane that supported it. And the power thus required in the wall might be immediately calculated for each section of its altitude; but the moment that water is introduced within the retained material, a multitude of other considerations arise, which no theory has yet furnished the means of estimating, and which require a series of experiments to enable us to predetermine with any chance of accuracy.

Upon the methods of draining retaining walls, reference may be made to the account of the Blisworth cutting, given in the second section of this paper; also to the description of the mode of repairing the walls of the London and Birmingham railway, contained in the seventh volume of the Professional Papers of the Corps of Royal Engineers.

Among the various considerations to be entertained in the designing of retaining walls, that of the influence of *season* should not be disregarded. A wall built during a dry season, or after a long drought, will incur an augmented pressure when the earth becomes saturated with water; and on the other hand, if built during a wet season, and backed up with wet earth, it will be subject to a shrinking away of this backing when subsequently drained. The engineer can provide against injury from these circumstances only by making the wall as far as possible self-supporting, so that any retiring of the earth behind shall not endanger its stability; and at the same time, offering every facility for the water to find its way through the wall, and for discharging it thence into the foundation drains. The most perfect wall would be that which should be throughout its whole surface completely permeable by water, so that no accumulation of that fluid could occur behind it, and which should yet effectually retain the particles of earth. Upon such a wall the effect of the earth would be reduced into that of its mere weight, and experiments would be needed only to determine the best arrangement of bricks and mortar, or other materials, for resisting this action.

As to the best and most economical *forms* for these walls, we are enabled to describe some which have been constructed, and have fulfilled the purpose of their construction, and we may also refer to the objections against some forms which have been suggested and adopted; but on this part of the subject experiments are also much wanted, and under this conviction, all must regret the premature loss of Lieut. Hope, whose skilful labours in this department promised so many valuable results to civil as to military engineering.

Of plane walls, five different forms have been constructed: first, having vertical faces; second, having one vertical and one inclined face, converging towards the top, and presenting either of these surfaces to the retained earth; third, having both faces inclined, and converging towards the top; fourth, having one vertical face, the other inclined and converging towards the bottom; fifth, having its faces inclined and parallel.

Each of these forms is sometimes varied, by curving the inclined lines: then, the second form will present a concave surface to the retained material, or otherwise a concave exterior surface; the third will have a concave surface; the fourth form will have a convex surface against the earth, and a plane vertical surface externally; and the fifth form will present a convex surface to the earth, and a concentric concave surface externally.

Of these forms, the first three are evidently adapted to stand alone; while the fourth and fifth will depend for their stability partly upon the outward thrust which the retained material will exert against them.

It is frequently found that the middle or upper part of a retaining wall fails first, and will be thrust some inches forward, while the lower part of the wall remains firm. This occurrence, which, considering the greater weight opposed to the lower part of the wall, cannot be attributed to the mere weight of the earth, is probably owing partly to the superior strata being less dense, and therefore more rapidly saturated with water than the lower strata. This would lead to the necessity of proving especially for the complete surface drainage of the retained district.

In other instances of defect, the whole wall is moved bodily forward, and sometimes with very little fracture. This was the case with a portion of the wall built on the line of the Birmingham, Bristol, and Thames Junction Railway, which, for a length of 40 or 50 yards, was pushed forward off the foundation, to a distance of 8 or 10 feet, the wall still standing. The failure was pronounced by Mr. Vignolles, who examined the works at the time, to have resulted from the accumulation of water, which, "having no outlet, had settled the earth against the back of the retaining wall, turning the clay into mud, and by the great additional weight forcing it into the position in which it then appeared."

There is no doubt that the ultimate stability of retaining walls is affected by the state of dryness of the masonry when the earth is filled in behind it; and also by the manner in which the filling in is conducted.

Reverting to the *forms* for retaining walls, it may be remarked that a preference has been shown towards the fifth, with some little modification. By railway engineers this form is usually reduced in thickness at the top, by steps on the inner face. The experiments made at Dublin, under the direction of Sir J. Burgoyne and the Board of Public Works of Ireland, are quoted by Mr. Vignoles as fully proving that the "parallel battering-wall" is the one which offers the most support, with the least quantity of material. And one of the results deducible from the experiments instituted by the late Lieut. Hope, at Chatham, is in favour of the "leaning wall with counterforts." Lieut. Hope "conceived that the face of the revetment might be a mere shell, hardly exposed to any pressure, the earth being chiefly supported by its friction against the sides of thin but frequent counterforts."

"These results cannot, however, be admitted as conclusive against the several other forms which have been, in some instances, adopted. Thus the second form appears well adapted for stability, and has the advantage of an enlarged section below, and a reduced one above, from the same amount of materials as No. 5. Again, the third form appears to be very strong, and well adapted to escape injury from any extra pressure resulting from the absorption of water by the retained bank.

"But it must be observed of the first, second, and third sections, that the inner face of all of them departs more widely from the natural slope of the earth, and therefore sustains a greater pressure than the inner face of section No. 5. Section No. 1 is evidently inferior, by reason of its uniform thickness, which must be either excessive at the upper, or deficient at the lower part of the wall. The defect of uniform thickness is parly compensated in No. 5 by its inclined position, which gives it a tendency to fall back upon the earth, and thus resist its pressure.

"The value of this fifth form of retaining wall appears to arise from the line of direction being thrown beyond the centre of the base, thus giving a preponderating weight within this line, the effect of which weight increases in proportion to the height of the wall and its divergence from the perpendicular. The angle of this divergence remaining the same, the height may be supposed to be reduced till the line of direction falls within the base, and the active weight of the wall becomes reduced to nothing; or, on the other hand, the height may be supposed to be increased until this active weight shall equal any pressure of the retained earth. And this consideration will, perhaps, partly account for some of those instances of movement in the *middle* or *upper part* of retaining walls thus formed, which are well known in practice, and which we have already had occasion to notice. In these cases we may imagine, that unless the construction of the wall is such as to insure a superior cohesion among its parts, the upper part of the wall will have a tendency to fall backward, while the lower part (of which the line of direction falls within its base) will have no such tendency. The upper part, obeying this tendency, becomes dislocated from the lower, and will be forced forward by the pressure beyond it.

"The great importance, in works of this class, of judicious construction, not only in design, but also in practical execution, will justify the introduction of a few hints upon brick-work and bonding generally, especially as in all considerations upon those works we have to assume the perfect cohesion and entire rigidity of their parts; and our conclusions will, therefore, be more fallacious in proportion as these conditions are neglected and non-realized in practice.

"In the first place, the arrangements of the bricks should be that known as English bond; viz., one course of headers and one of stretchers alternately. The bonding of the plain part of the wall should be secured by introducing a half brick for every alternate outside header on both sides of the wall, so as to connect the outside headers with the bricks in the interior of the same course. At every fourth course, or thereabouts, three or four bands of iron hooping, laid parallel, and bedded in the joints, assist the bond. At each returning wall or counterfort, quarter bricks are required, in order to avoid straight joints on the face of the wall, and preserve the bonding at these angles. In all battering walls it is especially necessary to insist upon narrow joints perfectly filled with mortar, and truly pointed. This is the only means of guarding against, or rather deferring, that penetration by wet and frost which is so detrimental to the stability of the work. The bricks, too, should be thoroughly wetted before and during the setting, so as to detect any injurious quantity of limestone which may exist within them, and also to cleanse them and render the mortar thoroughly adhesive. In all cases the work should be brought forward simultaneously, or as nearly so as possible, throughout the whole length in hand, otherwise the shrinkage which invariably occurs will be unequal, and produce internal dislocations of the wall, which will accelerate, if not produce, ultimate failure. Similarly, all counterforts must be erected along with the wall itself, for all subsequent connections of these parts will be necessarily imperfect.

"The concrete and lower courses of brick-work or footings should be deeply notched into the solid ground on the inner side of the wall. If this be carefully observed, and all spaces in the excavation or trench cut for putting in the foundations be well rammed, no movement of the foundations can take place without it be actually lifted to the extent of its entire depth, or without crushing the solid ground before it. In a similar manner, all the courses of brick-work should have a dip downwards from the outside face of the wall, and, in short, every possible means be adapted of connecting the entire mass of wall and foundations indissolubly together.

"All reductions in thickness should be made in steps, keeping the intermediate sections of the wall parallel; for if any attempt be made to reduce by tapering lines, the restriction to proper sized bricks and parts of bricks is necessarily disregarded: bats, and pieces of every variety, size, and shape, are thrust in, so as to preserve the outside lines only; and good bonding and narrow joints are alike unheeded. And this ms a great practical superiority of the fifth form of wall over the second, third, and fourth. The fourth section, indeed, is otherwise so objectionable, that it can be selected only under the absolute necessity of preserving a vertical face, and a back inclined towards the natural slope of the retained earth.

"A practical rule for a section of retaining wall which has in many cases proved sufficient, and has yet been deemed economical, is as follows:—let the batter equal one-sixth of the vertical height of the wall; the thickness of wall at the bottom equal one-fifth of this height, and the thickness at top one-tenth the height, or one-half the thickness at bottom: and for the reducing of the thickness, divide the entire height into as many equal parts, plus one, as there are half bricks in the difference between top and bottom thickness. Thus a wall 30 feet high will batter 5 feet, be 6 foot thick at bottom, 3 feet at top, and be divided into nine different thicknesses, each $4\frac{1}{2}$ inches less than the lower adjoining one, and each 3 feet 4 inches in height, measured vertically. Under ordinary circumstances, however, economy of material may perhaps be effected, or greater stability be secured, by reducing this thickness, and introducing small counterforts at frequent intervals."

Average Items of the Construction of a Mile Railway.

"The average quantities, per mile, of the several items which are involved in the formation of a double line of railway, of the 4 ft. $8\frac{1}{2}$ in. gauge, up to the completion of the permanent way, and exclusive of the stations and buildings, and locomotive and carrying stock, may be computed as follows:—

"The quantity of excavations in 342 miles of double line of railway (comprised in ten railways) amounted to 35,338,000 cubic yards, giving an average of about 103,330 yards per mile, or 58·71 cubic yards of earthwork for each yard forward of the line. Assuming the width of the formation level to be 10 yards, or 30 feet (which is about the average), with an additional width of 5 yards on each side, for ditches, hedges, &c., the slopes at $1\frac{1}{2}$ base to 1 of height.—and also assuming the whole line to be, either in cutting or embankment, of an average depth of height of 11 feet,—we shall require 56·73 cubic yards of earth-work per yard forward of the line. This is sufficiently near to the actual average of 58·71 yards to answer the purpose of this general calculation. The average width of land required will thus be

$$\underset{\text{Central width}}{30} + \underbrace{16{\cdot}5 + 16{\cdot}5}_{\text{Base of Slopes.}} + \underbrace{15 + 15}_{\text{Ditches, \&c.}} = 93 \text{ feet, or } 31 \text{ yards,}$$

which will give about $11\frac{1}{4}$ acres of land per mile. Allowing for severance, &c.. this may be assumed at 12 acre.

"The quantity of ballasting 30 feet wide, and 18 inches thick, will equal 5 cubic yards per yard forward, or 8800 cubic yards per mile.

"The sleepers, transverse, 8 feet long, and 10 inches by 5 inches, placed 2 feet 6 inches apart, will require 11,733 cubic feet, or 235 loads of timber; or 4224 sleepers per mile.

"The chairs required, supposing the rails to be rolled in lengths of 15 feet each, will be 1408 joint chairs, and 7040 intermediate; and their weight, reckoning each joint chair at 20 lbs., and each intermediate chair at 15 lb., will be 12 tons 11 cwt. 1 qr. 20 lb., and 47 tons 2 cwt. 3qrs. 12 lb., respectively, or 59 tons 14 cwt. 1 qr. 4 lbs. together.

"The rails, assuming the weight at 56 lb. per yard, will weigh 176 tons,—1408 lengths being required.

"If two oak trenails and two iron spikes be required for each chair, 16,896 of each will be wanted per mile, with 8448 wooden keys for fixing the rails in the chairs.

"If felt be interposed between the chairs and sleepers, and the former be assumed at 10×5 inches bearing surface, 2933 square feet of felt will be required per mile.

"The timber in the side fences, formed of posts 8 feet long, 6×4 inches, 9 feet apart, with four rails $5 \times 2\frac{1}{2}$ inches, and intermediate upright stay 3×2 inches, will cousume as follows: 1174 posts = 1565 cubic feet; 4696 fails = 3666 cubic feet; 1174 stays = 269 cubic feet; or a total of 110 load.

"Of the masonry, timber, iron, &c., &c., in bridges, viaducts, culverts, drains, retaining walls, &c., scarcely any estimate can be formed. Taking the average of a few cases, the masonry would appear to amount to about 110,000 cubic feet per mile; but in some cases from 30 to 50 per cent. of this quantity is substituted by timber and iron."

Railways made of wood were first used in Northumberland about the year 1633, and made of iron at Whitehaven in 1738. The first iron railroad was laid down at Colbrook-dale in 1786. Steam power to convey coals on a railway was first employed ky Blenkinsop, at Hunslet, near Leeds, and afterwards on the Stockton and Darlington Railway.

The draught of water of the respective brigs composing the Experimental Squadron no their arrival at Plymouth Sound, Dec. 6, 1844:—

	Forward.		Aft.	
Osprey	11 ft.	8 in.	15 ft.	0 in.
Flying Fish	13	0	14	7
Espiegle	12	6	14	8
Mutine	12	2	13	10
Daring	11	$8\frac{1}{2}$	16	7
Cruizer	12	2	14	6
Waterwitch	10	3	14	9
Pantaloon	11	6	13	5

EXPERIMENTS ON THE STRENGTH OF CAST IRON GIRDERS.

In a paper read by Mr. Redman, at the Institution of Civil Engineers, an account was given of some experiments on the strength of the girders which support the platform of the Terrace Pier, Gravesend. We cannot avail ourselves of the whole of Mr. Redman's paper, as the subject has been already noticed in this Journal. The following particulars will however be acceptable.

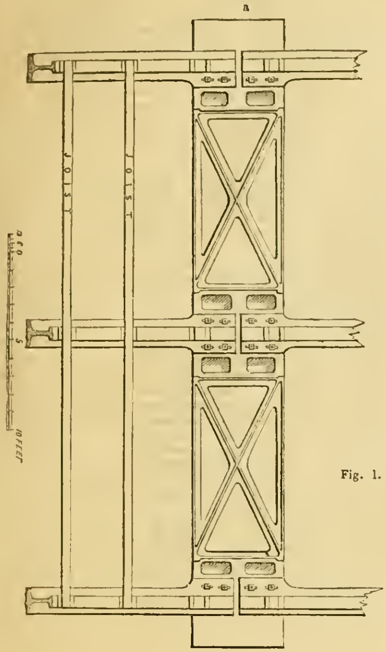


Fig. 1.

Cross braces.

The columns of the pier are held together at their tops by means of cast-iron cross-bracing frames, fitted between the caps and bolted to them (fig. 1); they were provided with a projecting clip at each angle, to support them while fitting, before the bolts were placed in.

A B represents one of these braces at right angles to the length of the platform. The columns supporting the platform are arranged three by three, consequently the brace is attached in three places—its centre and two ends. The figure also shows truncated portions of the longitudinal girders (A, B C,) and some of the cross joists of the platform.

The three girders which support the platform over the esplanade, from the abutments to the first tier of columns, and those of the T head of the pier are cast to one section (fig. 2); the nine girders forming the three main openings are also of one section (fig. 3); six of them are 54 ft. 9 in. long, and the three next the T head are 55 ft. 9 in. long; they are all of a parallel

Fig. 2.

Section of the abutment girders.

Fig. 3.

Section of long girders.

depth and breadth top and bottom, and the long girders are cambered 1$\frac{3}{4}$ inch in their length; they are all provided with projections on the top flanch to receive the joists. The weight of these girders is very materially reduced, by making the sectional area of the ends about one-half of that at the centre (figs. 2 and 3). The smaller girders were proved to 20 tons on the centre, with which they deflected, on an average, $\frac{7}{32}$ inch, and the large girders were proved to 45 tons on the middle. Their deflection averaged 1$\frac{13}{32}$ inch, and the results, as shown by the table of experiments were very regular. The section at the end of the abutment girders is marked *a*, the section at the centre *b*; *c* is the section at the end of one of the top girders, and *d* the section at its centre.

The girders are secured from lateral twist and vibration by wrought-iron ties, 2 inches diameter, with clip ends, embracing the top flanches of the outer girders, and keyed to them; they are screwed up to a casting fitted and keyed upon the centre girder. These ties are fixed over the centres of the main spans; the abutment girders and those of the T head on the N.E., S.E., N.W., and S.W. sides (which are most exposed) are secured in a similar manner, the ties being, however, shorter, and accured to the joists which form the tie.

To test the quality of the iron, bars 1 inch square and 3 feet 3 inches long, were cast horizontally from the ladles from which the castings were run, and were broken across with a bearing of 3 feet. The average breaking weight, of sixteen experiments, was 782 lb.; the highest result was 896 lb., and the lowest 672 lb.; in this latter case the bar was barely of the prescribed size, and two small air-holes appeared in the fracture. The other cases that yielded the least amount of resistance were also, generally, barely of the proper dimensions, or there were air vacuities. In most cases, where air-bubbles occurred, the bars did not break at the centre, but they discovered the faulty place nearest to the centre, in some cases as much as 2 inches from it.

Table of Experimental Tests of the Strength of the Cast Iron Girders, showing the deflections at their centres in inches.

ABUTMENT and T-HEAD GIRDERS.

Weight in Tons.	No. 2, Abutment Girders.	No. 1, Abutment and No. 1 T head Cantilever.	T-head E. and W. Girders.	T-head S.E.&S.W. Girders.	No. 2 T-head Cantilever.	No. 2 T head Cantilever.	Average of all.
5	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{3}{32}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{1}{16}$
10	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{8}\ \frac{1}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}\ \frac{1}{32}$	$\frac{1}{8}$
15	$\frac{1}{8}\ \frac{1}{32}$	$\frac{3}{16}$	$\frac{3}{16}\ \frac{1}{32}$	$\frac{1}{8}\ \frac{1}{32}$	$\frac{3}{16}$	$\frac{3}{16}\ \frac{1}{32}$	$\frac{3}{16}$
20	$\frac{3}{16}\ \frac{1}{32}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}\ \frac{1}{32}$
Bearing	22 feet	22 teet	25 feet	21 feet	21 feet	21 feet	22 feet

LONG GIRDERS.

Weight in Tons.	No. 2 Girders 54' 9" long.	No. 2. 54' 9".	No. 2. 55' 9".	No. 2. 54' 9".	No. 2. 54' 9" and 55' 9".	Average of all.
5	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{16}$
10	$\frac{3}{16}$	$\frac{3}{16}\ \frac{1}{32}$	$\frac{3}{16}$	$\frac{3}{16}\ \frac{1}{32}$	$\frac{1}{4}\ \frac{1}{2}$	$\frac{3}{16}\ \frac{1}{32}$
15	$\frac{5}{16}$	$\frac{5}{16}\ \frac{1}{32}$	$\frac{3}{8}\ \frac{1}{32}$	$\frac{3}{8}\ \frac{1}{32}$	$\frac{3}{8}\ \frac{1}{16}$	$\frac{3}{8}$
20	$\frac{7}{16}\ \frac{1}{32}$	$\frac{1}{2}\ \frac{1}{32}$	$\frac{1}{2}\ \frac{1}{32}$	$\frac{1}{2}\ \frac{1}{16}$	$\frac{5}{8}$	$\frac{1}{2}\ \frac{1}{32}$
25	$\frac{5}{8}\ \frac{1}{32}$	$\frac{5}{8}\ \frac{1}{16}$	$\frac{5}{8}\ \frac{3}{32}$	$\frac{3}{4}$	$\frac{3}{4}\ \frac{3}{32}$	$\frac{5}{8}\ \frac{1}{16}$
30	$\frac{3}{4}\ \frac{1}{32}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}\ \frac{3}{32}$	$\frac{7}{8}$
35	$1\frac{1}{16}$	$1\frac{3}{32}$	$1\frac{3}{32}$	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{1}{16}$
40	$1\frac{1}{4}$	$1\frac{1}{4}\ \frac{1}{32}$	$1\frac{1}{4}\ \frac{3}{32}$	$1\frac{1}{4}\ \frac{1}{32}$	$1\frac{5}{16}$	$1\frac{1}{4}\ \frac{1}{32}$
45	$1\frac{3}{8}$	$1\frac{3}{8}\ \frac{1}{16}$	$1\frac{3}{8}\ \frac{1}{16}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{3}{8}\ \frac{1}{32}$
50	..	$1\frac{5}{8}\ \frac{1}{32}$	..	..	..	..
Bearing	50 feet	46 feet	50 feet	50 feet	50 feet	49·2 ft.

After reading the paper referred to, Mr. Redman added that with respect to the form and the dimensions of the cast iron girders, he would not in future, for several reasons, reduce the thickness to such an extent towards the extremities. The parallel form had been adopted, on account of the greater facility afforded for attaching the entablature and the platform, but the beams (which were of great length) twisted much in cooling, in consequence of the inequality of thickness of the metal, and this gave some trouble in fixing them. The girders had returned to their original camber after the removal of the strain, applied in testing them. He had not observed that there was any perceptible deflection from their own weight, before the strain was applied.

Mr. J. R. McClean said, in allusion to the length of the cast iron girders, the longest beams that had been executed in Staffordshire were those for the bridge on the Tame Valley Canal; they were designed by Messrs. Walker and Burges, and were cast at the Horseley Iron Works.

The dimensions of the girders of the bridge at Perry Bar, and of the Towing Path Bridge at the junction of the Birmingham and Fazeley Canal, were—

	Perry Bar. Ft. In.	Towing Path. Ft. In.
Extreme length	60 0	80 8
Between the bearings	55 0	75 0
Depth at centre	2 3½	1 8
Width of bottom flanch	1 0	1 0
Thickness of ditto	0 3½	0 2¾
Ditto of body of girder	0 1½	0 2
Width of top flanch	0 6	3 7½
Thickness of ditto	0 2½	0 1¾

Mr. Redman has subsequently communicated to the Secretary of the Institution of Civil Engineers a letter from Mr. Fairbairn, in which be says,—

"Since the receipt of your note of the 13th instant, I have gone into the calculations of the strengths of the girders composing the Gravesend Terrace Pier, and find them as under:—

Breaking weight of the large bearers, 50 feet span .. 81½ tons.
Breaking weight of the small bearers, 22 feet span .. 35 tons.

"I have computed these weights, on the assumption, that I am correct in the distances between the supports, and that the other parts of the section are a proportional of the middle, which I find to be nearly the case. You may therefore consider the whole perfectly secure if not loaded beyond 80 tons in the one case, and 30 tons in the other, equally distributed over the surface or whole length of the bearers."

IMPROVEMENT OF THE PAUMBAN CHANNEL.

Between India and Ceylon.

There is scarcely any more gratifying proof of the triumphs of modern engineering and practical science than the facilities which have within these few years attained in the communication between this country and India. The engineering operations recently undertaken at the instance of the Indian government, for widening and improving the passage between Ceyloo and the main continent of India, form an important part of the efforts made for shortening the travelling distance from England to Calcutta and Madras. The following account of these operations is taken from the "Foreign Quarterly Review." The effect produced gains additional value from the fact, that the voyage round Ceylon is almost always delayed by strong opposing currents. The distance saved by the improvement of the Paumban Channel is nearly 3,000 miles.

Before the survey of the Chagos Archiepclago had been completed, the government of Madras made an application to that of Bombay, for a surveying party to examine the Gulf of Menaar. The idea of this undertaking originated with General Monteith, chief of the Madras engineers, who, having been wrecked on the shores of this gulf in 1809, had from that time forward felt the strongest possible desire to see its coasts, and shoals, and sunken rocks, examined and laid down, in order, as far as possible, to diminish the obstructions to navigation. In consequence, Lieutenant Powell was ordered to detach himself from Captain Moresby, and with Lieutenant Ethersey under his orders, to undertake this service. At the same time a party of Madras engineers was engaged, under the direction of General, then Colonel Monteith, in cutting a navigable channel through two formidable ledges of rock, extending from the island of Ramisseram to the coast of Madura, on the continent of India.

The passage through these rocks, while they remained in their natural state, had a depth of at most six or seven feet, while on the great horseshoe sand bank, a little to the south, there was scarcely a depth of five feet at high water. Notwithstanding these obstacles, however, numerous small craft engaged in the coasting trade had long made use of the channel, though always compelled to land a portion of their cargoes on entering the strait. The object of the Madras government was to widen and deepen the passage, so as to obtain a sufficient depth of water for vessels of moderate burthen, and for the steamers from the Red Sea to Calcutta, when they should be established.

In order fully to comprehend the value of the works projected by the Madras government, certain facts, not perhaps generally known, must be borne in mind. Up to the year 1837, when General Monteith commenced his enterprise, all vessels beyond the smallest class were compelled, in passing from one side of the Indian peninsula to the other, to beat round the Island of Ceylon, sometimes in the teeth of heavy and contrary winds, and always against currents more or less powerful. The addition thus made to their voyage consisted under the most favourable circumstances of at least 2000 miles; but as it was often necessary to run down ten degrees of latitude before they could open the Bay of Bengal, they had to sail full 3500 miles ere they recovered their proper course. The craft exposed to this inconvenience and loss of time were engaged in conveying the produce of Malabar, Travancore, and other fertile provinces, to Madras.

It is easy to perceive how very materially such a state of things tended to enhance prices on the coast of Coromandel. Fewer persons would engage in the trade because of the dangers to be apprehended in rounding Ceylon; while the mere length of the voyage, by multiplying the wages of crews, and the interest of capital, necessarily raised the prices of commodities. Its general effect, however, was to confine the coasting trade chiefly to small vessels, which by the slow and laborious process of lightening themselves, by landing a portion of their cargoes during the passage of the Strait, and afterwards re-shipping it, could reach their point of destination through the Gulf of Manaar and the Paumban passage.

It is well known that the dangers and difficulties of the Faro of Messina have called forth on that point of Sicily the energies of a hardy race of pilots, who subsist by the inhospitable character of their coast. Something similar has taken place in the little island of Ramisseram, where the village of Paumban owes existence to the intricacy and shallowness of the neighbouring channel. Circumstances, it will readily be perceived, may occur which would render the impractibility of this route a public calamity. Of this, an occurrence which took place in 1839, may be regarded as a proof. The "Enterprise," a well-built and powerful steamer, bound, with treasure and arms, for Sinde, during the war in Affghanistan, was completely beaten back and detained for weeks by the force of the south-west monsoon, while numbers of coasting vessels were passing and repassing daily through the Paumban Channel, completely under the shelter of land. From the detention of the "Enterprise," no particular evil, as it happened, arose; but had the fate of India depended on her progress, she could not have overcome the resistance of the weather.

The attention of government was directed to this subject as far back as 1828, when some efforts were made towards removing the principal obstacles to the navigation of the Paumban passage. For reasons which are not stated, these labours were discontinued, and not again resumed till 1837. In the February of that year, Colonel Monteith sailed from Madras with a party of sappers and about fifty convicts. His journal of proceedings, though too voluminous for publication, is, from its very minuteness, highly interesting. He describes, with soldier-like simplicity, the aspect of things at his arrival, which was sufficiently unpromising. An immense congeries of rocks, many of them rising to the surface of the waves, at high water, the small and venturous craft of the country steered, as we have seen, their tortuous, if not dangerous, course. Through the politeness of General Monteith, a section of the rock is now lying before us, together with a plan of the canal through the reefs.

The geological structure of the strait is curious. First, commencing at the north, we have coral and limestone, to which succeeds shingle, mixed with granite boulders, but not loose. Having passed these, we come upon a breadth of blue soft sandstone, mixed with lime and madrepore. Then follows the great northern reef, composed of hard red sandstone, and extending east and west almost in a right line. Having traversed this, we reach a broad belt of broken sandstone, interspersed with boulders of other substances, and then come upon the southern reef, consisting, like the former, with which it runs parallel, of hard red sandstone. A bed of the same rock, but less indurated, then stretches southwards to the site of the great sand bank.

It is not very surprising that persons taking only a cursory view of this formidable mass of obstacles, should have pronounced it insurmountable, and been disposed to turn into ridicule the sanguine colonel of engineers who was about to encounter them. Nor ought we, perhaps, to wonder that the Court of Directors at home should, at first, have put little faith in the success of the enterprize, and felt no way disposed to sink a large sum of money among the submerged sandstone, shingle, and boulders, we have above described. But Colonel Monteith was all along perfectly confident. He maintained that, if the requisite means were placed at his disposal, he could cut through the interposing reefs a channel of fourteen feet at low, and sixteen at high water, and at the same time of sufficient breadth to allow of its being safely navigated at all seasons. He located his gangs of convicts on the Island of Ramisseram, where he likewise erected barracks for the troops. A large diving bell, five tons in weight, was sent him from Ceylon: he purchased or constructed various catamarans, and with the least possible delay commenced operations.

Perhaps the most laborious work was removing the huge fragments of rock when they had been detached. This was effected by raising and swinging them to the sides of the catamarans, or large boats, by which they were carried away and dropped into the sea, with the view of forming a sort of breakwater on either side of the channel. Sometimes the explosion under water took place before the men could get out of the way, and on one occasion a large catamaran was overturned with six persons upon it. Another time, when the fuse had been twenty two minutes without exploding, a diver was sent down to withdraw the powder, but found the fuse burning fiercely, and had scarcely effected his escape before immense fragments of rock were projected above water, and scattered with tremendous force on all sides.

During the whole period in which operations were carried on, however, few casualties occurred, while the deaths from sickness were scarcely greater than they would have been in any ordinary service. This must have been chiefly owing to the excellent system of management pursued by General Monteith, who treated all those under his care with remarkable humanity. At first, many unnecessary difficulties were added to those offered by the nature of the ground; but these were at length removed, and a powerful steam-dredge was sent out from England, which cleared away the loose rock at the rate of about 2000 cubit feet per day. Nevertheless, the channel has not yet been excavated to the depth required, having only ten feet at low, and twelve feet at high water, with a breadth varying from 90 to 150 yards. Its edges are carefully marked throughout by buoys. It may with truth be said, however, that the undertaking has proved successful, since not only do all the country craft use the channel, but the Calcutta steamers also. The "Nemesis" and the "Pluto," on their return from China, came this way, and thus in coal, &c. effected a saving of 400*l.* sterling. But, perhaps, the most striking illustration of the value of the Paumbao, or, as we should rather call it, the Monteith Channel, is supplied by the fact that whereas, before the works were undertaken, the amount of tonnage that traversed the strait was from 20,000 to 23,000 tuns a year, it has now increased to upwards of 100,000 tuns in the same period, or four times the amount of what it was before.

CARROW RAILWAY BRIDGE.

This massive structure is fast approaching to completion, and in the space of about another week, Yarmouth and London will be connected by one continuous line of railway. This bridge presents rather a novelty in railway engineering—it being the first swing-bridge which has been thrown over a river to serve the purpose for which drawbridges were formerly used. It is made entirely of cast iron, and is supported upon a pier composed of 16 piles, sunk in the bed of the river. The roadway is 106 feet long, and projects at an equal distance on each side of the pier. The whole weight of the bridge rests on a bed plate, which weighs 20 tons, and from this plate is suspended by 8 rods another plate, the object of which is to carry the centre for the spindle. The spindle works in a water-tight casing. On the top of the bed-plate is the roller frame, which consists of 8 wheels; and so easily managed is this immense carriage way, which projects 53 feet on each side of the pier, and weighs upwards of 160 tons, that by the machinery attached to the pier, the "girders," or, to speak less technically, the whole bridge can be moved in the space of one minute, by a single man. There is a peculiarity in the construction of this bridge which distinguishes it from others on the same principle, which consists in the weight not being supported, as in the old bridges, by the rollers alone, but resting partly on the spindle, and partly on the rollers. The carriage way is 10 feet 6 inches broad. The approaches on both sides of the river are 20 feet long, and they rest on 3 rows of 4 piles each, which are graduated to a level with the line. These piles vary from 2 to 3 tons in weight; and some idea may be formed of the immense quantity of iron used, when it is stated that there are 24 of these piles supporting the approaches, 16 forming the pier, and 10 cut water piles. There are upwards of 260 tons weight of cast iron altogether in this bridge. On the top of the bridge two beautifully constructed lamp-posts are erected, which will display red or green lamps, according to the position of the "girders." If the girders are swung across for the trains to pass over, the green light will be used; but if the connection is taken away, a red lamp will intimate that circumstance. The pier on which the bridge rests is 16 feet in diameter, and is about 20 feet from one bank. The water-way which is thus given is 45 feet 6 inches, and it will always be kept open for the navigation, unless when it may be necessary to swing round the girders for the passage of the trains. We understand that it is also contemplated to construct a basin close to the bridge for the landing of goods, which we have no doubt will be hailed with considerable satisfaction by those for whose use it is intended. It is expected that the works in connection with the bridge will be completed next week.—*Norfolk News.*

CODE OF INSTRUCTIONS FOR SURVEYORS,

Deduced from the Standing Orders, &c., adopted for general Utility in preparing the Plans and Sections of Proposed Railway for Parliamentary Deposit.

The plan must be upon a scale of at least 4 inches to a mile, and must describe the line or situation of the whole of the proposed work, and the lands in or through which the same will be made; and also any communication intended to be made with the proposed work.

The General Act enables the company to divert their Railway 100 yards on either side of the line shown on the deposited plans; excepting where the line passes through towns, or continuous houses, and then to the extent of 10 yards only; the limits of such deviation on each side of of the line of railway must be defined upon the plan, and the lands included within them must be shown.

It is not essential that the limit of deviation should always extend to 100 yards where circumstances (*e.g.* the existence of a farmstead, or turnpike-road, or a park), render it advisable to restrict the power to deviate within narrow limits. Upon this latter supposition, the line of deviation will be drawn so as to exclude the excepted property, and the lands beyond that line, although within 100 yards, need not be described or numbered.

If the plan is on a scale less than a quarter of an inch to every 100 feet, there must be an additional plan upon that scale (¼ inch 1000 feet) of any building, yard, court yard, or land, within the courtilage of any building, and of any ground, cultivated as a garden, included within the limits of deviation.

These enlarged plans are so frequent a source of error, as to render it usually expedient to draw the whole plan to the enlarged scale.

The plan is to exhibit thereon the distances, in miles and furlongs, from one of the termini; if the plan is not lithographed, the distances will be best marked in figures of red ink, to distinguish them from the figures of the fields, which will be in black ink.

A memorandum of the radius of every curve, not exceeding one mile in length, must be noted on the plans in chains where the curve occurs. Where a tunnel is intended to be constructed, it must be marked by a dotted line on the plan.

Each distinct property, divided by any visible boundary from another property, should have a separate number, with this exception, that any collection of buildings and grounds within the curtilage of a building belonging to one person, and in one occupation, may be described under one number—thus, "Farm house, yards, garden, barn, and sheds."

When it is necessary to interpose a number, a duplicate number should be added, thus, 8a 4a.

The numbering should commence in every parish. All lands included within the limits of deviation shown by lines drawn on the plan, and all lands which those lines touch, must be numbered and described if the limits of deviation are not defined, all the property shown on the plan must numbered and described.

Public roads should have a separate number, in each parish, where they appear on the plan. Private or occupation roads should have a separate number, if fenced off from adjoining land; so footpaths, if repaired by the parish, or if fenced off, should be numbered. Navigable streams, and mill streams, must be separately numbered.

The section must be drawn to the same horizontal scale as the plan, and to a vertical scale of not less than one inch to every 100 feet it must show the surface of the ground marked upon the plan, and traversed by the proposed line of railway.

It must exhibit by a line the intended level of the upper surface of the rails, and it must show an uniform datum horizontal line the same throughout the whole length of the work and its branches, and referred to a fixed point near one of the termini, and stated in writing on the section.

This fixed point should be some marked unvarying object, easily accessible to the public, *e. g.* a tide-mark, chiselled in a dock gate, the plinth of a pillar, or other public building.

The surface water level of a canal at a particular spot would not be good, because that level varies; the surface of a road, without stating the particular point, would also be bad for vagueness.

The distances from one of the termini must be marked along the datum line in miles and furlongs, to correspond with the distances marked on the plan. This rule afford a frequent test of inaccuracy.

A vertical measure from the datum line to the line of railways must be marked in feet and inches at each change of the gradient or inclination, and the proportion or rate of inclination between each and such change must also be marked.

Wherever the railway is intended to cross any turnpike road, public carriage road, navigable river, canal, or railway, is intended to form a junction with a railway, the distance of the surface of those objects from the upper surface of the rails must be marked in figures upon the section, at the point of crossing or contact; and even if the levels coincide, that fact should be stated upon the section.

Where a railway crosses a road or navigation, or is crossed by a bridge or viaduct, the height and span of each must be marked.

The extreme height of the surface of the railway over the surface of the ground must be marked in figures in the case of every embankment, however trifling—and likewise in every cutting the extreme depth of the railway below the surface of the ground must also be marked in figures.

If any alteration is intended to be made in the present level or rate of inclination of any turnpike road, carriage road, or railway, that alteration must be stated on the section; the road or railway must be numbered, and there must be a cross section (with a reference to that number,) on a horizontal scale of one inch to every 330 feet, and on a verticle scale of one inch to every 40 feet.

The cross section must show in figures, as well as by measurement, the present level and the intended level of the road.

Intended tunnels and viaducts must be marked in the section, and special care must be taken that the lengths of the tunnels on the plan and section agree.

A horizontal and vertical scale must be given on the plan and section

The scale and datum line, as well as the other foregoing requisites must be shown upon each plan for deposit with the parish clerks.

It must also be borne in mind, that, where the levels of any road is altered, the ascent of any turnpike road must not be more than one foot in 30 feet; and of any other public carriage road, not more than one foot in 20 feet.

The pattern plan and section annexed to the standing orders was drawn several years ago, and cannot now be considered as a safe guide alone, as the standing orders have since undergone much alteration.

A published map upon a scale of not less than half an inch to a mile, with the proposed line of railway laid down, must be deposited before the

1st of December at the Board of Trade.—*From the November number of the Railway Review, a new well-arranged magazine of information respecting Public Companies.*

NEW THEATRE AT LISBON.

The architecture of this great work is of a most creditable character. The building occupies one whole side of the most splendid square of Lisbon, commonly known by its ancient name of Rocio, and stretching along the heads of the three principal streets in the lower part of the city, usually called by the English "Gold-street," "Silver-street," and "Cloth-street." It is built on the site of the former Inquisition. In approaching the square from any of these streets, the theatre is seen to great advantage. It has received the appropriate name of the "Theatre of Donna Maria Segunda." Its *facade* is very attractive, and may be even described as magnificent. The entire building has the advantage of being constructed of the native Lioz stone, which, in fineness of texture and purity of colour, far exceeds even Portland stone, and very nearly approaches to marble. The building is of the Ionic order, constructed in accordance with Palladio-classic ideas, and is adorned with a fine portico of six handsome Ionic columns, crowned by a bold pediment, which is to be filled with a sculptured alto-relievo in marble representing Apollo surrounded by the Muses, and to be surmounted with an appropriate marble statue over each of the three angles. The columns of the portico are raised upon massive bases, and further thrown up by being placed over seven easily receding steps. In front of each exterior column rises a second basement, surmounted by a rich lamp, and two other lamps are thrown out with fine effect at the end of the side-steps ascending to the atrium. The extent of the building may be inferred from the fact that its front contains two rows of 17 windows each, surmounted by *bassi relievi* and upper semicircular windows. The windows at the sides are thrown into very rich and effective groups, to which a fine Ionic character has been cleverly imparted; and at the west end a covered arcade, extending to the length of five boldly-turned arches, and relieved by an elegant balustrade, affords to the visitors to the theatre the great advantage in wet weather of being set down and taken up in their carriages under complete cover. In this respect there is no theatre in London which can compete with the new Lisbon theatre. The entrance hall and staircase are likewise very commodious and elegant, most certainly not surpassed, and probably not equalled, by anything in Europe. The roof is supplied with what is termed in Portuguese a *terraca*, answering to the *azotea* of Andalusian and Buenos Ayrean houses, and presents a large space for cool promenading to enjoy the fresco of this southern climate. Great forethought and provision for universal convenience and comfort have evidently presided both over the design and its execution. The architect is Senhor Lodi, brother-in-law of the Count de Farrobo, and the work does him very great honour.

The theatre was commenced in the spring of 1843, and its cost is 50,000*l*. The rapidity and completeness of its execution, as well as the moderate cost for which so brilliant a work has been produced, do great credit to the Portuguese.

The interior of the theatre even exceeds its exterior splendour. Nothing could surpass the dazzling magnificence of the decorations, unless, perhaps, the pure taste and elegance which presided at their distribution. The house is about the size of Drury-lane Theatre, and internally of nearly the same form, the stage well up and forward, and the facilities for hearing perfect. It preserves its national character in this respect, that there are four tiers of boxes, with the royal box in the centre, occupying a portion of nearly three tiers, and surmounted by a rich crown, with an extensive gallery all over head. But the jealous old Portuguese, half-Moorish system of shutting up each box from the inspection of all its neighbours, has been happily replaced by the interposition merely of light arabesque columns of white and gold, which enables every one to see every one else in the theatre. The ceiling and chandelier are most superb, and the stalls are judiciously arranged in a single row all round the pit. The entire internal decoration is in white and gold, and the royal box is supported on each side by handsome caryatides.

DESTRUCTION OF THE SCREW PROPELLER OF THE GREAT BRITAIN STEAM VESSEL.

The Great Britain arrived at Liverpool, Oct. 4. During her passage she was partially disabled by the breaking of her propeller, and in consequence the principal portion of the passage was performed under sail. Some extracts from her log given below cannot fail to be interesting to the engineer. They seem to fully prove the capabilities of this important vessel as a sailer.

Oct. 18th.—Saturday noon went on sectional dock; found two arms gone close to the boss, and one blade; shifted the blade of our remaining arm to the opposite side, and secured the other blades; the rivets were nearly all loose; came off the dock.

22d.—Wednesday afternoon, commenced coaling immediately, and cargo next day.

26th.—All coals, near 1,000 tons, in by o'clock Sunday morning; cargo all in Monday night.

28th.—Started at 2 p.m. on Tuesday, with low steam, cut off at 13 in. ship in good trim. 18 ft. 8 inches, 17 ft. 6 in., and going well until 11 p.m. the 30th, when we found something wrong with the propeller, and striking the stern-post very hard; reversed the engines, and, after two or three good thumps, the arm broke off.

Went on with very low steam, cut off at 12 inches, steered by the sails; wind north-easterly; ship making very good way, seven to nine knots, until Friday, the 1st, about 3 p.m., when another of the arms of the propeller broke, leaving only one, I think the repairing one, and the half of another, with a small plate we had put on the end of it.

Wind hauled to the southward and south-westerly; made the most of our sails, and very fair way, just keeping the propeller from dragging, at times going 10 knots.

Nov. 3.—Wind fell to a calm on the evening of the 3rd, making 5 knots, and in the course of the night came a-head, a moderate breeze from the eastward, and little swell, ship making 3½ knots against it.

4th.—Have been economising water and provisions since we broke first arm off, and estimate we have at least 30 days, from to-day, of everything, without going on short allowance.

5th.—Very fine weather, with N.E. swell; wind veered round to the N.W. and squally, then to N.E. and easterly.

6th.—Made use of our sails, whenever there was a chance, within three points of her course; she feels them directly, and has, I think, very superior sailing qualities. Every appearance of westerly winds the last three days, but have been disappointed so far; yet we have made, under the circumstances, very good way indeed.

The propeller, or what is left of it, has done wonders, at times making four knots against a moderate easterly wind, and N.E. swell, rather high. Wind hauling from eastward to southward this morning, and, I think, looks well for a south-wester very soon; making 8½, close as she can lay, with fore and aft sails, reefed topsail and mainsail; this is good decidedly.

About a quarter past 5 the remaining arm of the propeller broke, leaving only a half-arm, and the small piece of another, about two feet from the centre.

Cut steam down as low as possible, going all night, with a fine southerly breeze.

8th.—At 1h. 20m. p.m., stopped the engines, with the half-arm vertical; moderate south-westerly winds; all sails we can carry set. Wind freshened gradually to a gale from the westward; reefed topsail, and off bonnets of spencers; sea rising fast; increased breezes to fresh gales, and hard squalls and high sea; mainsail, topsail, and one spencer set, ship scudding and steering beautifully, taking a spray on larboard-quarter and beam occasionally, but as easy, or easier, than any ship I ever knew.

10th.—Passed a large ship hove to with maintopsail and foresail; dirty rainy weather; dead lights all closed, scuttles, &c., well secured.

11th.—Wind moderating and hauling to the northward; made all sail on her; wind to the N.E. and E. Noon.—Saw two ships ahead, and came up with them, at the rate of two miles an hour, closs hauled. This is wonderful with our little spread of canvass, and more than I expected, well as I thought of her sailing qualities. Wind variable, and getting light.

12th.—Light breezes inclined to the N.W. again; a ship in sight that we are coming up with as fast as those yesterday.

13th.—A light breeze from the N.W.; increased to a moderate breeze and fine weather; a ship astern at daylight; ran her out of sight by noon. Wind fell light again in the evening.

14th.—A breeze sprang up from S.W.; made all sail; at noon increased to a gale; double-reefed topsail and off bonnets of spencers; dirty rainy weather, and sea rising fast; moderating, and hauling to the W.N.W. in the evening.

15th.—Moderate and cloudy; high N.W. swell; made all sail; 8h. 30m. lighted fires; increased to strong breezes, and squally, southerly, very thick, dirty, rainy weather.

16th.—Daylight; cleared off, and saw the mizen-head; a fine breeze all day; running 10 and 11 knots.

17th.—At 1h. 30m. passed the Tuskar; 11 off Holyhead; 1 p.m. off Point Lynas; 8 p.m. got a pilot and steam-tugs off N.W. light vessel; waiting for water.

Captain Hosken, the commander, had the gratification of receiving a most flattering address from the passengers, testifying the zeal and prudence with which he discharged his duties under the difficulties of the voyage. The following passages from the address amply confirm the opinion expressed in the log of the excellence of the Great Britain as a sailing vessel

"The Great Britain left New York on the 28th ult. with every prospect of making a good passage. It is true that on her outward trip she met with an accident to her propeller, which rendered important repairs necessary before leaving on her return to Liverpool; and these were done in a manner which was hoped to be efficient and substantial.

"Scarcely, however, had she been at sea 48 hours when an accident occurred similar to that which befel her on the previous passage—the loss of one of the arms of the propeller. Again, and when but a few days longer at sea, two more of the arms of the propeller were carried away, and the ship was now so far disabled that her commander deemed it prudent to discontinue the use of the engines, and to depend entirely for the remainder of the passage on the good qualities of his ship as a sailing vessel. Favourable weather soon gave us the opportunity of testing her ability in this character, and from what we then experienced we have no hesitation in saying that, in our opinion, her ability as a sailing vessel is not inferior to any ship afloat. We overtook several vessels at sea sailing the same course, all of which we passed. This fact we deem as the best evidence of her qualities as a sailing ship.

"On the 10th instant we experienced a very heavy gale from the north-west, which continued for nearly 24 hours, and we then had an excellent opportunity of judging of her strength and ability as a sea-boat. Far from encouraging any of the ill-founded prejudices against the Great Britain, she, on this occasion, strengthened our confidence, and won the admiration of all on board.

"Those of us who have experienced severe weather on the Atlantic cannot refrain from expressing the opinion of the superiority of the Great Britain in a heavy gale; and we venture to predict, that if she should ever encounter worse weather than she has already, she will sustain her character as one of the ablest triumphs of modern naval architecture.

"In conclusion, we take pleasure in making public the statement that we are well pleased with the Great Britain in every respect. For safety, speed, and comfort, she is, in our opinion, unsurpassed; and during this passage of unexpected length, we have not suffered the slightest diminution of comfort, and, in particular, our table has been as good and well supplied as if we had been only the usual period.

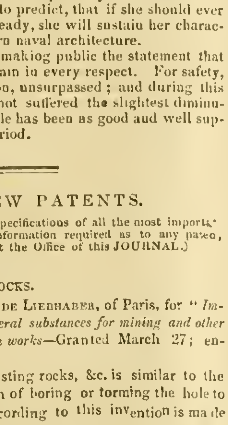
REGISTER OF NEW PATENTS.

(Under this head are given abstracts of the specifications of all the most important patents as they are enrolled. Any additional information required as to any patent, may be obtained by applying to Mr. LAXTON at the Office of this JOURNAL.)

BLASTING ROCKS.

William Joseph Conrad Marie, Baron de Liebhaber, of Paris, for "*Improvements in blasting rocks and other mineral substances for mining and other uses, and in apparatus to be used in such works*—Granted March 27; enrolle September 27, 1845.

This invention for improvements in blasting rocks, &c. is similar to the mode hitherto practised, with the exception of boring or forming the hole to contain the charge of powder, which, according to this invention is made larger at the bottom or lower end, in place of having the same perfectly cylindrical, as heretofore. The following is the mode of effecting the above object; let *a a* represent a hole bore in the ordinary means now in use, and to the required depth; then, in order to enlarge the size of the ole at the lower end, which the inventor effects by dissolving certain portions of the stone by means of muriatic acid, diluted with about three times its weight in water. A tube is to be inserted in the hole and sealed round at the lower end with some suitable composition, so as to prevent the froth or vapours from the acid passing between the outside of the tube and inside of the hole bored in the rock. Within his tube there is a smaller tube, through which the acid passes into the hole. These tubes are bent at the top, and terminate in a vessel containing the acid, and which vessel receives the froth that passes from the hole through the annular space formed by the two tubes. The inner tube is bent at the lower end, so as to prevent the froth passing through the same. This operation is continued until the hole is sufficiently large for the purpose intended; after which, the content of the hole are removed by means of a syphon, or pump, and the same, wel washed out and dried with tow, or other absorbent material, when it will be ready to receive the powder, which is discharged in the ordinary manner. It will be found necessary in some cases to employ other acids than muriatic, according to the nature of the rock to be dissolved.



MAKING TILES.

Richard Weller, of Capel, near Dorking, Berks., for "*Improvements in the manufacture of drain and other tiles and pipes.*—Granted March 27; Enrolled September 27, 1845.

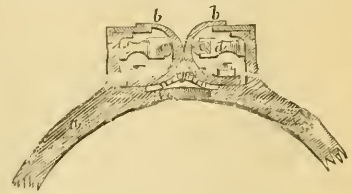
This invention is supposed to be for an improved machine for manufacturing bricks, tiles and pipes, which we have no doubt will be sufficiently understood by the following description. The machine in question consists of a frame mounted upon four wheels; this frame supports at each end two semicircular cylinders similar to a (◠) retort. Between the cylinders there is a rod, having a piston at each end, made to fit the cylinders; this rod is actuated by a lever and ratchet wheels, so as to force the piston alternately into one or other of the cylinders, the motion of the lever being similar to that of pumping or working a fire engine. The cylinders are mounted upon an axis, or trunions, so as to be capable of being moved from a horizontal to a vertical position. The object of this is that, during the operation of forcing or expressing the clay from one cylinder, which passes through dies, and which cylinder is in a horizontal position. The other cylinder may be placed in a vertical position, for the purpose of being re-filled with clay; and in this manner the cylinders are alternately filled with clay, which is forced, in the manner described, though suitably formed for the purpose of making bricks, tiles, or pipes.

ATMOSPHERIC RAILWAYS.

William Prosser, jun. of Pimlico, and Jacob Brett, of Hanover-square, for "*Improvements in railways, and propelling railway carriages.*"—Granted December 18, 1844; Enrolled June 18, 1845.

We have given two drawings of this invention, which, with the following description, will be sufficient for most of our readers to judge of its originality. Figs. 1 and 2 show sections of the valves and portions of the upper part of the tubes. The mode of propelling is the same as that proposed by Mr. Pinkus, in the specification of his last patent, as will be hereafter described. In fig. 1, *a a* shows a portion of the tube, or propelling

Fig. 1.



main *b* ar two pieces of leather, or other flexible material, bolted on each side of the opening in the pipe, which in this case, in place of being one continuous slit, or opening, consists of a number of round or oblong holes, with narrow stripes of metal between them. The object of this is to make stronger pipes with a less quantity of metal; the two pieces of leather, *b b*, are also secured at the upper edge to a projector attached to the pipe; *c c* are flexible rods of wood, which, by means of springs, *d d*, force the two pieces of flexible material together; *f* is a bent piece of iron, extending the whole length of the line of pipe. This piece of iron, which is intended to support the under-side of the flexible material, is perforated with a number of small holes, and is in appearance like a honey-comb. Fig. 2 shows another modification of fig. 1; the object of the inventors in this case being to propel two lines by one line of pipes, which is to be placed between the two lines of rails. The mode of propelling is by a hollow arm, flattened at one end, so as to pass freely between the flexible material, or lips, forming the valve. The other end of this hollow arm is connected with the eduction part of cylinders of an ordinary locomotive: thus, by exhausting the air in the main or traction pipe, a pressure will be exerted on the pistons of the locomotive, that will propel the same. The hollow arm is provided with a small roller, that runs upon the bent plate *f*.

Fig. 2.

The inventors propose to have a cylinder or reservoir attached to the locomotive, and connected with the cylinders of the same, the object of which is, that when the train is descending inclines, the pistons of the engine will at every stroke condense or force air into the reservoir, and thus act as a brea to the train. The air thus condensed is intended to be employed in moving the train out of the sidings, or from one line of rails to the other at the several stations.

WASHING AND MANGLING MACHINE.

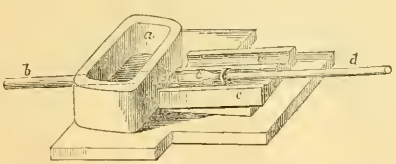
Samuel Wilkinson, of Balloon-street, Leeds, mechanic, for "*A certain machine, to be called a patent washing, wringing, and mangling machine.*" Granted April 17; enrolled October 14, 1845.

The novelty of this invention consists in combining the three machines in one, whereby a great saving in room and expense is effected. The washing machine consists of a semi-cylindrical box, in the centre of which there is a shaft supporting a frame consisting of a number of bars of wood, or suitable metal, such as brass. Motion is given to this frame, so as to cause it to vibrate backwards and forwards in the same cylindrical trough, by means of a handle keyed on the end of the shaft; the process is therefore effected by placing the clothes, with suitable washing liquor, within the trough, about equal quantities on each side; the vibrating frame thereof, which is to be worked to and fro until the clothes are sufficiently cleansed; after which, they may be wrung by passing them through the wringing and mangling machine, which consists of a pair of wood rollers, supported in a framing at the end of the washing machine, so that the clothes may be passed directly from the washing machine through the rollers for the purpose of wringing. In order to effect the mangling process, the top roller, which is weighted by an arrangement of levers, is capable of being raised from the lower by means of a cord attached to the weighting lever, and made to pass round an axis, upon which is a ratchet-wheel and fly-wheel, so that by turning the latter, the top roller may be raised from the bottom one, round which the clothes are to be folded by suitable mangling cloths. The top roller may then be lowered so as to press on the under one containing the clothes. Rotatory motion is then given to the rollers, by means of a handle, until the clothes are sufficiently mangled.

IMPROVEMENTS IN WATER PIPES.

Freeman Roe, of the Strand, engineer, for "*Improvements in the manufacture of pipes for conveying water and other fluids.*" Granted 22 April; Enrolled 22 October, 1845.

This invention consists of manufacturing pipes, for conveying water and other fluids, of glass, in place of iron, as heretofore. The invention proposes to prepare the glass by means of a hot air furnace, after which, it is to be manufactured into piping in the following manner. In the drawing annexed *a* shows a pot or cauldron, made of, or lined with clay or other suitable composition; *b* is a hollow iron mandrell, covered with baked clay, the diameter of which is to be somewhat smaller than the bore or calibre of the pipe intended to be made. This mandrell passes through a hole at the back side of the pot of the same diameter as the mandrell, and luted therein; the end of the mandrell also passes through a hole at the front side of the pot, and is supported in a suitable manner in the centre of such hole, so as to form an annular space through which the metal passes, as will be hereafter explained. *c c* is a hollow mould in two parts, attached to each other by means of a hinge joint, so as to be readily turned over, and thereby form a complete mould for the pipe when required; *d* is a hollow rod enlarged at the end *e*, so as to form an enlongated cup; behind this cup there is a circular projection or enlargment of the rod, which keeps the same in the centre, or proper place.



In making pipes according to this invention, the glass is to be put into the pot *a*, and an air hydrogen jet director either upon it, in the pot, or whilst issuing from the pot. The glass having been put in the pot, the enlarged end of the hollow rod *d*, which has previously been made hot, is inserted into the annular hole, when the glass which adheres to the end is drawn through such annular space by the aforesaid rod, which reserves, during the process of drawing, a rotary motion. During the operation above described, a current of air is directed through the hollow mandril and rod by suitable machinery. At the other end of the rod there is a stop-cock, or suitable valve, which, after the glass has been drawn into the mould, and the half *c'*, turned over to complete the same, the current is suddenly stopped by closing the valve, which has the effect of forcing the glass against the sides of the mould, and thereby forms the pipe, which is afterwards removed to the analising oven.

The specification, after showing a number of modes of joining the pipes by means of brass or iron cuplings, claims the manufacture of or from glass, or of or from the vitreous materials of which glass is or may be made, of pipes for conveying water or other fluids.

ARTIFICIAL FUEL.

Frederick Ransome, of Ipswich, engineer, for "*improvements in combining small coal and other matters, and in preserving wood.*"—Granted May 10; Enrolled November 10, 1845.

This invention consists in a method of using a solution of silica with small coal and wood, for the purpose of cementing them together, and in some cases for preserving wood. The solution of silica is made by dissolving 100 lb. of sub-carbonate of soda, known in commerce as soda, in so much water as will make the solution of the specific gravity 1·150 at a temperature of 60° Fah., the carbonate of soda is then rendered caustic by adding lime; or in place of carbonate of soda the inventor sometimes employs 50 lb. of carbonate of potash. This caustic alkaline solution is then put in an iron vessel with about 100 lb. of finely broken flints; the above mixture is then to be submitted to a temperature of about 300° Fah. for 10 or 12 hours, and well incorporated, after which it is to be passed through a sieve to free it from the grosser particles, and finally evaporated till the specific gravity is about 1·500 at a temperature of 60° Fah., after which the mixture is rendered fit for use either by adding finely ground flint or sand, or by adding water, depending upon the consistency required.

In cementing small coal, the inventor takes 100 parts of coal and from 10 to 20 parts of the above siliceous part or cement, and after mixing them together, the same are to be pressed into blocks of suitable size by hydrostatic or mechanical pressure, and afterwards dried ready for use. The inventor proposes to put one or more pieces of wood in the form of a case, into the moulds so as to form a hole or holes through the blocks to render the combustion of the same more perfect.

In cementing timber the inventor proposes to saturate or impregnate it with a solution of silica in such manner as to cement the fibrous part of the wood so as to form a solid and durable mass. For this purpose the timber is placed in a suitable vessel or receiver, from which the air is to be exhausted by means of pumps; the above solution of silica is then admitted, which will enter in a great measure the pores of the wood, but in order to do so more effectually, force pumps may be employed; after this process the timber is to be immersed in a solution of muriatic acid and water, which will render the same insoluble.

The inventor claims the use of the above solution for the purpose described; also the making of block of fuel with holes through them to render the combustion more perfect.

THE COMING DECISION—THE GOVERNMENT COMMISSION ON THE GAUGES.

We have abstained, on principle, from all interference with the progress of the investigations of the Royal Commission on the Gauges—we have abstained from all commentary on the evidence as it has proceeded—we have even abstained from publishing any extracts from, or abstracts of the evidence, although we have been made acquainted with the progress of that evidence from time to time. We do not mean now to anticipate the probable nature of the decision; we disclaim the slightest pretence to knowing what that decision may be. We are advocates of neither gauge, in the abstract, for we cannot see any mysterious or cabalistic power either in the numbers 84 or 57, which represent in inches the respective broad and narrow gauges. We are not sure that some intermediate number, such as 60, 72, or 75, might not prove more magical than either. Practically, we believe that an ill-conditioned, ill-managed line on the broad gauge would be about as much worse than a well-conditioned, well-managed line on the narrow gauge, as a good broad gauge line would be better than a bad narrow gauge. Practically, also, it does not appear, as far as we happen to know, that any broad gauge line has hitherto achieved much more than the narrow gauge line. The precise optimum gauge we presume, therefore, to be a subject on which it would be idle to theorise, and absurd to dogmatise.

There is one point, however, which it is entirely within our province to submit to the Commission, which it is indeed our duty to represent to them, and which it is not likely that, in the conflict of the opposing statements by mere partizans of either gauge, they have had fairly presented to them: a few words on this subject we take the liberty, with perfect deference, to place before them. We conceive it therefore to be most important to the public interests, we know it to be anxiously desired by the great railway interests of the country, that we should have a DECISIVE JUDGMENT on the case at issue:—not a rehearsal of balancing opinions, not a *rechauffage* of contending evidence, all of which we have already had the benefit(?) of, nearly *totidem verbis*, in the evidence on the rival gauge lines last session: what we do want is some plain practical decision which can be fairly and readily worked out by such means as are easily within reach. In short, the railway interest requires a decision, not a discussion, on the long-pending question of gauge.

Next, we want to know of you this: Do you think the broad gauge so much better than the narrow gauge, that we should take up all the narrow gauges and lay them down as broad gauges? If you do, don't be afraid to say so. Many railways have already taken up their rails and laid down new. The Liverpool and Manchester, for example; also the Great Western is now in the act of doing so, as all travellers know. If you think the broad gauge so much better, pray say so; and when, in a few years, there is a change in strength or kind of rails, and new ones are about to be laid down on any narrow gauge line, let it be then converted into a broad guage. Let us have this decision, if it be your honest opinion, and we now, and our successors after us, will thank you—certainly for your honesty and decision of character—possibly also for your wisdom and foresight. Thus, at least, your decision will tend to confer on us and future generations the great benefit of uniformity of system:—of a national gauge—which we think very important, and likely every day to become more important; and whether you take 84 inches or 57, we shall in either case be grateful for a decision.

But there is another alternative for the Commissioners. You may be of opinion that neither gauge has sufficient superiority over the other to render it desirable that either should be taken up for the purpose of national benefit. You may be of opinion that the broad gauge is better than the narrow, but neither better nor worse in a sufficiently high degree to justify the extreme measure of supplanting either by the other. This is a probable enough alternative.

Permit us to say that this has been suggested as a decision not only possible, but even probable. If this be your ultimate decision, we beg to point out the influence which that will have on our property. Suppose you to have decided that the Great Western line has advantages over the narrow;—suppose you to have thus decided, that the advantages of the broad gauge are so great over the narrow, as to countervail all the disadvantages and inconveniences of diversity of gauge—suppose this to be your decision, that we are to keep on two gauges, then we wish to call your attention to the enevitable consequences of your decision.

You have before you, in this event, the following practical alternatives. The first of these has, we hear, been proposed to you, viz., to tie up the guages each into a district of country—to give as the boundary of demarcation, which shall separate the broad gauge district from the narrow; and the contest, in that case, will merely be as to which line shall have a given district of country.

Now, we wish strongly to direct your attention to the practical effect of such a decision. We take leave to assure you that a theoretical scheme of tying up the broad gauge into any particular district, leaving all the rest to the narrow, would on such grounds be grievously unjust to the broad gauge—would be inevitably injurious to the public—would be, in the end, impracticable, and therefore foolish.

If the broad gauge be, as you shall decide, the better gauge; and if it be so much better that its superiority shall countervail all the evils of diversity of gauge; and if we are to have both; and if your opinion in this respect be adopted by the Legislature; then we beg to submit to you that all attempts to tie it up into any given district are not only wrong, but absurd and impossible. Having decided that the broad guage is so much the superior of the narrow, are you to say to the authors of such great national improvements, that they are not to enjoy its benefits over the whole country, wherever people wish to enjoy them? Is one gauge to be the better for Bristol and the other for Birmingham? Would you allow a man to take out his patent for some valuable invention and improvement, and then say his invention must only be used and sold in Cornwall, but should be contraband in every other country? Such legislation would be iniquitous—unworthy of a just nation—unjust in the highest degree to the broad-gauge party. Such a restriction, therefore, being wrong, could not possibly last.

Moreover, if you decide the broad-gauge to be the better, and so much better as in its excellence to overbalance all the disadvantage of diversity of gauge, then why is one part of England only to have the benefit of it? If you decide that we can travel faster, cheaper, safer by it, why should I, who reside in Manchester, who own works in Staffordshire—I who have manufactories at Leeds and coal mines at Newcastle—be debarred from the same benefit, in bringing my commodities to market, as the miner of Cornwall, the ironmaster of South Wales, and the merchant of Bristol. If, therefore, the broad gauge be thus much the better, I too am surely not to be shut out from repairing its advantages in my own district! To the general public, therefore, as well as the broad-gauge party, the proposition is unjust.

Suppose, however, on your recommendation, some imaginary boundary to be laid down, some theoretical line to be assumed, we will undertake that, in a very short time, the restriction will show itself impracticable and absurd. The broad gauge would in that case have an easy task to break through its restrictions. It will only be necessary for that party that it should fill its district with branches, occupy as expeditiously as possible every acre of that ground given over to it, and rapidly push orward numerous branches to every practicable point along its boundary, stopping short always at this imaginary line of the Commissioners—we say the broad gauge would only require to play this game well—(and who doubts their playing it capitally?)—to overwhelm the boundary by demonstrating its own great practical inexpediency, and enable it, like a giant, to break through the wretched cobwebs of a legislation so feeble and foolish.

We place, therefore, most respectfully, before the commission the inevitable effect of their decision on people and things out of doors. There are also two great questions now to be decided—the capabilities of the gauges, and the capacity of the commissioners. Their decision, if for the public interest, will reflect on them personal credit and enduring gratitude; if otherwise, it will overwhelm the commissioners with never ending disgrace. The public at large care little, perhaps, which guage is the better: only, if there be but little difference between them, pray let us only have one; if there be a great difference, sufficient to countervail the disadvantage of two, then by all means let the whole country have the benefit of the latter; as undoubtedly it ultimately must, whether present legislation choose it or not.

Such are the questions before the commission. We leave our interests with confidence in its hands. In saying thus much, we have discharged the responsibility laid on us as representatives of railway property. Henceforth, we leave the commissioners in peace to deliberate and to decide on the interests committed to their charge, as well also for the public benefit as for their own personal reputation.—*Railway Chronicle.*

ROYAL SCOTTISH SOCIETY OF ARTS.

XXV. SESSION.—I. MEETING.

The Annual General Meeting of this Society was held at Edinburgh, on Monday, November 10, 1845, Professor More, President in the Chair.

The President opened the Session with the following address:—

"Before resigning this chair, to which you so kindly advanced me, permit me to return my best thanks for this honourable distinction, and to congratulate you on the cheering prospects with which we enter upon the 25th session of this Society. I rejoice that a Society, which has already done so much for the advancement of the useful arts, should be going on with increased progress, and that during the last session as many, at least, and as valuable communications were laid before you as during any previous session; and I sincerely trust that every future President, on retiring from the chair, will be able to make a similar, or even a more gratifying statement.

"Many societies which have commenced as vigorously as ours, have, after a time, languished and decayed; but I anticipate no such result to our Society. Its constitution, by which even the humblest efforts of genius are fostered, and by which our operative artizans are called to assist us by their contributions, give it a principle of stability which will preserve it from such a fate, and which, I trust, will long enable it to flourish in undecaying vigour. Nothing can be more conducive to the improvement of the arts than that free interchange of views and suggestions which takes place at our meetings, and to which we have to ascribe several of the most valuable communications with which we have been favoured. Without intending to disparage any other Society, I hope I may boldly say, that there is no other institution in this country which is better calculated to foster and stimulate all the useful arts.

"While I congratulate the Society on our past success, and on our future prospects, I have to lament, with you all, the losses we have sustained by death during the last year. In particular, let me mention the names of two distinguished naval officers, both of whom took a warm interest in this Society, I mean the late Admiral Sir David Milne, who at one time acted as one of our vice-presidents, and the late Admiral Tait, who when his health permitted, was seldom absent from our meetings. We have also to lament the death of our honoured member Dr. Abercrombie, whose numerous avocations alone prevented him from taking such an interest in our meetings as he would otherwise have done. Two other members who took a deep interest in our affairs I must not overlook, I mean the late Mr. Hunter of Thurston, and Mr. Robert Forsyth, advocate. I hope that the places of these eminent men will soon be supplied by the accession of new members; and this leads me to mention that the number of our members at present on the roll is 363, of whom 21 were enrolled during the last session. Allow me to add, in conclusion, that no member can either render more essential service to the Society, or confer a greater benefit on his friends, than by inducing such of them as are likely to become useful and efficient members to join this Society."

At the request of the Council, an Experimental Exposition of some of the recent applications of Electricity, particularly of the Electro-Magnetic Machine, to Silvering and Gilding, was given by George Wilson, M.D., F.R.S.E., F.R.S.S.A.

Dr. WILSON commenced by stating, that although different observers had noticed that the decomposing action of electric currents might be applied to the reduction of metals for practical purposes, the art of Electro-Metallurgy must be considered as dating from Daniell's invention of the Constant Voltaic Battery. He then mentioned, that in the year 1839, Messrs. Jordan and Spencer, in this country, and Jacobi, in Petersburg, contemporaneously announced their processes for making metallic casts of bodies by electricity. Soon after, Mr. Mason devised an improved battery for the purpose. Mr. Murray showed that non-metallic might be made to receive coatings of metal, by covering them with black lead. Mr. Smee introduced a great improvement on the voltaic apparatus in use. Mr. Elkington discovered and applied a new class of gold and silver salts to electro-plating. Lastly, Mr. Woolrich of Birmingham, substituted the magneto-electric machine for the voltaic battery which had been employed by all his predecessors. Dr. Wilson stated that he had brought Mr. Woolrich's method before the Society, because there was every reason to believe that it would supplant all the plans at present in use in electro-metallurgy.

The magneto-electric machine consists of a large compound horse shoe magnet laid horizontally, in front of which a bar or keeper of soft iron, surrounded by coils of covered copper wire, is made to rotate.—The electricity is obtained from these wires, in virtue of the following law:—If a copper wire be approached to a magnet, a momentary wave or current flows in one direction along the wire. If the wire be withdrawn from the magnet a second wave or brief current passes along it, but in the opposite direction from that which showed itself when it was approximated to the magnet. In this way a series of alternating electric currents, in opposite directions, may be obtained. On this principle the magneto-electrical machine is constructed. The soft iron keeper which revolves in front of the horse shoe magnet becomes a temporary magnet whenever its rotations bring it in front of, and in the same plane with the permanent one, and ceases to be one when it has turned so as to be at right angles to the horse shoe. Every time the keeper becomes a magnet an electric current flows along it in one direction, and on each occasion of its ceasing to be one, a second current shows itself in the opposite direction. These currents flow along the wires surrounding the keeper. In the course of the revolutions of the latter, moreover, each extremity comes to be alternately opposite the north and the south poles of the permanent magnet. This also occasions a reversal of the direction of the electric currents. In consequence of these alternations, the magneto-electric machine without some further equipment is useless for the purposes of the electro-metallurgist, as the counter currents necessarily destroy each other, and no permanent chemical decomposition can be effected by them. Mr. Woolrich obviated this difficulty, by attaching to the magneto-electric machine a very simple and ingenious break, or contrivance, by which a uniform current is obtained. This cannot be explained without a diagram. A drawing of it will be found in Shaw's Electro-Metallurgy. Its effect is to provide a new circuit for each current, at the moment that its direction changes, so as to carry all the positive Electricity by one channel and the Negative by another.

Dr. Wilson "*exhibited a Magneto-Electric Machine*," fitted up with Mr. Woolrich's break, and showed, by the uniform direction in which it moved the needle of a galvanometer, that the originally alternating currents were converted into a continuous one. Its application to Electro-Metallurgy was further illustrated by employing the current from it, to plate with silver a copper medal.

It was further mentioned that Mr. Woolrich had successfully substituted for the expensive Cyanide of Potassium, which was previously in use, a much cheaper salt, the sulphate of potass, as solvents of the silver and gold employed in Electro-plating. Dr. Wilson concluded by stating that the superiority of the Magneto-Electro Machine, over the Voltaic Battery, as a source of Electricity, was great. The expense of maintaining the keeper in rotation was the only outlay needed to secure the efficacy of the instrument. So that, though originally more expensive than the Voltaic Battery, it was, in the end, much less costly. It is also much more cleanly, and quite under control. By increasing or diminishing the magnetism of the keeper, which can be effected by altering the distance at which the horse shoe magnet stands from it, and by other methods, as well as by varying the speed at which the keeper revolves, the quantity and intensity of the Electricity can be varied within wide limits, accurately adjusted to suit the exigencies of the Electro-Metallurgist.

The Report of the Prize Committee, awarding the Prizes for Session 1844-45, was read; and the Prizes were delivered by the President to the successful candidates.

INTERESTING DISCOVERY AT HARTLEPOOL. DURHAM.—The site of an ancient chapel at Hartlepool, dedicated to St. Helen, was recently discovered by Mr. J. Yeal. It had long been supposed that the ruins of this chapel were buried under a large mound in the Farewell-field; and in 1813 an attempt was made, but without success, by Sir Cuthbert Sharp, to discover sume remnant of the building. Mr. Yeal, however, directed some workmen to remove the earth near the centre of the mound,—beneath which was discovered the base of a beautiful Gothic pillar. This having placed the mattet beyond a doubt, he was directed by the corporation of the town to pursue his researches, and exhume whatever portion might remain. The base of three other columns, a portion of the north and south walls, a part of the east end of the chapel, and a flagged pavement at the west end, have already been brought to light. A considerable quantity of beautifully carved stone, in a state of excellent preservation, and two mutilated images, have also been dug out. From these it is evident, that this was at one time a Gothic building of great architectural richness and beauty. It is impossible as yet to ascertain the form and dimensions of the chapel, but a few more days will probably throw light on the matter. The building, of which only the ruins remain, is believed to have been erected by William de Bras, who died in the reign of King John. Among the relics which have been since turned up is a stone coffin—complete, with the exception of a piece broken off the lid, which was a single large flat stone, shaped the same as the coffin; inside of which were a perfect skeleton, measuring five feet ten inches, that had evidently, from its position, never been moved since its interment, and a considerable number of very small human bones, all lying together, in a separate place from those of full-grown individuals, and which seemed to have been the receptacle of infants only.

ENGLISH HARBOURS OF REFUGE.

At the sitting of Monday, Nov. 17, of the Royal Institute of France, M. Mathieu in the chair, Baron Charles Dupin read the following paper:—

It is now 28 years since I laid before the Academy an account of great works undertaken by the British Government, with a view of making Plymouth the finest port of defence and refuge for the royal Navy and merchant vessels. These works carried on with a remarkable activity, although begun 30 years after those of Cherbourg, have long since been completed.

At this present moment England is projecting the making of new ports of agression, or, if you prefer it, of defence and refuge, nearer and nearer to the coast of France. Under more than one point of view these works interest the arts and science; and such is the reason which leads me to communicate them to the academy.

In 1843 a select committee of the House of Commons, appointed to inquire into the accidents to trading vessels off the coast of England, in its report recommended to the government the establishing of ports of refuge in the British channel. The committee, acting most judiciously, abstained from pointing out any particular situations for such ports; it, on the contrary, gave it as its opinion that the subject would be much better treated by scientific persons having practical knowledge, and specially appointed for the purpose. With a view of carrying out this recommendation, Sir Robert Peel, the Prime minister, first ascertains that the persons the most capable will undertake the inquiry just mentioned.

Having taken this first step, Sir Robert Peel obtained from the Lords of the Treasury the appointment of a commission, consisting of Sir Byam Martin, who was for many years chairman of the Navy Board, and who, during the war, had been a member of several important commissions of inquiry as chairman; Lieut.-General Sir Howard Douglas, formerly High Commissioner at the Ionian Islands, and previously Governor of the Military College at Sandhurst, author of several very valuable military works; Rear-Admiral Deans Dundas, an officer of great experience; Sir William Symonds, Surveyor General of the Navy, and successor to the celebrated Sir Robert Seppings; two naval captains, John Washington, and Fisher; Colquhoun, a colonel of artillery; Alderson, a colonel of engineers; Sir H. Pelly, deputy-master of the Trinity House; and Mr. Walker, President of the Institute of Civil Engineers of Great Britain, and worthy of such an honour from the important works of which he has had the superintendence.

Here is the formal instruction given by the Lords of the Treasury to this grand commission as to the objects to be forthwith more immediately considered:—

"First. To detererminе whether it be advisable to have a port of refuge in the British channel, with a view to the public benefits which such a work shall hold out; and, on the other hand, what would be the cost of executing the works to be recommended.

"Second. To determine the spot which will be best suited for a port of thie description, so as to combine, in the highest degree, the three following capacities:—

"1. That it may be entered with ease at any state of the tide by vessels in danger from bad weather.

"2. That the port be such as to be suited to a naval station, in case of war, and may at the same time serve for purposes of defence and attack.

"3. That it may offer ready means of defence in case of attack from an enemy."

This is not all; should the commissioners not find that all these requisites can be obtained by only one port of refuge in the British channel, they are authorised to extend their surveys in consequence, and then to report on the advantages peculiar to the different situations they shall deem advisable to reccommend, pointing out such as they may consider the most eligible.

These remarkable instructions are dated the 2d of April, 1844.

These commissioners lost no time in setting about the duties imposed on them. The English coast and ports on the British channel were surveyed. The commissioners had the assistance of the information possessed by persons of special knowledge. They examined the most experienced pilots, the officers of the coast Guard, the most celebrated engineers—such as Mr. Brunel, Mr. Rennie, Captains Samuel Brown and Vetch; learned geologists—such as Mr. Beche, President of the Board of the Geological Map; Mr. Philipps, President of the Society of Geological Economy, &c.

As early as the 7th of August, 1844, the commission had got through its labours, and presented its report to the Lords of the Treasury. Finally, in consequence of an address to the Crown on this subject, the First Lord of the Treasury laid on the table of the House of Commons the commissioners' final report.

I shall, in a succinct analysis, lay before you the chief results of their labours, looking at them with reference to hydrography and nautical arts.

At the first view it might be thought that the south-west coast of England, liberally provided by nature, and during a long period seconded by art, offers a sufficient number of ports of refuge, possessing all requisites.

We have already mentioned Plymouth, to which must be added Falmouth, the situation the farthest to the westward. Returning eastward, we successively find Dartmouth, Southampton, Portsmouth, and the Thames.

Not only did the commission not find these chief ports of refuge to be sufficient, but it found that the addition of one great port to the preceding would not suffice; it recommends works, and an outlay for four new stations, which I shall successively mention.

The commissioners made a survey of the whole line of coast between Falmouth and the port of Harwich to the north of the Thames, and beyond the limits of the British Channel.

They took new soundings for the purpose of ascertaining whether the depth of water at the principal naval stations along this whole line of coast had not varied since the publication of the most recent maritime charts. All this was effected under the skilful direction, at the ports of the eastern part, by Commander Sheringham, and at the ports in the western division under the superintendence of Captain Brown, one of the members of the commission. Besides this, the commission received all the assistance which the Lords of the Admiralty could afford it, and was further assisted by the knowledge possessed by Captain Beaufort, the chief hydrographer of the Royal Navy, and correspondent of the Academy. It availed itself of the opinions of the two great societies of Lloyd's and of the shipowners, as to the selection of naval stations, which may be or become the best as to places of refuge.

A special commission, appointed in 1840 (this is a period worthy of remark), gave the preference for creating new ports of refuge— first, to Dover, secondly, to Beachy Head, thirdly, to Foreness, near the North Foreland.

The following are the particular instructions to the Commission of 1840:

"To survey the coast from the mouth of the Thames to Selsea Bill; to examine the ports with reference to the shelter they may be capable of affording in case of bad weather to vessels sailing in the British Channel, and as to their being places of refuge for merchant vessels chased by armed vessels in time of war, and more especially as to their becoming stations for armed steamers, in order to protect British trade in the narrow parts of the Channel."

Foreness, nearer than Margate to the extreme point of the southern coast of the Thames, is a fine situation, which was recommended by the commission of 1840, but only as a third place, for a port of refuge: it recommended in preference two other points—first, Dover; second, Beachy Head. Most certainly, Foreness, converted into a port, would often present a very faourable anchorage, whether for trading vessels sailing froms the Thames, aad whichencounter gales of wind when off Foreland; or foie vessels returning to England, and which are detained by contrary winds.

The new commission observes, that the same advantages may be more fully and conveniently obtained by improving the port of Harwich, on the other side of the Thames, as the point of the coast where the North Sea begins. In fact, this port, which will be the natural station for a fleet of war-steamers, will afford the best refuge for merchant vessls; whilst the neighbouring anchorage afforded by the bay of Hollesley will suitably receive ships of war. In consequence, it does not appear that the secondary situation of Foreness is to be selected for making a port of refuge. One is strengthened in coming to this conclusion on looking to the advancement in a commercial point of view of Ramsgate, which is but a very short distance from Foreness. In 1748 Ramsgate was no more that a small creek—an open bay without importance; it is now a harbour of sufficient extent to receive a considerable amount of shipping.

The following is the increase in numbers of merchant vessels having entered Ramsgate harbour in the following year:—

Years.	No. of Vessels.
1780 time of war	29
1785 time of peace	215
1790 time of peace	387
1841 time of peace	1,513
1842 time of peace	1,652

Four years ago the 31 largest vessels which entered Ramsgate harbour measured on an average 457 tons—a greater tonnage than that of two-thirds of the British merchant vessels in foreign trade.

In 1832 as many as 434 vessels were at the same time in Ramsgate harbour; if the new basin about to be formed to the westward be added, Ramsgate will then be capable of containing simultaneously 600 vessels.

Sir John Pelly, deputy master of the Trinity-house, had proposed, as a place for constructing a port of refuge between Ramsgate and the Thames, at the anchorage ground called the Brake. In support of this proposition, he produced plans made by Sir John Rennie, the second son of the celebrated engineer Rennie, of whose works at Plymouth, Sheerness, London, &c., I have given a description. Sir John Rennie, jun., proposed to erect on the top of the longitudinal sand-bank, within which is the anchorage called the Brake, a breakwater, or jetty, similar to that at Cherbourg, but only 60 centimetres (23 inches) above the highest water. His plan would lead to an expense of 80,000,000f. (3,200,000*l*.), including the necessary deepening of the projected anchorage-ground, which would not have been less than five miles in length.

If so large an expenditure were objected to, Sir John Rennie would reduce to 1,500 yards the proposed length, in which case the cost would only be 850,000*l*., that is about 21,000,000f. Finally, Sir J. Rennie, as a middle course between these two extreme plans, proposed a third, which would have led to an expenditure of 1,200,000*l*. or 30,000,000f.

Among the reasons adduced against the adoption of any of these plans, and, and several others proposed by Captain Vetch and Sir S. Brown, I must mention the strongest.

A naval officer, employed on the hydrography of the coast, has found that the sand-bank called the Brake, had shifted nearer to the land by 700 yards, or 640 metres. So soon as the corporation of Trinity house became acquainted with this fact, it altered the situation of its buoys from the south and the middle on to the Brake sand-bank; at the same time publishing, for the information of all seamen and the public in general, an accunt of this very remarkable change.

The commission of 1840 had already rejected the plan of erecting a harbour at the Brake. The commission of 1844 comes to the same conclusion founded on the ground, that a port in such a situation could only be of service to vessels having already escaped all the dangers of the narrow part of the British Channel, or to vessels leaving the Thames to begin their voyage by a course to the Southward. Grounding themselves on these motives, the commissioners reject the very expensive proposition of a harbour at the Brake, and they are strengthened in this resolution that the Downs in their present state possess an excellent bay. This bay may be said to be contiguous to Ramsgate harbour, which can already contain 400 vessels at the same time; a port about being rendered capable of holding 600, if not more. Continuing to advance from the north towards the south, the commissioners arrive at the most important situation—at that which they prefer. It is the situation of Dover, a point at once the nearest and the most threatening for France.

In my works on the naval and military forces of Great Britain, I have pointed out the great importance of Dover for one and the other of these forces, and the vast werks, whether of the port for trade or the fortifications of this town. Since the publication of my first descriptions, Dover has become of greater importance, as being the terminus of the railroad which comes from London to this port, and embranching on sundry other lines. In two hours' time corps of troop ships' stores and munition, and an entire train of artillery, may be brought down to Dover from London, Deptford, Woolwich, aad Portsmouth. Dover has a dry dock suited to the repairing of merchant vessels, a great extent of large quays, and extensive warehouses. Besides its outer basin, the floating basin has an area of more than six acres superficial measure, and works are going on for doubling this extent. There is also a third basin (called the Pent) which might be put into a state for containing a great number of sloops of war and gun-brigs—a basin which is now undergoing considerable improvements.

At the time the celebrated Mr. Pitt was carrying on a mortal struggle between England and France, he strongly wished to form an enclosed roadstead in front of Dover, and he had plans made with that view; the Ordnance department found them in its achives, and communicated them to the commission whose labours I am now noticing.

Two kinds of objections have been started against resuming the consideration of these plans. It was contended that the bed of the roadstead has a constant tendency to rise, owing to the deposit of alluvions. 2. That the anchorage ground was bad. In order to test this latter objection Captain Washington superintended experiments, which have been deemed conclusive, by anchoring in the roadstead a steamer of 500 tons and 120-horse power. After having cast anchor in the most important parts af the roadstead, the whole force of the engines was made to act on a sufficient length of cable run out, without this powerful action having in any way loosened the anchor from its hold. No action of the wind on a vessel without sails could equal a similar impulsion. This experiment must appear conclusive as to the excellence of the anchorage in Dover-roads.

In order to ascertain what is to be apprehended from the deposits by the gaters in front of the present port of Dover, samples of the water have been taken at the times of the highest tides, selecting calm weather:—

Samples of Water, taken July 2, 1844.

Time and situation of the water being taken.	Depth of the water at the point where taken.	Foreign substances deposited, per cubic foot.
	Feet.	Grain.
1.—At low water at the surface of the sea	42	10.21
2.—At half tide—		
At the surface	51	13.20
At 9 feet below	42	6.00
3.—At high water		
At the surface	60	3.43
At 9 feet below	51	7.21
At 18 feet below	42	11 33
4.—At half ebb tide—		
At the surface	31	6 38
At 9 feet below	42	6.92
Foreign bodies in suspension per cubic foot of sea water in front of Dover, average quantity		8.11

NOTE ON ATMOSPHERIC TRACTION.

On re-examining the papers which appeared in this Journal last month, estimating the loss of power on Atmospheric Railways from the preliminary exhaustion, I find two numerical errors, which, though of little consequence as regards the general result, had better be noticed for the information of those who have sufficient industry to go over the arithmetica computation indicated.

The numerical values of log 79 and log 3, have been given to the base 10, instead of base ϵ, making the two necessary alterations, it will be found that the expression marked (8) becomes 19,138,419. Hence the power lost =6,460.224 which is rather more than I first estimated to be. This makes the loss almost 34 per cent: it was before stated to be rather more than 33 per cent.

If we suppose the whole of the branch pipe made available for the purpose of locomotion, we shall find for the expression marked (7) the amount 7,586,614 and (8) and (9) become 19,714,129 and 15,173,229 respectively. Hence supposing the whole of the branch pipe made use of, the loss independently of leakage and friction, is rather more than 23 per cent.; but it must be added that the supposition makes the loss less than it could possibly be in practice.

Perhaps it would be more accurate to call this loss not "loss of power" but "power uselessly expended." It is employed in constantly altering the constituent arrangement of the molecules of air among themselves. The action of the air pump is to alternately draw apart, and bring together the particles of the air within it, and these operations absorb part of the force exerted.

The following are familiar instances of the loss sustained by communicating power by an elastic medium.

If a man raise a weight by an elastic string, he has to stretch the string before he can raise the weight. The longer the string the greater the additional labor required. By analogy, the longer the atmospheric main, the greater is the amount of power lost.

If a weight be raised by a flexible lever,—for instance, if a fire be stirred by an elastic poker, a great proportion of the muscular effort is absorbed in bending the instrument.

In a Bramah's press the work required to produce a given effect would be enormously increased, if air were pumped into the machine instead of water.

H. C.

NEW CHURCHES.

Holy Trinity, Harborne, Staffordshire, is an odious structure rendered at once offensive by pretence, and ridiculous by failure. The sprawling nave and transepts, the mis-proportioned tower and spire, and the little apsidal chancel (which is about the depth of a buttress), and the whole stuck over with pinnacles—what shall we say of them?—they are quite in character in a new church. The style, we scarcely need say, is Early English.

S.—— Handsworth, Staffordshire, is a trifle better in plan, having no transepts and more of a chancel; but in detail is as bad as can be. A bad Early English building with a bad Perpendicular east window; a bad early tower with bad late buttresses will be allowed to merit condemnation. The modern "Gothick" buildings of this neighbourhood really make one regret that their architects have wandered beyond their proper province of Anglican paganism. It is a consolation, however, to know that Mr. Carpenter is gaining a name here.

S. ——, Oldbury, Worcestershire.—We wish we knew the name of the architect who is answerable for this design: he really ought either to be fixed for a week in the stocks, in view of his own church; or else never to be allowed to meddle again with ecclesiastical work. High red brick walls and low roofs, overgrown couplets all down the sides and triplets placed about anywhere in the ends, an Early English whole, with Perpendicular details, sufficiently demonstrate his incompetence to build a church.

S. ——, Kingswood, Walton-on-the-Hill, Surrey.—A Norman building; as bad as anything can be. The north side has a series of sham windows.

S. John Evangelist, Clapham Rise, Surrey.—This is a pagan structure, and therefore beyond our province; but we notice it with a view to expose the abominable arrangement of the altar. We have said the structure is pagan, and our readers will have already concluded for themselves that its street-front is adorned with a tetrastyle portico. Now it happens that this front faces the east, and some of the subscribers to the building were actually old fashioned enough to desire that the altar should be placed towards that quarter. In order to obtain both an eastern portico and an eastern altar the following arrangement is adopted. The main doorway is formed in the middle of the front under the portico; by this, access is obtained not to the nave—to apply church language to a heathen building—but to the large gallery which runs completely round the church. On the inside of the door north and south spring staircases, which embrace as it were with their crooked arms a spacious chamber, fenced at the sides by the stair walls and covered at the top by the organ and seats for children. This chamber is the vestry, and a very luxurious one it is. Outside its western partition is placed the altar, in a chancel formed by two pilasters supporting the organ. This chancel is about the smallest we have seen. It is less than three feet deep, so that an easy "altar-chair" placed against the eastern wall projects into the nave! The only article in the place which bears any resemblance to church furniture is the clerk's desk. This is something like a simple lettern; but it certainly struck us as a little cruel that, while the reader and the preacher have each their snug box respectively, like a cellaret and a wine-cooler, the poor responser, who has never been taught what to do with his hands in company, should be exposed in plain clothes to the criticism of so large and so well dressed a congregation.—*Ecclesiologist*.

CHURCH RESTORATION.

S. Mary, Morpeth.—From the chancel have been ejected the high pues and the gallery, which usurped the place of the rood-loft; and double rows of benches erected for the choir. The walls have been freed from whitewash and plaster, preparatory we hope to the introduction of distemper painting. A new roof has been put up, of the original pitch, covered with lead, and terminating in a gable cross. The floor of the sacrarium is laid with encaustick tiles with good effect. In the nave open sittings are substituted for about one half of the close pues. Lettern and litany desks (from the *Instrumenta Ecclesiastica*) are used. The font is removed to its proper place. The church-yard cross, we are glad to say, is restored. We wish the energetick rector God speed in his labours.

S.—— Mitford, Durham, has been altered for the worse. Doors and blue cushions decked with scarlet tape, make the pues more offensive than before. However, the old font has been brought back to the church from the squire's flower-garden, where we trust the font lately used has not taken its place. This church affords an example of the monstrousness of the monument system. The greater part of the south transept is railed off for a tomb.

S. Andrew's Cathedral, Wells.—Commendable vigour is displayed in the works, which when completed we hope to describe in detail. The scraping is carried on with zeal throughout the nave, while the west-end and the roof are being painted. The tablets are all removed into the cloisters. We cannot sufficiently praise the complete, the faithful character which marks the attempt to restore this glorious cathedral; nevertheless we watch with extreme anxiety the proposed alteration of the stalls. Funds are said to be wanting; but we will never believe that the men of Somersetshire, where church restoration has made as great advances as in any part of the kingdom, will withhold their contributions *now*, when it is in their power to make their mother-church the glory of the land. Why are not collections made in every church in the diocese towards the restoration of the cathedral? Why should the poor be debarred the privilege of offering out of their little for the honour of God's House?

S. Mary, West Lydford, Somersetshire.—A small Perpendicular church has lately been taken down, and built again upon the old foundations and after the original design. Such a plan, if not ingenious, is at least safe. The architect employed was Mr. Ferry. How many cathedrals, churches, chapels, we wonder would satiate a first rate London architect? or is his willingness to undertake jobs absolutely illimitable! There is need here of reform.

St. Peter, Evercreech, Somersetshire.—It is most annoying to learn, that in a church where so much has of late years been done, and well done, as in Evercreech, the authorities should shew themselves so destitute of taste as to put up in the newly erected south aisle, a gallery to match the one constructed in the north aisle, in 1825. Save in these galleries, there are no pews in the church. The font and the pulpit were carved by the hand of a former incumbent. The chancel roof is painted or, azure, and gules. This parish is fortunate in retaining a fair village cross. We would suggest to the parishioners the wisdom of setting the fine old church of St. Peter free from the disfigurement of galleries, and erecting a chapel of ease in a convenient situation, for the accomodation of the large population. In such a case, perhaps, as the mother church is St. Peter's, the chapel might be consecrated under the invocation of St. Paul.

St. Giles, Little Malvern, Worcestershire.—We are glad to find that steps are being taken for the restoration of this beautiful church. We are informed by a circular that—"The nave has altogether disappeared, the transepts and side chapels are in a ruined and dismantled state, while the tower and chancel, which are alone available for Divine worship although comparatively in a sound and good condition, are most lamentably disfigured by injudicious repairs, mutilations, and neglect. As a step towards the complete restoration of this church, it is proposed to put the substantial part of the fabrick into a perfect state of repair, to remove the soil which has accumulated around the walls, to re-open the original windows, to thoroughly scrape and cleanse the walls of the interior, to substitute open oak sittings for the present irregular pues, and, as far as possible, to restore this part of the church to its former beauty, and render it more becoming the worship of God."

St. Nicholas, Great Yarmouth, Norfolk.—This church is one of the largest parachial edifices in the kingdom. It consists of a chancel with north and south aisles, a nave with north and south aisles, and a transept, over the intersection of which and the nave is erected the tower and spire. Its great peculiarity is, that the nave is considerably smaller than the aisles, both as regards height and breadth. The church of Cheux, in Normandy, is somewhat similar. It has suffered dreadfully. Among other things, the east wall has been taken down, with about nine feet of the side walls, by which means one of the three windows on each side has been totally destroyed, and the east wall re-built in the most ordinary manner, with an offensive carpenter's window. Some other noble windows have been partially blocked up, and the remaining space filled by a barbarous imitation in wood of Gothick tracery. The spire has been considerably shortened; tasteless battlements have been substituted for the ancient parapet; and the whole of the south side and west front (as well as the tower,) covered with most unseemly plaster. It is now proposed thoroughly to restore this church, and to secure the poor remains of the priory (which adjoins it,) from its present use as a *stable*. The architect is Mr. Hakewill: the estimate is 5000*l*. It looks well for the feeling of the College of Arms, that Rouge Dragon should be one of the secretaries for the restoration.

We have received the following account of St. Michael's, Clifton, Oxon, from a correspondent. The only thing which we find to object against this restoration, is the panelling, &c., of the altar and the character of the spire. "The whole interior and a great part of the exterior is entirely new, and it is only the massive, low, round pillars which mark its ancient date. The restoration has been carried out at the sole expense of the lord of the manor. The front is new, square, and very richly carved. The seats are all open, of oak, with plain square ends, free and unappropriated, excepting two seats which are cushioned and stand in the most convenient place in the nave, and are reserved for the poorest and most infirm people in the parish. The pulpit is of stone, with rich carvings; the lettern good. There is no visible division between the nave and chancel outside; within there is erected a handsome oak screen. The chancel has an extremely rich appeaeance. All the windows are filled with stained glass. The altar is of stone, and solid, panal.ed and ornamented with carving; the top is a thick stone slab, on which stand two handsome gilt candlesticks. On the north of the chancel, stands a very fine canopied tomb, with a recumbent effigy of the refounder's brother, who died about three years ago, clad as a merchant. There are two rows of stalls in the chancel, which is paved with encaustick tiles. The church is lighted by two large *coronæ* with wax candles. There is daily service. The porch on the south is of stone and very spacious. The roof is of a *very* high pitch, filled with dark oak. The whole effect is most religious. The bells, five in number, are hung one over another in a small spire: I have not seen one before like it; they can only be chimed. There is a floriated east gable cross. There is also a very good new lych-gate of dark stained oak with seats in the interior, very high pitched; surmounted by a gilded cross, and appropriately carved with texts from the burial service. The poor are proud, as they well may be, of their little church."—*Ecclesiologist.*

MISCELLANEA.

Consumption of Iron in France.—A great many experiments are being made in France in the improvement of working forged iron bars, and cast iron, in the manner in which it is generally used by the trade, which, in 1843, produced to the value of 1,279,173*l*., composed of small round iron bars or rods, split iron, iron wire, cast iron, tin, and cast metal. The quantity of large iron used in the same period amounted to the value of 50,191*l*. The total production being annually only 154,073 tons, there would remain for the trade 91,698 tons of large iron. The quantits of moulded iron amounts to 65,233 tons; besides there were 2,343 tons of cast iron, which were used in the steel forges, from which it will be seen that France cannot produce sufficient iron for her forges and other factories, so that, to make up the deficiency, she is obliged to import it from foreign countries, particularly England and Belgium, the German States, Savoy, &c. In 1843, the quantity consumed was 256,611 tons. The Government is giving every encouragement to the improvement in the making of iron and steel, and the working of the iron mines by the local authorities rendered every facility they can to the ironmasters. The Chambers of Commerce in the different mining districts or departments have also, within the last few years, distributed prizes to those who have not all produced the greatest quantity of metal, but made improvementa in amalgamating or casting it. It will be many years to come before France will be able to meet the demand for iron now making for the numerous railways being constructed in nearly every point of the kingdom, as well as for iron ship-building, and manufactories where steam machinery is used in the building of residences, &c., where iron is employed as pillars, rafts, and frontage, so that she must import it from Wales, the north of England, and Scotland, or else Belgium; but, as her iron is far inferior to our metal, and nearly as dear, and having an extensive demand for her own consumption, the iron trade of this country is becoming one of the most lucrative enterprises, not only for our own railways now being laid down, and will be for three or four years hence, but for exportation.—"Mining Journal."

The Gauge Commission has resumed its sittings after an interval of more than a month. The broad gauge part of the inquiry was entered upon by the examination of Mr. Gooch, locomotive superintendent of the Great Western. Mr. Brunel and Mr. Saunders, the secretary of the Great Western, will follow.

Iron Steamer.—On Saturday a new iron steamer, intended to ply between this port and Dublin, and built for the City of Dublin, and built for the City of Dublin Steam-packet Company, was launched from the building-yard of Mr. Peter Cato, Brunswick Dock. She is intended for the cattle trade, and may be considered one of the strongest vessels ever constructed. She has been built entirely of Staffordshire iron. Her length is 173 feet, her breadth 24 feet, her depth 14 feet, and her measurement (old) about 500 tons. Her build throughout is very plain and substantial; and should her engines be of sufficient power, which is somewhat doubtful, her speed it is thought will be above the average rate of cattle steamers. Her draught of water, when her engines and masts are fitted up, will be about eight feet. She was launched in splendid style, about half past 11 o'clock; but, unfortunately, owing to the wetness of the forenoon, the number of spectators was considerably less than it would otherways have been. She was named the Roscommon, after one of the Irish counties, from which the principal materials of her traffic are expected to be brought. The steamer sat gracefully upon her native element, and was towed round by a steam-tug to the Clarence-dock, where her boilers will be put in and her masts supplied. It is thought she will be ready for sea in about a month. After the launch about 80 ladies and gentlemen sat down to an elegant dejeune in the moulding-room. Mr. Grantham delivered an excellent speech on the occasion, illustrative of the superiority of iron over timber for shipbuilding. It was remarked, in the course of the proceedings, that there are not half a dozen wooden steamers in course of erection throughout all England, so rapidly and generally has the use of iron been adopted at the several ports, and that Mr. Cato was now building four additional iron steamers, the first of which, intended for the City of Dublin Company, and to ply between Dublin and London, will be ready for launching in about a month.—'Liverpool Albion.'

Roman Antiquities.—The remains of a Roman villa, of considerable extent, have been recently discovered near Wheatley, Oxfordshire, and some excavations have been made under the direction of Dr. Bromet, a member of the Archæological Institute. All that has yet been made out is a hypocaust and a bath. Drawings of these have been made by Mr. Jewitt, for the Institute. These remains are distant about a mile and a half from the palace of the Bishop of Oxford at Cuddesden.

The various returns continue to prove the eagerness with which the labouring classes accept the boon of the bath and the wash-house,—and the consequent progress of the good spirit of cleanliness throughout the land. During the last season, the Committee of the Houseless Poor voted the sum of 100*l*. for the fitting-up of a washing and bathing apparatus, for the inmates of the eastern asylum; and, in the short space of nineteen evenings, 987 individuals availed themselves of its advantages. On the closing of that asylum, the apparatus was placed at the disposal of an association for promoting cleanliness amongst the poor; which association commenced its operations by allowing necessitous persons to wash and bathe gratuitously in the buildings. The number of those who have benefitted by this permission amounts now, at the end of twenty-two weeks, to 24,027.

Excavations at Pompeii.—The following extract giving an account of recent excavations at Pompeii, on the occasion of the Italian Scientific Congress Meeting at Naples, is taken from a letter published in the Athenæum. "The ground now to be opened had already been prepared, that is to say, the outer crust had been taken away to the depth of ten or fifteen, or in some cases, twenty feet, leaving a crust of only three or about four feet. Below this lie all the treasures which have been crushed to earth, however massive, by the superincumbent mass of ashes, and this lower crust is never touched except in the presence of the authorities. It was an anxious moment, I assure you, when the first stroke was given to the soil—every eye was set, and every neck outstretched in expectation of seeing treasures of Art turned up every moment. Several houses, however, were excavated without anything being discovered—indeed, sometimes they were abandoned without being one-half cleared out—the parties engaged appearing to know as if by a kind of instinct which sites were likely to prove productive. Eventually, many articles of artistic value were brought to light, amongst which I may mention a fountain adorned with mosaics, and close to it a marble table supported by lions' paws beautifully cut; in bronze, some vases extremely elegant; several and different coins of a small size belonging to the reigns of Galba and Vespasian, an oil jar, with handles representing two extremely beautiful human figures embracing the neck of the vase; small tripods sustaining candlesticks; in creta many amphoræ and vases of different forms; and, in marble, five statues of different sizes and subjects, of which one well-draped figure of a woman has the peculiarity of representing a skeleton with a flame near, intended perhaps for Canidia on Envy, or as Cav. Avellino suggested at the Section the following day, one of the Parcæ. These objects of interest were placed on the table in the Temple of Augustus for the curious scrutiny of the multitude. In this manner were excavated nearly twenty houses; and, after a day of intense interest, with the most delightful weather, we returned towards the evening to Naples."

The Gazette of Augsburg mentions the death, at Florence, of the Nestor of modern archæologogists, as it describes him, James Millengen,—after a short illness, and just when he was preparing to pay a last visit to his native country. For twenty-four years past he has resided principally in Florence. "It is to practical archæology in particular," says the very laudatory correspondent of the 'Gazette,' "that his labours have such great importance—though its science had never before him a man of experience so rich, tact so sure, or criticism so correct." Mr. Millingen is best known by his work, 'Ancient Unedited Monuments of Grecian Art,' begun some twenty years since, and discontinued for want of public patronage.—The French papers mention the death, in that capital, of Juan-Earia de Maury-Pleville, a member of the Spanish Academy. The 'Journal des Débates' gives a list of works chiefly poetical, published or written by him, both in Spanish and in French,—with which latter language he had acquired a perfect familiarity. He has left behind him two unpublished poems—about to be included in a complete edition of his works undertaken by a Spanish bookseller, and announced before the author's death; and an inquiry, of great interest, says the Journal, into the principles of versification in all languages—portions of which have obtained the high commendation of the Spanish Academy. The Paris papers report the death, at Algiers, at the age of 55, of the Doctor Antonini; charged with the inspection of that French settlement—in which he has resided since the conquest. Dr. Antonini had collected an immense body of valuable particulars relative to the country; which he was preparing to arrange and classify, on his approaching return to France—when he fell a victim to his necessary exposure amid the intolerable heats of the summer months.

New Park at Battersea.—The Commissioners of Woods and Forests have given notice of their intention to apply, during the next Session of Parliament, for a bill to form a new park at Battersea—on about 330 acres of land, stretching from the banks of the Thames, between Battersea and Nine Elms, as far as Wandsworth.

Wellington Statue at Glasgow.—The Glasgow papers inform us that the Wellington statue in that city has been subjected to a further mutilation; one of the bas-reliefs on its pedestals having been injured—happily, it is said, to no very serious extent.

Melrose Abbey.—In consequence of the wanton damage done to the Abbey of Melrose, by tourists, and other visitors, in chipping and defacing its beautiful carvings and stone-work, and carrying off the fragments as relics, its noble owner, the Duke of Buccleuch, has felt himself compelled to exclude the public, for the future, from the inspection of the ruins.

Turnpike-roads and Railroads.—There are 30,000 miles of turnpike-roads in this country, and there are at present 6,000 miles of railway.

A monument of very elegant design has been recently erected in Saint George's churchyard, Birmingham, to the memory of the late Mr. Rickman, architect.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM OCTOBER 27, TO NOVEMBER 20, 1845.

Six Months allowed for Enrolment, unless otherwise expressed.

Benjamin Nickels, of York-street, Lambeth, mechanist for "Improvements in piano fortes."—Sealed October 27.

Reginald Orton, of Villiers-street, Sunderland, surgeon, for "Improvements in life-boats, life-buoys, and apparatus for conveying persons ashore from wrecked or stranded vessels."—October 27.

Samuel Childs, of Earl's-court-road, Kensington, wax chandler, for "Improvements in the manufacture of candles."—October 27.

Dennis Jonquet, of Chateaudun, France, for "Improvements in machinery for preparing skins for tanning and dressing."—October 31.

Robert William Brandling, of Low Cosforth, Northumberland, esq., for "Improvements in railways and railway carriages for the security and convenience of the public."—October 31.

Charles Henry Collins, of Lambeth, engineer, for "Improvements on atmospheric railways."—October 31.

Henry Clark, of Redcross-street, Cripplegate, London, oil merchant, for "Certain improvements in the preparation of materials to be employed for producing illumination."—October 31.

James Hardcastle, of Firwood, Bolton-le-Moors, esq. for "Certain improvements in tha methods of scouring, bleaching, preparing, dying, and finishing piece goods or woven fabrics."—October 31.

Thomas Forsyth, of Salford, Lancaster, engineer, for "Certain improvements in signals or in the method of giving signals which are applicable to the working of railways, and which are also applicable to maritime purposes, and for certain other improvements in the working of railways."—October 31.

Dalrymple Crawford, of Birmingham, gentleman, for "Certain improved means of, or machinery for, arresting the progress of railway carriages and trains."—October 31.

Henry Waller, of Vauxhall-road, engineer, for "Improvements in sluice-cocks."—October 31.

Richard Archibald Brooman, of Fleet-street, gentleman, for "Improvements in printing and figuring silk, cotton, and other textile fabrics." (communication.)—November 3.

Richard Archibald Brooman, of Fleet-street, gentleman, for "certain Improvements in gas-meters." (A communication.)—November 3.

Richrad Biddle, of Leadenhall-street, surgical mechanician, for "Certain improvements in driving mills and other machines or machinery by the power of the wind."—November 3.

Christopher Binks, of Friars' Goose, Durham, chemist, for "Certain improvements in manufacturing certain compounds of nitrogen, particularly cyanogen, ammonia, and their compounds, and the use or application in these manufactures of a substance or substances not hitherto so employed."—November 3.

Chandos Hoskyns, of Dublin, gentleman, for "Certain improvements in trusses."—November 3.

Thomas Edwards, of Islington Foundry, Birmingham, engineer, for "Certain Improvements in steam-engines."—November 3.

Paul Ackerman, doctor of medicine, of Skinner's-place, Size-lane, for "Certain improvements in harpoons and other similar instruments."—November 3.

George Ewart, of the New-road, zinc manufacturer, for "Improvements in the manufacture of chimney-pots."—November 3.

Thomas Bell, of the Don alkali works, South Shields, Durham for "Improvements in certain processes in the manufacture of alkali, which improvements are applicable to the purposes of condensation."—November 3.

Alfred Watney, of Wandsworth, gentleman, for "Improvements in the manufacture of horseshoes, and in applying shoes to horses and other animals."—November 3.

George Minter, of Gerard-street, Soho, patent chair manufacturer, and Jonathan Badger, of Walworth, carpenter and builder, for "Improvements in the construction of easy chairs."—November 4.

Edward Augustin King, of Warwick-street, Middlesex, gentleman, for "Improvements in obtaining light by electricity."—November 4.

Richard Atha, of Walton, near Wakefield, engineer, for "Improvements in atmospheric engines."—November 4.

Charles Sanderson, of West-street, Sheffield, manufacturer, for "Improvements in combining steel and iron into bars for tyres for wheels and for other purposes."—November 4.

Samuel Carson, of Norwood, gentleman, for "Improvements in treating eggs for the purposes of food."—November 5.

Henry Blumberg, of Camberwell-grove, Distiller, for "improvements in the purification of spirits for the use of brewers, distillers, and rectifiers."—November 5.

George Scholfield, Agent, of Manchester, for "certain improvements in machinery or apparatus to be employed for lithographic printing."—November 5.

William Thomas, of Cheapside, merchant, for "improvements in apparatus for impregnating liquids with gasses." (Being a communication.)—November 5.

Laura Laughton, late of Plymouth-grove, Manchester, but now of Everton, Nottingham, the wife of Edmund Laughton, of the same place, gentleman, for "improvements in the manufacture of soap."—November 6.

Uriah Clark, of Leicester, Dyer, for "certain improvements in the manufacturing and making looped fabrics."—November 6.

Robert Burton Cooper, of Swinton-street, Grays-inn-road, gentleman, for "improvements in the manufacture of taps or cocks, and in stopping bottles and other vessels."—November 6.

John Soloman Bickford, George Smith, and Thomas Davy, all of Tuckingmill, Camborne, Cornwall, patent safety fuze manufacturers, for "certain improvements in manufacturing the miner's safety fuze."—November 6.

John Campbell, of Bowfield, Scotland, bleacher, for "certain improvements in the apparatus or machinery for drying and finishing of bleached cotton and other goods."—November 6.

Peter Armand Le Cumte de Fontainmoreau, of Skinner's place, Size-lane, for "certain improvements in producing artificial fuel." (Being a communication)—November 6.

Bryan Donkin, of the Paragon, New Kent-road, civil engineer, for "improvements on wheels as applicable to railway carriages, and on the mechanical contrivances by which railway carriages are made to cross from one line of rails on to another line, or on to what are generally called sidings."—November 11.

William Henson, of Skinner's-street, St. John-street-road, civil engineer, for "improvements in machinery for weaving."—November 11.

Christopher Vaux, of Frederick-street, gentleman, for "Improvements in machinery or apparatus for tilling land."—November 11.

Charles Frederick Bielefeld, of Wellington-street, Strand, papier mache manufacturer, for "Improvements in the manufacture of embossed or pressed paper, calico, leather, and other fabrics and articles."—November 11.

George Hill Dutton, of Dutton, brewer, for "certain improvements in conveying intelligence from one part of a railway train to another."—November 11.

Samuel Thomas Cromwell, of Romsey, Hants, teacher of music, for "Improvements in apparatus to be applied to piano fortes."—November 11.

Robert James Hendrie, jun., of Blossom-street, Norton Falgate, dyer, for "an improvement in the preparation of silk."—November 11.

Jacob Brett, of Hanover-square, Middlesex, esq., for "improvements in printing communications made by electric telegraphs." (A communication.)—November 13.

Joseph Ramon Yglesias, of Mark-lane, London, merchant, for "a new mode of application and combination of mechanical arrangements, (or of mechanical and hydrostatical arrangements,) already known and in use for the purpose, by such application and combination of augmenting the power or moving force of first moving machines or engines." (A communication.)—November 15.

Thomas Palmer, of Tavistock, in the county of Devon, currier, for "certain Improvements in mine-lifting machinery, which are also applicable to other purposes."—Nov. 15

John Ayre, of Tynemouth, in the county of Northumberland, sail-maker, for an "Improved fabric for sail cloth."—November 15.

Edward Hall, of Dartford, Kent, civil engineer, for "an improved double cylinder condensing engine."—November 15.

Stephen R. Parkhurst, of Liverpool, merchant, for "a method of propelling vessels."—November 17.

James Boydell, jun., of the Oak Farm Works, Dudley, iron-master, for "Improvements in the manufacture of binges and handles of knives, and other instruments."—Nov. 17.

James Boydell, jun., of the Oak Farm Works, Dudley, iron-master, for "Improvements in the building of ships and other vessels."—November 17.

William Newton of Chancery-lane, civil engineer, for "Improvements in manufacturing types and other similar raised surfaces for printing." (A communication.)—Nov. 17.

Frederick Oldfield Ward, of Cork-street, Middlesex, gentleman, and Malcolm William Hilles, of Henrietta-street, Covent-garden, gentleman, for "Improvements in the construction of railways, and in machinery and apparatus for working carriages thereon."—November 18.

Richard Wright, of Hermitage-terrace, sugar refiner, for "Improvements in refining sugar."—November 18.

Christopher Vaux, of Brighton, gentleman, for "Improvements in apparatus or machinery for preventing accidents to carriages and passengers on railways, parts of which improvements are applicable to save lives and property in other places."—November 18.

Henry Dircks, of Nicholas-lane, London, engineer, for "Improvements in the means of obtaining and preparing extracts from certain vegetable matters, and in the apparatus connected therewith, which apparatus may be also applied to other similar purposes."—November 18.

Edward Brown Wilson, of Leeds, engineer, for "Improved apparatus applicable to swivel bridges and turn tables." (A Communication.)—November 18.

John Finlay, of Glasgow, Ironmonger, for "a certain improvement or certain improvements in raising and lowering gas and other lamps, lustres, and chandeliers."—November 18.

Henry Buckworth Powell, of Pennington House, Southampton, lieutenant and captain in the grenadier guards, for "certain improvements in carriages to be used on rail and other roads.—November 18.

William Malins, of Mansion-house-place, London, and West Bromwich, Stafford, Iron-master, for "improvements in constructing roofs and other parts of buildings of iron an other metals, and in the preparation of the materials of which the same are or may constructed."—November 18.

Moses Poole, of the Patent Bill Office, London, gentleman, for "improvement i raising and transporting earth and other heavy bodies." (Being a communication.)—November 18.

James Laming, of Mark-lane, London, merchant, for "improvement in making the cyanides, ferrocyanides of potassium and sodium." (Being a communication.)—November 18.

Thomas Hunnybun and E ard Venden, of Cambridge, coachmakers, for "improvements in that description of p ssenger carriages called omnibuses."—November 20.

Frederick Gye, of South Lambeth, Surrey, gentleman, for "improvements in moulding sugar." (Being a communication.)—November 20.

Thomas Samuel Parlour, of Holloway, in the county of Middlesex, gentleman, for "improvements in propelling vessels."—November 20.

Nathaniel Chappell, of Arcadian Villa, Cumberland-road, Bristol, gentleman, for "improvements in the manufacture of worts."—November 20.

John Depledge, of the Thorncliff iron works, near Sheffield, draughtsman, for "a certain improved metallic broacher."—November 20.

William Johnson, of Farnworth, near Bolton, Lancaster, agent, for "certain improvements in machinery or apparatus for preparing cotton and other fibrous substances for spinning."—November 20.

William Corscaden Thompson, of Liverpool, master mariner, for "certain improvements in machinery or apparatus for propelling vessels on water."—November 20.

James Donaldson, of Haslengdon, Lancaster, woollen printer, for "certain improvements in the processes of scouring, bleaching, and washing wool, cotton, silk, and other fibrous substances, both in a raw or manufactured state."—November 20.

Ernest Edge, of Manchester, mechanic, for "certain improvements applicable to the wheels and axles of engines, tenders, carriages, waggons to be used upon railways."—November 20.

George Skinner, of Stockton-upon-Tees, in the county of Durham, merchant, and John Whalley, of South Stockton-upon-Tees, earthenware manufacturer, for "certain improvements in the manufacture of earthenware pastes and vitreous bodies; and also a new composition and material for the same, with certain new modes of combination thereof, which improvements, compositions, and combinations are applicable to the manufacture of earthenware pastes, vitreous bodies, slabs, tiles, and pavement, and various other useful and ornamental purposes."—November 20.

Eugene Francois Vidocq, of Gallerie Vivienne, France, for "improvements in combining materials to be employed in the manufacture of tea-trays, boxes, trunks, table-covers, oil-cloths, and other articles, to be used in place of the materials now employed in such manufactures."—November 20.

TO CORRESPONDENTS.

E. H.—You will see by the present number that the error in using common for Napierian logarithms has been observed. If it be desired, the paper shall appear next month.

Alpha.—Your objection fails, because the air in the tube, after the train has passed, is not the same air (though of the same density,) as that which was in the tube at first.

Dr. Shoklizh (Lemberg, Austria).—Next month, as there was not time to prepare an engraving for this number.

We have not heard whether Mr. Bashforth wishes to have his communication published.

END OF VOLUME VIII.

INDEX.

LIST OF ILLUSTRATIONS.

DIRECTIONS TO BINDER.

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