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The geographical changes which are produced near the embouchures of rivers by deposition of alluvial matter are in no part of the world exhibited in a more remarkable manner than in the delta of the Rhine. The natural operations of that river interest the antiquarian by the remoteness of their date, the geologist by their extent and physical character, and the engineer by the grand artificial works undertaken to resist or modify their effects.

The Rhine on entering the Low Countries divides into several branches: the southernmost of these, the Waaal, reaches the sea near Kampen; the most northern branch is nearly at right angles to the former, and empties itself into the “rolling Zuyderzee,” and another branch passes Rotterdam. The Rhine proper continues its unfeigned course to Leyden and Utrecht, and, nearly exhausted by the numerous canals which are connected with it, finally reaches the sea by a small artificial sluice. Its fate has been aptly compared to that of a de-throned monarch, who is deprived even of the satisfaction of attracting admiration and sympathy by the grandeur of his exit.

It is very interesting to observe how this delta has been altered even in the historic period. In the time of the Romans the Rhine had but two branches; Virgil calls it bisornis, and Tacitus says that the largest of these branches, that nearest to Gaul, is called Pakalum. Even in the days of Charlemagne, the Rhine communiced with the Escut, by a branch of the Meuse, which has since entirely disappeared. A great inundation, A.D. 880, destroyed the regularity of the mouths of the river. But perhaps the most remarkable alteration of all has been the conversion of the Zuyderzee from an inland fresh-water lake, such as it is described by Pomponius Mela, into a gulf of the sea. This change took place in the 13th century, and was the result of violent storms, during which the sea destroyed the barrier between itself and the lake. Traces of this barrier still exist in the islands and shoals between the Heider and Ter-shelling.

The natural division of the Rhine into two branches was first disturbed by the Roman legions under Drusus, who, in the 12th year before the Christian era, dug a canal from the Rhine to the small river Salo, as a military defence. This canal soon became enlarged by the force of the current into a third branch of the Rhine. A fourth branch, the Leck, was created subsequently, in a similar manner, during an insurrection under Claudius Civilis.

In our own times another important change is about to take place. The Lake of Haarlem is a large fresh water lake, between Leyden and Amsterdam, and communicates with the Zuyderzee. The project of draining this lake has been long entertained. The bottom consists of an alluvial deposit, well suited for agriculture. It was at the end of the last century, when steam engines began to be used for drainage, that the idea of employing them in draining the Lake of Haarlem was first entertained. The idea was but the extension of that which had already been practically exemplified in the drainage of the Beim and Diem, in Holland. The longest side of the lake of Haarlem is parallel to the sea, and is separated from it by a very narrow strip of land. Moreover, the level of the lake is some twenty feet below that of the sea. When, therefore, the drained country is covered with villages and farms, it must be well protected by dikes, or the sea may some day perhaps pay the sober Dutchman a visit for which even their amphibious nature has not sufficiently prepared them.

In order to ascertain the most approved method, and at the same time the most economical manner, of draining the lake, the Dutch Government appointed a Commission of Engineers to report upon the best means and to examine the various plans of drainage adopted in England. After examining a great variety of schemes and proposals, it was determined to adopt the plan submitted by Mr. Joseph Gibbs and Mr. Arthur Dean—who have, by close attention to all the details, produced an engine which is working with great effect and astonishing economy of fuel. It is proposed to have three engines of the same power, and three sets of pumps.

The first of these engines is now in operation, and the engineers have furnished us with the following description, which is replete with valuable and interesting information, and is accompanied by ample illustrations of the details. The means taken to avoid shocks or impulses in an engine of this magnitude are especially worthy of attention.
DESCRIPTION OF THE ENGINE.

The Leegwater Engine, as shown in Figs. 1, 2, and 3 of the accompanying Engravings, Plate 1 and 2, has two steam cylinders A and C, one within the other, united to the same bottom X, but the inner one is not attached at the top, a clear space of 1½ inch existing between it and the cover, which serves for both cylinders. The large cylinder A, is 144-37 inches diameter and 1½ inch thick, and the small cylinder, 84-25 inches diameter and 1½ inch thick; both are truly bored out, and the small cylinder is turned over on its outer center. The outer B is a steam jacket for the large cylinder, cast in 13 segments—which is again enclosed by a wooden casing, having 4 inches of peat ashes between them.

Pistons.—The small cylinder C is fitted with a plain piston of 5474-81 square inch, and the large cylinder A is occupied by an annular piston of 10,828-80 square inches area. The areas of the two cylinders, after deducting 472-8 square inches for the thickness of small cylinder, are as 1 to 265. The internal and external packings of the pistons consist of hard cast iron segments at bottom, with gasket above, pressed down by glands, also in segments; the open spaces in the pistons are filled with cast iron plates, and the tops of the pistons have movable cast iron covers.

Cap or Crosshead.—The pistons are connected to the great cap or crosshead G by the main piston rod Y, of 12 inches diameter, and by four small rods y of 4½ inches diameter (figs. 1 and 5). The great cap G has a circular body 9 feet 6 inches diameter, divided into eight compartments which can be filled with cast iron vessels, one of which forms a centre a guide spindle s passes through a stuffing box placed in the centre of a great beam of timber 2 feet square, which passes across the engine-house, and is secured to its walls; there are two other guide rods, c, which pass through stuffing boxes in the arms of the great cap G, and are secured to the upper and lower spring beams.

Plungers.—Suspended from the arms of the great cap are two 9-in. plunger poles F, working in plunger cases D; attached to D are two valve nozzles d, connected with stand pipes d, by two branch pipes d; the valve nozzles are connected with each other and an hydrostatic equilibrium valve nozzle O, from the bottom of which a branch piece is connected with the stand pipes d by the pipes d. The exterior surfaces of the plunger cases D are turned truly, so as to allow the rings to slide up and down freely; the rings are suspended from the great crosshead by rods e, and are furnished with cross bearings, on which the jaws of the main air-pump balance beams E rest: the inner ends of these balance beams move in a perfectly vertical line, and the outer ends are furnished with rollers working between guides, to allow for the variation of the beams during the up or down stroke.

Air Pump.—From the centre of the air-pump balances, the two air-pump plunger pistons s' are suspended (fig. 2) a diameter of plunger pistons 6 inches; the main air-pump M is also suspended by a branch piece with the bottom of the condenser M. The condenser has an intermittent injection by a valve 8-in. diameter, and a constant injection by another valve of 3-in. diameter. B is the condenser cistern. Air and Water.—L is the steam pipe (2 feet diameter) from the boilers; in it is placed a double-bore governor valve of 16-in. diameter.

P. the induction valve, 16-in. diameter and nozzle.

Q. Equilibrium valve, 20-in. diameter and nozzle.

S. Eddy valve, 20-in. diameter and nozzle.

g. Equilibrium steam pipe.

The induction and equilibrium nozzles are each connected to a separate port cast in the cylinder's bottom. The injection nozzle is connected by a pipe M, 34-in. diameter, to the branch-pipe M of the condenser. The pipe M is also connected to the bottom of the cylinder, which is a port cast, which communicates with the space under the annular piston; by this arrangement a constant vacuum is maintained beneath that piston.

The Hand Gear is connected to the weigh post K, and the pump rod is worked by a lever and shaft T, the outer end of which is slotted and worked on a pin in the sliding ring.

Atmosphere.—The engine is provided with a supply of 63-in. diameter; each pump is furnished with a cast iron balance beam (fig. 1), which radiates from the centre of the piston rod; the inner and outer arms are of equal lengths from the centre gudgeon. The inner ends of the balance beams are furnished with cast iron rollers, working against a plate, and the outer, which is screwed up against the under-side of the great cap; each beam is connected to the cap by two slotted bridles, to ensure simultaneous upward motion during the up-stroke of the engine. From the outer end of the balance beam the pump piston is suspended by wrought iron rods, 3-in. diameter and 16 feet long, and an additional length of 14 feet of patent chain cable attached to the pump piston. Fig. 3 shows a section of one of the pumps, and fig. 4 an elevation of the piston. A, working barrel, 63-in. diameter; B, windbox and check piece; C, the piston or bucket; D, bottom valve and seat.

The pump piston C is of a peculiar construction; it is composed of a wrought iron centre piece, 1 inch thick; firmly bolted to this piece are two double elbow frames of cast iron, called the oradles; the elbows are faced with gun-metal plates; the oradles serve to support two wrought iron semi-elliptic valves e, which occupy the whole area of the pump when they fall out, and constitute in fact the piston. These valves are edged with wood, having a piece of leather on the upper side secured by a wrought iron gland; the valves are hung to the centre piece at about 3 inches from their lower edges, so that when they open during the down stroke, any dirt or sand which has been on the bottom may fall through. Attached to the centre piece are two plates of cast iron, which serve as ballast to sink the piston; these ends are cast with a jaw, in which pieces of wood are secured to prevent friction against the sides of the pump and to give steadiness to the piston. These pistons require a weight of 14 lb. per square inch of the area of the pump to sink them with the velocity required upon the down stroke. The pump pistons of the Leegwater are not furnished with guides, as shown in figs. 3 and 4, and work very well without them; but the pistons for the pumps of the Cruquius and Van Lynden engines (now constructing for the drainage of the lake) have guides, as shown in the drawings, in consequence of the diameter of the pumps being increased to 72 inches.

Pump Valves.—The bottom valves have cast iron seats secured to the windbox, the valve seats are of wood, and the valves are simply plates of wrought iron, 1 inch thick; the valves are not hung on fixed joints, but are each fixed to a bar, the ends of which are entered in cast iron slot pieces, allowing a rise of 1½ inch, so that the valve can rise altogether from its seat, and give a large water passage all round.

Power of Engines.—The steam and pump pistons both perform a stroke of 10 feet in length; each pump by calculation should deliver 5,020 tons of water per stroke, or 96,524 tons for the eleven pumps but by actual measurement, out of the quantity delivered, it is found to be 63 tons. The loss might be reduced, but probably at the expense of increased friction.

The Engine House is a massive circular tower, concentric to the cylinders; on its walls are placed the eleven pump balances radiating from its centre, shown in the accompanying sketch. The pump balances a, b, c, are placed at 120 degrees from each other; d, e, s, f, g, g, are placed opposite each other; therefore, by this arrangement, the equilibrium of the great cap of the engine, under which the inner and outer balances are being increased to 72 inches. If any of the pumps require repairs, the opposite pairs can be easily detached, without causing more than a trivial delay to the working of the engine.

The Action of the engine is very simple; the steam being admitted into the small cylinder, the whole of the dead weight and pump balance beams attached to the great crosshead are elevated with it, and the steam being cut off at such portion of the stroke as may be required, the remainder is effected by the momentum acquired by the dead
weight and the pressure of the expanding steam upon the small piston (the pump pistons at the same time make their down stroke); at the end of the up stroke a pause of one or two seconds is requisite, to enable the valves of the pump pistons to fall out, so that upon the down stroke of the steam piston they may take their load of water without shock. During this time it is necessary to sustain the great crosshead and its load of dead weight at the point to which it was elevated by the up stroke, as otherwise it would fall back until the expanded steam under the small piston was again compressed to the equal pressure to square inch of the load lifted, or would cause a very violent shock upon the pump valves by suddenly throwing them out against the sides of the pumps. To avoid these evils, the hydraulic apparatus D F was devised.

Hydraulic Apparatus.—When the engine makes its up stroke, the plungers of the small piston push the water from the stand pipes and reservoirs through the valves d', and follows up the plunging poles as fast as they are elevated. At the end of the stroke the spherical valves instantly close, and the dead weight is suspended exactly at the point at which it had arrived—and, of course, if the valves are tight, could be maintained there for any given period; and all that was required for any given period, there was no pressure to close the valves of the pump pistons beyond their own weight; therefore, they fall out without the slightest shock. To make the down stroke, the equilibrium steam valve Q, and the hydraulic valve O are opened simultaneously: the water from beneath the piston of the small is pushed into the open valve, by the pressure of the pipes d', and the steam from the small cylinder passes by the pipe g, round to the upper side of the small and annular pistons, puts the pressure on the small piston in equilibrium, and presses upon the annular piston (beneath which a constant vacuum is maintained), in all of the rest the inner ends of the pump balances; by the united effort, the pump pistons are elevated, and the water discharged. Before the next stroke is made, the education valve is opened and a vacuum formed over both pistons.

So well does the hydraulic apparatus just described, effect the object for which it was designed, that the Harslem Meer Commissions have decided to use only eight pumps, but of 78-in. diameter, for the other engines. It has been the 63-inch pumps for the Leegwater Engine having been the fear of the shocks to which such large pump pistons are ordinarily liable.

Boilers.—The Leegwater Engine is furnished with five cylindrical boilers, each 30 feet long and 6 feet diameter, with a central fire tube, 4 feet diameter; a return flue passes under the boilers to the front, and there a flue pipe is shown in; two of the boilers have 35, and the other has 40 tons steam heating surface. The 63-inch boilers for the Leegwater Engine being having the fear of the shocks to which such large pump pistons are ordinarily liable.

The drainage.—Prior to the construction of the engine-house, for an earthern dam of a semi-circular form was thrown out into the lake, to enclose about 1/4 acre; after the water was pumped out from within the dam, a strong piled foundation was made, and the machinery commenced at the depth of 21 feet below the surface of the lake: a small steam engine was erected to evaporate the water from the dam. When the Leegwater Engine was completed, the Commissions determined to test its merits fully before deciding on the construction of the other engines upon the same model; and they had the means of evacuating the water within the dam to any level required, the Leegwater could be tried and worked continuously under any circumstances, precisely similar to those which will occur during the drainage of the lake, if, instead of discharging the water from the pumps into the upper canal, it was allowed to fall back again to the level from whence it was derived.

The average depth of the lake is 13 feet below the general level of the surface water of the canal and watercourses conducing to the sea; when the communications between those waters and the lake are closed, the engine will at first have only the head of water caused by the discharge from the pumps, and the friction of the machinery, to overcome; in this state, all the filling plates or bellast of the great cap and pistons will be taken out, and counter-balances added to the pump balances to make the engine as near as possible to the dead weight attached to the great cap as may be required for working the engine: as the lift becomes greater, the dead weight "in doors" will be gradually added. In this manner, the engine was worked for a considerable time, to get all the parts in good working order. A sub-committee of the Commission conducted a series of experiments, and satisfied themselves that the Leegwater will perform a duty of 75 million pounds, lifted one foot high, by the consumption of 94 lb. of good Welsh coal, whilst exerting a net effective force of 380 horses' power. With a lift of 13 feet, the engine easily worked the eleven pumps simultaneously; the net load of water lifted being 817 tons, and the discharge 2 tons per minute.

When the bed of the lake is cultivated at 18 inches below the general level of the bottom; but in time of winter floods, the waters of the upper level of the country will be raised above their ordinary height; in which case, and as the cap, of the bed of the lake due to the regulated height, the lift and head may be increased to 17 feet; and this increase of 4 feet will not affect the engine under these circumstances (and without regard to the consumption of fuel), the whole of the 11 pumps were worked simultaneously, and the extraordinary quantity of 109 tons net of water was raised per stroke to the height of 10 feet; but, in practice, it will be advisable to work a less number of pumps, and increase the number of strokes per minute.

After numerous and severe trials of the engines, the Commissioners were satisfied that it is capable of performing its work under the most difficult circumstances that can arise; and immediately determined on having two more engines constructed, of equal size, and on the same principle. The new engines will be run on the same lines as before, a distance of 73 feet, 1 inch, in diameter, placed in pairs opposite each other, and the ends of the balance beams projecting over the great cap of the engine (instead of under as in the Leegwater), to which they will be connected by stout iron straps. The engines also will be increased in number, and in power nearly 100 horses. All the feed-water will be filtered before passing into the boilers.

Advantages of Two Cylinders.—Many persons imagine that the engines are constructed with two cylinders to obtain a greater expansion of the steam than would be attainable in one cylinder; but such is not the case, as no greater economy of steam can be obtained by the use of two cylinders than by one, although greater steadiness of motion for rotary engines, and less strain upon the pitwork of a direct-acting engine, may result from the use of two cylinders. In the Harslem engines two cylinders are used, because if one cylinder only were employed it would sometimes be necessary to use a dead weight of 125 tons to overcome the resistance of the water load and friction of the engine and pumps; such a mass of iron or other heavy material would be unmanageable, and no alteration in the force of the engine could be effected but by taking from or adding to the dead weight, which would be a source of great difficulty and inconvenience, when the varying height of the load, during the drainage of the lake, is considered; particularly as at times the water will be entering the engine, and have no other matter to add to the friction of the pumps. By the adopted maximum dead-weight elevated by the small piston will seldom exceed 85 tons; the additional power required being derived from the pressure of the return steam, at the down stroke on the annular piston; by varying the expansion and pressure of the steam in the small cylinder, the engineman can add or diminish the pressure upon the annular piston, so as to meet any case of variable resistance without the inconvenience and delay attending an alteration of the dead weight; the load is therefore under perfect command at all times.

Quantity of Water.—The area of the Harslem Lake is 45,290 acres, the estimated contents to be pumped out about 800 million tons, but should the quantity be increased by any unforeseen cause even to 1000 million tons, the whole amount could be evaporated by the three engines in about 400 days.

The bed of the lake when drained must be always kept dry by machinery, and observations continued during 15 years show that the greatest quantity of rain which fell upon the area of the lake during that period would give 86 million tons as the maximum quantity of water to be elevated by the engines in one month; to perform this work would require a force of 1084 horses' power to be exerted during that period, the average annual demand as estimated is 54 million tons.

The cost of the Leegwater, buildings, engines, and machinery was 96,000/.; of this amount about 15,000/. is due to the boilers, and certain contingencies. For the foundations 1400 piles were driven to the depth of 40 feet into a bed of hard sand, and a strong platform laid thereon at the depth of 21 feet below the surface of the lake; upon this platform at the distance of 32 feet from the engine-house, a strong wall pierced with arches was constructed, and at 7 feet from the coping, a stout floor of oak was laid between the wall and the engine.
HOUSE; the pumps rest upon the platform beneath and opposite the arches, and their heads come through the floor slidi to, and stand about 3 feet above its level; into the canals thus formed between the engine-house and the outer wall, the water from the pumps is discharged, and flows off on either side of the boiler house, through sluice gates, into the canals conducting to the sea sluices.

The great cost of the buildings for whatever description of machinery might have been employed, rendered it an object of considerable importance to lessen this expense by concentrating the power to drain the lake in three engines; in addition to which a considerable saving in the wages of enginemen, stokers, and others is effected, as these large engines require very little more attendance than an ordinary mine engine; this is an important feature in the economy of the charge for the permanent drainage of the "Polder," which will be formed by the drainage of the lake.

The average consumption of the ordinary land-draining engines applied to scoop wheels and Archimedean screws, may be taken at 15 lb. of coal per net horse power per hour; this quantity will be greatly reduced if the horses power of the engine be calculated by the pressure of the steam on the pistons, and not by the net delivery of the water; in a case where the water delivered by a large steam engine working a scoop wheel, was measured during eight hours, the engine was found to exert a net force of 73 horses' power during the first hour, with a consumption of 18 lb. of coal per net horse power; as the steam power diminished, and the consumption of fuel increased, until at the eighth hour it was found that the engine only exerted a net force of 33 horses' power, and consumed 24 lb. of coal per net horse power per hour. The consumption of fuel by the Leegwater is 23 lb. of coal per horse power per hour when working with a net effective power of 350 horses.

No new principle has been developed in the Leegwater, but important facts have been demonstrated, which must have an immense influence on the progress of agricultural hydraulic engineering: it has proved that with proper attention to well-known principles, steam engines of the very largest class (the Leegwater is believed to be the largest and most powerful land-engine ever constructed), may be employed to raise great bodies of water from low lifts for the drainage or irrigation of low lands with as great an economy of fuel as was hitherto generally supposed to be confined to the elevation of comparatively small quantities of water to great heights. To the Haarlem Meir Commissioners belongs the merit of having first by the Leegwater to carry out this bold experiment, and they will reap their reward by an economy of at least 100,000l. over the cost of draining the lake by the ordinary system of steam engines and hydraulic machinery employed to drain low lands, and of upwards of 170,000l. three years time, over the cost of draining the lake by the windmill system hitherto in use in Holland.

Upon the cost of annual drainage an important saving will also be effected; by the system adopted it is estimated at 4000l., by windmills at 6100l., and by the ordinary steam engines at 10,000l. per annum, and if interest at 5 per cent. on the money saved in the original cost of draining the lake be taken into the account, the figures would stand thus, 4600l., 14600l., and 15000l.

The Leegwater is named in honour of a celebrated Dutch engineer, who, from his great success in draining numerous lakes in North Holland, was popularly known by the name of "Leegwater," or "the drier-up of water," and with him the first proposal of the drainage originated in 1628. The other two engines are called Cruquius and Van Lynden, after two celebrated men who have at various periods interested themselves in promoting the drainage of the Lake.

The engines and pumps are manufactured at the well-known establishment of Messrs. Harvey and Co., of Hayle, and Messrs. Fox and Co. of Perran, Cornwall; the pump balances and boilers by Messrs. Van Vlissingen and Van Heel, of Amsterdam.

TRABEATE AND ARCULATE ARCHITECTURE.

THIRD ARTICLE.

It is but a thankless office to demonstrate that an object of general admiration is unworthy of the homage paid to it: though the innovator may dethrone the idol, he cannot propitiate its worshippers. The advocate of heterodox opinions in architecture must not, therefore, even if he succeed in convincing his opponents, expect to win their applause. In these papers, of which the object has been to demonstrate the errors which have crept into our architectural system from an attempt to combine two irreconcilable means of construction—the arch and architrave—we have endeavoured to avoid the appearance of heterodoxy by confirming our opinions by the citation of acknowledged authorities. For the last three centuries it has been customary to consider architectural forms independently of their purpose; but though the effort to inculcate similar principles be comparatively recent, the labourers in this arduous undertaking are by no means few. We already reckon the names of Hope, Willis, Whewell, Cockrell, and Paley, among the advocates of architectural truth.

As an example of the effects of confounding trebates and arcuate architecture, we have referred to the inconstructive arrangements of the dome and other parts of St. Paul's Cathedral—a bold illustration, certainly, but one supported by the recorded opinion of Professor Cockrell, that this building exhibits a confusion of the principles of Classic and Christian Architecture. If by way of contract with the dome of St. Paul's, we examine the spires of Chichester or Salisbury Cathedrals, the difference between the principles of the medieval architects and of those who succeeded them will be seen in a very clear light. In the two mediæval spires there is no casing or outer covering to conceal the inner mechanical arrangements of the structure. Every course of stones used in the construction is visible, both from the outside and inside of those noble works. The visitor on ascend- ing finds himself within a vast cone, formed of circular horizontal courses of masonry, diminishing in diameter from the base to the summit: he looks in vain for a single means of support not visible from the exterior of the cathedral. In St. Paul's, on the contrary, the real spire is, as has been shown, a concealed cone of bricks: the dome is merely a wooden frame-work fixed on to the cone after it was finished. Two ends are answered by this contrivance: the bricks are hidden, and an appearance of vaulting is given where it does not exist.

This and similar inconstructive arrangements are readily explained when we consider them the natural effects of an attempt to combine arch and architrave construction. It is time however to turn to another example of those effects; and the inference with respect to modern art being far more direct in the instance which we are about to select than in the former, the necessity of quoting authorities becomes greater.

"But of all the parts borrowed from Grecian Architecture," says Hope in the eighth chapter of his admirable Essay, "that which came to be applied in the way most different from, most inconsistent with, its nature and distinction in the original, was the festoon, the part which we call the pediment. The pediment, which was only the termination of a roof slanting both ways from its central line or spine, of which, throughout its whole length, from end to end, the continuity was never broken, which was never seen in Grecian buildings, except on the straight line at the summit and the gable formed by the extremity of the roof, in Roman architecture frequently appeared as if cut off from all that belonged to it, and grew out of, and was stuck under, the entablature which it should have surmounted, against the upright wall, or a window, or a niche,—even as in the temple of Balbe, placed within a projecting portico, a situation in which it could not be useful even to carry off the wet. . . . In Grecian architecture the square pilaster only terminated the square pier or ante; by the Romans it was carried in shallow slips or slices along the whole surface of the wall; and as the tyrant Maxentius tied together the living and the dead, so the architects of Rome everywhere attached the round, vigorous, and independent column to one of these flat, weak, and confined pilasters, for no other purpose that can be conjectured than that the effect of its tapering form might be destroyed by the straight lines of the pilaster."

These opinions respecting the use and abuse of pediments and columns are applied, in another part of the same work, to the Cathedral of St. Peter's, at Rome, in the following terms:—"One condemn the church its front so much broken by partial projections, its pediment standing on a base too narrow, and an expance too small, and rendered evidently useless by the ponderous attic that rises behind it and crushes the façade to which it was intended to give elevation."
"Contemplating those columns of nearly 9 feet in diameter, but which, formed of masonry of small stones, only look on a near approach like small turrets, one cannot help casting a lingering look back on the poriose of the Pantheon, and thinking that elevation of insulating columns of granite of one single piece, though smaller in its dimensions, grander in its conception, and more striking in effect, than these clusters of large pillars, all reticulated with joints, and jammed up against a wall."

All these solecisms in the employment of pediments and columns may be easily traced to the attempts to retain the forms of Greek architecture, after the invention of the arch. By means of this invention the Romans were enabled to give to their edifices an extent and diversity of form before unknown. It was no longer necessary for the stability of a structure, that its roofs should be supported directly from the ground by vertical columns, placed so close that the intercolumniation might be spanned by a single block of stone. On the contrary, the buildings were raised to many stories in height, and both vertically and laterally were made up of vast multiplicity of parts which, judging by the eye alone, we should pronounce the main formal distinction of Roman from simple Greek architecture. A natural consequence of the invention of the arch was the vaulting of roofs, which rendered the pediment generally unnecessary, and therefore adventitious.

It is by no means to be inferred that the introduction of the arch was prejudicial to the art. On the contrary, every new contrivance by which construction is facilitated ought to be looked upon as a direct benefit to architecture; for the most liberal and elevated views of an art are those which encourage its extension by every available means. The injurious effects complained of by Hope arose, not from the invention of the arch abstractedly considered, but from the injudicious application of it. It had rendered almost all the Greek forms unnecessary; they ought therefore to have been unreservedly abandoned in accurate building, or at least those of them alone should have been retained which were necessarily common to the two modes of construction.

The pediment was appropriate and had meaning where what Hope aptly terms the spine of the roof (that is, the line formed by the two inclined planes intersecting at their vertical angle) was continued throughout the building from end to end. Where, however, the roof was flat, or surmounted by a horizontal entablature, as in Roman, and subsequently in Lombardic, architecture, or where the structure was crowned by a "ponderous attic," as in the case of St. Peter's, and numerous modern English buildings to which it is unnecessary to specify, it is clear that the pediment could have no real constructive use.

To the general reader we may appear unnecessarily minute in insisting upon these points, because he is not aware how much prejudice has to be surmounted in establishing them. A great change of opinion on architectural subjects is, however, happily taking place, and we trust that the day is not far distant when these observations will appear superfluous arguments in favour of self-evident propositions. For the present, however, we must be content to utter truths, and to illustrate them in every possible way their application and effect.

Flat-roofed buildings can never require pediments: let us apply this rule to the new show-front of the British Museum, now nearly completed. We will at once allow that there is something exceedingly attractive in the long range of numerous columns there presented to the eye. Columnation on an extensive scale has such peculiar magnificence; the difficulty is rather to produce an ungraceful, than a graceful, appearance by means of it. The architect of the British Museum has, however, surmounted this difficulty to a great extent. Still, much remains that will captivate the general eye, and we doubt not that those who prefer profusion of ornament to the right use of it, will greatly admire the new façade. But we are now addressing those who are willing to estimate architecture not by the eye alone, but by the judgment also.

It is to be observed then, in the first place, that the British Museum, though an isolated structure, in a position where it is seen from many points of view, has only one side decorated, the decorations being of course placed where they will be seen from the most frequented street.

"Per unreachable, late quid splendidas, ursu et alter
Amator petas."  

The pediment, consistently enough, is stuck on to the façade, just as the façade is stuck on to the building. The horizontal entablature of the wings are either mere marks to conceal the real outline of the roofs, or else the roofs are flat. On the latter supposition, it is quite clear that the central pediment is placed where it does not define the outline of another roof; for a glance will convince us that there is not behind this pediment an inclined roof with its axis perpendicular to the front of the building, and its spine continued throughout the whole length from end to end.

In point of fact, this pediment has no more connection with the building than the sign-boards frequently seen on the parapets of taverns have with walls to which they are attached. The comparison may be a homely one, but it exactly expresses the nature of the case. Similar remarks might be applied to the Mansion House, Buckingham Palace, and numerous other buildings, in and out of London, but the general principle is so clear, that it is useless to provoke unnecessary opposition by pointing out all its consequences.

Had not custom familiarised us with the absurdity, there would appear something inexpressibly ludicrous in the fashion of uniting the front of a Greek temple to a modern secular square-built structure.

It is well known that a systematic and growing opposition to Classic architecture now exists in this country. Those who resist the noble tenets and express their indignation at the term "Pagan," do not consider that they themselves strengthen the arguments of their opponents by their adherence to debased Classic architecture. A barbarous confusion of different principles of construction can never be permanent, however obstinately it may be defended; and it certainly appears the most prudent course to give up a part of the contest at once, and return to pure and faithful Classic architecture, than by blindly defending its most corrupt forms, to ensure the ultimate demise of every form of it.

The attempt to combine the forms of trabeate and accurate construction has produced, as all will admit who are not interested in the denial, a strange mongrel style, in which members, which had originally significance and utility, are distorted and disarranged in every conceivable manner. Such architecture resembles a mere "hortus siccus," or herbal filled with botanical specimens; for its relation to true architecture is that of withered leaves to a living flora. Or is it not, rather, an architectural Frankenstein, endowed with vitality indeed—

but vitality of that monstrous kind which renders it only the more hideous by adapting its individual members to strange, unnatural uses?

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REMOVAL OF WESTMINSTER BRIDGE.

Many arguments have been urged in favour of the existing site of Westminster Bridge; those in favour of a new site have not yet been communicated to the public. There can be no doubt that the Commissioners of Woods and Forests have wise and cogent reasons for giving notice of their intention to apply for "an act to alter, amend and repeal, several acts of Parliament passed during the reigns of George II. and III., relative to Westminster Bridge, &c." And as we give the Commissioners credit for the best and most prudent motives, it cannot but be regretted that the public have of late years fallen into the unhappy habit of judging for themselves on matters of public interest. It has been argued (indifferently, no doubt) that the collective opinion of the inhabitants of Westminster and Lambeth is to the relative advantage of the new and old sites, is as valuable as that of a Government commission. The ideas that the latter possesses exclusive information on the subject, and are therefore the most com-
petent to decide, is summarily rejected by the opposing party, who reply (and it is difficult to detect a flaw in their reasoning) that the nature of the subject precludes the existence of exclusive information—that whatever knowledge of the facts may be possessed by the Commissioners is shared with the inhabitants of the districts affected—that the convenience of any particular thoroughfare to the latter is a matter of daily observation, and that in the ordinary line of trade they would be certain to learn whether traffic was obstructed by difficulties in the route chosen for it. Finally, it is argued that if the Commission were to use any exclusive knowledge on the subject, it is the very kind of a knowledge which they ought not to have; for though private information may be very important in carrying on business of high diplomatic importance, the existence of private information on such a very matter-of-fact topic as the alteration of a thoroughfare gives colour, at least, to a charge of undue regard for private interests.

At a meeting of the inhabitants of Westminster, held during the last month, the chairman, Mr. B. Hawes, the member for Lambeth, opened the proceedings, said—

"There had been so much annoyance of public feeling in favour of the proposed new bridge to Charing-cross, although the money for erecting it, amounting to upwards of £2,000,000, would be taken from the public purse. The old bridge had not been composed to the government in the way that a public department had consented to give certain notices prior to the introduction of the bill. He hardly thought any member for Lambeth, Westminster, or Surrey would be found to support such a measure; and he might be asked with some reason what he would do for it? He understood the architect of the new Houses of Parliament thought the present bridge an eye-sore; but could it not be repaired and beautified, or rebuilt on the existing site? There were many reasons for retaining it: first of all, on the ground of economy. All the approaches to the present bridge were the property of the bridge commissioners. In the next place, a bridge lower down, as was proposed, must be longer and larger; and all the approaches would have to be bought. But was it just to existing interests to build a bridge elsewhere? There were at present two private bridges close to the site of the new bridge—Waterloo and Hungerford bridges—the first of which did not pay a farthing to the subtenants, and the other paid but very badly. From the proposed bridge to Waterloo-bridge there would be a distance of only about 250 feet, whilst the Hungerford-bridge would be close to it; and Westminster-bridge being taken down, there would be an accommodation for the public from the Charing-cross bridge to Vauxhall bridge—a distance of about a mile. When the present bridge was built, the site was a matter of considerable discussion; it was, moreover, selected as the most beneficial for the public at large; and he believed, that from the corner of York-road over the new bridge to Lambeth, would not be 20 yards nearer than by the present route. Besides this, the view was so fine, being westward over Westminster Bridge to Belgrave-square, Pimlico, Knightsbridge, &c., and access to the Houses of Parliament, and the law courts. He pledged himself to oppose the bill in every stage, and he did not believe that five gentlemen would be found in parliament to sanction such an unnecessary waste of public money."

It was also asserted at the meeting, that the Commissioners themselves were not very strongly persuaded of the necessity of altering the situation of the bridge, but had merely allowed their solicitor to prepare the notices: another suggestion was, that Hungerford Bridge had been already conditionally sold to the Southampton Railway Company, who intended to use it as an approach to their new terminus in Lambeth. If this important information be correct, it may reasonably be feared that the promoters of the removal of Westminster Bridge to Charing-cross will incur the charge of over anxiety to facilitate the conversion of Hungerford Bridge to the purposes of the Southampton Railway Company. This bridge and the new Westminster Bridge would so nearly adjoin at their Lambeth ends, that the former would be rendered nearly useless to the public at large; and it might be as well therefore be greatly facilitated.

The metropolitan bridges are so near that it is difficult to see the distance. This arrangement secures the greatest amount of benefit from each of them: but by removing Westminster Bridge to Whitehall-place, a large and densely-populated district, extending from that point to Vauxhall Bridge, will have no intermediate communication with the opposite bank of the river. There can be no doubt but that after a time, this evil will be so seriously felt, that another bridge must be built above the new Houses of Parliament—that is, the public will be put to the expense of building two bridges instead of one. Moreover, may we not justly complain of the inconstancy of pronouncing Hungerford Bridge by one legislative act a useful, by another a useless, structure? The only just ground for sanctioning its erection was public convenience. If it were not of public utility it ought not to have been erected: if it were of public utility it ought not to be rendered useless, by the erection of another bridge almost close to it. In every point of view, the proposed measure presents the same appearance of being anticipatory of a purchase of Hungerford Bridge for private purposes. For no one would be mad enough to propose two contiguous bridges, unless one of them were about to be closed against the public.

We have said little of the injury to existing and justly acquired interests consequent on the alteration, because we wish to view the question on general grounds. But it certainly seems a matter of injustice, almost of robbery, to ruin the property adjacent to the present line of traffic. Many of the houses in the roads leading to Westminster Bridge have, doubtless, frequently changed hands during the last century, and the price of purchase must have been materially influenced by the consideration of the present facilities of communication. The purchaser, who has bought on faith of the permanence of those facilities, finds suddenly that the amount of his purchase-money was twice too much. On the other hand, the owner of mean tenements in Lambeth, adjacent to the new site of the bridge, finds himself in possession of valuable property, at a most inadequate cost. The injustice is double. The latter class of purchasers have no moral right to a treble or quadruple value of their property—the former class are deprived of the value of investments honestly and legally acquired.

To the lover of architecture, it will appear no small argument against the removal of Westminster Bridge, that by that act the only convenient point for viewing the Houses of Parliament is lost to the great body of the inhabitants of London. This consideration has gained additional force since the spires of the old bridge have been in progress. Recently, the footway has been lowered, and a light parapet of wood, breast high, has been substituted for the former lofty balustrade, by which the view was almost entirely obstructed. The river facade of the New Palace, consequently, presents itself to the eye with a distinctness and unity never before exhibited. It is really curious to observe how much the appearance of the edifice has been improved by the alteration of the bridge. Of course, this advantage would be sacrificed by removing the bridge to Whitehall-place; in fact, the public generally would then have no means of viewing the Palace of Westminster except from a considerable distance that Mr. Barry has nothing to do with the proposition for altering the site of the bridge, but is, on the contrary, desirous that it should remain unaltered, may be announced on the authority of a statement made by Mr. Grissell at the meeting referred to above.
We should like to know which of these arguments satisfies the reader; neither has much weight with ourselves. We do not fear that the merits of Mr. Burton's arch will be destroyed, because we are unable to perceive their existence; and the same consideration removes all apprehension respecting Apsley House and the row of stone columns adjacent to it. In the first place, the triumphal arch displays eminently the fault of all its tribe—forms without purpose. If the arch be real, its object must be to support a superstructure of proportional size; a vault so enormous as this would never have been erected without such a superstructure, had the least idea of constructive propriety entered the mind of the architect. The vast arches which form the portico beneath the Victoria Tower of the Houses of Parliament are about as large as that in Piccadilly, but then they are of a size corresponding to their purpose—were it not intended to support a vault tower upon them, they must appear ridiculous. It seems to be forgotten that an arch is not an integral building, but only a part of one, just as a single limb is only one of the component parts of the animal body. Again, if Mr. Burton's arch were real, it would have butresses; for we know by ordinary mechanical principles that an arch cannot exist without lateral pressures, and that a buttress diminishing in breadth from its base upwards is the proper form for resisting those pressures. The fact that the buttresses being dispensed with, proves that this arch is applied to no purpose, or to a wrong purpose. Lastly, if the arch were real, what is the purpose of the Corinthian columns and horizontal entablature? An arch properly built requires neither. If the weight be supported on a single beam of stone laid on vertical props (as the columns and entablature suggest), the arch is superfluous. Or if the construction be altogether different—if the space be spanned by numerous wedge-shaped stones, arranged in the form of a vault—then the columns are superfluous. The arch and the entablature cannot both be wanted; one at least of them is incoherent: we believe that both are.

Neither is Apsley House much likely to be injured. In our view, the columns, stuck in front of the walls of the first floor for show, effectually put the building beyond the pale of criticism. We should have thought the same of the adjacent screen of columns, had not the Institute of British Architects pronounced it "elegant." Where is the elegance? We can see the beauty of the periphery of a Greek temple, for there the columns have meaning and purpose. But surely the row of columns at the entrance of the Hyde Park are use-meaning. They sustain no weight but that of the small horizontal course of stones laid atwatt them. Judging from their dimensions, you would say that the architect had intended to build a large solid edifice, but had been compelled to relinquish his work when only just commenced; or it might be thought that the substructure was begun by one architect and that another, who did not know for what superstructure it was intended, had finished it in the readiest way he could.

Amphoraque

Inst: cur est? cur non est?

In the second paragraph of the Report, the Institute speak of the triumphal arch as "a successful work." In the concluding paragraph it is recommended that it should be enriched with "accessorial and subordinate" decorations, as "it would then no longer be subject to the severe criticism of artists, foreign visitors, and persons of acknowledged taste." When the writer of the Report praises the arch as successful, he contradicts the laws of good architecture and common sense; but when he suggests means of avoiding the severe and general criticism of it, he does something totally different—he contradicts himself. We are told, first, that the arch is successful; secondly, that it should be decorated in a very different way to what it has ever yet been, in order to be "no longer subject" to universal condemnation. Clearly then, its success has been of a very different kind to that which the Institute set out by assigning to it.

These strictures upon the Report of the Institute are dictated by a sincere conviction that the formal opinion of so distinguished a body ought to possess far greater weight and authority than will be assigned to this document. The Institute is comprised of those whose learning and position command general respect, and whose seal in the cause of architecture, and success in the practice of it, indispensably entitle
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them to the support of the profession which they represent. But dissatisfaction at the acts of the collective body is not inconsistent with a most ample acknowledgment of the talents of the individual members.

Considering that the leading architectural doctrine of this Journal is the dependence of decoration on construction, it is natural enough that when the Institute applaud structures in which this great principle is grossly violated, we at least should examine the grounds of their judgment. How has it been arrived at? Certainly not in ignorance of the principle of architectural truth. Neither, we suppose, in defiance of it, for this—to put the question on its lowest basis—would indicate opposition to the doctrines advocated by the most learned architectural writers of our own day, and exemplified by the noblest monuments of ancient architecture. No other supposition remains but that the Institute recognise the principle, but are literally afraid of its consequences. Much opposition, doubtless, must be overcome before what may be called nonsensical architecture is consigned to its deserved destiny. But the Institute carry their complaisance and caution too far when, to avoid offending individual prejudices, they advocate an irrational system which is fast growing obsolete. It lies in their power to contribute most effectually to the emancipation of art from the artificial and conventionalism which have too long enthralled it. They may direct the reformation, and beneficially modify its operations; but it is beyond their power to restrain its progress.

Every paper read before this learned body, or sanctioned by it, is retrospective—some prospective. The progression, the improvement of art is severely ever heard of. The past—the past only, claims all attention; and this among those who are best qualified to make provision for the future. The Institute owe it to themselves, and owe it to the public, to take a far more elevated and independent position than they have yet assumed: when they have shown their determination to lead the public taste, instead of following it, we doubt not that their title to do so will be universally recognised.

A statement has been made that Mr. Weale offered to the Institute to publish illustrations of the works of the members, and that his offer was rejected. We are in no way concerned in this statement, and know nothing whatever of it but that it appears in the Westminster Review, and has been contradicted at a meeting of the Institute. But the very existence of the rumour, and the earnestness of the denial, indicates its importance. The difficulties of procuring information respecting the progress of architecture are, as we know by experience, almost insurmountable. Have we not a right to complain that this information is not voluntarily offered? Our applications to individual architects have been met with uniform courtesy and liberality. But we still feel that the greatest possible benefit which the Institute could confer on their art would be by calling on the members to detail, from time to time, the progress of their works—not to read dissertations on Roman remains in London, or the scenelli impostes of Vitruvius. We are also perfectly certain that this feeling is strongly participatid in by the architectural profession at large and the whole body of the lovers of architecture. Surely an opinion so universal ought to claim some respect from the Institute.

To the remarks made at the meeting just referred to respecting the impropriety of authors reviewing their own writings, we fully assented. All public confidence in reviews must cease when the slightest objection or even suspicion of partiality attaches to them. It has been an invariable rule of this Journal that every paper should be rejected, whatever might be the subject of it, if it seemed written with a covert purpose of furthering individual interests: We are quite willing, or rather, we are most solicitous, that if cases should occur in which our subscribers think that this rule has not been applied with sufficient stringency, the particulars should be publicly communicated in our own pages. These observations have somewhat of personal interest; but the occasion seemed to demand them.

ON THE INFLUENCE OF HEAT UPON THE COHESION OF LIQUIDS.

By C. Brunner, jun.

(Translated in an abridged form by M. Rosenthal, M.D.)

Laplace and Poisson have established it as a law, that at various temperatures the height of the capillary column is in a direct ratio with its density. In asserting this, however, they were solely guided by theoretical views on the “force moléculaire.” Guy-Lussac’s experiments bearing on the above are too insufficient in number to settle the question; and, notwithstanding many valuable publications being since communicated by several authors, Brunner deemed it worthy his consideration to undertake a fresh investigation of the matter. M. Hagen having lately stated that in the case of water, a change of temperature, amounting to a certain number of degrees, has no influence on the phenomena of its capillarity, the author was the more attentive to this point in his researches. M. Hagen in his experiments employed brass plates, brought together in a parallel direction, but Brunner operated with capillary tubes.

These experiments were conducted in the following manner:—The liquid to be examined was introduced into a cylindrical jar, and the latter put in an oil bath; care being taken that the portion of liquid contained in the capillary tube should be of the same temperature as that observed in the external liquid. To measure the height of the liquid column raised, a glass mass was first immersed in the external liquid, in order to raise the liquid surface until it reached the point of a steel needle fixed for this purpose. The observer, by means of a callibrometer, having noticed the uppermost point of the liquid column raised in the capillary tube, removed again the glass mass immersed as above; the water thus lowered ceased to touch the steel point, and the callibrometer was directed towards the steel point.

The distance between the highest point of the capillary column and the steel point, obtained by means of the callibrometer, indicated the amount of elevation occurring in the capillary tube above the natural level.

These experiments were made with water, ether, and olive oil. In all these liquids, it appeared, the height of the capillary column was considerably diminished by an increase of temperature, in a ratio far greater than would answer to Laplace or Poisson’s law relative to the proportionality of density; water, for instance, its temperature being raised from 32° to 150° F., had its density lowered by 3%, whereas its capillary height decreased to almost ½. It seems in general that the diminution of the capillary height, caused by elevation of temperature, is not proportional to density, but that it is rather corresponding with the increase of temperature.

Founded on this assertion, Brunner calculated his experiments agreeably to the method of the “least squares.” In this manner he had this law fully confirmed; and the height (A) at which a column of liquid in a capillary tube of one millimeter radius, at a given temperature, is raised, may be determined by means of the following most simple formula:—

For water, \[ A = \frac{15.54215}{t - 0.026598} \]

For ether, \[ A = \frac{5.3654}{t - 0.026013} \]

For olive oil, \[ A = \frac{7.8610}{t - 0.014056} \]

In these formulas, \( t \) expresses the temperature in degrees of the centigrade scale.

The law, that capillarity is not a direct ratio with density, but that it is inversely proportional to the elevation of temperature, becomes most evidently corroborated by observations made with water at low temperatures. About 800 experiments, instituted with water at temperatures varying from 6° to 8° centigrade, or 46° to 58° Fahr., showed that the well-known anomaly occurring in the density of water, from 33° to 35°, had no influence whatever on its cohesion; and starting from 35° F. cohesion, diminished in a ratio proportional to the increase of temperature.

We may, therefore, consider it as established that heat has another influence on cohesion than that caused by mere change of density.
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WILD'S RAILWAY SWITCH.

(With an Engraving, Plate III.)

In the present number we give an engraving of a new railway switch. There have been since the first introduction of railways, several arrangements proposed for passing trains from one line of rails to another; the whole of these, however, which have been adopted may be classed under two heads: those in which, in order to effect a change from one line of rails to another, the apparatus had to be moved by hand; and those in which an engine can pass from either of the two diverging lines on to the single line without such aid, clearing the way for itself, should the switch be in the wrong position. These are termed, and are, to a certain extent, self-acting.

The former possessed the advantage of making the gauge perfect for either line, but was deficient in the more essential quality of safety; while the latter, to attain this quality, sacrificed the parallelism of gauge. In the improved switch the advantages of both are united, the self-acting principle being accompanied with perfect uniformity of gauge.

In order to describe the working of the new apparatus, it will be first advisable to refer to the one now mostly employed, in which either tongue rail is embedded in the ordinary rail according to the position of the switch; in this arrangement the gauge is always imperfect, as the notch occupied by the end of the tongue rail is, when this is withdrawn, left exposed: this defect is partially provided against by the introduction of a check rail.

In the improved switch, the end of the tongue, when in contact with the rail, is also embedded in a notch, which however ceases to exist when it is no longer required. This motion is effected by causing the rail abutting against the end of the tongue to move in connection with it, but in the opposite direction, so that when the tongue is withdrawn, the protruding rail which formed the notch is withdrawn also.

In all inventions of this class, however ingenious they may appear on paper, practice is the main test of their utility, and we are informed that the invention which we have now noticed, has been for some time in successful operation upon several railways, among which we may mention the Grand Junction, the Manchester and Leeds, the Chester and Birkenhead, and the South Eastern Railways.

Le Verrier's paper confirmed that of Mr. Adams. The self-explanatory tone adopted by the superintendent of the two principal English observatories does not seem altogether needless. The fact of their both offering apologies, seems to indicate that apologies were necessary. The Astronomer-Royal had "always considered the correctness of a distant mathematical result to be a subject rather of moral than of mathematical evidence." Professor Challis says, in a paper following that by Professor Airy, that his motive for undertaking the search for the predicted planet, was the agreement of M. Le Verrier's "deductions with those of Mr. Adams, together with the recommendation of the Astronomer-Royal." He tells us, also, that he was deterred from commencing the work sooner, because it was considered a thing to undertake observations in reliance upon merely theoretical deductions.

We have no desire to depreciate M. Le Verrier's labours. On the contrary, they entitle him to high renown. His first paper alone, investigating the perturbations of Uranus without assigning any new cause for them, is a work of the utmost scientific value. But the chief peculiarity of this event in the history of science is the predictive evidence and application of the laws of gravitation. Hitherto, the evidence of the truth of those laws, wonderfully minute and varied as it has been, was restricted to the explanation of observed facts; but the most overwhelming evidence of their correctness is, its incapacity to explain the result of observations before they are actually made. This kind of evidence is furnished in an unsurpassed degree, by the anticipatory calculation of the mass, &c., of the unseen planet. Regarding, therefore, the prediction of the planet as an event altogether unparalleled, and as the feature of the discovery most important with respect to the evidences of science, we cannot over-estimate the value of the fact established by the Astronomer-Royal, that Mr. Adams was the first predictor of the position, mass, and orbit of the new planet.

When the Astronomer-Royal speaks of the discovery as a consequence of what may properly be called a movement of the age," we must take this as a rhetorical expression, not intended to have any specific meaning.

In fact, the utmost that can be made of the sentence is this, that there has for some time existed a general suspicion of the existence of a planet beyond Uranus. The numerical determination of the longitude of the planet (328 34), &c., by an elaborate mathematical investigation, required something a little more tangible and definite than a "movement of the age."

It has not been usual to admit into the Memoirs of this Society mere historical statements of circumstances which have occurred in our own times. I am not aware that this is a matter of positive regulation: it is, I believe, merely a rule of practice, of which the application in every particular instance has been determined by the discretion of those Officers of the Society with whom the arrangement of our Memoirs has principally rested. And there can be no doubt that the ordinary rule must be a rule for the exclusion of papers of this character; and that if a positive regulation is made, it must be made for the purpose of excluding such histories. Yet it is conceivable that events may occur in which this rule ought to be relaxed; and such, I am persuaded, are the circumstances attending the discovery of the planet exterior to Uranus. In the whole history of astronomy, I had almost said in the whole history of science, there is nothing comparable to this. The history of the discoveries of new planets in the latter part of the last century, and in the present century, offers nothing analogous to it. Uranus, Ceres, and Pallas, were discovered in the course of researches which did not contemplate the possible discovery of planets. Juno and Vesta were discovered in following up a series of observations suggested by a theory which, fruitful as it has been, we may almost venture to call fanciful. Astraea was found in the course of a well-arranged re-examination of the heavens, apparently completing the discovery of a new planet as only one of many possible results.

But the motions of Uranus, examined by philosophers who were fully impressed with the universality of the law of gravitation, have long exhibited the effects of some disturbing body: mathematicians have at length ventured on the task of ascertaining where such a body could be; they have pointed out that the suppression of a disturbing body moving in a certain orbit, precisely indicated by the work of Mr. Adams, produced the observed disturbances of Uranus: they have expressed their conviction, with a firmness which I must characterise as wonderful, that the disturbing planet would be found exactly in a certain spot, and presenting exactly a certain form of appearance; and in that spot, with that appearance, the planet has been found. Nothing in the whole history of astronomy can be compared with this.

The principal steps in the theoretical investigations have been made by one individual, and the published discovery of the planet was necessarily made by one individual. To these persons the public attention has been principally directed; and well do they deserve the honours which they
have received, and which they will continue to receive. Yet we should do wrong if we considered that these two persons alone are to be regarded as the authors of the discovery of this planet. I am confident that it will be found that the discovery is a consequence of what may properly be called a movement of the age; that it has been urged by the feeling of the scientific world in general, and has been nearly perfected by the collateral, but independent labors, of various persons possessing the talents or powers best suited to the different parts of the research.

While it is proper to express very sensible that the authentic history of this discovery should be published as soon as possible; not only because it will prove a valuable contribution to the history of science, but also because it may tend to do justice to some persons who otherwise would not receive in future times the credit which they deserve. And as a portion of the history, I venture to offer to this Society a statement of the circumstances which have come to my own knowledge. I have thought that I could with propriety, not pretend to know all the history of the discovery, but because I know a considerable part of it; and because I can lay claim to the character of impartiality to this extent, that, though partaking of the general movement of the age, I have not contributed either to the theoretical or to the observing parts of the discovery. In a matter of this delicacy I have thought it best to act on my own judgment, without consulting any other person; I have, however, solicited the permission of my English correspondent of letters.

Without pretending to fix upon a time when the conviction of the irreconcilability of the motions of Uranus with the law of gravitation first fixed itself in the minds of some individuals, we may without hesitation date the general belief in this irreconcilability from the publication of M. Alexis Bouvard's Tables of Uranus in 1821. It was fully shown in the introduction to the tables, that, when every correction for perturbation indicated by the best existing theories was applied, it was still impossible to reconcile observations of Flamsteed, Le Monnier, and Mayer, with the orbit required by the observations made after 1781: and the elements of the orbit were adopted from the latter observations, leaving the discordances with the former (amounting sometimes to three minutes of arc) unexplained.

The orbit thus adopted represented pretty well the observations made in the years immediately following the publication of the tables. But in five or six years the discordance again growing up became so great, that it could not escape notice. A comparison was shown by the Kremsminster Observations of 1825 and 1826; but, perhaps, I am not in error in stating that the discordance was first prominently exhibited in the Cambridge Observations, the publication of which from 1825 was conducted under my superintendence.

[Here intervene letters from Mr. Hussey (1834) and M. Bouvard (1837), summing up the perturbations which might be produced by an unseen body.]

I have departed from a strictly chronological order for the sake of keeping in connexion the papers which relate to the same trains of investigation. Several months before the date of the last letter quoted, I had received the first intimation of those calculations which have led to a distinct indication of the place where the disturbing planet ought to be sought. The date of the following letter is Feb. 13, 1844:

No. 5.—Professor Challis to G. B. Airy.

[Extract.]

"Cambridge Observatory, Feb. 13, 1844."

"A young friend of mine, Mr. Adams, of St. John's College, is working at the theory of Uranus, and is desirous of obtaining errors of the tabular geocentric longitudes of this planet, when near opposition, in the years 1818-1826, with the factors for reducing them to errors of heliocentric longitudes. I have your reductions of the planetary data to the times of a recent observation, both of right ascension and of polar distance. No alteration is made in Bouvard's Tables of Uranus besides that of Jupiter's mass."

No. 7.—G. B. Airy to Professor Challis.

[Extract.]

"Royal Observatory, Greenwich, 1844, Feb. 15."

"I send all the results of the observations of Uranus made with both instruments (that is, the heliocentric errors of Uranus in longitude and latitude from 1744 to 1830, for all those days on which there were observations, both of right ascension and of polar distance.) No alteration is made in Bouvard's Tables of Uranus, except increasing the two equations which depend upon Jupiter by \( \frac{1}{4} \) part. As constants have been added (in the printed tables) to the equations printed in that part, and as \( \frac{1}{4} \) part of the numbers in the tables has been added, \( \frac{1}{4} \) part of the constants has been subtracted from the final results."

No. 8.—Professor Challis to G. B. Airy.

[Extract.]

"Cambridge Observatory, Feb. 16, 1844."

"I am exceedingly obliged by your sending so complete a series of tabular errors of Uranus. * * * The list you have sent will give Mr. Adams the means of carrying on in the most effective manner the inquiry in which he is engaged."

No. 9.—Professor Challis to G. B. Airy.

"Cambridge Observatory Sept. 29, 1845."

"My friend Mr. Adams (who will probably deliver this note to you) has completed his calculations respecting the perturbation of the orbit of Uranus by a supposed exterior planet, and has arrived at results which he will be glad to communicate to you personally, if you could spare him a few minutes of your valuable time. His calculations are founded on the observations you were so good as to furnish him with some time ago; and from his character as a mathematician, and his practice in calculation, I should consider the deductions from his premises to be made in a trustworthy manner. If he has the good fortune to see you at Greenwich, he hopes to be allowed to write to you on this subject."

No. 10.—G. B. Airy to Professor Challis.

"Royal Observatory, Greenwich, 1845, Sept. 29."

"I was, I suppose, on my way from France, when Mr. Adams called here: at all events, I had not reached home, and therefore, to my regret, I have not seen him. Would you mention to Mr. Adams that I am very much interested in the results, and, that I should be delighted to hear of them by letter from him?"

On one of the last days of October, 1845, Mr. Adams called at the Royal Observatory, Greenwich, in my absence, and left the following important paper:

No. 11.—J. C. Adams, Eqd. to G. B. Airy.

"According to my calculations, the observed irregularities in the motion of Uranus may be accounted for by supposing the existence of an exterior planet, the mass and orbit of which are as follows:"

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Distance (assumed nearly in accordance with Bode's law)</td>
<td>384</td>
</tr>
<tr>
<td>Mean Sidereal Motion in 365.25 days</td>
<td>179.9</td>
</tr>
<tr>
<td>Mean Longitude, 1st October, 1844</td>
<td>122.8</td>
</tr>
<tr>
<td>Longitude of Perihelion.</td>
<td>0.155</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>0.0001056</td>
</tr>
<tr>
<td>Mass (of that of the Sun being unity)</td>
<td>0.0000006</td>
</tr>
</tbody>
</table>

For the modern observations, I have used the method of normal places, taking the mean of the tabular errors, as given by observations near three consecutive oppositions, to correspond with the mean of the times; and the Greenwich observations have been used down to 1830: since which, Cambridge and Greenwich observations, and those given in the Astronomische Nachrichten, have been made use of. The following are the remaining errors of mean longitude:

<table>
<thead>
<tr>
<th>Observation—Theory.</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1790 + 0°27</td>
<td>1801 - 0°04</td>
</tr>
<tr>
<td>1793 - 0°23</td>
<td>1804 + 1°76</td>
</tr>
<tr>
<td>1796 - 0°06</td>
<td>1807 - 0°21</td>
</tr>
<tr>
<td>1799 + 0°23</td>
<td>1810 - 0°38</td>
</tr>
<tr>
<td>1802 + 0°11</td>
<td>1813 - 0°48</td>
</tr>
<tr>
<td>1805 + 0°09</td>
<td>1816 - 0°31</td>
</tr>
<tr>
<td>1808 - 0°9</td>
<td>1819 - 0°00</td>
</tr>
</tbody>
</table>

The error for 1780 is concluded from these values, given by observation, compared with those of four or five following years, and also with Le Monnier's observations in 1769 and 1771.

"For the ancient observations, the following are the remaining errors:

<table>
<thead>
<tr>
<th>Observation—Theory.</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1690 + 4°4</td>
<td>1750 - 1°6</td>
</tr>
<tr>
<td>1712 + 6°7</td>
<td>1773 + 5°7</td>
</tr>
<tr>
<td>1715 - 6°8</td>
<td>1776 + 4°0</td>
</tr>
</tbody>
</table>

The errors are small, except for Flamsteed's observation of 1695. This being an isolated observation, very distant from the rest, I thought it best to use it in forming the equations of condition. It is not improbable, however, that this error might be destroyed by a small change in the assumed mean motion of the planet."

I acknowledged the receipt of this paper in the following terms:

No. 12.—G. B. Airy to J. C. Adams, Eqd.

"Royal Observatory, Greenwich, 1845, Nov. 5."

"I am very much obliged by the paper of results which you left here a few days since, showing the perturbations on the place of Uranus produced by a planet with certain assumed elements. The latter numbers are all extremely satisfactory: I am not enough acquainted with Flamsteed's observations about 1690 to say whether they bear such an error, but I think it extremely probable."

"But I should be very glad to know whether this assumed perturbation will explain the error of the radius vector of Uranus. This error is now very considerable, as you will be able to ascertain by comparing the normal equations, given in the Greenwich observations for each year, for the times before opposition with the later observations."

I have before stated, that I consider the establishment of this error of the radius vector of Uranus to be a very important determination. I therefore considered the trial, whether the error of the radius vector would be explained by the same theory which explained the error of longitude, to be truly an experiment of crux. And I waited with much anxiety for Mr. Adams's answer to my query. Had it been in the affirmative,
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should at once have exerted all the influence which I might possess, either directly, or indirectly through my friend Professor Challis, to procure the publication of Mr. Adam's theory.8

From some cause with which I am unacquainted, probably an accidental one, I received no immediate answer to this inquiry. I regret this deeply, for many reasons.

While I was expecting more complete information on Mr. Adam's theory, the results of a new and most important investigation reached me from another quarter. In the *Compte Rendu* of the French Academy for the 19th Nov., 1846, which arrived in this country in December, there is a paper by M. Le Verrier containing a discussion of the figures of *Jupiter and Saturn*, and on the errors in the elliptic elements of *Uranus*, consequent on the use of erroneous perturbations in the treatment of the observations. It is impossible for me here to enter into details as to the conclusion drawn by M. Le Verrier, but it is evident that the correctness of the former theories, as far as they went, was generally established, many small terms were added; that the accuracy of the calculations was established by duplicate investigations, following different courses, and executed with extraordinary labor; that the corrections to the elements, produced by treating the former observations with these corrected perturbations, were obtained; and that the correction to the ephemerides for the present time, produced by the introduction of the new perturbations and the new elements, was investigated and found to be incapable of explaining the observed irregularity of *Uranus*. Perhaps it may be truly said that the theory of *Uranus* was now, for the first time, placed on a satisfactory foundation. This important labor, as M. Le Verrier states, was undertaken at the request of the Astronomical Society of Greenwich.

In the *Compte Rendu* for June 1, 1846, M. Le Verrier gave his second memoir on the theory of *Uranus*. The first part contains the results of a new reduction of nearly all the existing observations of *Uranus*, and their treatment as a result of the theories of Adams and of the former memoir. After concluding from this reduction that the observations are absolutely irreconcilable with the theory, M. Le Verrier considers in the second part all the possible explanations of the discordance, and concludes that the orbit of *Uranus* is to be restored, except to *Uranus*. He then proceeds to investigate the elements of the orbit of such a planet, assuming that its mean distance is double that of *Uranus*, and that its orbit is in the plane of the ecliptic. The value of the mean distance, it will be remembered, is not yet determined by any other method than the hypothesis of *Uranus*. It is suggested by it; several considerations are stated which compel us to take a mean distance, not very greatly differing from that suggested by the law, but which, nevertheless, without the suggestion of that law, would lead to the conclusion that the most probable form of the orbit of *Uranus* is that which the investigation takes is then explained. Finally, M. Le Verrier gives as the most probable result of his investigations, that the true longitude of the disturbing planet for the beginning of 1847 must be about 232°, and that an error of 1° in this place is not probable. No elements of the orbit or mass of the planet are given.

This memoir reached me about the 23rd or 24th of June. I cannot sufficiently express the feeling of delight and satisfaction which I received from it. The place which it assigned to the disturbing planet was the same, to within one degree in longitude, as that assigned to me seven months earlier. To this time I had considered that there was still room for doubt of the accuracy of Mr. Adam's investigations; for I had always thought that any spherical solution of a perturbed system of so long and so complicated as those of an inverse problem of perturbations, are liable to many risks of error in the details of the process: I know that there are important numerical errors in the *Mécanique Céleste* of Laplace; in the *Théorie de la Lune de Plana*; above all, in Bouvard's first tables of *Jupiter and Saturn*; and to express it in a word, I have always considered the correctness of a distant mathematical result to be a subject rather of moral than of mathematical evidence. But now I felt no doubt of the accuracy of both calculations, as applied to the perturbation in longitudes. I was, however, still desirous, as before, of learning how the perturbation in radius vector was fully explained. I therefore addressed to M. Le Verrier the following letter:—

No. 13.—G. B. AIRY to M. LE VERRIER.

"Royal Observatory, Greenwich, 1846, June 30."

"I have read, with very great interest, the account of your investigations on the probable place of a disturbing planet disturbing the motions of *Uranus*, which is contained in the *Compte Rendu* of the French Academy of June 1; and I beg leave to trouble you with the following question. It appears, from all the later observations of *Uranus* made at Greenwich (which are most completely reduced in the *Observations of Uranus* of each year, so as to embrace the first observations, either of mine or of M. Lalande), that the tabular radius vector is considerably too small. I wish to inquire of you whether this would be a consequence of the disturbance produced by an exterior planet, now in the position which I have supposed, or that I decline undertaking the search myself. **I have a purpose to carry the sweep to the extent you recommended."

*This sentence is copied from the written draft of the speech. Sir J. Herschel appeared to suppose that the sentence had not been reported in the public journals as spoken. I did, however, see it so reported in an English newspaper, to which I had access on the Continent.*

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8 Here the Astronomer Royal explained to the meeting, by means of a diagram, the nature of the errors of the tabular radius vector.
The remainder of the letter was principally occupied with the details of a plan of observing different from mine, and of which the advantage was fully proved in the practical observations.

On August 7, Professor Challis, writing to my confidential assistant (Mr. Main) in my supposed absence, said—

No. 18.—Professor Challis to the Rev. R. Main.

[EXTRACT.]

"Cambridge Observatory, August 7, 1846.

"I have undertaken to search for the supposed new planet, more distant than Uranus. Already I have made true trial of two different methods of observing. In one method, recommended by Mr. Airy, I met with a difficulty which I had anticipated. I adopted a second method."

From a subsequent letter (to be cited hereafter), it appears that Professor Challis had commenced the search on July 29, and had actually observed the planet on August 4, 1846.

Mr. Main's answer to the other parts of this letter, written by my direction, is dated August 8.

At Wiesbaden (which place I left on September 7), I received the following letter from Professor Challis:—

No. 19.—Professor Challis to G. B. Airy.

[EXTRACT.]

"Cambridge Observatory, Sept. 2, 1846.

"I have lost no opportunity of searching for the planet; and the nights having been generally pretty good, I have taken a considerable number of observations, but I could get over the ground very slowly, thinking it right to include all stars to 10-11th magnitude; and I find, that to scrutinise, thoroughly, in this way the proposed portion of the heavens, will require many more observations than I can take this year.

"I have also been engaged in preparing a paper on the subject of the stability of the solar system, which I shall publish as soon as I have completed it."

On the same day on which Professor Challis wrote this letter, Mr. Adams, who was not aware of my absence from England, addressed the following very important letter to Greenwich:—

No. 20.—J. C. Adams, Esq., to G. B. Airy.

"St. John's College, Cambridge, Sept. 2, 1846.

"In the investigation, the results of which I communicated to you last October, the mean distance of the supposed disturbing planet is assumed to be twice that of Uranus. Some assumption is necessary in the first instance, and Bode's law renders it probable that the above distance is not very remote from the truth: but the investigation could scarcely be considered satisfactory while based on any arbitrary; and I therefore determined to repeat the calculation, making a different hypothesis. The following mean distance. The eccentrics also resulting from my former calculations was far too large to be probable; and I found that, although the agreement between theory and observation continued very satisfactory down to 1840, the difference in subsequent years was becoming very sensible, and I hoped that these errors, as well as the eccentrics, might be diminished by taking a different mean distance. Not to make too violent a change, I assumed this distance to be less than the former value by about the same. The result is very satisfactory, and I hope that, by still further diminishing the distance, the agreement between the theory and the later observations may be rendered complete, and the eccentricity reduced at the same time to a very small quantity. The mass and the elements of the orbit of the supposed planet, which result from the two hypotheses, are as follows:—

Hypoth. I. Hypoth. II.

Mean Longitude of Planet, 1st Oct. 1846 320° 9' 320° 9'

Longitude of Perihelion 351 57 299 11

Eccentricity 0-16109 0-19062

Mass (that of Sun being 1) 0-0001663 0-0001503

"This investigation has been conducted in the same manner as in both cases, so that the differences between the two sets of elements may be considered as due to the variation of the fundamental hypothesis. The following table exhibits the differences between the theory and the observations which were used as the basis of calculation. The quantities given are the errors of mean longitude, which I found it more convenient to employ in my investigations than those of the true longitude.

Ancient Observations.

<table>
<thead>
<tr>
<th>Date.</th>
<th>Hypoth. I.</th>
<th>Hypoth. II.</th>
<th>Date.</th>
<th>Hypoth. I.</th>
<th>Hypoth. II.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1712</td>
<td>+0° 7</td>
<td>+0° 3</td>
<td>1720</td>
<td>-4° 0</td>
<td>-4° 0</td>
</tr>
<tr>
<td>1715</td>
<td>+3° 6</td>
<td>+3° 2</td>
<td>1724</td>
<td>-5° 7</td>
<td>-5° 7</td>
</tr>
<tr>
<td>1720</td>
<td>-1° 9</td>
<td>-1° 8</td>
<td>1729</td>
<td>0° 0</td>
<td>0° 1</td>
</tr>
<tr>
<td>1725</td>
<td>+7° 3</td>
<td>+7° 2</td>
<td>1731</td>
<td>+11° 8</td>
<td>+12° 8</td>
</tr>
</tbody>
</table>

Modern Observations.

<table>
<thead>
<tr>
<th>Date.</th>
<th>Hypoth. I.</th>
<th>Hypoth. II.</th>
<th>Date.</th>
<th>Hypoth. I.</th>
<th>Hypoth. II.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1870</td>
<td>+0° 27</td>
<td>+0° 24</td>
<td>1810</td>
<td>+6° 56</td>
<td>+6° 61</td>
</tr>
<tr>
<td>1873</td>
<td>+0° 23</td>
<td>+0° 21</td>
<td>1813</td>
<td>-0° 94</td>
<td>-1° 00</td>
</tr>
<tr>
<td>1876</td>
<td>+0° 36</td>
<td>+0° 31</td>
<td>1816</td>
<td>+0° 31</td>
<td>+0° 36</td>
</tr>
<tr>
<td>1879</td>
<td>+3° 32</td>
<td>+3° 28</td>
<td>1819</td>
<td>+0° 29</td>
<td>+0° 34</td>
</tr>
<tr>
<td>1879</td>
<td>+0° 91</td>
<td>+0° 06</td>
<td>1822</td>
<td>+0° 30</td>
<td>+0° 14</td>
</tr>
</tbody>
</table>

The greatest difference in the above table, viz. that for 1771, is deduced from a single observation, whereas the differences immediately preceding, which is deduced from the mean of several observations, is much smaller. The error of the latter is found by interpolating between the errors given by the observations of 1761, 1762, and 1763, and those of 1709 and 1771. The differences between the results of the two hypotheses are exceedingly small till we come to the last years of the series, and become more precisely at the point where both sets of results begin to diverge from the observations; the errors corresponding to the second hypothesis being, however, uniformly smaller. The errors given by the Greenwich Observations of 1845 are very sensible, being for the first hypothesis 1° 04' and for the second 5° 30'. By comparing these errors, it may be inferred that the agreement of theory and observation would be rendered very close by assuming a₀/α₁ = 0° 57, and the corresponding mean longitude on the 1st October, 1846, would be about 315° 20', which I am inclined to think is not far from the truth. It is plain also that the eccentricity corresponding to this value a₀ would be very small. In consequence of the divergence of the results of the two hypotheses, still later observations would be most valuable for correcting the distances, and I should feel exceedingly obliged if you would kindly communicate to me your two methods of calculation, the one at 1° 04' and the other at 5° 30'. It would be desirable to ascertain whether Flamsteed's manuscripts throw any light on this point.

The corrections of the tabular radius vector of Uranus, given by the theory for some late years, are as follows:—

<table>
<thead>
<tr>
<th>Date.</th>
<th>Hypoth. I.</th>
<th>Hypoth. II.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1834</td>
<td>+0° 00651</td>
<td>+0° 00592</td>
</tr>
<tr>
<td>1840</td>
<td>+0° 0072109</td>
<td>+0° 0066435</td>
</tr>
<tr>
<td>1846</td>
<td>+0° 0086762</td>
<td>+0° 0082540</td>
</tr>
</tbody>
</table>

The correction for 1834 is nearly the same as that at which you have deduced from observation, in the Astronomische Nachrichten; but the increase in later years is not so great as the observations appear to give it; the second hypothesis, however, still having the advantage.

I am at present employed in discussing the errors in latitude, with the view of obtaining an approximate value of the inclination and position of the new planet. The quantities of both sets of observations are so very small that I am afraid the result will not have great weight. According to a rough calculation made some time since, the inclination appeared to be rather large, and the longitude of the ascending node to be about 360°; but I am treating the subject much more completely, and hope to obtain the result in a few days.

I have been thinking of drawing up a brief account of my investigation to present to the British Association.

Mr. Main, acting for the Astronomer Royal in his absence, answered this letter as follows:—

No. 21.—The Rev. R. Main to J. C. Adams, Esq.

"Royal Observatory, Greenwich, 1846, Sept. 5.

"The Astronomer Royal is not at home, and he will be absent for some time; but it appears to me of so much importance that you should have immediately the normal errors of Uranus for 1844 and 1845, that I have taken the trouble of sending you the values for 1844 which have been published for some time, and I shall probably be able to send you those for 1845 on Tuesday next, as I have given directions to have the computations finished immediately. If a place (geocentric) for the present year should be of value to you, I could probably send one in a few days."

In acknowledging this letter, Mr. Adams used the following expression:—

No. 22.—J. C. Adams, Esq. to the Rev. R. Main.

[EXTRACT.]

"St. John's College, Cambridge, 7th Sept. 1846.

"I hope by to-morrow to have obtained approximate values of the inclination and longitude of the node."

On the same day, Sept. 7, Mr. Main transmitted to Mr. Adams the normal places for 1845, to which allusion was made in the letter of September 5.

On the 1st of August, M. Le Verrier's second paper on the place of the
disturbing planet (the third paper on the motion of Uranus) was communicated to the French Academy. I place the notice of this paper after those of September 3 and 9, as the usual course of transmission to this country, the number of the *Comptes Rendus* containing this paper would not arrive here, at the earliest, before the third or fourth week in September; and it does not appear that any earlier notice of its contents was received by the Royal Society.

It is not in my design here to give a complete analysis of this remarkable paper; but I may advert to some of its principal points. M. Le Verrier states that, considering the extreme difficulty of attempting to solve the problem of an unknown quantity, he would not attempt to determine the period and the epoch of the disturbing planet were determined approximately by his former investigations, he adopted the corrections to these elements as two of the unknown quantities to be determined. Besides these, the semi-major axes, the eccentricity, and the longitude of perihelion may be inferred; making, in all, five unknown quantities depending solely on the orbit and mass of the disturbing planet. I have thereon proceeded, correct the notation that I had found, the longitude of the planet in its epoch of longitudes, to its longitude of perihelion, and to its eccentricity; making, in all, nine unknown quantities. To obtain these, M. Le Verrier groups all the observations into thirty-three equations. He then explains the peculiar method by which he derived the values of the unknown quantities from these equations. The elements obtained are—

<table>
<thead>
<tr>
<th>Semimajor Major</th>
<th>36154 (or (a/c = 0.331))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodic Time</td>
<td>217 ± 387</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>0.14701</td>
</tr>
<tr>
<td>Longitude of Perihelion</td>
<td>29° 23′</td>
</tr>
<tr>
<td>Mean Longitude, 1 Jan. 1847</td>
<td>31° 47′</td>
</tr>
<tr>
<td>Mass (m)</td>
<td>(0.0001075)</td>
</tr>
<tr>
<td>True Heliocentric Longitude, 1 Jan. 1847</td>
<td>32° 23′ 33° 06′</td>
</tr>
</tbody>
</table>

It is interesting to compare these elements with those obtained by Mr. Adams. The difference between each of these and the corresponding element obtained by Mr. Adams in his second hypothesis is, in every instance, of that kind which corresponds to the further changes in the assumed mean distance recommended by Mr. Adams. The agreement of observations does not appear to be better than that obtained from Mr. Adams’s elements, with the exception of Flamsteed’s first observation of 1840, for which (contrary to Mr. Adams’s expectation) the discordance is considerably diminished.

M. Le Verrier then enters into a most ingenious computation of the limits between which the planet must be sought. The principle is this: assuming as a first approximation all the others given, that the planet must be varied in such a manner, that though the observations will not be so well represented as before, yet the errors of observation will be tolerable. At least, on continuing the variation of one element of observation will be intolerably great. Then, by varying the elements in another way, we may at length make another error of observation intolerably great; and so on. If we compute, for all these different varieties of elements, the place of the planet for 1847, its flux will evidently be a discontinuous curve or succession of straight lines. If we do the same with different periodic times, we shall get different polygons; and the extreme periodic times that can be allowed will be indicated by the polygons becoming points. These extreme periodic times are 207 and 283 years. If now we draw one grand curve, circumjacent polygons, we would be certain that the planet must be within that curve. In one direction, M. Le Verrier found no difficulty in assigning a limit; in the other he was obliged to restrict it, by assuming a limit to the eccentricity. Thus he found the longitude of the planet was certainly not less than 32° 15′, and not greater than 33° 55', according as we limit the eccentricity to 0.125 or 0.9. If we adopt 0.125 as the limit, the mass will be included between the limits 0.00007 and 0.00009; either of which exceeds that of Uranus. From this conclusion, combined with a probable hypothesis as to the density, M. Le Verrier concluded that the planet would have a visible disk, and sufficient light to make it conspicuous in ordinary telescopes.

M. Le Verrier then remarks, as one of the strong proofs of the correctness of the general theory, that the error of radius vector is explained as accurately as the error of longitude. And finally, he gives his opinion that the latitude of the disturbing planet must be small.

My analysis of the elements has certainly been exceedingly imperfect, as regards the astronomical and mathematical parts of it; but I am sensible that, in regard to another part, it fails totally. I cannot attempt to convey to you the impression which was made on me by the author’s undoubted correctness of the general truth by the clearness and cleanness with which he limited the field of observation, and by the firmness with which he proclaimed to observing astronomers, "Look in the place which I have indicated, and you will see the planet well."

Copernicus’s demonstration, yes, and his purity and prudence in improving the vision, it would be found that Venus had phases like the moon, nothing (in my opinion) so bold, and so justifiably bold, has been uttered in astronomical prediction. It is here, if I mistake not, that we see a character far superior to that of the able, or entertaining, or ingenious mathe-

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* I borrow this history from Michael’s *Optics*, sect. 1000. Since reading this Memoir, I have, however, been informed by Professor De Morgan, that the printed works of Copernicus do not give me any support in this history, and that Copernicus appears to have believed that the planets are solid and immovable.—G. B. A.

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THE GOVERNMENT SCHOOL OF DESIGN.

 Though a considerable time has elapsed since the following report on the French Schools was presented by M. Peytrier to the Council of this Institution, it has remained unpublished. The Council have since sanctioned its publication, and as the subject of the document is not of temporary interest, it is well worth perusal.

My Lords and Gentlemen,—Previously to entering upon the exercise of the office to which the Council have done me the honour to appoint me, I considered that a more intimate acquaintance with the system adopted in the French Schools, and its results, would enable me to judge more advantageously of the condition and prospects of our own. I have, therefore, visited Paris with a special view to this subject; and would willingly have extended my journey to Lyons, had time permitted. But,

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although it was out of my power actually to inspect any other School than that of Paris, I have had the advantage of obtaining an intimate acquaintance with the Schools of Lyons and Toulouse, through the Reports lately made by M. Charles Texier, commissioned by the Government to inspect the Schools of Art, which were very obligingly placed in my hands for perusal.

"The Report laid last year before the Council by Mr. Townsend, will render superfluous any detailed account of the views entertained regarding to industrial art, and the system upon which they are carried out, in this branch of the Provincial Schools. I shall therefore confine myself to those points which appear to me might be of importance with reference to our own Schools, and which may be mentioned without needless repetition.

"The course of instruction at Paris is divided into three main branches: I. Fine Art and Decorative Art; II. Construction; III. The three courses of study (subdivided and classified) are taught on alternate days, in the order named, a day being devoted to each; but the limited space to which the School premises are confined has caused a most inconvenient system of taking the classes in relays, greatly to their disadvantage. The students are admitted free of charge, and no pledge is required from them of their exclusive devotion to any branch of industrial art; many, it is well known, pass from the elementary classes of the Ecole des Beaux Arts to the Ecole des Beaux Arts, in order to follow the higher branches of painting and sculpture, but this is not considered necessary in any way against the usefulness of the School, as a nursery of art applied to manufactures. To extend a sound knowledge of art in general is held to be the best mode of preparing for industrial art, and the School has been so arranged that the pupils are bound is, that they remain in the School they must follow the whole course of study prescribed by the regulations. Each pupil must study under the master of a class, and the master of any who think to take advantage of the means afforded by the School, are charged with the discipline of their taste. This class of students, however, have recourse more generally to the Ecole de Commerce, for an account of which I must refer to Mr. Townsend, etc.

"There is one branch of instruction in the Paris School which I beg leave to offer to the special notice of the Council — a course of lectures on the History of Ornament, illustrated by examples drawn by the Professor in the absence of the pupils. These examples he sketches to a working scale, on large canvas covered with paper. They consist of a chronological series of every class of ornament, beginning with the Greek, and followed throughout all the various styles and all ages, explaining their origin, their connexion with the different materials used, the peculiarities of each style, and the manner in which they have been discriminated. Each lecture is a continuation of the subject from that which precedes it; and the Professor is bound by his engagement to vary the examples during the period of three years. This professorship is held by a Professor at the Ecole des Beaux Arts, and is on the subject of Ornament, applicable not only to that style of drawing, but to sculpture in wood, metal, and stone. From this period important modifications have been made from time to time in the system of instruction, so that scarcely anything is now left of the original organization of the School. In these changes some are personal, while others have been effected as experience has dictated their necessity, and the results, as is well known, is eminently practical.

"The present course of study pursued in the School is as follows: — the elementary, or of Drawing and Painting to the young men, and from the living model. Hence the pupils enter the classes for drawing and painting flowers, and after passing through the class of architectural ornament (combined with geometry and perspective), finish the course of study obligatory on all who remain in the school by a class of composition applied to manufactures. Thus it will be seen that to prepare the classes for designers and manufacturers, so that the great point is to be attained, a sort of instruction of measure is adopted, beginning with the figure, thence passing to the details of expenditure, until the student is placed in a position to come with a sound artistic education for finishing with the course of composition peculiar to the silk manufacture. To give instruction in this course, there are ten professors, including one for anatomy, one for etching, one for embroidery, and one for drawing. The annual expense of the establishment amounts to about 40,000 francs, of which 30,000 are supplied by the city, and 10,000 by the Government; and the pupils of the school, as already mentioned, are free of all expenses.

"The school is open nine hours every day, — the professors attending from nine o'clock till two in the winter, and from eight to one in the summer. The pupils enter at the age of fourteen. They must be able to read and write, and to do the four rules of arithmetic, and are compelled to follow the whole course of instruction. They are removed from one class to another on the recommendation of the Professor of their class to the Council of Professors. During the first month the pupils are employed in ornament, embroidery of the class in which they are to be placed. Two years' trial are allowed before they are dismissed for inactivity.

"The Director has abolished the use of heads in lithography as studies for the pupils, as being inadmissible, and requiring the monopoly of a great number of artists. This is a wise regulation. It is strongly recommended for the students of the Ecole des Beaux Arts, that the species of draughtsmen required for this purpose, and the frequent competitions at the Ecole des Beaux Arts for "ateliers d'expression," should be collected to provide a sufficient number of valuable drawings of this class, mostly prize works, from which the pupils may be selected. This example is strongly recommended to be adopted in all schools, not only for the first course, but also for embroidery, and other objects of study. The Director greatly desires that these Parthenon marbles may be added to the collections of the School.

"The object of Government in supporting the Provincial Schools, is to develop art in such a manner as to enable the pupils in quitting them to exercise a profession, each town directing the final studies of the pupils more particularly to its predominant manufacture, and the system upon
which the schools are worked is calculated to direct not only the hand and eye of the pupil, but also their taste. For this reason, the study of the figure is found by practical experience to be the most instructive. Geometrical forms alone, though useful to exercise the fingers, are insufficient to give a perception of the face and figure, and are often studied by the practice of the School at Toulouse, where the latter mode of study has been substituted for the former. Cold and unmeaning lines convey no intelligence to the pupil, and excite no interest. Hence the pupils who at Toulouse pass as models, seem, as it were, strikingly inferior to those of the same standing at Paris and Lyons. When they come to draw other objects from the round, they are altogether deficient in the knowledge of light and shade, and relief, and even facility of hand. The errors in the latter have been committed at Toulouse, of confusing the study of the figure to a small and select class, the master of which has another class to attend to; so that, to make matters worse, 'the figure has only half a Professor allotted to it.' It is therefore proper, an attention being paid, to the want of necessity, that the School of Toulouse should be assimilated, in this respect, to those of Paris and Lyons. A pupil who has followed the elementary study of the figure, with the management of the chalk and stump, is found to possess a knowledge of shadows and reflections, which opens to him a thorough understanding of every work in relief before which he may be placed. The School is also deficient in other particulars: the classes sit for two hours only even for the study of the figure—a space of time totally insufficient. There is no class for plants, and in the class for ornaments, the composition of ornaments of all dates and styles, described under the Paris School, is much to be desired, not only at Toulouse but at Lyons. There seems to be a difficulty in getting a competent Professor. The Council of Toulouse wish for the establishment of a course of chemistry applicable to manufactures.

4. I could have wished to take such a view of the manufactures of Paris as might have been given with that of any other country; but as the time at my disposal did not admit of any general inquiry, I confined myself to the subject of stained glass, of which a great quantity has lately been executed in France. The church of St. Denis has been completely fitted up with modern coloured glass, in a style which it is impossible to commend. Part of this glass is designed on the imbecile principle unhappily too prevalent in England, of imitating the wretched drawing and composition of the middle ages, under the notion that this pervasion of art is essential to the character of the work. But the glass of this order at St. Denis is destitute of the archæological knowledge and taste in the arrangement of colour, which are the redeeming quality of many English performances of this class. Other portions of the glass at St. Denis are designed on the still more mistaken system of assimilating glass painting to painting on canvas.

5. At the royal manufactory of Sévres, great pains have been bestowed on the improvement of stained glass. Being, however, doubtful of the impression to be produced by the view of mere specimens, I did not visit Sévres, but performed a journey to Dreux, about sixty miles from Paris, where a magnificent chapel, designed by the present king as a mausoleum for his family, has been completely fitted up with Sévres glass. There is much good art in this glass. There are figures and groups, of which the drawing, composition, and expression are extremely fine, but the colouring is in some portions crude, and in others vapid. There is an insufficiency of the detail essential to the proper effect of stained glass. The draperies are too plain. There is an attempt at diaper-work upon some slates of applying the same grounds, but it is feeble and ineffectual, and the general effect of the whole is poor. The artists, with all their merit, and it is great, have evidently been hampered by the principles and practice of painting on canvas, and the mechanical process of joining the glass has been so ill understood that all the subjects are cut up into squares by the ironwork. The same observations will apply to the glass in the chapel erected at Paris to the memory of the late Duke of Orleans, also from the Sévres manufactory.

The modern glass displayed in the Church of the Innocents in Paris is of extraordinary quality. In this the artist has solved the problem of uniting high art with the conditions required for the due effect of painting on glass. Fine design, drawing, and expression, combined with a perfect conception of the distribution and collocation of colour, with a correct attention to detail in the draperies, background, and borders, render it an example of rare perfection in stained glass, not inferior to the ancient in brilliancy and harmony, and inexpressibly beyond it as a work of art. Each window containing thirty or forty, or a block containing four, is produced upon the same principle, the arrangement of the border of small figures in compartments, formed by green arabesque. This glass is the work of M. Maréchal, of Metz, an artist also greatly distinguished as a crayon painter. I should consider a fine specimen of this work an important acquisition to our factories, if it could be obtained at any price.

6. It is probable that some of the facts and observations which I have not had the leisure to pursue, are connected with our own establishments, and it is not impossible that comparisons may offer themselves during my approaching visit to the Provincal Schools. I have therefore hastened to submit these remarks to the Council whilst they were fresh in my mind, and unbiased by anything arising out of the course of my tour of inspection.

7th Oct. 1845.

AMBROSE POTTS.
often considerable, and when thick cuts are taken, is usually far larger than the former force. If the bending were of small extent, then the force to be exerted would vary as the square of the thickness of the shaving multiplied by some constant, dependent on the nature of the metal operated upon. But the bending very frequently proceeds to such an extent that the shaving itself is broken at very short intervals, and some shavings of iron and steel present a continued series of fractures not quite running through the metal. In this case, the force capable of being done is consequently even with the most careful annealing to unwind the spiral. This partial severance of the atoms in the shaving itself will require for its accomplishment a considerable exertion of force. The law by which this force increases with the thickness of the metal probably embraces higher powers than the first and second, and may be assumed thus:

$$\text{force} = a + b + c t + d t^2$$

For the present illustration it is unnecessary to consider more terms than those already more particularly explained, namely the constant force, and that which varies as the square of the thickness of the shaving. Hence if $t$ be the thickness of the shaving, and $A$ and $B$ two constants, we shall find amongst the forces required for the separation of the shaving the two terms:

$$A + Bt^2$$

where $A$ and $B$, depend upon the nature of the metal acted upon. We may learn from this expression, even without being acquainted with the values of the constants $A$ and $B$, that the force required to remove the same thickness of metal, may vary considerably according to the manner in which it is operated upon. For example, if a layer of metal, say 2 inches thick, be to be removed, it may be done at two successive cuts, and the force required will be equal to:

$$2A + 2Bt^2$$

But the same might have been accomplished at one cut, when the force expected would have been:

$$A + 4Bt^2$$

The latter quantity always exceeds the former when $t^2$ exceeds $A/2B$.

The writer shows algebraically. Consequently, when the square of the thickness exceeds half the ratio of $A$ to $B$, less force is required to effect the operation by two cuts, than by one. And in the same way it may be shown that any number of slices ($n$) require less force than a single slice of a times the thickness if $t^2$ exceed $A/nB$.

The angle of relief should always be very small, because the point will in that case have its support nearly in a line directly opposed to that force acting upon it. If a tool either for planing or for turning is defectively formed, or if it is presented to its work in such a manner that it has a tendency to dig into it, then a very small angle of relief, in addition to a long back $e$, will in some measure counteract the defect.

The smaller the angle of the tool, the less will be the force necessary for its use. But this advantage of a small angle is counterbalanced by the waste of metal produced in the point of the cutting tool. There is also another disadvantage in making the angle of the tool smaller than the escape of the shaving requires; for the point of the tool being in immediate connection with a smaller mass of metal, will not so quickly get rid of the heat it acquires from the operation of cutting, as it would if it formed part of a larger mass.

The angle of escape $A$ is of great importance and it varies with the nature of the material to be acted upon. If this angle is very small the action of the tool is that of scraping rather than of cutting, and the matter removed approaches the form of a powder. If however the material is very flexible and cohesive, in that case shavings may be removed. The angle I have found best for cutting steel is about 27, but a series of experiments upon this subject is much required.

After the form of the cutting tool is decided upon, the next important point to be considered is the manner of its application. The principle which is usually stated for turning tools is, that the point of the tool should match with the axis of the shaving. This rule may be very slightly below it. This rule when applied to the greater number of tools and tool-holders is calculated to mislead. Before applying the correct rule it is necessary to consider in each tool or tool-holder, what is the situation of that point around which the cutting point of the tool will turn when any force is put upon the tool. Let this point be called the center of escape. Then the correct rule is, that the center of escape should always be above the line joining the center of the work and the cutting point.

On looking at fig. 984, $A$ is the line joining the cutting point $a$ and the center of the work $c$. By making the tool weak about $Q$ that point becomes the center on which the point $a$ will bend when any angular force occurs. On the occurrence of an angular force arising from any point of unequal density in the matter cut, the point of the tool $a$, by bending about the center $Q$ will dig deeper into the work and cause some part of the apparatus to give way or break. If on the other hand the point $P$ is that around which the point of the tool when resisted tends to turn, then since this point is above the line joining the cutting point and the center of the work, the tendency of the additional strain on the point is to make it sink less deeply into the work, and consequently to relieve itself from the force opposed to it.

Fortunately the position of this point can always be commanded, for it is always possible, by cutting away matter, to make one particular part weak. This is indeed a circumstance too frequently neglected in the construction of machinery. Every piece of mechanism exposed to considerable force is liable to fracture, and it is always desirable to direct it to some other part. That part being taken to be thick or thin, the saving in power by taking thin cuts separately would be accomplished by a considerable expense of time. This however need not be the case if proper tool holders are employed, in conformity with the following several conditions:}

The tool-holders should be so contrived as to have several cutters successively removing equal cuts. The cutting edges should be easily adjusted to the work. The steel of which the cutters are formed should be of the best kind, and after it is once hardened should never again be submitted to that process. The form and position of the cutter should be such that it may, when broken or blunted, be easily ground, having but one or at the utmost but two faces requiring grinding. It is desirable that when broken it should be such that it can be ground and it should be in order that it may always be ground to the same cutting angles. The cutters should be very securely, but also very simply tightened in their places. The center of escape of the cutter should, in turning, be above the line joining the center of the work and the cutting point; while in planing the center of escape should be in advance of a line perpendicular at the cutting point to the surface of the work planed. Examples of some tool-holders of this kind will be given subsequently.

The effects of such cutters on the tools would be to diminish greatly the strain put upon lathes and planing machines, and consequently to enable them to turn out better work in the same time and at a less expense of power: whilst the machines themselves so used would retain their adjustments much longer without alteration.

The next paper contains an account of various tool-holders invented by Mr. Babbage. Prof. Willis' papers relate not so much to the mechanical as to the geometrical theory of cutting tools or the relations of their sides and angles, the inclination of the edges required for different metals being assumed to be known. Prof. Willis also describes a new tool-holder invented by him, which Mr. Holtskampf states to be now generally used in his manufactories.

Among the papers in this appendix one of the most useful is that on the diversity of gauges of wires and sheet metals, &c. Our author compares the different scales of measurement of rod iron, nail rod, ribs tubes, wire, sheet iron, zinc plates, crown-glass, &c.: he shows that the greatest inconvenience arises from the numerous scales, which are perfectly arbitrary, and vary in different manufactories. He has given a table of the values of several of the principal gauges to three places of decimals of an inch, the measures being ascertained by an exceedingly accurate sliding gauge, constructed by himself, and indorsing by a vernier the thousandths of an inch. In the following extract we take advantage of a general application of decimal notation to small quantities is admirably illustrated.

### Decimal Gauges.

"The remedy proposed to remove the arbitrary incongruous system of gauges new needed is simply and in every one of the cases above referred to, and also in all other requiring minute measures, to employ the decimal divisions of the inch, and those under their true appellations. Thus for most purposes the division of the inch into one hundred parts would be the best. The word inch is 15 or 100 hundredths, would be sufficiently expressive to the mind; their quantities might be written down as 1. 2. 5. 10. 15 or 100 hundredths, as the decimal mode of expression might if preferred be safely abandoned, and the method would be very distinctly for common use if the word "Mundredth" were stamped upon the gage, to show that its numerals denoted hundredths of an inch, quantities which could be easily verified by all. In practice no difficulty could be seriously felt even without this precaution, by rejecting the thousandths or thousandths or Thousandths; as we should not more readily mistake 5 thousandths for 5 hundredths, than we should 5 tenths or half an inch for 5 whole inches, or 5 entire inches for as many feet. The great point is not that such gauges are attainable as may be read of in hundredths or thousandths. The demand would immediately create the supply, and there could be no difficulty in constructing the inches of the customary forms, with notches made to systematic and definite measures, that may be easily arrived at or tested, than with their present nonsystematic and arbitrary measures, which do not admit of verification. Besides, for those who desire to possess them, several very correct decli-
The Civil Engineer and Architect's Journal.

1847

THE CIVIL ENGINEER AND ARCHITECT'S JOURNAL.

The civil engineer and architect's journal.

Architectural and building materials, with particular reference to the ancient systems of construction.

To these may be added—La Rivière's gage, modified and enlarged from that used for the balance springs of watches amongst the Greeks and their successors. La Rivière's gage, modified and enlarged, may be a useful tool for measuring the thickness of materials used in construction.

The proposed decimal scheme would introduce one universality of system, intelligible alike to all, instead of the numerous and irregular measures now used, which are but partially and indifferently known and lead to frequent mistakes.

Ancient Architecture described and demonstrated by its Monuments.

Ancient Architecture described and demonstrated by its Monuments. By M. Canina. Rome, 1834-1844. 9 vols. 8vo. text, and 3 vols. gr. fol. Plates. Price £24. M. Canina divides the history of ancient architecture into three epochs and classes—the Egyptian, Greek, and Roman—and symptoms and characteristics of each epoch and class are described in detail. Canina has contributed much to the knowledge of the architect, that of the hieroglyphist and philologist.

The new next feature of this excellent work is, that M. Canina considers the architecture of Egypt, and its liturgies, as the generic and prototype of which that of the Jews, Assyrians, and Phcenicians is merely derivative and co-generic. To that common source, also, those very ancient monuments of Asia Minor, only lately discovered, are ascribed, when Greek and Roman art have taken origin. Going still further, Canina unites to Egyptian architecture that of Persa, India, China, and South America, being the only the diverse modification of one prototype, modified according to climatic, social, and material conditions as the case may be.

In the portion of the work treating of the structures of Hellas, many valuable illustrations of those now variously treated are represented in all their original symmetry. Still, some weighty critics have taken umbrage at the hypothetical form which has been given to some of the finest temples of Greece—for instance, to that of Zeus Parthenelius at Argos, the Parthenon, the Temple of Jupiter at Olympia, that of Apollo Epuricos at Bassa, of Neptune at Ptoleum, &e. This controversy points has occupied much of the attention of architects, and been also dilated upon in the transactions of the Archaeological Society of Athens. The opinion that the Greeks left the middle part of the cella—where the figure of the goddess was surrounded by valuable volutions—unroofed, or partly so, has been generally received, and M. Canina also adheres to it. Quatre-mère de Quincy and Wilkins first combated it, and C. Ross later, of late, again brought it before the public. The monastic histories hinging on the passage of Vitruvius, Ill.—"Hypoepithra vero decaestylis est in prono et postico—medium autem sub divo erat sicut atque, admodum velutam ex uirgine parte in pronoe et postico. Hujus autem exemplar Romae non est, et Athenae octaustylos est in templio Olyimp."—This passage is construed by German critics against M. Canina. It is scarcely to be supposed, that the Greeks could leave such beautiful and surprising colossal sculptures as Pallas Athena of the Parthenon, or Jupiter Olympia, to be merely illumined by the dim light from the entrance of a cell, without any windows running down the whole length of the walls.

Among the Greek temples, which our author has so beautifully pictured, some omissions have occurred—unavoidable, perhaps, in so large a work. Amongst these, we may mention that Ione—show—

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Temple of Jupiter Parthenius at Aizaui, described by Texler. The department of Roman architecture, as M. Canina's more immediate and autocratic province, is treated with a detail descending into the slightest minutiae of theory and practice. The great number of 256 plates is devoted to this portion of the work.

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Narrative of the Recovery of H.M.S. Gorgon. By Astley Cooper Key, Commander, R.N. London: Smith, Elder, and Co. 1847. 8vo, pp. 118.

During the military operations of the Buena Ayrean army against Monte Video, in 1848, a violent gale occurred, by which H.M. steam-ship Gorgon, part of the British squadron stationed in the River Plate, was driven ashore. The present work contains a clear, interesting, and most minute account of the mechanical means by which the vessel was rescued from her perilous position. The difficulties encountered against were so formidable, and the ingenuity and energy displayed in overcoming them so great, that the account given by an officer of the vessel, who appears to have had an important share in the work, possesses a general interest. To the naval officer and engineer, however, the narrative will appear of much more importance than an interesting story: the accurate and detailed explanation of all the operations and apparatus, and the record of their comparative efficacy, brings this work into that class of circumstantial publications which the two professions have learned to consider invaluable. It may be added that the present moment seems happily chosen for pub.lishing this work, when general attention is accorded to the fate of the Great Britain.

Before analysing the part of the work referring to the recovery of the ship, we may be doing some service by calling attention to certain defects of construction, which Lieut. Key assigns as contributing causes of the stranding of the Gorgon; they are these—1st, insufficiency of engine-power for extraordinary emergencies; 2nd, the want of anchors and cables in number and size proportioned to those of sailing vessels; 3rd, the absence of a mine-mast. Under the first head, our author wall remarks that a steam ship ought to have power sufficient for extraordinary as well as ordinary occasions. The Gorgon had not during the gale sufficient power to steam into deep water, and barely gained steerage way. Again, the sails could not be used to bring the vessel to the wind, for from the position of the mainmast, the effect of the main staysail was neutralised by the action of the wind on the paddle-boxes, which were as much before the centre of the ship as the staysail was abaft it: had there been a mine-mast, its sail would have had leverage to turn the vessel.

In order to understand the subsequent operations, we must consider the position of the vessel after stranding. She was found on examination after the storm, to have run head foremost into a sand bank, 13 feet high. A few feet of her stern were still in the water, but by far the greater part of the ship rested on—and, forward, was imbedded in—the sand. The idea of getting the ship from such a position, without taking her engines out, when first expressed by her commanding officer, Capt. Hotham, subjected him to the pleasant suspicion of labouring under a fit of insanity.

The means of the recovery were mainly these: the formation of a docks by the application of large screws on the beach, partly to raise her vertically and partly to start her forward; the lashing of buoyant caissons to the ship's bottom to lighten her; the haulage by cables attached to the vessel worked by capstans on the beach; and by other cables attached to anchors in deep water, and worked by the ship's engines.

The first of these operations was by far the most arduous, and was continued almost incessantly during the whole time occupied in recovering the vessel—upwards of five months. From the loose nature of the sand and effect of the tides, the banks of the dock frequently gave way, and the labour of a month was undone in a few hours. A great part of the excavations were effected manually, but an ingenious machine, constructed upon the spot, was also used for the same purpose. To a fulcrum on either side of a barge was fixed a long lever, with a capacious mud-bag at the end of it; the mouth of the bag being kept open by a hoop, to which chains were attached to drag it through the sand; the chains were worked by winches in the extremity of the barge. By these simple means, 44 tons were cleared away in an hour, and the apparatus was sometimes kept in use night and day. For several weeks at a time, however, it was not to get the mud out, but to keep it out. A resident civil engineer undertook the construction of a dam of piles of three-inch plank, driven 'four or five feet into the sand—the first high tide carried them all away. Another dam, however, constructed on the starboard side of the vessel, where the water had little force, answered its purpose tolerably well, the piles forming it being driven deeply into the sand. A complete breakwater against incursions of the sand was subsequently constructed by mooring alongside the vessel three large iron boats, which together formed a break-water 120 feet in length.

The application of pressure to the vessel forward seems to have been a novel one. The employment of vertical screws in transporting and launching vessels had been already practised, but here for the first time screws were used to propel the ship as well as to raise it. Only a limited number of cables could be obtained for hauling, and the aggregate strain which these would bear without breaking was totally inadequate to move the ponderous mass to which they were attached. The application of the screws therefore effected that which without them would have been impracticable. The great difficulty was to obtain a firm purchase for them, as the abruptness of the loose foundation, against which they acted, were liable to give way. This difficulty was overcome by embedding enormous blocks of wood deep in the sand, so as to distribute the back-pressure of the screws over a large surface.

Our author calculates that a force of about 650 tons was applied to start the ship forward—800 tons from the pressure of screws, and the remainder from the tension of cables. The screws were all inclined to the horizontal, so that their force was partly vertical, partly horizontal. The pressure resolved in the former direction was about 130 tons; in addition to this upward force there were 470 tons arising from the buoyancy of large masses of sand, and 25 tons extended to the ship's bottom, so that the total force tending to raise the ship was about 600 tons. We cannot pursue the narrative further than to state that by these means, after nearly half a year of forethought and invention on the part of the officers, and unceasing industry on the part of the men (nearly 800 in all), the vessel was restored to her native element, without any injury, unless we except the following very trivial one, which we allude to merely because it arose from a cause worthy of the attention of the practical engineer:

"At one of our previous attempts to move the ship, when no impression could be made on her, beyond giving her a lift to port of about 10°, the sudden heel had fractured the waste water and injection pipes, thereby showing that the ship must be slightly strained somewhere; but, as these pipes are made of cast iron and are rigidly bolted to the ship's side, a very slight jerk would be sufficient to break them; soon afterwards, however, when the ship was brought upright by the camels, the broken parts resumed their original position, and so exactly, that the fracture could not be discovered without very minute inspection, and in that state were easily and efficiently repaired; this showed what a trifling strain was sufficient to break these pipes, and it would appear that in the event of a steamer taking the ground under any circumstances, should she not be so strongly built as the Gorgon, these vital parts of the engine were liable to serious injury—certainly a remedy for this might readily be found, by fitting these pipes with a sliding joint, and also, instead of bolting the extremities to the ship's side, less liability to fracture would be incurred, by fitting it with a slide and flange, and eliminating the extremity of the pipe free motion in every direction, and making the diameter of the hole in the ship's side, something less than that of the pipe."

The principal practical value of this book arises from the minuteness with which the information is given. There are eighteen lithographic plates, and every piece of apparatus of any importance is carefully delineated and described in a detailed manner. The information respecting the measurements also is generally complete, and the author seems to possess considerable knowledge of theoretical mechanics.


These splendid engravings, illustrative of Rome, have just been imported into this country from Rome, by Meares. Groombridge and Sons; they are admirably drawn and engraved in the line manner, by Domenico Amici, and one engraver of considerable merit; they are the commencement of a series. The above four prints are well suited to the studio of the architect.


This treatise is addressed to those who wish to acquire only a limited knowledge of perspective, but to acquire that little correctly. The object of the author has been to render the work as concise as possible, and to
SIR JOHN SOANE.

For the following memoir we are indebted to the labours of Mr. George Bayley, the able Curator of the Soanean Museum; it was published some time since as an Appendix to a Memoir of Sir John Soane, by Mr. Dalston, and has now received some trifling corrections to render it more perfect.

1853. September 10, born near Reading.

1856. Entered the office of Mr. George Dance.

1872. Exhibited his first drawing at the fourth exhibition of the Royal Academy, "Front of a nobleman's town-house."

1872. Obtained the silver medal at the R. A. for the best drawing of the front of the Banqueting House at Whitehall.

1774. An unsuccessful competitor for the gold medal at the R. A.

1776. Gained the gold medal for the best design for a triumphal bridge.

1777. Left London for Italy.


1789. Elected member of the Academy of Fine Arts at Parma, and returned to London from Italy in June.

1784. Designed and executed extensive alterations and additions to Mulgrave Hall, near Whitby, Yorkshire, for the Earl of Mulgrave—and to Ryston Hall; designed a house for the Rev. G. Gooch, Norfolk; Tendering Hall, Suffolk, for Admiral Sir Joshua Rowley.

1785-8. Designed a house at Stockton, near Norwich, for Robert Fellowes, Esq.; Leiston Hall, for B. G. Dillingham, Esq.


1788-1794. Designed alterations and additions to Norwich Castle.

1791-2. Designed and executed alterations and additions to Barons Court, in the Marquis of Abercorn.

1791-3. Designed and executed alterations and additions to Wimpole, the seat of the Earl of Hardwicke.

1792. Designed and built his own house, No. 12, Lincoln's-inn-fields.

1792. Designed and executed alterations and additions to Sulby Lodge, Northamptonshire, the seat of R. Payne, Esq.

1793. Published a work, entitled, "Sketches in Architecture."

1793-6. Designed and executed Tymnham Hall, near Newport Pagnel, for Mr. Praise, Esq.

1794-1802. Designed and executed a house at Reading, for W. B. Simmonds, Esq.

1794. Designed and executed the entrance gates and lodge in Hyde-park, opposite the Green-street (since taken down); a house for the Hon. Mrs. Yorke, near Southampton.

1795. Became a member of the Society of Antiquaries; elected Associate of the Royal Academy; appointed architect for new buildings and repairs in the royal parks, woods, and forests, July; designed and executed extensive alterations and additions at Bagnet House, for the Earl of Allerbury.

1796. Designed and executed extensive alterations and additions at Hinton St. George, for Sirari Palmet; designed and executed a house at Reading, for L. Austwick, Esq.

1797-9. Designed and executed alterations and additions to Holwood House, the seat of the Right Hon. W. Pitt.

1797-8. Elected a house in Stratton-street, Piccadilly, for Col. Graham; designed and executed alterations and additions to a house for the Countess of Pembroke, Grosvener-square.

1799. Offered himself candidate for the surveyorship of the East India Company; published a letter to the Earl Spenser, K.G.

1800. Designed and executed extensive alterations and additions to a house in St. James's-square, for Samuel Thornton, Esq.

1800-1. Designed and executed extensive alterations and additions to Araby, Bucks, the seat of W. R. Cartwright, Esq.

1801. Designed and executed the banking-house at Fleet-street, for Messrs. Prade and Co.

1802. Elected Royal Academician; designed and executed alterations and additions at Albury Park, the seat of Samuel Thornton, Esq.; ditto, at Cricket Lodge, near Chard, the seat of the Viscount Bridport.

1804. Designed and executed the obelisk in the market-place at Reading, erected at the expense of R. Simson, Esq.; built a large house, counting-rooms, warehouses, &c., in Fountain-court, Aldermanbury, for W. A. Jackson, Esq.; a villa, for himself, at Raling; designed and executed alterations and additions to Fort Eliot, St. Germans, Cornwall, the seat of Lord Eliot, afterwards Earl of St. Germans.

1804-1807. Designed and executed alterations and additions at Ramsey Abbey, Huntingdonshire, the seat of W. H. Fellowes, Esq.

1804-1806. Designed and executed alterations and additions to a house at Roehampton, for John Thomson, Esq.


1806-1809. Designed and executed the Gothic Library, at Stowe House, Bucks.

1806-1807. Alterations and additions to Macartney House, Blackheath, the seat of the Hon. G. F. Lyttleton.

1806. Elected professed architect, in the Royal Academy.

1806-1811. Erected a mansion at Moggerhanger, in Bedfordshire, for Stephen Thornton, Esq.

1807. Erected a monumental tomb, in the church-yard, at Leytonstone, in Essex, for Samuel Bosanquet, Esq.; appointed clerk of the works of the Royal Hospital, at Chelsea.

1808. Made designs for the completion of Tynemouth Castle, the seat of the Earl of Bressingham; for the Royal Academy Institution, at Belfast; and executed and executed a model, and executed and executed a model, of the project, adjoining the house of Mr. Desenfans, in Charlotte-street, Portland-place.

1808-1810. Designed and executed the five new houses in Princes-street, forming "New Bank Buildings."

1809. Designed and executed the new infirmary, at Chelsea Hospital; 27th March, read the first lecture, Royal Academy.

1810-1811. Repeated the first lecture, Royal Academy, January 8; lectures stopped, at the fourth lecture, on January 29; designed and executed alterations and additions to Whitley Abbey, near Coventry, the seat of the Right Hon. Lord Hood.

1811. Designed and executed the entrance to the London Dock Company House, and to the counting-house of Messrs. Thelusson and Co., in Meeting-houses, Old Jewry.

1812. January 9, Lectures resumed, Royal Academy; designed and executed a house in Park-lane, for Mr. Robins; alterations and additions to Everett-house, Bedfordshire, the seat of William Astell, Esq.; designed and built his own house, 13, Lincoln's-inn-fields; the New Gallery, at Dulwich College, to receive the collection of pictures, bequested by Sir Francis Bourgeois, and a mausoleum, wherein are deposited the remains of Sir F. Bourgeois and Mr. and Mrs. Desenfans.


1813-1815. Designed and built a house for the Rev. G. Monins, at Ringwould, near Deal.

1816. Designed and executed additions to the Earl of Hardwicke's house in Cannon's-square; appointed one of the attached architects to the Office of Works.

1816-1817. Designed and built a farm-house, for Thomas Swinnerton, Esq., at Bottleton, in Staffordshire.


1819. Alterations and additions to Marden Hall, near Hertford, the seat of George Thornton, Esq.

1819. Designed and built the National Debt Redemption and Life Annuities Office, in the Old Jewry.

1820-1821. Designed and built houses in Regent-street, for Mr. Robins, and others.

1822. Designed and superintended the re-building of Wotton House, in Buckinghamshire, the seat of the Marquis of Chandos.

1820-1827. Designed and built the new law courts, at Westminster.

1821. Chosen a Fellow of the Royal Society; designed and executed Pelwall House, near Market Drayton, for Purney Sillito, Esq.

1822. Designed and executed a new church at Walworth, in the parish of St. Mary, Newington.

1822-1824. Designed and executed the new Scala Regia, Royal Gallery, and Library, in the House of Lords.

1824. Designed and executed Trinity church, St. Marylebone; a new chapel in the parish of St. Matthew, Bethnal-green.

1824-7. Designed and erected the new offices for the Board of Trade, and the Privy Council offices.

1825. Designed and erected additional committee-rooms, House of Lords.

1826. Designed and erected additional committee-rooms and a new library for the House of Commons; the new grand Masonic Hall, adjoining Freemason's Hall, in Great Queen-street.

1827. Printed for private distribution, "Designs for public and private buildings."
1829. Published "a brief statement of the proceedings respecting the new law courts, at Westminster."


1831. Designed and executed the ante-room to the Sculpture Gallery of Sir Francis Chantrey, R.A.; September 21, received the honour of Knighthood from the Majesty King William IV.

1832. Printed for private distribution, a "Description of the house and museum on the north side of Lincoln's-inn-fields."


1833. April 20. Procured an Act of Parliament for settling his museum, library, and works of art in Lincoln's-inn-fields, for the benefit of the public.

1833. March. Presented with impressions in bronze, silver, and gold, of a medal, struck in his honour by the architects of England; received a medal from the Société libre des Beaux Arts at Paris; elected member of the Academy of Fine Arts at Vienna.


PROCEEDINGS OF SCIENTIFIC SOCIETIES.

HARBOUR OF OSTIA.

On the Ancient Harbour of Ostia. Paper read at the Institution of Civil Engineers, by Sir John Rennie, President.

New Harbour of Ostia—The river Tiber appears to have been used exclusively as the port of Rome until the reign of the Emperor Claudius, who, conceiving it to be utterly hopeless to improve it against the obstacles of nature, adopted the bold and original idea of making an entirely new port altogether independent of the Tiber. Having once come to this determination, he communicated his views to his engineers, and asked their opinion as to the sum which would be required to carry it into effect; they replied that the sum would be so great that if he knew the amount he would never think of undertaking it. Not at all discouraged by this answer, which, on the contrary, only served to confirm Claudius in his resolution, he ordered the necessary preparations to be made for commencing the work. The situation selected for the new harbour, was a little to the northward of the then mouth of the Tiber, with the entrance pointing N.W., by which means it would be better protected against the southerly and westerly gales, and further removed from the deposit of alluvial matter brought down by the Tiber; still, however, it was too near to be effectual, for the projection of the new works only served as jetties to check the current along the shore, and thus to occasion the accumulation of a deposit as great as that occurring at the mouth of the Tiber itself. It could hardly, however, be expected that the knowledge of the day was sufficient to enable the engineers to predict all the consequences of this state of things. The effects of the Tiber were evident, and it was naturally concluded that abandoning the river, all danger from deposit would be avoided, and it was only by experience that their error was discovered. Accordingly, the Emperor Claudius determined to construct an entirely new harbour, independent of the Tiber, but at the same time having a convenient situation to the circumstances.

The ancient writers agree generally as to the principles of the design, construction, and extent of the celebrated port of Claudius. The general plan of the harbour is shown in fig. 1. It consisted of an extensive lower outer harbour, B, and a small inner harbour, F. The outer harbour, B, was formed by two artificial molets, D, of 1000 feet in length, projecting nearly at right angles from the shore; each mole consisted of two parts or arms; the one nearest to the shore was perfectly straight for about 900 feet, the remainder formed a quadrant of a circle 1800 feet long, the breadth, which was equal throughout the whole length, being 180 feet. Between the outer extremities of the two piers or molets was a distance, C, of about 1100 feet. Immediately in the centre of the entrance, or opening between the two molets was an isolated mole, G, 750 feet long and 400 feet wide, forming as it were an island, and leaving an opening at each extremity between it and the opposite pier, or mole, of about 140 feet, thus giving a double entrance to the harbour. The distance between the two piers at the shore, or the total length of the harbour, was about 8000 feet, the width 2830 feet, and the surface extending over about 130 acres; about one-third of this space, however, was excavated out of the land. Immediately in front of the outer entrance, there was a small inner harbour, F, 1200 feet long and 499 feet wide, covering an area of about 7 acres; this inner harbour was divided from the outer harbour by another isolated or detached mole, G, of the same length as the outer one, with an entrance at each end 120 feet wide.

Immediately behind the harbour were two parallel cuts or canals, H, J, communicating both with the Tiber and Mediterranean. The one nearest to the harbour communicated with it at each end of the inner harbour, so that the vessels could proceed either up the Tiber to Rome, or they might go to sea, or in fact might make use of it either for entrance or departure as the wind and other circumstances might be favourable. The other canal was quite independent of the harbour and of the first canal. It was probably used for vessels going direct to Rome, or proceeding to sea without stopping at the harbour. Above both these there were communicating bridges and probably stop gates, particularly on the one next to the harbour, so that the waters of the Tiber might be turned into the harbour, or be prevented from communicating with it, according as circumstances might render such steps advisable. The lock does not appear to have been then known. The circular part of the northern outer mole was open, or constructed upon arches, so as to give free access to the current, but was at the same time built sufficiently solid to break the sea and produce tranquility within. The circular part of the southern outer mole was solid, to prevent the deposit of the Tiber from entering the harbour. At the extremities of the detached mole, and also of the outer and inner molets, were towers for the purpose of defence, and for drawing strong chains across the entrances, in order to prevent the access and egress of vessels when necessary; thus converting the port into a close harbour (μυρο απαγωγος), as used by the Phoenicians at Tyre, and subsequently adopted by the Greeks and Romans. The upper part of the molets was covered with sheds or colonnades, which were used probably for landing goods and for promenades; the interior harbour was surrounded with magazines and warehouses. In the centre of the detached mole, at the entrance to the outer harbour, was placed the great lighthouse, described by Strabo: the base of which rested upon piles, and was founded out of the vessel which brought the great obelisk from Egypt. The depth of this harbour does not appear, but judging from the nature of the coast and the extent to which the piers were carried out into the sea, it could not have been less than from 15 feet to 20 feet, at low water, and that of the inner harbour not less than 8 feet to 10 feet, to have enabled it to accommodate the vessels used at the time.

After the reign of Claudius, the inner harbour was found too small and inconvenient; Trajan therefore enlarged it by making an entirely new inner harbour or basin, K. This was of an hexagonal form, each side being 1100 feet, the diameter being about 1800 feet, and the superficial area being about 70 acres. The entrance between it and the outer harbour was 120 feet in width, and was formed by part of the inner canal made by Claudius to communicate both with his harbour and the Tiber. The remainder of this canal and of the other one by Claudius, was filled up, and a new one, L, nearly parallel to them, was made about 400 feet to 500 feet nearer to the Tiber, communicating with the hexagonal basin, and was no doubt used for the same purpose as the canals of Claudius before mentioned. The inner harbour was also surrounded with quays and storehouses upon...
an extensive scale, containing all the requisites for carrying on a considerable trade for the supply of Rome, and for the construction and maintenance of the fleet stationed in this quarter for the protection of the capital, as well as for the purposes of sending expeditions to the various departments of the widely extended Roman Empire. The whole of the harbour was surrounded by an extensive and lofty fortified wall, flanked on the north by the independent town of Ostia, which was also surrounded by a wall.

Old Port filled up.—The port of Claudius Caesar has now become completely filled up by the alluvial matter brought by the torrential currents, as well as by the deposit of the Tiber, and is now about a mile from the shore. It cannot be supposed, but at the same time we must admire the great skill, ingenuity, and perseverance by which it was attempted at that early period, to overcome by means of art the obstacles interposed by nature.

Discuss.—It is a question well worthy of serious consideration how far this principle may be carried with advantage, or where the obstacles interposed by natural causes become too powerful for the comparatively feeble resources of art. The Clyde at Glasgow, and the Liffey at Dublin, are extraordinary examples of what may be effected by this system. The harbours also of Boulogne, Calais, Dunkerque, and Ostend have all been materially improved in this manner; it still, however, remains to be proved how much further this system can be carried with advantage at these ports. It is doubtful whether the ancients were acquainted with, or had applied the modern system of penning up water in large reservoirs, and then discharging it with increased velocity by means of sluices, so as to enable it to act with more effect in scouring and deepening navigable channels; it must, however, be observed that this can only be an advantage when there is a considerable rise of tide (which does not take place in the Mediterranean), for otherwise it is difficult to obtain sufficient head or fall to discharge the water from the reservoirs with the required velocity.

In the second place, as regards the harbour of Claudius, there was clearly a great effect, accompanied by considerable boldness, as well as ingenuity, both in the design and execution. He must have foreseen, judging from past experience, that the mouth of the minor branch of the river Tiber, which runs into the estuary of the Tiber, and at the same time would be sufficiently near to communicate with the Tiber, and to take advantage of the navigation to Rome. The works were designed and constructed upon a magnificent scale, comprising almost every principle, both in design and construction, adopted at the present time, with the exception of the open or arched mole, which was peculiar to the ancients. This principle is certainly ingenious, and is well designed to obviate one of the most serious difficulties in maintaining a harbour upon a flat alluvial coast like that of Ostia. It might be applied with advantage to many cases in modern times, and it is singular that it has not been more studied, although it must be admitted, that the great rise of tide and the stormy nature of the northern seas (circumstances which do not exist in the Mediterranean) interpose practical difficulties in carrying the system into effect. It has been tried with advantage in the small scale in the outer mole of Ramsgate, but it is very probable there are many cases where it might prove equally applicable. The double entrance, when circumstances admit of its being tried, is very valuable, and where it cannot be used, such a particular form of entrance is desirable as would render small the distance between the mouth of the river and the open sea. The same time would prevent too great an increase of sea. Such a principle was adopted by the late Mr. Rennie at Dundaghead, and was also proposed by him at Kingstown.

The curved form of the outer piers, although well calculated to facilitate the passage of the current, was ill adapted to break the waves; on the contrary, it tended rather to increase their force, particularly at the entrance, where tranquility was much required: the angular form would therefore have answered this purpose better.

Construction.—As regards construction in Ostia, there is an illustration of almost every principle in use at the present time; the rubble thrown promiscuously into the sea to form its own slope, according to specific gravity of the materials and the action of the waves upon them; the solid vertical wall of sand, worked into a smooth surface, and covered with pozzolana and rubble mixed in caisons; and the caison and piled foundation for the light-house on the outer detached mole. There is no account of the diving-bell having been applied to the purpose of building under water, but the use of the material pozzolana, as mentioned, was well understood and generally adopted. The mode employed in using it was to mix the pozzolana in a moist state with certain proportions of lime and ashes, then stone the mixture with other pozzolana, and thus construct the caison, constructed in the form required, and there to leave it until it had set sufficiently hard; the caison might then be removed, and the mass of concrete left standing, and which became more solid the longer it remained, as the rise of the tide brought it a step nearer the surface. The system is praised in many of the ports of Italy at the present day. The French, at their new moles at Algiers and Cherbourg, are said to have extended this system with advantage; yet its merits, as compared with masses of natural sandstone, can scarcely be looked upon as of great material importance in connexion with the subject under discussion, both for the theory and practice, as given in his Chapter on Harbours, especially describes the different

modes of operation before mentioned, with respect to rubble, and pozzolana walls, coffer-dams, piling, &c.

From the above account of the ancient port of Ostia, the following general conclusions may be drawn —

First. That the ancients were well acquainted with the general principles of design and construction of harbours.

Secondly. That as regards the mouth of the Tiber, they carried the improvements as far as was practicable, and that having arrived at that point, they determined to proceed no further, or, if it be true, from the difficulties by which the Tiber was surrounded.

Thirdly. In flat alluvial and deeply embayed coasts like those adjacent to the Tiber, it is a matter of the first consequence to ascertain by practical experience, the extent to which the coast line may be expected to advance from the construction of works at the mouth of a river. This point being first decided, if further improvements be required, then the question of a new harbour free from the difficulties of the old river port may be entertained; and its construction should be so designed as to give the required protection, without incurring the risk of an injurious accumulation of deposit. The port of Claudius, although it was well designed and constructed in itself, was too near the mouth of the Tiber to be effectual, and in fact it acted like a great jetty or continuation of the old works at the mouth of the Tiber; thereby obstructing the free action of the current and producing stagnation on both sides, and by thus, to a certain extent, facilitating the deposit of alluvial matter, which it was intended to obviate, it became overwhelmed and destroyed.

Fourthly. The fate of the port of Claudius and Trajan demonstrated the impracticability of making an effective harbour near the mouth of the Tiber. Trajan therefore determined to select an entirely new site free from the difficulties of the old, and, with that view, constructed the well known works of Civis Vecchi, anciently called Centum Cellae, which has been preserved to the present time, a monument of skill and ingenuity in this department of construction. Upon the whole, therefore, the history of the port of Ostia is replete with instruction, as we at once see exemplified in all the various changes of the various local circumstances, that we can obtain a complete knowledge of this difficult but highly useful and important branch of Civil Engineering.

The Castle of Ostia.

From a Sketch by Mr. Hipplegill in 1844.

Remarks.—After the paper was read, the following observations were made.

Mr. F. Ginn had listened with much interest to the excellent paper which had been read; it was full of instructive, practical facts. He had been forcibly struck with the similarity of the results described, to the effects which were daily under the observation of engineers, in the harbours of the south coast of England. Rye, Dover, and Shoreham, might be quoted as examples. Of the ancient harbour of Rye, scarcely any traces remained. Mr. Giles was sent to Dover by the late Mr. Rennie, during the last year of the Pitt administration, in 1805, with instructions to make a survey, for the purpose of forming an extensive harbour of refuge for the Channel fleet. The design was not proceeded with, but certain improvements were commenced, with the view of removing the mass of shingle on the bar, and preventing a further accumulation. Mr. Walker had since done much for the further improvement of the harbour, by extending the breakwater, and affording greater safety in the Channel, so as to give room for improvement; and, although there was at present rarely such an accumulation of shingle across the entrance, after a storm, as to close it up, which frequently occurred in former times; yet it was evident, that wherever piers or other obstacles were projected directly from the shore, the shingle would accumulate against them, and turning the point, would be thrown, in the form of a bar, across the entrance. This had become so evident, that the
attention of engineers was now directed to the formation of a harbour of refuge, which must, in his opinion, be detached from the shore, in order to permit the free run of the shingie. Such a harbour, or even a good breakwater, would be of great advantage, particularly in case of war, as from the proximity to the French coast, Dover would require special protection. There were several harbours where, in the course of his practice, Mr. Gilles had seen these views exemplified. Bridport harbour, although small, was built out beyond a small piece of land and timber jetty, through which the shingie was carried, and was deposited in the entrance. When he was called upon to devise methods of improvement, he directed the open jetty to be filled up with rubble work, and by establishing a system of scouring by the use of water wheels, the shingie would be carried across the bar, in the same state, and in spite of all that had been done, it still remained a bar harbour. The harbour of Sunderland was liable to be choked up with sand, and but for the scour of the river Wear, it could with difficulty be kept open. Yet, however, by the use of water wheels, the shingie was carried across the bar, when the ebb of the tide was filled up with the catter, and other waterports that had been mentioned, could vessels be received at low water; but only during the time the tide was up. It would always be observed, that upon coasts which were subject to the shifting of shingie, sand, or mud, any solid projection would inevitably cause effects analogous to those which had been mentioned; and to which might be added, the instances of the works of the harbour of Cowtown, County Wexford, commenced by Mr. Nimmo, and continued by Mr. Gilles.

Sir John Rennie, President, said, that the chief object he had in view, in bringing the history of the ancient port of Ostia before the Institution was, in a certain degree, the interest which attached to such an extension of our knowledge of the past, which had so far entirely from natural causes, to direct the attention of the members to the important question of the effect of the action of tides, and of rivers, in the formation of deltas, shoals, and bars, at the entrances of harbours; and he had been struck with the number of instances that he had heard of a few of the harbours, but the opposite coasts of France and Holland exhibited, in a more marked degree, the effects of this action, not only in the bars of the harbours, but in the formation of banks parallel with the shore. The ports of Dunkerque, Calais, Boulogne, and Havre, might be especially mentioned. In all of these, he thought the attention of the Institution might well be directed to the works of the French, and the constant attention to the works, the accumulation of matter at the entrance extended with the new works. Havre was, perhaps, the most extraordinary instance. The current, at the entrance, was at times so strong, that a powerful steam vessel, such as the "Phonias," had found much difficulty in entering the harbour.

The formation of the Goodwin Sands was a subject of interesting observation. There could not be any doubt of these sands being formed by the action of the eddies of the tide and the river Thames; an attentive study of the position, with respect to the headlands nearest, the currents, and the effect of the tides, bearing in mind the direction of the prevailing winds, enabled a reasonable solution of the problem to be arrived at.

Dover harbour was a curious example of the effects of the motion of shingie, which was produced from the debris of the fallen chalk cliff, the drifts of which formed the pebbles, and the chalk and earth composed the silt. In the time of Henry VIII., Dover bay was instanced as being very fine, and having very deep water. The prevailing winds caused the silt and silt to be removed freely along the shore. As soon as an obstruction was offered by piers, the silt was gradually removed, and the channel, with the crowded bed, of the stream, enclosed a short distance from the shore, and the name of the channel. The piers were built, and successfully, to improve the harbour by extending the piers, but, as had been stated, very much yet remained to be done, to form a good harbour at Dover.

It should be remarked particularly in the paper, that one of the leading features in the works at Ostia, was, the construction of the mole upon arches, below the line of the low-water mark, so that the moles afforded still water for the vessels, while the arches permitted the alluvial matter to be carried through by the current. The same system had been adopted at Pozzolana, in the Bay of Naples, and for the same purpose, in building the Pons Asinari. Sir John Rennie was of opinion, that this system of construction might be very advantageously adopted in many situations, and he had frequently proposed it. At Carrickfergus he designed two solid breakwaters to keep the entrance clear, and a mole led from the shore at right angles to it, and pointing to the centre of the breakwater, an arched mole would have been built, besides which vessels would lie, at all times of tide; the run of the shingle along the shore, would thus have been very little impeded.

The Italian harbours deserved very particularly the study of engineers. The port of Genoa had been badly designed, and was constantly embarrassed by the deposit in it. Ancona being situated on a promontory it had less deposit. At Ravenna the harbour had been nearly destroyed. The port of Venice was almost entirely kept open by dredging by manual labour, assisted by the moderate rise of tide at particular seasons. In the Lagoon, the accumulation of alluvial matter was immense. A canal was constructed entirely round the Lagoon, with locks and sluices, to admit the fresh water when the sea was not unfavourable. In 1826, the point of Murano being obtained, and the channel was kept open. Civita Vecchia was principally indebted to its position for being preserved from the alluvial deposit, which was so severely all along the coast.

Mr. Thomson was struck with the apparent similarity between the harbour of Ostia and that of Antioch, both of which had failed from the same causes; whereas Rampole was, like Civita Vecchia, an instance of the advantage of a proper selection of a site for a harbour. The port of Dublin might be also instanced as another example of comparative failure; while that at Cono was most successful, as he believed it was almost entirely free from sand. The system of scouring away accumulations of sand and silt from harbours, by means of large reservoirs, did not appear to be sufficiently resorted to. Mr. Theodol was of opinion, that in some cases, especially where there were deep fair grounds, the use of the flash wheel, for raising water into the scouring reservoirs. In the case of Lincolnshire, and near Yarmouth, he had found that arrangement of machinery very economical for draining. It had been applied in the river cutting of the Yarmouth and Norwich roads, by the use of a flash wheel, half a mile in length, 100 feet wide at the top, and 20 feet in width at the bottom, and it was 10 feet in depth. It was completely drained in 36 hours, with an expenditure of only 5 tons of coal. A reservoir of those dimensions would be found a great assistance for scouring a harbour, when any extra accumulation had occurred.

ANCIENT DECORATIVE ART.

At the Archaeological Institute was read the following interesting paper on the various Ancient Decorative Arts and Process of Working in Metals, such as Chasing, Embossing, Niello, Filigree, &c. By Mr. Horace Tun-

The paper contained rather a general view of the subject than details respecting the several processes in metalurgy anciently used. The writer observed that in the majority of instances we can now show scarcely more than the names whereby numerous artificial processes connected with working in metals during the medieval period were designated, in some cases by their having been practised. The variety, however, of these distinctive appellations rendered it desirable that a catalogue of the descriptions whereby they were distinguished in commercial traffic should be formed, in order that distinctive names yet unrecognised, may be appropriated to the several objects of curious workmanship exhibited from time to time. To the British antiquary it would be an attainment of great interest if his readers would enable him to form some idea of the various classes of gold or silver practised at an early period in this country, and known by peculiar national names in other parts of Europe as the work of England, opus Anglicum, and a variety of it familiarly designated as the work of Durham, opus Durhamense. It would be equally desirable to be enabled to classify such examples of foreign workmanship as may be found in our isles by their proper designations; as the work of the Saracens, opus Saracenorum,—or the work of the Greeks,—the opus Hellenicum,—or the work of the Romans,—opus Romanum,—or of Cyprus, opus Cyprium. Any attempt towards such a classification would possess more than a merely curious antiquarian interest; since it could not fail to throw important light on the history of commerce and international relations in early times. Moreover, the extent of the lists of objects of metal, and the characte-

strictees of such objects as separated from the mass of objects of daily use and were used in a country afforded valuable collateral evidence of the actual state of society. It is obvious that any considerable introduction of foreign luxuries during the infancy of commerce must have been the subject of strict regulation, by which the time was fixed or modified; and therefore the prevalent esteem for any particular objects of foreign production may be taken as evidence of commercial and friendly relation at that period. The elevation of an ecclesiastics of Greek origin, Theodorus, to the see of Cæsarea, in the seventh century, has been hitherto the introduction of the arts and choler productions of Greece or Asia, as well as of the dogmas or ceremonial peculiarities of the Eastern Church; and it was in sacred ornaments that most of the costly productions of art were lavishly displayed. The practice of performing pil-

grimages to Rome, the Holy Sepulchre, and other remote places—where the rich produce of various countries was displayed, and an emporium opened for the supply of the most remote regions of Christian Europe—existed only as an inducement to foreign artificers into this country. By such pilgrimages, even more perhaps than by commercial traffic, were the productions of Italy, Greece, or the East, imported into our country in earlier times.
explaining the introduction of arts into our country which are undoubtedly of oriental character. It was scarcely needful to remind the archaeologist that ecclesiastics of the highest grade did not account themselves debarred in practising the crafts in which they had attained to eminent skill as smiths. It was natural to expect Englishmen, such as Eloi, bishop of Noyon, in France, who lived at the close of the sixth century, are instances of priests celebrated for their skill in working the precious metals.

Mr. Turner next adverted to the undoubted practice in Ireland, from a very early period, of the various arts of working in metals. His observation applied not only to productions in gold and silver, but to castings in bronze or mixed metals, presenting the united characteristics of very early fabrication and of a workmanship on which none of the centuries followed bestowed the superior advantages enjoyed by Irish antiquaries for the prosecution of such an inquiry in the existence of a national collection. The nature and extent of the collection formed by the Royal Irish Academy was known, and many of the sonnets were read, the drawings of the numerous objects preserved in their museum, which, by favour of the Council and the kind intervention of Dr. Todd, were exhibited at the last year’s meeting of the Institute at Winchester. It was observable that some of the Irish specimens exhibited a remarkable skill in the use of the metallic compound technically called mielle, at a period long antecedent to that at which writers have usually accounted that curious art to have been practised. That art, indeed, is of far earlier date than the supposed origin of iron-works of the fifth century, as is shown by the researches of Conri Cicognara, who has given examples of it earlier than the eighth century. In the possession of the Society of Antiquaries there is a Stylus, or pointel, for writing on waxed tablets, and, as it is unmarked, apparently a piece of mielle. This little work is of early Norman, or possibly Saxon, date. After some remarks on the art of engraving as applied to the decoration of sepulchral memorials familiarly termed "Brasses,"—which, independently of their value as specimens of costume, &c., possesses additional interest as examples of design, and of a peculiar kind of artistic method in the working of metals, viz., the combination of the work of the burnia with the use of enamel, and of a coarse assimilation to the process of the true brass, Mr. Turner observed that at present impracticable to offer any definitions of a precise nature in regard to many of the terms of the medieval terms to which he had occasion to advert. As respected the distinctive term opus Anglicum, by which the works of the councillors of England are understood abroad, we are obliged to express an opinion that the phrase was not applied to denote any particular process of art, but was rather used to describe the general character and design of the objects fabricated in the precious metals in this country at an early period. Reference to the works of Richard and Edward the First, and the decorations of the altars in the churches of the bishops of Salisbury and other bishops, the great skill in the working of gold and silver, can be pointed out in the various objects to which reference has been made.

An ignorance of acoustics was said to be evident in the construction of our churches. Mr. Dwyer referred to several well-known forms, such as tunnels, archways, and long curved spaces; as also to the stone-coped seats on Westminster Bridge,—where the slightest whisper in one could be heard in the opposite,—as so suggestive that he could not but feel the greatest surprise at such repeated blunders. The procession to each of the London theatres was said to be different in arrangement;—no two being alike, and none exhibiting an approach to any principle which the laws affected. Mr. Dwyer would dictate. In attempting to produce an audible and satisfactory effect throughout the house, Mr. Dwyer propounded a theory which, he said, comprehended the principles embodied in two familiar instruments of sound,—viz., the bell and the violin. He said he would construct two bellows, one for blowing over not less than eight feet on the stage to the sides of the theatre; each composed of two thicknesses of wood placed about six inches apart. The front should be perforated ornamentally;—the service to require and distribute equally within itself, the sounds given forth near it. The elevation should assume the form of an arch, with spandrel also perforated—thereby distributing with distinct resonance the words or music to all parts of the house. Mr. Dwyer has made some remarks upon the construction of ceilings; which we report now, as having more immediate connection with the acoustic theory last described. He proposed the use of a spherical or a spheroidal roof, supported by iron ribs, which might be ornamented; the spaces between each rib to be enriched with elaborate perforations (or otherwise, according to the general style of the house), in a manner similar to the doorway in the circle at Asley's. The additional height thus given to the interior would enable the chandelier to be placed above the line of sight from the upper part of the theatre to the stage; and the objections that might be made to this position of the chandelier were met by the fact that a concave surface...
fects much more than a flat one. Another important advantage arising from this form of ceiling was the facility afforded for a powerful system of ventilation. The painting-room would be raised some nine feet; and the increased depth of the roof and the canvas, scenery, and other properties, from the top of the ceiling, would add considerably to the reverberation of sounds—besides contributing greatly to the comfort and health of the artists employed in the theatre. Mr. Dwyer elucidated his ideas by sketches. Advertising the influence of colour on the eyes of the beholder, he quoted the case of white ribbons, which have a distinct effect to the opposite sex, with a light touch of red; but the white was concealed, and the red was visible. Coloured decorations when composed of splashing cupids or allegories were slightingly mentioned. Some suggestions were made stating that rich fabrics, coloured as Persian carpets, cloth of gold, etc., when thrown over the fronts of the figures in the background of the stage, would excite the imagination of the audience and denote a special interest. The disregard of unity in the construction of theatres generally was pointed out; and, among other instances the St. James's was named—where light floating ornaments, in the French style, are in black and white, and the curtains, etc., are without any instance of discordant arrangement. The application of various decorative materials, such as distemper paintings, paper-hangings, composition, paper maché, to the fittings, etc., received attention; and it was asserted that the Princess's was conspicuous for elaborate richness and diversity of ornament—but that it was questionable whether the Herculaneum expression therein, rather than the grace and delicacy of Apollo, may be deemed appropriate. Mr. Dwyer said, that as a specimen of decoration it merited warm praise; owing to the characteristic vigour throughout every part (up to the ceiling), as well as for a suitable strength and richness of colour. The usual enrichment on the fronts of boxes was commented on; and the use of bas-relief, or raised ornament, recommended in preference to the most ornamental painting. It was exhibited at the Italian Opera House, where the effect partakes of the weakness peculiar to paper-hangings and similar media. The second tier in the Princess's was alluded to as a good specimen of this manner; being decided in character, with the details subordinate, and the terminal figures and compartments skilfully devised. The velvet valances to the boxes in this theatre were commended; but the practice of having them, as in several theatres, to extend only above the private boxes was deprecated. When it is not the wish of theboxers to be exposed in the boxes, the valances of this kind suspended from the cushion were suggested as imparting a peculiar and good effect. Ornamental iron work, it was said, may be introduced with great diversity of design, for balconies, open fronts to the boxes, or ornaments in relief for the parts of a theatre. Some remarks were added on the usual method of supporting the boxes by several columns; and others commendiatory of the manner in which the tiers of stage boxes are generally placed between large Corinthian columns. Sculptured and ornamental annexes to a theatre, and the higher quality of class, —and encaustic painting as facilitating cleanliness and durability.

At the following meeting some observations on the paper were made by Mr. Coors; in which, referring to the remarks on a plan of a theatre, he suggested that another form offered considerable, and probably greater, advantages. This he described as the oval; which he would have divided by its longer diameter, one half apportioned to the audience, and the other to the stage. He alluded to several Continental theatres, which adopted this form in construction—the Circus Francon, Napoleon's grand amphitheatre at Milan, the Roman Circus at Verona, and the Colosseum. As painted or shifting scenery was not employed with the Greek Drama, the present system of decoration was derived from marble and gilded, and bronze. The advantages of the semi-circular and semi elliptical over those of the horse-shoe form were enlarged upon; and the Olympic Theatre at Vicenza, built by Palladio, was said to exhibit them in a perfect manner. This theatre may be considered the chief theatre of Palladio whose members directed it to build in accordance with the ancient plan, that they might afford their competitors an idea of the magnificence of ancient theatrical exhibitions. Among his works, which is a remarkably elaborate architectural composition, were exhibited in an old work upon the public and private buildings of Vicenza. Mr. Coors further adverted to Mr. Dwyer on decoration; several of which met with his concurrence, and other he has extended by additional descriptions and suggestions; referring especially to the decorations of the Théâtre Comédié at Paris, as of a chaste and appropriate kind. The decoration of the latter was largely in wood, the design of the effect supported by Mears, Parr, Seddon, Crabbe and others; and the following observations are selected from others of interest. A spheroidal form of ceiling, it was admitted, offered several advantages; in fluence between scenery and lighting, as a picturesque and pleasing effect. The decorations of the ceiling in the Italian Opera House, it was observed, had been copied from one in the Ducal Palace at Mantua (a coloured plate was exhibited from Gruner's work); it had not been successfully adopted. It was considered questionable if the example was suitable for such an extensive surface; if, admitting the propriety of selection, the figures hold their just proportions. The great distance at which they are required to be seen has not been sufficiently considered; and the circular character of the ceiling, it was added, demanded a different treatment. The use of bright colours, such as vermillion, it was remarked, ought to be restricted to a very limited application. Mr. Parr supported this opinion by references to works by Raphael and Rembrandt; and recommended Indian red and Venetian red, when supported by a bold mass of shadow, as producing a more powerful effect. He also objected to the prevalent use of bright colours for interior decorations—from their harsh and, owing to the general absence of green, fatiguing impression. It was remarked that the decorations of the Italian Opera House appear most satisfactory when the seats are vacant; and consequently, that the design does not embrace some essential principles. The box was praised, and the position of the boxes above the orchestra was highly commended; but was not in the plan of the Prince of Wales's Theatre, where it is to be seen. The box was composed of stamped brass. A description was given of Covent Garden Theatre as it was when first opened. It was designed by Smirke, and painted under his directions. The drop-scene was painted by William Dixon in subdued colours; and the scenery was said to have been a very agreeable, though splendid, effect was not aimed at.

SOCIETY OF ARTS, LONDON.
Dec. 16.—Dr. Rogers, Sec. E.S., V.P., in the Chair.
The Secretary read an address from the Council, which gave a retrospect of the proceedings of the past year, and the proposals of the Council for the coming session. It stated that the Society, once clearly established, can now claim to have a footing in every branch of the fine arts, and of late years to have added a new branch to its province of Fine Arts in the fine arts of sculpture. It is stated in the address that the Society is one of the few national institutions of the kind in the country, and that it has been strongly approved of by H.R.H. Prince Albert, President of this Society, as being the only one in any analogous position. That now, however, that great field is happily full of co-operating Societies, and the fine arts are now receiving the attention of the public; and the Council, at that being regarded as an evil, that moral and useful work of promoting art in connection with the mechanical, for which our manufacturers are so justly celebrated.
The address then proceeded to state the various alterations and improvements which had been effected on the Society's premises during the recess, and concluded with a list of the various pecuniary and honorary rewards about to be offered for competition during the current session.
The first paper read was "On the principles employed in the recent Decorations of the Society's Great Room." By D.R. Hay, Esq.
The paper commenced by stating that the decorator who has been intrusted with the embellishment of the hall of a Society which has for its object the advancement of the ornamental and useful arts, naturally felt much anxiety as to the result of his labours; and this anxiety was increased by the reflection, that his work must necessarily be of a nature calculated to accompany one of the greatest efforts in high art of which this country can boast. It was the object, therefore, to select one of the most effective and useful styles of decoration as should not only embellish the hall, but at the same time the additional effect to those great works of art which it contains, connecting the whole in one general harmony of form and colour.

Mr. Coors, speaking on the subject of the decoration of the ceiling, was answered by Mr. Bartley, who thought that the decoration of the ceiling was to be considered as a picturesque and pleasing effect. The decorations of the ceiling in the Italian Opera House, it was observed, had been copied from one in the Ducal Palace at Mantua (a coloured plate was exhibited from Gruner's work), and it had not been successfully adopted. It was considered questionable if the example was suitable for such an extensive surface; if, admitting the propriety of selection, the figures hold their just proportions. The great distance at which they are required to be seen has not been sufficiently considered; and the circular character of the ceiling, it was added, demanded a different treatment. The use of bright colours, such as vermillion, it was remarked, ought to be restricted to a very limited application. Mr. Parr supported this opinion by references to works by Raphael and Rembrandt; and recommended Indian red and Venetian red, when supported by a bold mass of shadow, as producing a more powerful effect. He also objected to the prevalent use of bright colours for interior decorations—from their harsh and, owing to the general absence of green, fatiguing impression. It was remarked that the decorations of the Italian Opera House appear most satisfactory when the seats are vacant; and consequently, that the design does not embrace some essential principles. The box was praised, and the position of the boxes above the orchestra was highly commended; but was not in the plan of the Prince of Wales's Theatre, where it is to be seen. The box was composed of stamped brass. A description was given of Covent Garden Theatre as it was when first opened. It was designed by Smirke, and painted under his directions. The drop-scene was painted by William Dixon in subdued colours; and the scenery was said to have been a very agreeable, though splendid, effect was not aimed at.
imparted to the ball must depend upon the embellishment of the plain surfaces, and that the architectural decorations could only be made to appear as bands dividing those surfaces. It became, however, requisite to unite in some measure the cornice with the walls, and this has been effected by painting it in blue, green, or light yellow, with a natural harmony with the colour of the cloth upon the walls. The plain surface of the cove which surrounds the cornice, afforded the decorator the first field upon which he could exhibit a style of decoration, and this he has employed to great effect. In the cove, three or four plain bands, each only one inch in width, and of colours arranged in a way that might have a rational effect, he has made this combination to represent mosaic work composed of *giallo antico*, *rosso antico*, *lapis lazuli*, and il sustain gold. This selection of materials has a double advantage, for while it gives meaning in the shape of a beautiful ornament, it being used in quantity, and giving the quality of unity and continuity amongst the parts. The band of stucco work which divides this cove from the flat part of the ceiling is painted pure white, to represent statuary marble, as are also the moldings round and upon the surface that leads to the cupola light. This was adopted in preference to the *terra cotta* colour of the cornice, as being equally appropriate and more light in effect. The flat part of the ceiling is also enriched by a mosaic work of a similar chromatic harmony of the same marbles, but of a different harmony of form from that of the cove, and without gold. The same space is also enriched by a mosaic work composed of *lapis lazuli* and *sienna* combined with infield gold.

The figures forming the design in the cove are produced by the combination of elliptical surface forms; they are all linear, and formed by arcs of the same ellipse, the size of which was proportional to that of the principal figures in the pictures. As a contrast to this arrangement of curvilinear forms in the cove, the decorator has introduced a rectilinear design in the flat part of the ceiling, which divides it into the cupola. This design arises out of a combination of equilateral triangles producing hexagonal and rhomboid figures, into the former of which the national emblems—the rose, the thistle, and the shamrock—are introduced as if inlaid in *rosso antico* marble. In the panels above this, and surmounting the sides and spandrels of the space below the cupola-light, the design is produced by the combination of an equilateral triangle and a circle; thus uniting the curve with the straight line, as an appropriate winding up of the linear harmony.

In the ornamentation of the four side panels, a shield has been inserted. The one over the chair is blazoned with the royal arms. The shield opposite to the chair is blazoned with the family arms of H.R.H. the President of the Society. The shield on the right of the chair, is blazoned with the arms of Barri the painter, and that on the left, with the badge of the Society.

The second paper read was "On the first principles of Symmetrical Beauty, and their application in certain branches of the Art of Design." By D. R. Hay, Esq.

This paper commenced by stating that the first principles of symmetrical beauty are in the power of nature, and that a man, applying the principle of numbers in the formation of plane figures is afforded by the division of the circumference of the circle into 360 degrees, which degrees are again divisible and subdivisible by 60 into minutes, seconds, &c. Thus the laboured and insensible harmony of proportion, which for certain numbers to each other, becomes apparent and visible in their application to the structure of geometrical figures by means of the division of the circle. It then proceeds to show, that to apply these degrees to rectilinear plane figures, each figure must be reduced to its primary element; that the triangle, which is half of the square, is the first and most simple of its class, and is the representative of the No. 2; that the scalene triangle, which is half of the equilateral triangle, is in like manner the representative of No. 3; that the acute triangle which arises naturally in the series is that which is half of one of the five isosceles triangles which form the pentagon, and is the representative of No. 5.

We have, therefore, in the square, the equilateral triangle and the pentagon, the principle of five parts of harmony, as represented by plane figures, and evolving the operation of the harmonic numbers of 2, 3, and 5. Out of the primary rectilinear figures already referred to, arises a second class, as, when an equilateral triangle is divided into two sections by a line drawn through one of its angles and bisecting the opposite side, these scalene triangles, if reunited by their hypothenuses instead of their longest sides, will form an obtuse angle—every rectilinear figure having its corresponding curvilinear figure.

The paper concludes by showing the operation of the principles of harmonic ratio in the formation of the mouldings of Grecian architecture, ornamental vases, household utensils, &c.

Dec. 23.—W. H. Bordes, Esq., M.P., V.P., in the Chair.

The first communication read was by Dr. Root, Sec. R.S., "On his Economical Chess-Board," the object of which is to give the chess-players a board of sufficiently small dimensions to admit of being put into the pocket, when folded, at any part of the game, without deranging the position of the men on the board, so that when it is reopened they will be found in the same place as before, and the game or problem can be resumed when it has been left off.

The second communication read was "On the effects of Heavy Discharges of Atmospheric Electricity, as exemplified in the Storms of 1846 (including an Account of the Destruction of St. George's Church, at Leicester, on 14th of August); and Remarks on the Use and Application of Lightning Conductors." By E. H. Milne, Esq., gentleman Engineer to the North Western Railway. Fragments of the roof of St. George's Church, and the apparatus used for getting rid of the injurious effects of lightning on electric telegraphs, are exhibited in illustration of the subject.

The author commenced by stating that the frequent occurrence of thunder storms during the past summer had afforded almost unequalled opportunities of investigating the effects of atmospheric electricity in the concentrated form of lightning. He then proceeded to give a description of the effects produced on St. George's Church, Leicester, by a lightning storm. The church, which was a new and handsome building, was entirely destroyed by the effects of the thunder storm of the 1st of August; the steeple having been burst asunder, posts of it were blown a distance of 50 feet in every direction, while the vane rod and top part of the spire fell perpendicularly down, carrying with it every floor in the tower, the bells, and the works of the clock. The falling mass was not arrested until it arrived on the ground, under which was a strong brick arch, and this also was broken by the blow. The gutters and ridge covering were torn up, and the pipes used to convey the water from the roof were blown to pieces. The author next proceeded to compare the power developed in the discharge of the lightning, which had destroyed St. George's Church, with some known mechanical force. He stated that 100 tons of stone were blown down a distance of 30 feet in three seconds, and consequently a 12,200 horse-power engine would have been required to resist the effects of this single flash. In the course of the paper the author showed how a second battery, constructed by himself, and which was less than the A. of a cubic inch in size. This battery, he had found, would for a mouth together ring a telegraphic bell 10 miles off. He also exhibited a second battery, which, although it was small, was very light, and is also of course of the power sufficient to work a telegraph. Having detailed the course of several discharges of atmospheric electricity, he then proceeded to show the effects produced on the electric telegraphs, and the means which have since been adopted to prevent injury to them in future.

M. Highton further stated that since the occurrence of the above storms he had examined the cathedral of St. Paul's, in London, to ascertain how far this noble pile of building is protected from the effects of lightning, of which since the two lightnings, the central dome has none. He found, however, that the position of the spouts and other metallic connections is such, that he considers if the same are preserved as they now are, the building will, for years to come, be free from damage by lightning; but should they be removed at any time, and glass or porcelain be employed in their stead, then the main part of that noble building would be in constant danger from every storm that passes over it.

He then concluded by urging the importance of a correct and systematic principle being acted on in the new Houses of Parliament, with a view to securing them from the disastrous effects of lightning.

ROYAL SCOTTISH SOCIETY OF ARTS.

Nov. 25, 1846.—David Maclaggan, M.D., F.R.S.E., President, in the Chair.

The following communications were read:

1. On producing White, or Neutral Light, by means of ordinary artificial light. By George Tait, Esq., Advocate, Vice-President.

The white light, or artificial day-light, was exhibited, in contrast with ordinary artificial light, upon the primary and the secondary colours, and upon a coloured sketch.

In this communication Mr. Tait shows, that, while the white light of the sun is composed of rays producing orange and of those producing blue, in equal parts, in ordinary artificial light the rays producing orange exceed by many times those producing blue; the consequence of which is that the latter light resolves into an orange light a little modulated by blue, which affects very much the appearance of the colours of objects exposed to it. In order to produce white light, he inclines the ordinary light in a lateral, or otherwise transects it, and by transmuting it he attains, by the proper depth of blue, so as to absorb the excess of orange; by which means it is produced at five or six times the expense of the same quality of the ordinary light employed, which, by using a gas argand lamp, is about a half of the expense of ordinary light; and thereby, the proper tint for the glass by combining it so that white paper receiving the light transmitted through it may be in unison with similar paper receiving the white light of the sun. He exhibited in a simple and striking manner the great contrast of the effect of ordinary light and of that of white light, or artificial day-light, thus produced by him (by means of glass which he had painted with "French blue") upon white, the primary and the secondary colours, and also upon coloured landscape sketches.
2. Description of a Patent Safety-Rein. By Mr. Alexander Miller, saddler, Edinburgh.—By this rein, which has been a considerable time in use, and severely tested, Mr. Miller states that all possibility of a horse running off is effectually prevented. Its effect when drawn is to compress the horse's windpipe, and thus render him powerless. A vicious horse once or twice checked by this rein is completely under command and learns obedience.

3. Description of a very cheap and convenient Coil-Electrical Machine. By Mr. Alexander Brown. Communicated by George Wilson, M.D. Dr. Wilson, in bringing forward this machine, did not so as claiming a different arrangement from the coil-electrical machines already in use, but he considered Mr. Brown had great merit in making his machine not only convenient in size and handsome in appearance, but very moderate in price. It can be sold at 1L. 15s., and is fitted for all medical purposes. The shock can be graduated from the slightest to the strongest, by withdrawing and again gradually introducing the bundle of wire into the centre of the coil.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Dec. 14.—S. Angell, V.P., in the Chair.

M. Lenuer, of Paris, was elected an honorary member.

Drawings were exhibited to illustrate the description of the modes adopted by Mr. J. B. Gardina to warm the Synagogue of the Spanish and Portuguese Jews, in Bevis Marks; that object having been successfully attained by the admission of warm air from a chamber beneath the building.

Mr. D. Mogata, read a paper descriptive of a distillery and its appurtenances recently erected from his designs in London; with some observations on the principles of distillation, heating furnaces, and general ventilation.

Mr. E. J. Asson describes a modification of the "Polmaine" system of warming, applied to a vineyard near London. A discussion arose on the ill effects of the system if applied to general purposes, in consequence of the vitiated air being reheated.

Remarks were made on the consumption of smoke, and also on the necessity of providing means of ventilation wherever warm air is introduced.

RUFFELLE.

The following is the 3rd of Pope Leo X., by which he conceded to Ruffelle the license to purchase all stone and marbles required for the construction of St. Peter's, and to prevent the destruction of ancient monuments and inscriptions by the masons and builders of Rome.*

"TO RUFFELLE URBANUS.

"As it is most necessary for the construction of the Roman temple of the Prince of Apostles, that stone and marble, of which we ought to have an abundant supply, should be rather procured at home, than be conveyed from abroad; and as it has been ascertained, that the ruins of Rome contain a great quantity of these materials, and that all persons who, either in Rome or even in the neighbourhood, intend to build, do appropriate the same to their own use; I make you, whom I use as the master of this said temple, the overseer of all the marbles and stones which, henceforth, may come to light at Rome, or at a distance of ten thousand passes therefrom—for this reason, that you shall purchase for me those which may be proper for the edification of this temple. Therefore, I command all people, middle, lowest, that wherever they shall, hereafter, dig out marbles or other stones, of any kind, within the space assigned by me, that they shall acquaint you, the overseer, forthwith, of the nature or kind of every thing so discovered or excavated. And also, that whoever shall not do so within three days from the time of such discovery, he be fined from 100 to 200 gold coins, as shall appear to you fit. And, moreover, as I have been informed, that much of ancient marble and stone, engraved with inscriptions and other monuments—which monuments often bear some exquisite stamp of art, and ought to be preserved for the cultivation of literature and the improvement of the Roman tongue—are vilely cut up by the marble-workers as building material, and that thus the inscriptions are destroyed, I command all persons who exercise the trade of cutting marble and other stones, that, without your orders or permission, they may not dare to cut or work any inscribed stone—supplying the same fine, as aforesaid, to all who may act otherwise than I command. Given this sixth Cal. of September. Year three. Rome."
which is effected in the manner shown in the annexed engraving, representing a vertical section of the apparatus, which consists of a wrought or cast iron pan or vessel d, for holding the zinc, placed within another wrought or cast iron pan c, with a span of about 14 inch all round and under the upper pan; this lower pan is set in brickwork a, over a furnace b, and surrounded by the flue, and contains molten lead, or lead combined with tin, through which the heat is transmitted to the upper pan, containing the zinc; the upper pan is lined on the inner face with fire-clay or fire-brick, to prevent any galvanic effect by the action of the zinc on the iron. By this method the zinc is kept in the bath at an even temperature of about 500° Fahrenheit.

IMPROVEMENTS IN GLASS.

James Timmins Chance, of Hardsworth, Staffordshire, glass manufacturer, and Henry Bardo, of West Bromwich, glass stainer, for "Improvements in the manufacture of glass."—Granted April 28; Enrolled October 26, 1846.

The improvements relate, first, to the application of heat to sheets, panes, or plates, or other articles of glass, when they require to be reheated for any purpose, such as the producing stained, painted, enamelled, or other glass, which has been hitherto effected either by placing the glass upon metallic shelves within a muffle, and applying the fire externally, or by placing the glass in a kind of reverberatory kiln, upon a bed of stone or burned clay, and then applying the fire internally and directly upon the glass. By the former method there is a difficulty in preventing plats of glass from becoming bent or cocked, and in heating the glass uniformly; and, by the latter plan, the direct action of the fire upon the glass is injurious.

The improvements consist in so applying heat that the advantages of the two methods above mentioned are united, and, at the same time, their respective peculiar defects are avoided. In carrying out this part of the invention, the glass is laid upon a suitable bed (stone is preferred), and the glass covered by suitable coverings, so as to enclose the glass in a chamber, by which the direct action of the fire on the glass is prevented, the inverted pans for the time being, producing a uniform heating to the kiln. In the top of each cover there is a small aperture, communicating, by means of a pipe, with the outside of the front of the kiln, this contrivance being intended to allow of the escape of any vapour. In order to facilitate the practical operation of enclosing the glass in covers, movable iron bars, is preferred, placed upon an iron carriage running upon rails, the kiln being properly constructed for receiving such carriages. The annexed engravings show a plan and longitudinal section. a a are the fire-places; b b carriages, with a bed or beds; c c inverted pans or covers. The carriages are introduced into the kiln at the doors e e; the doors are then closed, and the flame and heat will be reverberated within the arch, and then pass off up the chimney f, which is to have a damper to regulate the draft. The process of heating and cooling the glass is then conducted in the ordinary way. And for the purpose of still further securing the glass from being injured by the fire or smoke, the edges of the covers are fitted into grooves cut into beds, there being powdered chalk, or other suitable substance, to close the joints.

The second part of the improvements relates to the mode of applying heat to sheets, panes, or plates of glass, when it is desired to alter their shape, whether to render them more flat, or to give any required curvature. According to the methods generally adopted, the kiln has to be cooled considerably before a second charge of glass can be introduced into it. Now, the improvements consist of so employing moveable beds and covers, as described, that the cooling down of the kiln is rendered unnecessary, and the glass, when enclosed in the chambers formed on the beds, can be safely introduced into the flattening or bending kiln, without necessarily reducing the temperature of the kiln. The moveable beds aforesaid, previously to their being charged with glass, are to be heated to a temperature approximately that of the kiln interior; this is done by means of a small kiln, similar to the main kiln. When the glass has remained sufficiently long in the flattening or bending kiln, it is withdrawn along a lead or long arch opening into the kiln, similar to that described in the specification of a patent granted to the said James Timmins Chance, July 7th, 1842. This lead or arch, however, is not an essential appendage to the present system of the patentees, because the beds and the covers above mentioned may be of such a thickness as to allow the glass to be withdrawn from the kiln without the intervention of a lead or long arch.

GLAZING CAST IRON.

Timothy Kennrick, of West Bromwich, Staffordshire, ironfounder, for "Improvements in glazing and enamelling the surfaces of Cast Iron."—Granted May 20; Enrolled Nov. 26, 1845.

The improvements relate to coating and glazing articles of cast iron, with two separate coats, one to give it a body, and the other the glaze, in the following manner:—The cast iron articles are first to be thoroughly cleaned, and then to be coated with a composition, consisting of 100lb. of calcined flints and 75lb. of borax, both ground fine and fused; when cooled, 40lb. of this mixture is to be added to 5lb. of potters' clay, ground in water till of such a consistency, that when the article is dipped, it will retain a coating 1/16th inch thick. It is then allowed to set, and while moist, the glazed composition is carefully sifted over the surface, consisting of 100lb. of cornish stone, ground fine, 117lb. borax, ground fine, 86lb. soda ash, 35lb. salpeter, 35lb. slaked lime, 13lb. white sand, and 50lb. white glass, well pounded; the whole are mixed, and well vitrified; when cool they are ground to a fine powder, washed, and dried; 45lb. of this mixture to be added to 11lb. of soda ash, in hot water, and well stirred, and then dried in a stove. When the article has received the glazing it is placed in a stove, and kept at a temperature of 215° Fahr. Afterwards it is fired in a kiln or muffle, raised to a heat sufficient to fuse the glaze, then removed and examined, and if the glazing be not perfect, the mixture is sifted over it, and it is again subjected to the action of the kiln or muffle.

For coating the interior of iron pipes, the first mixture, or body coating, is poured through the tube, at the same time turning it round so as to insure its contact with every part throughout its entire length, and whilst moist the glazing powder is passed through in the same way; after which the tube is to be treated as above described.

The patentee does not claim having the inferior surfaces of vessels of capacity, but only for enamelling the external surface of such articles, and the enamelling and glazing of cast-iron Italian irons, box irons, knobs for door handles, and such like articles, and the inside of cast iron pipes, and ornamental surfaces of cast iron ornaments.

IMPROVEMENTS IN Smiths' Water TUE-IRONS.

By W. Norton.

(Reported in the Franklin Journal.)

The smiths' water tue-iron as fitted up on the ordinary construction, is bad in principle, lasts a very short time before it is destroyed, and is eminently calculated for being an expensive item in the economy of the smith's work-shop. Much inconvenience and hindrance results from the frequent stoppage occasioned by the failure of this useful appendage to the smithy fire.

The construction was directed to the circumstance, eight or nine years ago, with the intention of finding a remedy for, or at least an amelioration of the evil. Upon examination of the disabled tue-iron, I found the inside, more especially the end nearest the fire, generally filled up with a substance sufficient to prevent any water getting to that part—the place where it is most required to carry away undue temperature; thus the tue-iron is not fairly worn, but burnt out before its time.

What is meant by the ordinary construction may be understood by reference to figs. 1 and 2, of the prefixed sketch.
A, water tee-iron.  B, cistern for water, at a convenient height above A.  $\alpha \times \gamma$, wrought-iron pipe, connecting the lower part of the cistern, B, with the lower part of the tee-iron, A.  $\delta$, another pipe, connected with the upper part of A, and passing either through the bottom of the cistern B, or by one side, and over the top with a bend.  Water poured into B will descend by the pipe, $\alpha \delta$, into the tee-iron, A, driving the air before it up the pipe, $\alpha \delta$, and if sufficient water be supplied till it stands at the height shown by the line in the cistern, the whole of the pipes and tee-iron will be full of water.

In actual working, the valve, $\mu$, is covered with burning coal; the water soon attains a boiling temperature, and steam being formed, a portion of the water is driven out of the tee-iron up the pipe $\delta$, into the cistern B, where a fresh supply descends by $\alpha \gamma$, to be in its turn heated and driven out as before.

If distilled water could always be supplied to the cistern B, and that kept clean, the tee-iron would have a fair chance of doing its duty to the end; but as it is not so, and as there is a great probability that other substances get into the cistern, and ultimately find a settlement in the tee-iron, some contrivance was desirable for preventing the accidental, or perhaps, in some instances, the intentional introduction of impurities, etc.  This purpose will be readily understood by again referring to the figures.  Instead of the water descending by the curved pipe $\alpha \gamma$, it is conveyed by the straight pipe $\alpha \delta$, into the cast-iron box C, which is fixed considerably below the tee-iron, and must first be filmed before any can rise up the pipe $\delta$, into the tee-iron.  Should any sand or ashes get into the cistern B, it will settle in the box C, and not in the tee-iron, which will be supplied with water containing no heavy particles.  A mud-hole door $\eta$, is provided, by which the box $\delta$, may be cleaned out at any time when the work is not going on.  This additional apparatus, if attended to, will ensure a satisfactory working and add a considerable period to the existence of the water tee-iron.  The box C I have made, is of the capacity of one cubic foot to each fire, and I would recommend that the mud-hole door be opened every two or three weeks according to circumstances.

ST. PAUL'S CHURCH, ALNWICK.

Sir,—In your notice on new churches in the last number of the Journal, you have made some remarks on the seats in the chancel of St. Paul's Church, Alnwick, and on the Duke of Northumberland, which I am sure you would not have done had you written from actual observation and knowledge of the case.  It therefore beg leave to say before you the facts.  You are correct in denying the name of stalls to the seats in the chancel; they are not stalls, neither are they pews—but open seats, two rows on each side, and the end of one row on the south side prepared so that the duke can wheel his chair into it.  In the aisles of the chancel are seats fitted up and reserved for the boys of his grace's school.

The castle not being in the district of St. Paul's, the family, with few exceptions, no one having been acquainted with the feelings under which the duke has acted throughout this munificent work,—that the only privilege he desired, was to be able, when he did go to that church, to get to his place,—seats I cannot call it—as quietly and unobtrusively as was possible, considering the abstinence he labourers under.

I am, Sir,
Your obedient servant,
A. SALVIN.

—The explanation given by Mr. Salvin is perfectly satisfactory as far as it refers to the Duke of Northumberland, and we readily believe that his munificence has been characterised by its usual unobtrusiveness, and that the architect has executed his task with his usual ability.  But we cannot regret having insisted that a church is not the place for mundane distinctions, and ought not to contain privileged seats for privileged worshippers.  The remark is intended to be perfectly general, and this protest against a specific application of it is an admission of its abstract correctness.

Regarding the propriety of setting apart a large portion of the church for liturgical purposes has been learnedly discussed on both sides.  It is not within our province to consider it except with reference to architecture; we certainly believe that the architecture of a church may be faulty, and that there may be one who would be admitted to the rest—the exception made in favour of singing men and choristers has no more valid excuse than the paid attendance and musical ability of this portion of the congregation.  Besides, the rubric expressly directs that the book to be used, not selected from that for public worship in this service.  Architects who view the question in this common-sense way incur a certain amount of vituperation, to which the slightest exercise of moral courage would render them perfectly indifferent.  It is certainly to be regretted that the controversy has not been satisfactorily settled.  On one point corrected with it there can, however, be no dispute.  If, in a new church, a chancel be built at all, it ought to be set apart exclusively and strictly for its professed purpose.  To build a chancel, and then suffer the laity to occupy it, or to erect stalls (as at St. Giles's, Camberwell,) which are merely superior seats to be had for paying,—is an idle, ostentatious retention of forms, after their significance and purpose have ceased.

BURNETTIZING TIMBER.

Sir,—In looking over your Journal for December, I meet in the "Noles of the Month" with an account on "Burnettizing Timber and Marine Worms," which statement I beg you to correct, it being replete with errors.  I am the person to whom the notice is made for Sir William Burnett, having given the subject of marine worms for many years past.  Your correspondent is totally unacquainted with the subject he handles, and asserts the specimen were "duly immersed in his (Sir William's) Burnettizing solution," a name so well known to the public as Sir William Burnett's far-famed solution.  When the pieces of wood (about six in number) arrived from him, I received them understanding them to be pieces immersed in order to try the effect of a preparation—which preparation is very different to the former, which stains the wood considerably; but in this instance the wood was not in the least discoloured.  The far-famed I am perfectly acquainted with, seeing the use of it every day.

Sheerness, Naval Yard.
JAMES MITCHELL.
Civil Engineer.
Dec. 13, 1846.

* * * The paragraph was taken from the Naval Intelligence in the daily papers.  With all due deference to Mr. Mitchell, we should have been much better pleased if he had stated what preparation had been used by Sir W. Burnett for the six pieces of wood, which it is not denied had failed, and we should be glad if Mr. Mitchell would state whether Burnettized timber, or any other prepared timber, had generally withstood the ravages of the marine worm at Sheerness.

SETTING OUT RAILWAY CURVES.

Sir,—I have seen, in your Journal for December, Mr. Tait's notice of my letter to you, inserted in your October number, and I have read his description of an instrument invented by him for setting out railway curves.

The objection which appears to his instrument seems to be obvious:—it clearly is that the principle is liable to much perplexity and error, because it is founded on a system of what surveyors call "building"—that is, making the accuracy of the whole work depend upon the nicest accuracy of a great number of minute parts, consisting of mathematical calculations in trigonometry, accurate measurement of small distances, exactness of instruments, straightness and uprightness of boxing rods, &c. &c.  This machinery appears to me to be too complex for practice.

It is objected by Mr. Tait to my proposal, that it may be possible a surveyor may not be able to see the two extreme points of a curve.  In answer to this, I need only say that surveyors, employed to set out curves, would have in possession of them the data to find the very great trouble, and without trigonometrical calculations by means of arithmetic—but merely by the aid of a common theodolite—the directions of the chord line: having once determined this, he must be a poor surveyor who does not see his way clear in laying down a curve, the radius of which is given.  The method follows from the system of chords mentioned in my former letter, and is obvious to any tyro in geometry.

The system suggested by me deduces particulars from generals; in other words, it proceeds upon the plan of ascertaining fundamentals or general points, and producing the minor points by means of them.  The plan of Mr. Tait proceeds by "building" a great number of minute triangles, one upon another; which is not, amongst surveyors, accounted orthodox.

Yours,
Oswestry, Dec. 5, 1846.
A. Engineer out of Employment.

ENGINEERING LITERATURE.

Sir,—In your reply to Correspondents in the December number, I noticed your answer to a six years subscriber, respecting the best published account of the details of the Steam Engine; and, notwithstanding you referred him to the treatise of the Artiston Club, yet your opinion was, "that a satisfactory work on the Steam Engine remains among the desiderata of Engineering Literature."  I am so much gratified that you have given expression and publicity to an idea which I believe very many persons have long thought most desirable, that I cannot forbear asking if it would not be possible to form a society for the purpose of publishing some valuable works on the "Steam Engine and Engineering Science."
Irrigation of Algeria.—The French Minister of woods and public works has nominated a commission, chosen from among the general staff of surveyors of roads and bridges, to examine the plans and projects sent to him by the government of Algiers. Upon the report of this commission, four plans have been made on the spot, by another commission, which is surveying Algeria for that purpose. The first plans of irrigation will be executed on the waters of the plain of Mihdaia.

Lewes, Dec. 24, 1846.

P.S.—If my suggestion is practicable, I will communicate with you again. I have the first volume of "Fancy on the Steam Engine" which can inform me if the second volume is likely soon to be published?

** We may probably reply to this letter hereafter.

NOTES ON FOREIGN WORKS.

Transactions of the Archæological Institute of Rome.—The volume of the proceedings of this Society, just published, again proves the richness of antiquarian relics, and likewise an increased activity of the Society, under the auspices of the present Pope. The first memoir contains Professor Ulrich's travels in Greece, from the Muses to Corinth and Athens, the Peloponnesus, Aitolia, and Corinth; and the second, the History of Rome, i.e. the origin and history of the town, and its political and religious imagery. The celebrated architect, L. Canina, has contributed a paper on a round pedestal in the Lateran, with emblems of Volcan upon it. The most attractive paper, however, is that on the Baptistery of St. John in Florence, by one of the most learned and most able writers on the subject. The splendour of the Lateran, and its influence, the present state of the Lateran, and the remains of the ancient churches of the Lateran, are all shown. The description is filled with details, and is admirably adapted to the purpose of the Society.

The great picture of Carcass, at Rome, representing the descent from the cross, a huge canvas, comprising seven figures of life-size, has been hitherto in a very precarious condition, on account of the wood, on which it was stretched, having become rotten, if not decomposed. M. Radice, its present owner, knowing the great artistic value of this historical picture, engaged the famous restorer, M. Bunsen, to transfer the canvas to another support. This has been done so successfully, that M. Overbeck has expressed his perfect coincidence and approbation.

Reichsbau from Naples to the Roman Frontier.—The Neapolitan government have granted to M. Falcone di Cimier the concession to construct a railway from either Capua, Cepnara, or Fossi, direct to the Roman frontier; but under this condition, that the newly discovered system of Josephson be employed. It is said to afford greater security to the railways, and a saving of expense, will first be tried on a space of two miles; a commission is to be decided whether it be advisable to employ it on the entire line.

Reichsbau and Coal Mines in Bohemia.—Austria has opened a new iron mine in Bohemia, and the coal mines of Lahn, a length of 20,000 cabins, was begun in 1896. It was at first intended that this line should extend to Palais, and thus a connection with the Bavarian States' lines. The Lahn coal mines now supply fifteen manufactures with 15,000 tons of coal monthly; but as this coal yields a superior kind of coke, which can be advantageously used on the Great North Line (whose engines have hitherto burned wood), these new branch lines will be of great commercial value to the whole country.

The Erection of the Termine of the Paris and Lyons Railway, at the former city, excites much controversy among our French contemporaries. The right bank of the Seine was originally fixed upon, but the subsequent underhand doings of certain land proprietors, who desired it near the Boulevard Mazarin, seems to have balanced the decision in their favour. Now, the Place de la Bastille seems likely to suit all requirements. The interest of this subject is great, not only commercial, but political, and demands that the termine be as near as possible to the centre of the commercial and banking activity of Paris.

The New Opera House at Vienna.—The present building near the Kärntnerth, is one of those insignificant edifices erected under the late Emperor. This having become too paltry, the plan for a new one has been devised. The two gates of Carinthia will be pulled down, and replaced by one in a monumental style; the ramparts on this side of the city demolished, and the limits of the city extended; by which alterations, sufficient space for a splendid new Opera House will be gained. As the lease of the present theatre, however, does not expire for two years, the operations will not commence until that time.

Great New's Hall at Berlin.—M. G. Julius has just completed the erection of the above establishment, in which the periodicals of all nations and countries, and of every branch of human knowledge and on every subject, are to be met with. Situated in the very centre of the town, its success is almost sure. [A similar place does not exist in London.]

Raffaelle an Architectural Author.—If some persons are astonished to hear that Raffaele, whom they supposed to be the painter of Cartoons and Madonnas, was also the creator of St. Peter's dome, at Rome, they should be informed that the fact is only a very slight portion of the merits of which, although, in the other branches of art, the only thing which the divine painter ever put to paper, his mind must be still more richly, if it is possible, is in a different and more famous writer. The New's Hall at Berlin, the draughting of the Zuider-Zee in Holland, the expense of which is calculated at 61 millions of florins (10 millions sterling). The plan is ready, and embraces a gigantic dyke to protect the new land against the force of the Baltic Sea—a maritime canal, accessible at all times of the tide, to connect the sea with Amsterdam. No plan, except to form a railway over one of the passes of the St. Gothard, can be compared with the above.

Anecdotes of Theatres and other Public Auditory Buildings.—It has been truly said that the recent competition for the design of the Opera House, to provide spaces in the body of the walls and pilasters, for increasing the acoustic character of the building. The rationale of this scheme is quite correct—it agrees with the theory of sound, lately brought before the French Insti...
tate, that it is not a vibration of air, but a substance—a material body, like electricity, magnetism, heat, &c. It is obvious that walls, other solid work, cannot and will not propagate the rays of sound dynamically, as well and accurately as air does, which is its appropriate medium, and vehicle. Of what shape these spaces are to be, and where they are to be placed—both according to the shape and size of the building—is a subject open to the investigation of architects. It is curious, indeed, to know the reasons given by M. Bras (Projet de Salon, 11th) that the ancient vases or pots in the walls of theatres, forums, &c., for increasing the vibration and power of sound.

Full of a Building on the French Northern Line.—On Friday, the 20th Nov., the large wooden building at Lille, in which the company gave the grand banquet to the French princes and the company invited to the inauguration of the line, and which was recently being prepared for a waiting-room for passengers, fell with a frightful crash. Not one of the supporting timbers resisted. The excavation of the earth around the support of one of the points of the accident.

Belgium.—The Luxembourg company contemplated building eight streets in the London style next spring around the station to be erected in the Quarter Leopold, Brussels, for the occupation of opulent English families. It is well known that the English establishing their residences at Brussels have always chosen the upper part of the city for the benefit of the air of the park and neighbourhood.

Tunnelling the Alps.—The Moniteur Béige announces that experiments have been made in order to test the efficacy of a machine just invented for the purpose of tunnelling new and improving old roads. A machine is about to be applied to this machine to the construction of the great tunnel about to be commenced in connection with one of the Italian lines. The machine was placed in front of the web, and was bored to the depth of 130 feet (40 metres) in thirty minutes; this invention will complete up to 5 metres (16ft. 6in.) of bore per day, and the proposed tunnel through Mount Cenis will be finished in the space of three years. The experiments have been repeated twice before several of the first engineers of France, and with the most complete success.

NOTES OF THE MONTH.

Electrical Telegraph.—At the Paris Academy of Sciences, M. Bréguet exhibited a new electro-magnetic battery, intended for the line of electricity telegraphs of the Paris and St. Germain, &c. A magnet of steel is fixed perpendicularly upon a strong board. Above and very near the poles a rectangular plate of soft iron is fixed upon an axis, which bears a pivot commanded by a large copper wheel. Upon the plate are engraved the letters of the alphabet, and opposite each letter there is a hole. The axis of the wheel has a handle, to which is fixed a steel point, capable of entering the holes of the wheel. The handle has a hinge, in order that it may be raised or lowered, and is free at the centre of the wheel, so that when the point is out of a hole the plate may turn in either sense to find the letter and transmit it. Very near the edge of the wheel is a lever, the small arm of which is above its centre of motion, with a larger one under, which serves to work a second lever; they are combined in such a way that the rotation of the first arm is translated into a lever to the extremity of the large arm of the second. The upper arm of the first lever serves as the point of arrest of the handle, at the same time that the large arm of the other stops the movement of rotation. The apparatus is so contrived as to engage and disengage itself in the finding and transmission of the letters, without any effort on the part of the person working the battery.

Steamers for the Ganges.—On the 21st Nov., a number of scientific gentlemen connected with India and steam navigation, met at the iron steam ship works of Messrs. H., O., and A. Robinson, Mill Wall, London, to inspect a large iron steamer, intended for the navigation of the river Ganges, between Mysore and Calcutta, and named (by the spirited Company who have constructed it) the Mysore. She is the third of a line of steamers for the Ganges designed and constructed by the same firm, and is the largest river steamer ever built, with one or two exceptions in America, her length being 250 feet and her breadth inside the paddles 38 feet. The vessel is built in strong combination of strength and lightness, and embraces some novelties in iron ship-building to attain this desideratum in the navigation of shallow rapid rivers. The engines are of the collective power of 250 horses; are horizontal and perfectly unconnected; their valves are of the balance type, and invariable, and are well geared for the easy manipulation of the engines. The first of these steamers, named the "Patna," has proved to be admirably adapted to the navigation and traffic of the Ganges, and the company have in consequence given the immediate order for two additional steamers.

Restoration of Llandaff Cathedral.—The Dean has just issued a statement of the progress of this work. The eastern chapel has been completely restored; the windows and open parapet work at the east end of the south aisle are in progress. Active operations have been commenced in the choir, and a noble arch of Bishop Urban's work, with elaborate mouldings, has been opened. Beneath this a beautiful screen of Bishop Marshall's, A.D. 1048, has been exposed; as also a beautiful recessed monument in the south-east wall of the choir.

All Saints, St. John's Wood.—Two stained glass windows have been presented by Mr. Fairs.

Holyhead Harbour.—The Admiralty have given notice of their intention to deepen and dredge this harbour, and to construct retaining walls and wooden jetties.

South Staffordshire Mines.—A weekly paper says—"We have been informed, on the best authority, that the Government have appointed an experienced engineer, thoroughly versed in the system of mining, who will immediately proceed to visit the iron and coal mines in South Staffordshire."

Cleopatra's Needle has, it is stated, been offered by the Bey of Tunis to Louis Philippe and accepted, and is to be placed in the Carousel at Paris.

New Act on Steam Navigation.—On the 1st January an important Act "For the regulation of Steam Navigation, and for requiring sea going vessels to carry boats," comes into operation. Every vessel of upwards of 100 tons is to be provided with hoes for extinguishing fire. Every steam vessel passing another steam vessel is to pass as far as may be on the port-side. No compensation is to be recovered for injury by vessels not exhibiting lights at night. In rivers steam vessels are to pass as near as practicable on that side of the mid-channel which lies on the vessel's starboard. Owners are to transmit to the Board of Trade twice a year certificates of the efficiency of the engines, and are to report the supposed loss of any vessel, &c.

At Leathenby Abbey, Gloucestershire, five ancient Norman pillars have been dug up.

Long Acre Improvements.—All the houses belonging to the Mercer's Company, in Long Acre, opposite the end of Bow-street, have been demolished, and a direct communication thus established with Waterloo-bridge. The street at the end of St. Magnus-court is rapidly progressing; it is one of the widest thoroughfares in London, its breadth being 110 feet.

The Fortifications at Sheerness.—Dec. 31.—These works continue to progress rapidly. The large and formidable battery opposite the dockyard front, facing seaward, in now complete, with the exception of the curtain or parapet wall, which will be proceeded with, after which the beds for the traversing platforms of from 40 to 50 guns will be laid down. The musketry walls connecting this battery, on the one hand to the fortifications at Garrison Point, and on the other to the land defences, are also complete, and present a fine appearance, being excellent specimens of substantial workmanship. These land defences, which extend continuously from the Thames to the Medway, interrupted only by the drawbridge to Mile Town, are now in course of being repaired and completed, by the usual and usual means, in the deepening of the moat which protects them. The excavations for the moat which surrounds the new battery, and which have been continued northward, as far as the second angle of the old works at Garrison Point, are now in course of being filled. The most is to be conducted round the ravelin, and a second drawbridge thrown over it. The repairs and alterations of the old works at Garrison Point are completed. The magazines are in course of being filled. New barracks, capable of containing 1,000 men, and immediately connected with the Martello towers on the line of Grain shore, should the foundation prove satisfactory. A party of Sappers and Miners are at present engaged there making the necessary borings and examinations.

Analysis of a Peruvian Alloy, by Mr. Henry How.—This was a small plate of a yellow metal, which was taken from a basin of similar plates surrounding a human skull: it consisted of—

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<td>Gold</td>
<td>30-35</td>
</tr>
<tr>
<td>Silver</td>
<td>50-55</td>
</tr>
<tr>
<td>Copper</td>
<td>5-10</td>
</tr>
</tbody>
</table>

It is a question whether the metal is an artificial alloy or the crude product of a metallurgical process. The author was inclined to the latter opinion.

Chemical Society.

King's Well, Both. Analysis of the Water, by Messrs. Mease and Galloway.—The whole method of analysis pursued in this investigation is given in detail in a paper to the Chemical Society, and the authors sum up with the following results in the imperial gallons:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of lime</td>
<td>80-90</td>
</tr>
<tr>
<td>Carbonate of magnesia</td>
<td>1-2</td>
</tr>
<tr>
<td>Carbonate of iron</td>
<td>0-2</td>
</tr>
<tr>
<td>Sulphate of lime</td>
<td>10-15</td>
</tr>
<tr>
<td>Sulphate of ossa</td>
<td>1-2</td>
</tr>
<tr>
<td>Sulphate of soda</td>
<td>1-2</td>
</tr>
<tr>
<td>Chloride of sodium</td>
<td>12-14</td>
</tr>
<tr>
<td>Chloride of magnesium</td>
<td>1-2</td>
</tr>
</tbody>
</table>

With traces of iodine and oxide of manganese.

Its specific gravity is 1·0025 d at its temperature 112°, the atmospheric being 60° at the time.
ascertained when a messenger was sent off to Captain D. with the report of the disaster; but he computes it at 100. We earnestly hope this may prove over the mark. We believe it was only the other day the bridge was examined by Major Sage and two other engineers, and favourably reported on."

The following paragraph appeared in a second edition of the same paper:

"We have since learnt from Captain Goodwin, of the Engineers, that this bridge was constructed in England by Mr. Dredge, the patentee, and that Captain Goodwin reported unfavourably upon it on its arrival here; and also the committee, who examined it after its erection, decided that the structure was only fit to endure the weight which would be placed on it by ordinary traffic. On the occasion of the sad accident in question, some five or six hundred persons were on the bridge for the purpose of witnessing a 'pooch,' and the accident was mainly owing to a sudden rush of the great crowd to one side of the bridge, which our readers may remember was the case in the Yarmouth catastrophe, which happened about a twelvemonth ago. There is no doubt but that on such an occasion there should have been police stationed to prevent the structure from being overloaded."

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**DREDGE'S SUSPENSION BRIDGES IN INDIA.**

For the following particulars of another failure of these bridges in India, taken from the Mercure of October 21, 1846, we are indebted to the attention of a correspondent in Calcutta, who states that the bridge at Dispurunjity was erected by military engineers, but that the iron work was sent over from England.

It is with deep regret we announce a melancholy and most fatal accident which has happened at Jagurunjity, nine miles this side of Jessore. The bridge there, recently completed by Captain Duncan, of the Engineers, has fallen. The chains gave way when the bridge was crowded with people, and at the moment three boats were passing under it, which were sunk with all their crews. Our informant says the loss of life had not been
and other forms in coating iron, and in preparing iron for coating and other purposes."— Dec. 7.

Eugene Bastie, of Rouen, France, manufacturer, for "Improvements in obtaining heat during the manufacture of coke, and applying such heat to various purposes." (A communication).— Dec. 7.

John Dade, of Poole, Kennington, Survey, gentleman, for "an improved apparatus to be attached to boots and shoes, for the purpose of protecting the wearer from splashes of mud in walking."—Dec. 7.

Samuel Cliff, of West Bromwich, Stafford, gentleman, for "certain improvements in the classification of tar and pitch."—Dec. 8.

Alexander Bann, of Hanover-street, Edinburgh, electrical engineer, for "certain improvements in transmitting and receiving electrical telegraph communications, and in apparatus connected therewith."—Dec. 12.

Moses Pool, of the Patent Bull Office, London, gentleman, for "improvements in the construction and working of electric telegraphs, and in apparatus connected therewith, and applicable to other purposes." (A communication).—Dec. 12.

James Yates, of Masham, in the parish of Rotherham, York, engineer, for "Improvements in the construction of blast furnaces."—Dec. 13.

John Besley, junior, of Newham, dyer, for "Improvements in dressing or finishing lace, and other fabrics."—Dec. 14.

William Longgood, of St. Helen's, Lancaster, gentleman, for "Improvements in the manufacture of alkali and chlorates."—Dec. 14.

Eliah Galloway, of Buckingham-street, Strand, Middlesex, civil engineer, for "Improvements in railway engines, and in locomotive carriages and railways."—Dec. 14.

John Shaw, of Blackburn, Lancashire, for "certain improvements in machinery or apparatus for carding, drawing, slubbing, and roving cotton wool and other fibrous substances."—Dec. 14.


Charles Ford, of Shetland, Stafford, engineer, for "Improvements in the manufacture of paper making machines, and in the manufacture of paper made by them, and applicable thereto, and part or parts of which improvements are applicable to other similar purposes."—Dec. 14.

Henry Biesse, of Chipping, Lancaster, roller-maker, and William Ryder, of Bolton, in the county of Lancaster, manufacturer of roller machinery, for "Improvements to be employed in the manufacture of rollers used in machinery for preparing and spinning cotton and other fibrous substances."—Dec. 14.

John Todd, of Glasgow, engineer, and William Johnson, of Birmingham, engineer, for "Improvements in arranging the rolls on certain parts of railways."—Dec. 14.

John Chubb, of St. Paul's Churchyard, City, for "Improvements in locks and latches to be used for fastenings."—Dec. 14.

Benjamin Vickers, of Sheffield, Yorks, merchant, for "an invention called the mechanical chirograph, or machine for delineating letters, figures, and other characters." (A communication).—Dec. 14.

Jeremiah Campley, of Somers-place, Hyde-park, Middlesex, gentleman, for "Improvements in soldiers' belts, and improvements to facilitate the carrying of knapsacks."—Dec. 14.

Thomas Friend, of Newcastle-upon-Tyne, sharebroker, and John Atkinson, of the same city, for certain improvements in machinery, for preparing paper, and applicable to other purposes, and in preparing sprue, ground, and mould paper for bookbinders and other purposes, and for preparing sprue, gound, and mould paper for bookbinders and other purposes, and for preparing sprue, gound, and mould paper in the places and for the purposes aforesaid."—Dec. 14.

Mark Bingley, of Cannon-street, London, stationer, for "Improvements in bookbinding, and in wearing materials used in bookbinding, applicable also to other wearings, and inapplicable also to other wearings, and in making the same, and also in bookbinding, and in other books and in books, and applicable also in the edges of books, and in graining or chiselling leather or other leathers."—Dec. 14.

Richard Turner, of Manvers-shire Works, Dukinfield, and Booth, new-road, Middlesex, for "Improvements in the manufacture of railway subjects, and roads and fences of other buildings."—Dec. 15.

Walter Smart, junior, of Leather lane, Middlesex, bibliographer, for "a new or improved bibliographic printing press."—Dec. 21.

John Watson, of Glasgow, manager to Messrs. Gilmour and Kerr, power-loom cloth manufacturer, for "Improvements in weaving, and in apparatus employed therein."—Dec. 21.

Peter Sorens, of the Crescent, Middlesbrough, City, engineer, for "Improvements in the construction of plans and harbours."—Dec. 21.

John Jennings, of Gillingham, farmer, for "certain improvements in machinery or apparatus for threshing."—Dec. 21.

Richard Royce Osborn, of Jemfond, Ireland, civil engineer, for "certain improvements in bridges, road, and canal."—Dec. 21.

Louis Sylvain Goyens, of Paris, manufacturer, for "Improvements in printing stuffs, paper, and other matters."—Dec. 21.


Joseph Whitworth, of Manchester, engineer, for "Improvements in machinery for building."—Dec. 21.

Augustus Applegarth, of Dartford, Kent, calico printer, for "Improvements in machinery for printing paper and other fabrics."—Dec. 21.


Antoine Perpina, of Paris, advocate, for "certain improvements in machinery for plating and bronze." (A communication).—Dec. 21.

John Perry, of Leeds, wool-comb manufacturer, and James Noble, of the same place, wool-combers, for "certain improvements in combing wool, and in preparing wool for combing and carding."—Dec. 21.

Pierre Frederic Gentil, of Leeds-square, Middlesex, gentleman, for "Improvements in apparatus and machinery for raising, lifting, and otherwise moving heavy bodies."—Dec. 21.

TO CORRESPONDENTS.

Sir Howard Douglas requests us to state that he will in a short time reply to the observations on the Strength and Stability of Hungerford Bridge, in our last (Dec. 14), in our next (Dec. 21). H. S.—The second letter was, we suppose, intended to prevent the publication of the first, which would otherwise have been inserted. Perhaps our correspondent will write again after reading the letters on the subject in the present number. 

Received: "Ancient and Modern Architecture," "Life of Gandon," X Y Z, North Wales,—Next month.
COLOGNE CATHEDRAL.

(With an Engraving, Plate IV.)

It is not a century since Christian architecture was praised for its barbaric magnificence. The admiration accorded to it differed in degree, but was identical in nature, with that given to the grotesque Indian pagodas, or the fantastic extravagancies of Louis Quatorze. Vitruvius had reduced the proportions of temple architecture to numerical calculation, and shown how many times the height of a column should exceed its width: but as there was no book extant in which cathedral architecture was similarly treated, it was condemned as unsystematic and inharmonious. The plumb-line and foot-rule were then the critic's stock-in-trade; with these implements the "noble art of criticism" was worked out with all the mechanical precision of plane surveying.

After a time, however, the bright thought was suggested that, perhaps, the mediaval architects were not the barbarians they had been taken to be; that, with all their caprices and apparent defiance of rule, there might be some method in their madness, if it could but be found out. It was questioned whether there might not be other harmonies more subtle than those which are capable of being settled by the multiplication-table. And when these heresies in architecture had once been started, they were not forthwith silenced in visionary; but, on the contrary, spread and multiplied exceedingly. It is true, that the orthodox Academies and "legally constituted authorities" had nothing to do with the promulgation of the new doctrines, and that one of those Royal Societies which have been kind enough to undertake the protection of art—namely, the Académie Royale des Beaux Arts at Paris—did in its wisdom pronounce, in June, 1848, a strong anathema against the revival of Pointed architecture. But, notwithstanding the resistance of this and other very solid bodies to external pressure, it has become more or less evident to all who are concerned in the matter, that the opposition, whether passive or active, was quite too late and might be safely disregarded.

Now, among all who love Art for its own sake, and who can, therefore, appreciate its existence independently of the aid of arithmetic, a general conviction seems to be growing up, that the most eloquent defence of their doctrines has been set forth on the banks of the Rhine. Universal consent appears to point to the fact that there stands the noblest and mightiest of all monuments of mediaval thought and skill,—The Cathedral of Cologne, wasted by time and the elements, despoiled by French soldiery, despoiled by classic connoisseurs, and neglected by its own proper guardians, has come to be considered the most beautiful of poems which man's hand has ever written in stone.

But this bolded poem, though it excel all others in beauty, is yet one of the least complete; so to speak, only a few books of it remain, and those have been sadly marred by the notes and emendations of commentators. Accordingly, the promulgators of the new architectural doctrines were desirous to repair the injuries which false friends and professed enemies had inflicted upon Cologne. But the work of reparation had scarcely been begun, before it was found out that another work, far more magnificent, might be attempted with every prospect of success,—namely, that of completion. Now, in order to comprehend the magnitude and boldness of this project, it is requisite to understand clearly the original plan and design of the building, and to what extent the intention of the first architects had been carried into effect.

The design of the building comprehended, in the first place, two enormous towers at the west end, surmounted by spires; a part of stone, as surpassed in magnitude everything similar to it in the world, so also would have been superior in the coldness of its decorations. For the spires were each to have attained the height of 536 feet—a height nearly double that at Lincoln, and exceeding that at Salisbury by 132 feet; and the profusion and delusion of sculpture would have outstripped Strasbourg itself. The height of the nave internally was to have been 160 feet, and some idea of its magnitude may be formed from the assertion, that it is of sufficient capacity to contain the Chapel of King College, Cambridge, completely within it. The nave at Cologne was to have double aisles, including which, its total breadth would be the same as its internal height, namely 150 feet. The approximate equality of the breadth and height of the nave is observed in most of the English cathedrals.

Besides the parts described, there were double transepts, and beyond them the stately choir delineated in our engraving, which is the only complete part of the building. The external height of the choir is 200 feet—as nearly as possible the height of the towers of Westminster Abbey.

The total length of Cologne Cathedral is not very great compared with its width, being 500 feet. In this respect it is exceeded by three of our own cathedrals—Winchester, Ely, and Canterbury, and equalled by two others—York and Lincoln: and it is curious to observe, that while in these edifices the length is six or seven times the breadth, in the great continental church the length is only three times and one-third the breadth. Of the vast pile thus contemplated, comparatively little has been actually executed. The choir, as we said, is the only complete part. In each transept a portion of the east walls is erected. Of the nave little is built, and there exists a great gap, which is covered in by temporary walls and roofs: the northern aisles are in the most perfect condition, seven compartments in their roofs being girdled over, and the windows being finished and filled with stained glass; but in the southern aisle the windows had only reached the springing of their arches. In the grand western facade of the cathedral there is a large vacant space between the north and south towers; and of these towers, the southern only had reached to the height of the nave and choir-rooms, the northern being only just commenced.

It will be seen, therefore, that the work of completing this Cathedral excels in magnitude that of erecting almost any other. And this consideration alone can give us an adequate notion of the boldness and enthusiasm which must have actuated the Germanic nations when they undertook this gigantic task; for though the mere magnitude of the work may be understood from the foregoing dimensions, their variety and intricacy can only be ascertained from minute local inspection. The tracery is different in every window (the manufacture of Gothic windows at so much a dozen being a somewhat later invention). The whole structure, as may be seen from the view of the choir, would tower above a forest of spires, pinnacles, and flying buttresses. Every part seems literally covered with the luxuriant overgrowth of delicate sculpture—rich canopies for figures of the saints, crockets carved into the semblance of roses with the minuteness of nature; every beautiful form which Flora could suggest, and every strange form which a fantastic imagination could create, seem here embodied in stone. Amidst flowers and foliage and clustering fruits, appear strange fabulous monsters, dragons, griffins, and winged unicorns. The demons and hobgoblins who, as every one knows, used in olden time to play such terrible pranks about the mountains of the Rhine, here live again, long after the printing press and the steam engine have laid them low. As you walk round the building, look up suddenly, and you will probably see some fantastic merry devil grinning at you from beneath a water-shoot or corbel; suddenly turn the angle of a buttress, and you find that a troop of little imps have been watching you round the corner; while within the gorgeous choir, solemn figures of the saints look down from their lofty niches, and gigantic angels seem to hover high up above the altar. Towards dusk, it requires strong nerves to look at these mysterious forms without awe, for they galal in apparent size, and look tenfold more mysterious, in the twilight; and no one, probably, would like to be locked up all night in Cologne Cathedral, with no other company than these saintly effigies, the sepulchral monuments, and the relics of the Three Kings.

* * *

* The account of the works of Cologne Cathedral will be continued, with additional Engravings for the one now presented to our readers we are indebted for the original to "Cathedral's Ancient and Modern Architecture."
HALL OF LIBERTY (LIBERATION), KEHLHEIM.

It is not only by its present historical and ethic character, but by the massiveness and sturdiness of its architectural conception, that this monument (called forth by the will of the King of Bavaria) deserves such high recognition. Thus, Liberty Hall, with its huge bronze memorial tablets, will inspire new ideas and thoughts in the mind of nations, which, however they may be imparted, we are much in need of.

Keihleim is situated about four leagues above Donsqvust; opposite which latter place the Waballa reflects its shadows in the waters of the Danube. Celebrated for years past by its valuable limestone quarries—another consideration has induced Lewis I. to select it for the site of his new creation, viz., it being the place where the Ludwig canal disembogues into the Danube. In the nearly right-angle space which the river and canal form here, the terrains ascends considerably, and forms, towards the Danube, an elevated steep wall of rocks. It is on this commanding plateau that Liberty Hall is being erected. The main structure, a huge rotunda with a dome ceiling, forms an octo-decagon (dodecagon) of 206 feet diameter in the greatest width of the hall, exclusive of the outer groined vaulted arcade that surrounds it; the outer hall abuts to a height of 80 feet (including a flat roof) against the dome structure, and round the outer vaulted hall extend the groined vaulted arcades, of a joint height of 22 feet, including the groining. The building will rise, up to the highest point of the lantern in the cupola, to a elevation of 175 feet. The height from the vaulting to the entablature is 100 feet. Beneath the latter extends the outer triumphal-arch, consisting of double arch-openings, separated by two pilasters, all round the octo-decagon.

Above the entablature three steps surround the outer dome vaulting.

The stairs, from the entrance, lead up to half the height, straight to the main building; they then branch off, laterally, in two ascents. If, therefore, we step in the centre of the building, we are surrounded by a cycle of columns, whose diameter, from the centre of one column to the opposite column, through the diagonal of the rotunda, measures 100 feet. Eighteen columns rise from the floor, on the radii of the octo-decagon. They are monuments of granite, and measure (including bases and capitals, of white marble) 27 feet, and have a diameter of 4 ft. 4 in. Above these, spring circular arches with archivolts, also of white marble, and the eighteen mural surfaces above them are of yellow marble; on these are inscriptional tablets of white marble. The space above the eighteen mural surfaces is divided by double arch openings, with pilasters and semi-columns. Behind these, extends the inner triumphal area. Above these arch-openings of the inner triumphal area, the vertical portion of the building extends to a height of 84 feet above the inner floor. The inner dome vaulting rises thence to a height of 80 feet up to the lantern, whose diameter in the clear, is 81 feet. Behind the circle of columns, on the ground floor, extends an arcade with groined vaultings, which the architect intends to dress with dark red marble, the effect of which will be surprising. This arcade is surrounded by a cela-wall of 8 feet thickness, which latter divides the inner from the outer arcade. According to these measurements, the plan, elevation, and sections of this gigantic structure may be easily conceived.

This huge rotunda and cupola structure is meant destinated to be the shell of its internal, strictly monumental, kernel. If we again go to the centre of the podium of the hall, under the lantern of the cupola (which alone will light this huge space), we shall see ourselves surrounded, at the distance of 40 feet, by a ring-formed stylobate, which has no entrance, save by one opening, opposite and in a right line to the main entrance of the hall. On this (continuous) stylobate, stand, in a circle, thirty-four colossal Victories, in pairs, close to each other, before the columns, and holding each other with one hand, with the other, each pair grasps a bronze shield, made of the enemies' cannon. On the gilded front of these shields are inscribed the names of the different battles, &c, and the names of the leaders will be put in the corresponding marble tablets on the same wall-face of the octodecagon. The backs of the shields will not be gilded, for the purpose of showing the metal they are made of. The winged Victories are each 10 feet high, and of white marble, and form, with the mass of shields which they bear, an uninterrupted and most imposing circle; this being only open at one place—the main entrance. They are to be made after models of Master (sic) Schwanthaler.

In conclusion, it is to be remarked, that the king of Bavaria has ordered that not one piece of wood is to be used in this structure, which will consist entirely of Keihleim limestone, granite, Slander's marble, iron, and copper, with which latter metal the cupola and the entrance-hall will be roofed. The very foundation of the walls had to extend, at places, to the depth of 50 feet, owing to the inequality of the terrain, is, in itself, a vast complex of numberless caves and vaults, well worthy the attention of builders. The ingenious manner in which the architect has executed the double vaulting of the dome is not to be passed over in silence. The name of this worthy master is Sir Frederick Guertner, P.R.A. of Arts at Munich.

J. I.——y.

DISCOVERY OF TERELOSSUS.

The site of Terelessus, one of the largest and most important cities of Asia Minor, has long been a matter of doubt. The recent travels of Lessis, Spratt and Professor Forbes in Lycia, have however settled the dispute, and to those enterprising travellers we are indebted for a discovery of great interest in an architectural point of view, and one which adds to the records of ancient art a whole city filled with Roman edifices, many of them very important and in an excellent state of preservation. Of these, one of the principal is the ancient theatre, which is minutely described. The nature and extent of the discoveries will be seen from the following narrative:

The valley became more and more confused. We were evidently entering a most important pass; we were yes in the region of fortifications: suddenly, in the narrowest part of the gorge, we came upon a range of perfect and admirably built Hellenic walls, stretching across it, fortified by towers, and passable only by the ancient and narrow pathway. The fortifications mentioned by Arrian, the pass through which the army of Alexander marched, seemed before us, and at every turn we expected to see the walls of Terelessus. Our guide pointed to the summit of the mountain above us, and said he had heard of ruins there. About a mile beyond the gateway, we reached a khan, consisting of three stone buildings, and a coffee-house, kept by Turkish soldiers, acting as guards to the pass. Here we put up for the night, not a little gratified by the assurance given us by one of these men, that the report of ruins on the neighbouring mountain was true.

Early in the morning we commenced the ascent of the mountain, to seek for the ruined city. The first part was over steep and rocky ground, but after a time we came upon an ancient roadway, leading towards an opening in the mountain side between two towering rocky peaks. Following this road, which was barred in trees, and necessitated by underwood, for an hour and a half, we suddenly came upon two ancient guard-houses, almost perfect, one on either side of the way. We did not linger to trace any connecting path, but hurried anxiously on, with sanguine expectations. For nearly a mile we met with no other traces of ruins; some sarcophagi were at length discovered among the thickets, and near them, on the face of a great rock, were carved in large letters, the words ΕΙΑΣΩΝΟΕΝ ΖΑΙΟΝΟΚΩΣ.

Suddenly, after crossing a low wall, we emerged from the thickets, and entered an open and flat area between the two great rocks, and walked in the midst of precipices. On it ruins were profusely scattered; numerous tombs and sarcophagi, fallen buildings of large size, and temples, the ornamented doorway of which still stood, fronted by a goodly flight of steps. Fluted columns of large dimensions lay strewn in fragments upon the ground. Unwilling to delay until we had ascertained the full extent of the city, after a hasty glance we proceeded to the upper end of the platform. Here the valley became more contracted, and a steep and perfect wall was thrown across it. Within this, ruins of noble style and more perfect preservation were seen. A building of great extent, having numerous doors and windows, and almost perfect to the roof; like the others, it was constructed of rectangular blocks of limestone, without intervening cement; before us, on what appeared to be the third wall was an arched gateway, presenting to the eye the acropolis. Hitherto we had met with no mention of the city in any of the inscriptions, but, on ascending to the last-mentioned wall, we came upon an inscribed pedestal, which assured us we were in Terelessus, a name shouted out by the fiders with no small delight, and echoed by the old rocks, as if in celebration. It must have been new to those after
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having rested so long unspoken. On reaching the third wall, our surprise was great at finding that hitherto we had been wandering as if it were only in the vestibule of the city, and that Termeusa itself was yet to some extent built on the mountain top, even as Arrian has recorded. It stood on a platform, surrounded by a natural wall of cliffs, three to four hundred feet high, except on the east, where it terminated in a precipitous precipice, diving into a deep gorge, opposite the Paphian plain.

After crossing the third wall, our attention was first attracted by an avenue, bordered on each side by a close row of pedestals, terminated at each end by public buildings, apparently temples. These pedestals were almost inaccessible, and the inscriptions in good preservation. One of them was of peculiar interest, confirming this site as Termeusa Major, EMPREISSONTI MEMONON IOIDAI.

Above the west sea was a point of the habitable portion of the city, the buildings there, which are all fallen, having the aspect of the remains of dwelling-houses. To the south and east the ground is covered by public edifices, many in tolerable preservation, others prostrate—like in the same fashion as the remains of Christian origin at this site. Termeusa was the seat of an episcopal see. Around the Agora are the most important public buildings; the most perfect of these is a great square elevation with high finished walls, ornamented with Doric pilasters, and two windows, placed high up. A smaller and similar building stands behind the latter, the most prominent object among the ruins, and by its side a second, in front of which are two pedestals, bearing inscriptions, one in honour of Plato, who appears to have been held in high esteem by the people; the other dedicated to the Musaeus, of whom this was probably the temple. By the side of the Agora, and on the left of the great square building, are the remains of a Doric temple, apparently (from an inscription) dedicated to the Muses, and a fragment of a statue of a woman, and are fragments of sculptured friezes. A search and excavation among them would most probably lead to the discovery of many works of art.

ANCIENT SYRACUSE.

Paper read by S. ANSELL, Esq., at the Royal Institute of British Architects, Jan. 11, 1847.

The ancient Syracuse occupied the first rank of all the cities of Sicily, or Magna Graecia, in point of wealth and political importance, and there were many ancient cities in Greece itself, which are more interesting to the scholar or the antiquary. I visited the ruins and the modern city in company with some fellow-students in the summer of 1822. The classical interest of the spot, the beauty of the situation, and the splendour of the climate (considered both as a tourist and a student), made me long to spend some time at the island, and I finally determined to spend the summer of 1823, five years before the Christian era. The city was named by them Ortygia, or the island of the Quails (the same name was originally given to the island of Delos).

We have the united testimony of ancient historians and poets to the effect that it had greatly increased in size and population, and that it was an important city, even in the early ages of the world, from Egypt and Phæacia; that it was driven out by the Siculi, who, in their turn, were replaced by a colony from Corinth, led by Archias, one of the Heliopolis, and Ortygia became the seat of a bishopric, in 732 years before the Christian era. The city was named by them Ortygia, or the island of the Quails (the same name was originally given to the island of Delos).

The city was under different governments until freed from the tyranny of Thrasylus, 446 a.c., and sixty-one years afterwards it was occupied by the Byzantines, who were expelled by Timoleon, 343 a.c. The celebrated part it took in the wars with Carthage, its memorable conflicts with the Athenians, and its sad and mighty fall, after enduring a three years’ siege by the Roman conqueror, Mascellus, are matters of history so well known to the scholar, as to require no further allusion to my part at this meeting.

In after years, the Saracens completed the ruin the Romans commenced; and a.d. 927 Syracuse resigned to her rival, Palermo, the proud title of Capital of Sicily. From that time the city has dwindled into comparatively insignificance. Her population at the present time does not exceed 12,000; and commerce which once filled its glorious harbours with the ships of Rhodes, Alexandria, and Carthage, is now confined to a few sforlaras engaged in a miserable coasting trade.

Syracuse is said to have derived its name originally from the neighbour town Marsha, called Bicyrmos, and situated on the right bank of the Aroman: it was afterwards called Termeusa, a city formed of four distinct quarters, and these were named Ortygia, Acrona, Tycka, and Neapolis.

According to Strabo, the circuit of the ancient walls was 80 stades, or 224 miles, including the suburb of Etrusca, which was to the westward of Neapolis, and commanded the whole city. At the extremity of Etrusca was an almost impregnable fortress, called Euryka, mentioned by Livy, and other historians. The great port of Syracuse—one of the finest in the Mediterranean—is about five miles in circumference. As you enter from the ocean, to the left hand is the rock Plemmyrion, distant from the island of Ortygia, 14 miles, and, from the mouth of the gulf, 19 miles. From this point the entrance to the port that the Syracuseans, by advice of Hermocrates, threw a strong chain, and thus blocked the Athenian fleet.

In modern times, the great port of Syracuse has its name connected with a glorious event; for it was here that Nelson revictuallt his fleet previous to the battle of the Nile. The lesser port is on the other side of the island Ortygia: it was called Portus Marmoreus, according to some authorities, from the bottom having originally been paved with marble; but perhaps with more probability from the costly buildings which lined its shores.

I shall now endeavour briefly to describe the four quarters of the city, commencing with the most ancient one. Ortygia was formerly considered the most important part, in consequence of its commanding the entrance to both the ports. The tyrants established their residences in this division, and added, from time to time, to the fortifications. The Romans also, when masters of Syracuse, regarded the situation of Ortygia in the same important light, and prohibited any native citizen from residing in that portion of the city.

The Temple of Minerva was the most sacred and important building in Ortygia: it now forms the cathedral, or duomo, to the modern city, to which purpose it was converted during the 12th century, when the Goddess of Wisdom was obliged to resign her shrine to the adoration of the Columns; for such was the change in the dedication of this edifice. The temple was of the Doric order, peripteral and hexastyle, with fourteen columns on the sides. The lower diameter is about six feet seven inches, and the height twenty-eight feet ten inches. The columns, unfortunately, have been disfigured with modern plaster and additional mouldings; but it is much to be regretted that these, by some oversight, have found their way into an important work on Magna Graecia, and are there shown as part of the ancient work. It was only after much entreaty and persuasion, and offering ample security, in case of injury, that the church authorities (who, unfortunately, in Sicily, are not so devoted to archeological pursuits as the clerics of this country) gave permission to remove the columns to Minerva, and to make them secure by a distance of the solar rays. A custom prevailed among the Syracusean sailors, to


* I have shown the capitals half the real size. The enta caput may be considered as a good example of the Favorite Baco di Orione, or Our's best-model of the ancient.
secure a safe return from their voyage, of carrying from an altar near the Temple of Juno some ashes in a chalice, which, with flowers, honey, frankincense, and other aromatics, they cast into the sea as soon as they were about to lose sight of this shrine. The interior of the walls of this temple were covered with paintings, amongst which was an equestrian combat of King Agathocles, one of the most esteemed works of the Roman art. From the two great eyes of the porphyry lions of the Roman forum, the spectacled Cornelian Verres carry away. According to tradition, Archimedes drew an equinoctial line in this temple, and Mirabellis says that in 1583 the commissioners appointed by Pope Gregory for the correction of the calendar came to Syracuse for the purpose of examining it. This building has suffered much from earthquakes, but it strongly suggests some of the features of the successful great destroyer: the modern façade of the Borromini school forms a strange mixture with the rigid Doric of the ancient peristyle.

Of the Temple of Diana, two Doric columns with a small portion of entablature alone remain. To judge of the effect of them is no very easy portion, but the Doric architrave, only preserved by the walls of a modern dwelling, and the capitals are absolutely inclosed in a wretched closet. Notwithstanding this sad modern degradation of the great Diana's fame, these scanty remains possess considerable degree of interest, as belonging to the most ancient temple of Ortygia; and it is a curious circumstance, that the style of the columns of this temple, strongly resembles the order at Corinth, the mother city. The Selinus and Pessinus examples have also a great resemblance to it. The Intercolumniation must have been very small, there being only 1 ft. 6 in. between the axis of the two capitals. I am happy to state, that since my visit to Syracuse, the Duke of Buckingham, who is well known to us all, his success in architectural researches in his native country, and for his contributions to the library of the Institute, has discovered the lower portions of these columns. Near this temple stood the celebrated Baths of Daphne, so named from a laurel grove sacred to Diana; the spot is now called Bagarna, and many remains have been discovered near it.

The celebrated fountain of Arethusa next claims our attention. This classic spot, sacred to the nymph to whom divine honours were offered, and upon whose shrine even Hercules sacrificed, still pours forth its abundant supply of fresh water as of old, but also how different is its present state! It is now the public washing place of the town; and when I saw it, a number of Hungarian soldiers were lounging about it, enjoying their mirths, unconscious of the fame of the spot, or of the gibe and wit that the Syracusan laundresses were indulging in at their expense.

According to Diodorus, the celebrated building, the palace of sixty couches, which in magnitude and splendour was so superior to the temples, that the gods, from jealousy, are said to have destroyed it by thunder, was situated in Ortygia. This, together with the palace and gardens of Dionysus, the citadel surrendered by Dionysus to Timoleon, the Palace of Hiero, afterwards the residence of the Roman praetor and proconsul, and the workshops of the immortal Verres, have all disappeared, and their sites are now occupied with modern fortifications, and narrow streets of miserable dwellings.

I now proceed to the adjoining quarter of the city, called Acradina, described by Cicero as the second city, containing a spacious forum, a beautiful portico, and an oracular propaedia, or market, from which Verres stole the inimitable statue of Sappho, the great work of Silanion. Of these buildings there are now no existing remains. It is, however, probable that the Church of San Giovanni occupies the site of an ancient temple; and Mr. Hughes, in his admirable and elaborate description of the city, has been induced to adopt the Temple of Jupiter, in which Hiero suspended the Gallic and illusory spoils presented by him to the Roman senate; and from a passage in which Cicero upbraids Verres for allowing a piratical corsair to sail into the port, and penetrate up to the very forum, we may infer that the forum was placed near the Ismene.

In this quarter of Acradina are several of those Latomie, or stone quarries, which are so numerous in Syracuse. The most remarkable one is perhaps the one attached to the Capuchin convent, and now converted into a garden, forming one of the most beautiful and retired spots that possibly could be selected for devotional study.

There is another remarkable remains in this quarter, with vaults constructed of earthen pots, and the ruins of a bath excavated by Landolina, in 1804, in which was found the beautiful Torso of Venus, now forming the most valuable specimen of ancient sculpture to be found in the museum of the modern city.

The remains are less numerous in Acradina, and whether they are the works of the Syracuseans previous to the Roman conquest by Marcellus, or subsequent to that period, is still a matter of conjecture. Mr. Hughes is inclined to attribute them to the Romans.

At all events they are prodigious works. Dance described them as a perfect subterranean city. The principal street or avenue in the catacombs is about eighteen feet wide and ten high, with numerous recesses and chambers on either side, with separate receptacles for the bodies, in one of which I counted no less than fifteen divisions. Swinburn relates that he saw a gold coin of the time of Iesetas just discovered in a tomb here; this must have been the Naullen, or Charon's fare.

Along the main street, at intervening distances, are transverse streets, forming at their intersections square and circular apartments, which are generally vaulted, and in some of them are conical apertures for light and air. Around these chambers are numerous receptacles and vaults covered with fine stucco, and there are the remains of painting, with monograms and symbolical devices, the works probably of the early Christians. An old Capuchin monk acted as our cicerone in going through the catacombs, and the effect of his slow and solemn step, and the echoes of his footsteps, through this city of the dead, will not be readily effaced from my memory.

Of the walls of Acradina there are still remaining considerable vestiges, and the rock itself is in some places formed into battlements.

From a gap in the rock, called Scala Greco, where the quarter of Acradina terminated, and that of Tycha commenced, may be traced one of the principal gates of ancient Syracuse, and which, like some of the other gateways, was admirably contrived for defence, the assaulting being forced to expose their right side, which was unprotected by the shield, to a great length of wall, and the missiles of its defenders falling on their right. From Scala Greco a broad road traversed the city to the point Ortygia, lined on each side by strong walls and towers. Fuzello states, that a little beyond it, in the quarter of Tycha, stood the town called Gialagony, where a Roman soldier, during the conferences of Epicides and Marcellus, by numbering the courses of stone and computing their height, found the wall much lower than common opinion, and scalable by the ordinary ladders. By these means Marcellus took the city in the night, during a festival of Diana, when the inhabitants, more attentive to their superstitious observances than the means of defence, were in a state of great intoxication.

By the theatre of Gialagony the city is divided into three quarters; and it is said he was so named from the Temple of Fortune within its precincts, and that it contained a spacious Gymnasium, and many sacred edifices. Of this once splendid quarter of the city little now remains, excepting large sepulchres cut in the rocks, channels of aqueducts, and vestiges of the city walls. To account for so large a space being so completely cleared of the remains of the numerous buildings which formerly occupied it, one is almost led to the supposition that, from the facility of transport given by the immediate vicinity of the port, the materials must have been transported to other shores.

The quarter, Tycha, is divided into three districts, the city, the theatre, and as its name implies, was well provided with a large theatre of vast dimensions, two superb temples—one of Ceres and another of Proserpine—and a very beautiful colossal statue of Apollo Teneinctus.

The theatre is perhaps the most perfect of all the ancient buildings of Syracuse. It was the largest in Sicily, and is computed to have contained 50,000 persons. Its situation, on a rising ground, commands a magnificent view over the ports and surrounding country. The greater portion of the seats are cut out of the living rock.

In my examination of this edifice I had the great advantage to possess the elaborate and careful studies made in the previous year by Professor Turner of the American Archæological Institute, and the volume of "Stewart's Athens," it is unnecessary for me to attempt a further description of a work already so familiar to the members of this Institute.

Above the theatre are numerous excavations in the rocks, remains of water courses, streets, and sepulchres. One, more perfect than the rest, is called the Tomb of Archimedes; and although the sepulchral stele, with the sphere and cylinder carved upon it, is no longer to be found to authenticate its identity, one feels unwilling to doubt that this must be the very monument discovered by Cicero, and pronounced by its admirers in the immortal Archimedes. It has been suggested that it might have been intended for a tomb to the Contemplative Arch, which forms a magnificent entrance to the theatre. The seats are arranged in tiers, and the Latomie, or stone quarries, are principally in this quarter of the city. They are said to have been excavated by the Athenian prisoners, and afterwards used as places of confinement. No greater contrast can be imagined than their former with their present state;
for those ones gloomy abodes of the victims of Dionysius are now
flourishing with the luxurious vegetation of the pomegranates and the
oranges, and are watered by the transparent streams which still flow
along the ancient channels; and the spot where the infamous Verres
incarcerated not only Syracusans, but Roman citizens, is now termed
"I. Paradisi." In this Latomia is the church of San Nicolò; under
which it is remembered, that during the rock, 64 ft. 6 in. in depth,
6 in. wide; and from the remains of a water-duct at one end it
was probably used as a reservoir.

I must not pass by the curious cavern called the ear of Dionysius, which
is about 170 feet in depth, 35 feet in width, and 60 feet in
height. It is stated that Dionysius constructed this cavern on acoustic
principles, for the purpose of overhearing the conversation of the
prisoners confined within its walls. There is beyond doubt a wonder-
ful power of conveying and increasing sound in this curious vault;
but an examination of it, including the somewhat hazardous ascent
with ropes and pulleys to the cavity near the top, impressed us with the
notion that this power, as is the case with most echoes, is more to
be ascribed to accident than to art.

Neapolis was also adorned by a colossal statue of Apollo Temenites,
which stood proudly pre-eminent on a rising ground, and was pre-
served, says Cicero, by its magnificence, from the sacrilegious grasp of
Verres. Subsequently states, that it was contemplated by the mark
of Tiberius to place it in the library which he had built, or restored, in
honour of Augustus; but that he was prevented by the Deity in a
vision.

The ruins of the Temple of Jupiter Olympius are situated on a gentle
elevation, about two miles from the Anapus, overlooking the great bay.
Portions of the statues of two Dogs of War, alone remain standing,
but I am rather doubtful whether these are in the original position. It
is to be much regretted, that so little is left of this temple, which, in
its original state, was described as the richest monument in Syracuse.
In its adytum was placed the famous statue of Jupiter, esteemed one
of the three most noble representations of that deity ever produced,
and from which Dionysius stripped off the golden mantle, replacing it
with one of wool, accompanying his robbery with the impudent apo-
logy, that gold was too heavy in summer and too cold in winter for
the king of the gods, but that wool was adapted for both seasons.

I trust this fervent attempt to describe the ancient Syracusian, will be
exceeded, with all its imperfections; and most amply shall I be repaid
for the labour I have given, though, I fear very imperfectly, de-
scribed the principal remains of the four quarters of the ancient city;
and I will trespass for a few minutes longer only upon the attention of
the meeting, by making some short observations upon the suburbs and
outports.

Epipolae, so celebrated in the sieges of Syracuse, is to the westward
of Neapolis, on a spot (as its name imports) commanding the whole
city. It was inclosed by Dionysius within those remarkable fortifica-
tions and walls said to have been constructed by him in the incredible
short space of twenty days, and upon which he employed 60,000
workmen and 6,000 yoke of oxen.

It was also defended by a fort, which, according to Fazello, was
called by the Greeks Labdalo, but Mr. Hughes is of opinion (judging
from the descriptions of Thucydides and Diodorus) that Labdalo was
considerably lower in the descent, and that the fort in question was
the celebrated Hexapilo, a work so constructed with extraordinary mili-
tary skill and art. Mr. Cockerell (and I cannot appeal to a higher
authority in these matters) states that he considers the remains of this
fortress to be the most admirable specimen of ancient military archi-
tecture he had ever met with in all his extensive travels.

The principal entrance is admirably defended for defence, with
flank walls, from which the assailants were exposed to the beating
of the defiles, and the bottom was covered with a wall of masonry 12
feet in thickness. Others, of that species of construction termed
empistoxη, are fifteen feet thick. At two of the angles of the walls are square
towers of solid masonry, and there are several remains of fossæ, 25 to
30 feet deep, cut in the solid rock, and defending the accessible ap-
proaches to the castles. In one part is a subterranean passage, nine
feet wide and twelve feet high, leading in an inclined plane from
the castle to the fossæ, probably for the use of cavalry; and in other parts
of the walls are small openings, about two feet in height, and sufficient
to allow a man to creep through, by which the sortie was probably
made.

The suburb of Epipolae was terminated by a second almost impreg-
nable fortress, called Euryale, mentioned particularly by Livy in his
account of the siege of Syracuse, by Marcellus. In the 17th century
the village of Belvedere was built on this spot, but no vestige of it
now remains.

The river Anapus, so much vaunted by the poets and historians of
old, is now a small stream, and its banks covered with lofty reeds and
aquatic plants, growing so luxuriantly as almost to impede our pro-
gress in a small boat. We contrived, however, to reach the beautiful
fountain of Cyane, a natural basin of about 50 feet in diameter, and
celebrated by the poets as the spot where Pluto made his descent
with Proserpine. We here saw the elegant Papyrus plant growing in
great perfection, and it is said to be the only spot in Europe where
this rare plant flourishes.

It has been remarked that there is no ancient example of any state
so circumscribed in territory, extending so far and wide its influence,
as Syracuse. In military fame she was equal to Laedermun, and con-
quered the Athenians with naval pre-eminence! Her laws excited the admiration of Aristotle. The great Thibaean bard sung
the victories of her conquerors in the games of Greece. From
her power emanated the colonies of Acra, Casymena, and Camarina.
Her resources were so great, that Gelon offered to assist the Grecian
state in their armament against the Persians with 20,000 troops and
200 Triremes, and, in addition, to supply provisions for the entire
army of Greece, during the continuance of the war; and the perfec-
tion she had attained in the fine arts was such as to soften the hitherto
rigid habits of her Roman conquerors, to refine their taste, and to ex-
cite and ensure their elenca.

Fazello tells us that her skill in works of gold, silver, and embroidery,
was proverbial! The extent and magnificence of her buildings we
have already adverted to. The superb medallions of Phileistides suf-
ciently testify the superiority she had attained in the numismatic
art; and of the extent of her sculptural embellishments we may form
some idea from the remark of Cicero, that the Syracusians lost more
Talent by the rapacity of Verres than they did men by the victorics
of Marcellus.

The indefatigable Capodiciæ presents us with a glorious list of
warriors, statesmen, poets, philosophers, and men of science, whom he
claims for Syracuse; and proud indeed must that city be which could
produce Alcibiades and Dionysius as commanders! Philius as an
historian! the poet Theocritus, and, greater by far than all these, her
own Archimedes.

I trust this fervent attempt to describe the ancient Syracusian, will be
exceeded, with all its imperfections; and most amply shall I be repaid
for the labour I have given, though, I fear very imperfectly, described
the principal remains of the four quarters of the ancient city;
and I will trespass for a few minutes longer only upon the attention of
the meeting, by making some short observations upon the suburbs and
outports.

* The compiler of forty folio volumes on the antiquities of his native city.

INSTITUTION OF MECHANICAL ENGINEERS.

A second meeting of the promoters for establishing a national "Institu-
tion of Mechanical Engineers" was held at the Queen's Hotel, Birmingham,
Saturday last. The gentlemen who attended at the appointment arranged
to establish the Institution. The meeting was attended by Mr. George
Stephenson and about 70 other gentlemen. The object in establishing
the Institution was explained by Mr. McConnel. It is to enable mechanics
who are not engaged in the various manufactories and ramifications of
the country to meet and correspond. The early progress of the
Institution having been briefly sketched by Mr. McConnel, and the formal
resolutions adopted for conducting it.

The President elect (Mr. Stephenson) addressed the members at some
length, adverted to the difficulties he had encountered in his own early
career, where, without education, assistance, or apprenticeship, and in
the face of a vast amount of prejudice, he has succeeded in battling his
way, not unmixed with toil and tribulation. He exhorts perseverance as
essential to a young engineer, pointed out the folly of attempting impos-
ibilities, for there was, he said, a law which governed mechanics, as every-
things else; and that a point to which we should look up, was to be
further. Mr. Stephenson concluded by observing that he should and this
rising Institution by every means in his power. The council, and other
officers were afterwards appointed, and a general meeting of the mem-
bers is to be held quarterly. A dinner afterwards took place; and in the
course of some observations during the after dinner, Mr. Stephenson
said:—"I have worked my way, but I have worked as hard as any man
in the world, and I have overcome obstacles which it falls to the lot
of few men to overcome. I am a man who when I was a child, that
after my daily labour was an end, I have gone home to my single
room and cleaned clocks and watches, in order that I might be en-
sabled to put my child to school. I had felt too acutely myself the loss
of that which is necessary to be fully and properly trained in me,
and not only to have the chance of becoming a useful being to
men. I may say, too, perhaps, without being deemed egotistical,
that I have mixed with a greater variety of society than, perhaps, any
man living. I have dined in mansions, for I was once a miner, and I
have dined with kings and queens, and with all grades of nobility; and
I have seen enough to inspire me with the hope that my exertions have not
been without their beneficial results—that my labour has not been in vain."
CORDES AND LOCKE'S ROTARY ENGINE.

We have received a copy of a report by Mr. Josiah Parkes on the merits of "Cordes and Locke's condensing rotary steam engine." This engine is a contrivance for gaining power from the momentum of impact of steam, unassisted by its expansive force. The apparatus is so simple, that the nature of it is best understood without a figure: It consists of a vertical paddle wheel, revolving freely in a cylindrical case, and each float or paddle in succession is exposed to the action of a current of steam rushing against it from a pipe entering the side of the cylindrical case tangentially; so that steam impinges perpendicularly on each float.

The action may be compared to that of an undershot water-wheel, except that the steam does not act on the floats at their lowest position, but when they are about half-way between their highest and lowest position. The cylindrical case opens into a condenser, so that the steam may be said to flow from the boiler through the case into the condenser, meeting the paddles in its course. The extremities of the paddle-wheels do not quite touch the internal cylindrical surface of the case, and the expansive action of steam is in no way employed.

Mr. Parkes makes out that under these circumstances the steam acts with, as nearly as possible, the same efficiency as in an ordinary cylinder condensing engine. He arrives at this result in the following manner:

"I must first state that this kind of engine precludes the employment of the indicator to ascertain its gross power, as in ordinary cylinder engines; and even if it did, there were no reason why it should not do it in the most perfect manner, it was deemed to be of far greater importance to measure the amount of force actually disposable, as delivered off by the engine, rather than the power of the steam in action, which alone is denoted by the indicator. To attain this end it was necessary to fix some sufficiently uniform load to be applied to your engine, as well as upon some method of determining the resistance overcome. The load selected was a screw-propeller, submerged and driven round in a tank of water, 16 feet by 11 feet square. The resistance was weighed by Mr. Davy's dynamometer, adapted to a strap-pulley on a counter-shaft, working independently between the engine and screw-shaft.

These preliminary arrangements having been made, the engine was worked during several days; the quantity of water, as steam, which passed through the wheel-case, as well as through the small auxiliary engine which drove the air-pumps, being carefully measured on each occasion. The resistance shown by the dynamometer was continually noted; the number of revolutions made by the wheel was exhibited by a counter; the pressure of the steam as it entered the wheel-case, was observed on a thermometric steam-gauge; the value of the vacuum in the wheel-case was obtained by an ordinary vacuum-gauge connected with it; and the amount of power employed to drive the air-pumps and maintain the vacuum, was ascertained by an indicator.

The diameter of the steam-wheel in question is 11 feet 7 inches, and at 900 revolutions per minute, its periphery travels at the rate of about 500 miles per hour. The width of the wheel-case is 15 inches; the number of vanes and radial arms 28; the breadth of each vane 6 inches, the depth 7 inches, and the area, therefore, of each vane about 42 square inches. The orifice of the steam jet is of an oval shape, 3 inches by 2 inches, set vertically.

It appeared, after a great number of trials, that your engine gave the following results, when using steam in the boiler at a pressure of 22 lb. per square inch above the atmosphere:

<table>
<thead>
<tr>
<th>Revolutions of wheel per minute</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse-power per dynamometer</td>
<td>23</td>
</tr>
<tr>
<td>Vacuum in wheel-case</td>
<td>22.4 lb. of mercury.</td>
</tr>
<tr>
<td>Water-power per paddle</td>
<td>100 lb. per hour.</td>
</tr>
<tr>
<td>Water-power per inch</td>
<td>80 lb. per hour.</td>
</tr>
</tbody>
</table>

The same dynamometer and strap-pulley were then applied to your works at Newport, Monmouthshire, and applied to a condensing engine made by Messrs. Bowman and Galloway, of Manchester, having the following principal dimensions, viz.: diameter of cylinder 30 inches, length of stroke 6 inches. Previous to the experiments, the engine was put into the best possible working condition. My indicator was applied to the cylinder; the dynamometer to the engine-shaft; cards were taken during several hours of continuous work, under an uniform load; the index of the dynamometer was noted down every five minutes; the water consumed, as steam, was accurately measured. The subjoined may fairly be considered to represent the mean result of numerous trials:

| Speed of piston per minute       | 220 feet. |
| Mean pressure per indicator     | 10-642 lb. per square inch. |
| Mean pressure per horse-power   | 10-364 lb. per inch stroke. |
| Vacuum in condenser             | 20-9 lb. of mercury. |
| Water-power per horse-power     | 100 lb. per hour. |
| Water-power per inch            | 80 lb. per hour. |

The indicated power amounted, from the above data, to 49-73 horses; and the water expended for each horse power, per hour, was 100-9 lb.

It hence appears that the power actually delivered off by the cylinder engine, was less than the gross or indicated power by 35-73 per cent.; and, that a similar useful effect was obtained both from the cylinder, and your rotary engine, with the same expenditure of steam and fuel.

Mr. Parkes has some years ago the misfortune to publish, in the third volume of the Transactions of the Institution of Civil Engineers, a paper calculating the power of steam engines, in a manner much more amusing than instructive. The reader who is curious in such matters may find in the second edition of the Count de Pambour's Treatise on Locomotive Engines, an ample critique upon this paper, and exposure of its errors. We are not going out of the way in referring to this matter, because we can only conjecture Mr. Parkes' present mode of calculation, by comparison with what he did in 1840. At that time he could not understand that the effect of a steam engine depends directly and absolutely on the evaporation, and that it is utterly impossible to compute the effect without having estimated numerically the quantity of steam generated in a given time. Seven years of subsequent experience have not much mended matters, for the calculations now presented to us are evidently independent of the essential consideration just stated. The "mean pressure per indicator," or cylinder pressure is given, together with the quantity of water evaporated per hour; but nothing is said about the boiler pressure.

Now, having given the quantity of water evaporated per hour, we must know the boiler pressure, in order to calculate the quantity of steam generated per hour; and this being known, we may calculate the velocity of the engine from the work done, or the work done from the velocity. By omitting, however, a single element of this computation, the whole chain of reasoning is broken, and when Mr. Parkes tells us that the "power actually delivered off by the cylinder engine was less than the gross or indicated power by 35-73 per cent." we are entitled to attribute the fault not to the engine but to his calculations.

The principal assertion, that an equal effect was produced from both kinds of engines, with the "same expenditure of steam and fuel," does not anywhere appear to have been corroborated by direct experiment. With respect to the expenditure of steam, we know that that could not have been ascertained, because the boiler pressure is not recorded: and if the expenditure of fuel in the cylinder and the rotary engines had been compared, something would have been said to show that in both cases it was consumed in firegrates of the same form and dimensions; as otherwise the comparison would not be a fair one.

Another altogether different application of the rotary engine was as an auxiliary to the common cylinder engine, by causing the steam in its course from the cylinders of the ordinary construction to the condenser to pass through a circular steam case with revolving paddles, as before described. The experiments on the rotary engine so employed were as follows:

"One of the wheel or rotary engines, divested of its air-pump, condenser, &c., is connected at your works with a common reciprocating condensing engine; in the following manner. The steam wheel is placed next to the cylinder of the condensing engine, in the same room, and is simply acted upon by the steam discharged from the latter. It therefore stands intermediate between the cylinder and the condenser, and derives all the power it gives off from the waste steam of the condensing engine; in its passage from the cylinder to the condenser.

Each engine drives a perfectly distinct load in the manufactory, that is to say, each drives sets of machines perfectly distinct, and in separate buildings; the power of the cylinder engine being given off to a main upright shaft engine; in one kind of machines and the power of the engine applied to a strap communicating motion to machinery at a distance. This condition of things has existed in actual daily operation at the works for 18 months past. In order to arrive at the separate value of the effect produced by each engine, and of their combined effect, the following methods of proof were adopted.

The usual loads were disengaged, and friction breaks were applied in such manner as to balance the whole power delivered off by each engine. Indicator cards were frequently taken from the cylinder engine; each break was placed under the separate management of an experienced mechanic, with every provision to maintain uniform friction; the water evaporated was measured throughout the experiments. The results were,
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The dimensions of the cylinder engine were:

- **Diameter of cylinder**: 10 inches.
- **Length of stroke**: 6 feet.
- **Power per minute**: 200 horses.
- **Mean pressure per indicator**: 15 lbs. per sq. in.

The dimensions of the rotary engine were:

- **Diameter of wheel**: 7 feet 6 inches.
- **Number of wheels**: 30.
- **Size of vanes**: 4 inches wide, by 6 inches deep.
- **Two steam jets**: 2 inches diameter each.

The useful fact developed by these last experiments is the recovery of five horses effective power per hour, which was afterward passed usefully into the condenser, and been annihilated. It is, therefore, manifest that nearly one-third more power may be obtained from any cylinder engine by combining with it this rotary engine, without the use of additional fuel, boiler, or apparatus of any kind.

With the view of proving that the auxiliary or supplemental wheel engine, as combined with the condensing engine, did not diminish the performance of the latter, the indicator and brake were arranged so that it would work alone, with the connection of the wheel engine having been shut off, and the waste steam suffered to pass through its usual pipe to the condenser. Under these circumstances the effective power of the Condensing Engine came out 1537 horsepower and the waste steam expended as steam 110 lbs. per hour per horse; thus demonstrating that no diminution of its effective power, nor increased consumption, were occasion by its combination with the Rotary Engine.

In order to prove that no opposition to the passage of the waste steam from the cylinder to the condenser is occasioned by the interposed wheel and case, the indicator was applied to the connecting pipe immediately in front of the jet holes, and the vacuum exhibited by it was in close accordance with the vacuum in the cylinder as ascertained by the same instrument. The wheel-case is, in fact, a virtual enlargement of the condenser, and the value of the vacuum in the cylinder suffers no depression from its interposition. The power recovered and given off by the wheel is simply due to the steam's moment—low as is its elastic force—acting by impact on the wheel vanes in truminae between the cylinder and condenser;—the working being done, and therefore, resisted or to the extent of imperfection of such vacuum. The more perfect the vacuum maintained throughout the case, the greater will be the useful effect obtained from the wheel.

SECTION ONE.  

<table>
<thead>
<tr>
<th>Birmingham</th>
<th>Birmingham</th>
<th>Lancashire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gage for Iron and Steel</td>
<td>Gage for Steel, Brass, Nickel, etc.</td>
<td>Gage for Round Steel Wire, and also for Sheet Iron and Steel</td>
</tr>
<tr>
<td><strong>MARK.</strong></td>
<td><strong>SIZE.</strong></td>
<td><strong>MARK.</strong></td>
</tr>
<tr>
<td>0500</td>
<td>0.05</td>
<td>0600</td>
</tr>
<tr>
<td>0800</td>
<td>0.08</td>
<td>0900</td>
</tr>
<tr>
<td>1100</td>
<td>0.11</td>
<td>1200</td>
</tr>
<tr>
<td>1400</td>
<td>0.14</td>
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</tr>
<tr>
<td>1700</td>
<td>0.17</td>
<td>1800</td>
</tr>
<tr>
<td>2000</td>
<td>0.20</td>
<td>2100</td>
</tr>
<tr>
<td>2300</td>
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</tr>
<tr>
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<td>2900</td>
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<td>3200</td>
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<tr>
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<tr>
<td>5000</td>
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<td>5100</td>
</tr>
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</tr>
<tr>
<td>5600</td>
<td>0.56</td>
<td>5700</td>
</tr>
<tr>
<td>5900</td>
<td>0.59</td>
<td>6000</td>
</tr>
</tbody>
</table>

The values of gages for wire and sheet metals given above, expressed in decimal parts of the inch.
NEW METROPOLITAN CHURCHES.

In almost every part of England new churches are being built, of which the architecture would be worthy of the best days of ancient ecclesiastical art. Those who love architecture for its own sake, and who, in order to see noble specimens of it, are willing to make short pilgrimages (no great labour in these railway times), may see, in every county, modern churches, the monuments of private munificence, which elicit the admiration of the strictest and most determined disciple of ancient art. The recent edifices, if they do not always possess the massive simplicity and unity which remains hitherto a characteristic of the olden time, still exhibit in their details a magnificence and propriety which we can hardly hope to see excelled.

In London, however, it is not so. Here, churches are built to cover a given number of square feet of ground, and the architect must so arrange the building, that the greatest possible number of sittings may be contained within it. It does not pay to build London churches with thick solid walls and massive piers and buttresses—the pew-rows would not cover the outlay. Plaster and patent cement and deal boards keep out the weather (while they last) nearly as well as stone and oak, and, if properly coloured, look as well. To be sure, these lath-and-plaster edifices will not last for quite so many centuries as the medieval piles which they mimic (one of these fragile fabrics has already begun to fall, almost before its completion)—but, then, those who build these churches have no concern in the permanence of them for centuries—for to themselves the pew-rows cannot accrue beyond the term of their natural lives. They have made the churches seasonable, and they build them just strong enough to answer the intended purpose. Our ancestors did not build in such a manner, nor with such objects. Do we wrong to condemn the old custom, as a good old custom?

We are not “travelling out of the record” in making these observations: they have more connection with architecture than may appear at first sight. In many even of the best of modern churches—through the critic can detect no fault of design or detail—something is felt to be wanting which renders these buildings less impressive than their ancient prototypes. The detection of this something is oftentimes very puzzling—the construction of the building is faithfully expressed by the decoration, the materials are honest and real, the composition simple and connected, and the mouldings, traceries, &c. graceful, and appropriate to the style adopted—and yet the eye is not satisfied. The more this anomaly is considered (and we doubt not that it has occurred to many careful observers), the more readily will it be referred to the comparative slightness of building adopted in modern structures. This explanation may perhaps be objected to as too material. It may be thought a very matter-of-fact kind of criticism which measures the thickness of walls and the sectional area of buttresses; but it is precisely this kind of criticism which, if it be correct, is the most useful, because it is the most easy of application.

It is by no means to be inferred that we would commend heavy clumsy modes of construction, when our present increased knowledge of mechanics has revealed improved and more scientific methods. The worst sort of affectation is that which spoils inferiority. But we do want to see churches built as if they were meant to last—not as if the architect had been accustomed all his life to “run up” cockney villas or new metropolitan streets—as if he had no idea of magnificence beyond the plainer glories of the Regent’s Park or Belgravia. How willingly does the eye, wearied of this showy, ephemeral finery, turn to the ancient, unpretending, village church, with its vast bold buttresses and massive tower! Those venerable walls tell their story so simply, and yet so well—that within them successive generations of men have assembled in piety and reverence for, it may be, these six or seven centuries past. It is not merely that we admire the village church for its own intrinsic beauty, but that we feel that it was built for ages. It is the type of permanence, as far as the work of men’s hands can go. The ancient churchmen, it has been well said, built “for religion, for fame, for security, not by contract; for devotion, not in a spirit of economy; pro salute animae, non pro crass.-

Old Street Road.—A new church has been recently built here by Mr. Ferrey, in the Early English style. The nave and aisles are under separate gables, and the entrance is under the tower, which is at the southwest angle. Externally, the masonry is of rag, with Caen stone dressings, which have (as in many other modern churches) been most unsatisfactory, “patchy” appearance. It is well enough to use Caen or similar stone for the moldings or tracery of a church, for rag cannot be worked for the purpose; but there is now a mania for sticking all over a church bits of the former kind of stone; and its light colour, contrasted with the dark base of the coarser material, gives the building an appearance of stone patchwork, or the fantastic pattern of a harlequin’s dress. Besides, it is ridiculous to use the seeder stone for quoins and angles, where, if any difference be made, it should be in favour of the material which had the greatest cohesive force. Had the angles of the buttresses, &c. of Mr. Ferrey’s church been of rag-stone like the rest, the effect would have been much better. The love of finery in architecture has grown into a habit which seems almost inerterent.

The windows on the south are arcades of four arches, two blank and two pierced for light—this arrangement, defended though it be by precedent, is most unworthy of modern imitation. Blank windows are equally inartistic, whether they occur in Classic or Pointed architecture. In the present case, the masses of Caen stone in the blank arches exaggerate the patchwork effect of which we have complained, to an unusual degree. The windows on the north side are coupled. This side of the building is much the best. The south side is next the street, and is of course made the most showy—for that very reason, it is inferior in appearance to the other. The rose window at the east end is much too large. We have not had an opportunity of seeing the interior of the building.

Horten.—Another Early English church is nearly finished here, which is a specimen of “Modern Gothic,” of more than ordinary hideousness. It scarcely deserves a detailed notice. It is sufficient to say that it exhibits all the following characteristics of its tribe in an eminent manner—minutely thin walls, with square reveals to the windows, as in an ordinary dwelling house—poor treatment of the Purbeck-stone pilasters—plinkeys ugly enough to have been built twenty years ago—plenty of plaster and stucco, and an enormous disproportionate chancel-arch, with a small communion recess beyond it.

RAILWAY STATISTICS.

From the Eisenbahna-Jahrbiich (Railway Year-Book), recently published by the Baron de Reden at Berlin, we obtain some valuable additions to railway statistics. The author is now in office under the Prussian government, and formerly superintended the construction of the railway from Berlin to Stettin.

The analysis of accidents which occurred on railways in Belgium, England, France, and Germany, respectively, during five years, commencing 1st August, 1840, is as follows:—

<table>
<thead>
<tr>
<th>Country</th>
<th>Fatal Accidents</th>
<th>Total Number of Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>80</td>
<td>850</td>
</tr>
<tr>
<td>England</td>
<td>92</td>
<td>1,200</td>
</tr>
<tr>
<td>France</td>
<td>71</td>
<td>1,080</td>
</tr>
<tr>
<td>Germany</td>
<td>12</td>
<td>55</td>
</tr>
</tbody>
</table>

It appears, from this table, that the total number of persons in any way injured during this period, in the four countries, was 1,848; and of these accidents, 417, or between one-fourth and one-fifth, were fatal. The following table shows approximately what proportion of these accidents have occurred in each country, and also the annual average of accidents:—

<table>
<thead>
<tr>
<th>Country</th>
<th>Fatal Accidents annually</th>
<th>Total accidents annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>7.2</td>
<td>90.4</td>
</tr>
<tr>
<td>England</td>
<td>6.0</td>
<td>120.0</td>
</tr>
<tr>
<td>France</td>
<td>4.4</td>
<td>44.0</td>
</tr>
<tr>
<td>Germany</td>
<td>3.2</td>
<td>32.0</td>
</tr>
</tbody>
</table>

In this table, the casualties on French lines include those of the Ver-sailles catastrophe, by which 55 lives were lost. The accidents on the Berlin lines in 1843 and 1844 arose almost entirely from breakage of axles and from carriages getting off the rails.

A more accurate estimate of the relative insecurity of railways in either country is obtained by comparing the number of casualties with the total number of passengers conveyed. Taking the annual mean proportion, we get the following results, which distinguish whether the accident arose from the fault of the sufferers or of the railway managers:—

<table>
<thead>
<tr>
<th>Country</th>
<th>Passengers killed from</th>
<th>Officially killed and wounded</th>
<th>Persons killed from their own fault</th>
<th>From their own management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>1 in 670,000</td>
<td>1 in 200,000</td>
<td>1 in 1,450,000</td>
<td>1 in 1,690,764</td>
</tr>
<tr>
<td>England</td>
<td>1 in 200,000</td>
<td>1 in 500,000</td>
<td>1 in 1,953,000</td>
<td>1 in 7,860,384</td>
</tr>
<tr>
<td>France</td>
<td>1 in 2,127,000</td>
<td>1 in 5,000,000</td>
<td>1 in 12,450,865</td>
<td>1 in 5,890,586</td>
</tr>
<tr>
<td>Germany</td>
<td>1 in 5,500,000</td>
<td>1 in 9,000,000</td>
<td>1 in 41,253,868</td>
<td>1 in 1,757,380</td>
</tr>
</tbody>
</table>

In this list, each country is placed in the order of the relative insecurity of its railways. The terrible disproportion in this respect, between the two former and the latter, is very significant and deserves careful attention.
SETTING OUT RAILWAY CURVES.

Sin.—The following mode of setting out curves, by means of equal chords and ordinates, which I have successfully practised, is both accurate and easy of being applied —

![Diagram](image)

Let B and D be the ends of two straight lines, tangents to the curve BCD, which we wish to set out; — the position of the two lines having been correctly determined from the base line of the survey. We must then ascertain the angle that a chord of any convenient length (say 10 chains) makes with the tangent AB; which having found, the intermediate points on the curve are fixed by offsets from the chord. The radius being known, and the length of the chord determined, the formula will enable us to find the angles of chord and tangent:

\[
\text{Sin } \frac{1}{2} \text{ chord } \times \frac{1}{2} \text{ arc } = \frac{1}{2} \text{ secant } \times \frac{1}{2} \text{ arc } = \text{ natural sine of } \frac{1}{10} \text{ of the chord.}
\]

Therefore, sin \( \frac{1}{2} \text{ the arc } = \text{ chord.} \)

2 radius.

Thus, if chord = 10 chains, and radius = 60 chains, sin \( \frac{1}{2} \text{ the arc } = \frac{1}{2} \text{ secant } = 0.933 = \text{ natural sine of } 9° 47'.

To find the offsets, the line FG which bisects the chord is at right angles with it. GH, which is a tangent to the curve, is also at right angles with FG. GH and IC are, therefore, parallel. If HC be drawn at right angles with IG, it will be parallel to IG, and also equal to it; and GH = 10 chains.

\[
\begin{align*}
H &= \sqrt{F + F + G - H} \\
G &= \sqrt{F + G + H} \\
&\text{and} \\
&\text{The parallel lines, H, F, G, and C, are all equal.}
\end{align*}
\]

Therefore, \( d = H - b \\ e = H - a, \text{ &c.} \) and \( G = H. \)

\[
\text{The formula } \frac{G}{G} \text{ will give a very near approximation to the distance of the tangent from the curve, and might be taken as the offset without producing any appreciable error; } \frac{G^2}{G^2} \text{ will give } b \delta; \text{ and } \frac{G^3}{G^2} = a, \text{ &c.}
\]

In the case where a building or other obstacle may intervene, at B, (fig. 2) to prevent the setting up of a theodolite; if from A we set off the distance A equal to \( b, \) we shall have the direction of a chord, 5A of 10 chains; by means of which we can determine the direction of a new chord, 5C.

Carmarthen, Jan. 8, 1847.

Z.

SAFETY OF RAILWAYS.

(Extract from a Report made to the Minister of Public Works in France, by M. DE Brillant, head of the Railway Department, Two Vol. Eng. Trans.)

The Special Commission, charged by the Minister of Public Works to inquire into the questions relating to the safety of transit upon railways, has, from the first, had two subjects of very different natures to consider. The catastrophe of the 8th May, 1842, had called public attention most particularly to the construction of axles of locomotives and carriages, and to the terrible consequences of the shocks to which passenger trains might be exposed upon railways.

The safety of railway travel may depend on various circumstances; 1st.—On the state of the road or way, and the mode of its construction; 2dly.—On the state of the materials employed, viz., the engines and carriages, and the different parts of which they are composed, viz., the wheels, axles, springs, &c.; 3dly.—On the formation of the trains; and 4thly.—On the mode of attaching the engines and carriages together, the kind of brake employed, the methods of deadening shocks, &c.; 5thly.—On the regulations to be observed when the trains are running, the speed at which they are to travel, the signals and means of communication between the engine-drivers or between them and the officials at the stations or on the road; 6thly and lastly,—On the degree of intelligence employed in the service, and the ability and character of the persons employed.

1. On the Railway and its Accessories, such as Crossings and Changes in the direction of the Road.

It will be unnecessary here to recapitulate the various plans which have been successively employed for the construction of railways: it will be sufficient to observe that the method now generally adopted in France consists in fixing the rails by means of wooden chairs placed in cast iron bearings, which are fixed two together upon wooden sleepers, placed at equal distances apart: the number of sleepers varies according to the nature of the road in which the road is to be formed, the weight of the wheels, &c.; the sleepers are covered with sand to keep them in their proper position.

Some engineers, in order to render the rails more firm, and to prevent their bending under the transverse sleeper, have proposed to lay the rails on a longitudinal sleeper, but this plan of construction to Bristol is laid down in this manner; but it is not apparent that this plan has been much followed in France.

The Commission had therefore to inquire, on the one hand, whether this method of constructing railways was sufficient to maintain the rails at the required distance. This was answered affirmatively, adding, however, that it would be advisable to place the sleepers nearer together at the junction of two lines of rail, than at the intermediate points. As a corollary to this question, the Commission inquired whether the breadth between the rails most commonly adopted, viz., 4 ft. 8 ins., was sufficient, and whether it would not be advisable to increase it. On the first point, the answer in the affirmative was given without hesitation; and, as to the width of road, the Commission was of opinion, that the gauge at present might be continued; adding, however, that it would be advisable to keep it in tunnels, and between the piers of the viaducts, as well as on levels and in cuttings.

With regard to any alterations to be made in the position and form of the road, the Commission declares, that the depression or elevation of the rails, a defect in fixing them in the chairs, derangement of the sleepers supporting them, inequality in the sand forming the foundation of the road, or too thin a layer of this sand, must be considered as very likely causes for the carriages getting off the rails. The Commission mentions two other causes of the rails getting out of order, which seem to be quite as dangerous:—First, the displacement of the rails in a longitudinal direction, or, what is equivalent, the inaccurate movement of the wheels, which is the uniform inclination of the sleepers; the consequence is, the consequent displacement of the rails. These various causes of danger may be averted, or at least greatly modified, by a constant and attentive surveillance of the road.

The Commission had still to examine, on the one hand, whether the form adopted for the rails was the most suitable; and on the other hand, whether the test of the manufacture of the rails, before employing them, was sufficient to be relied upon.
There are three different systems of switches employed upon railways; the first—that of movable rails, which act by pressing upon the inside of the carriage wheels, so as to force them to run in the required direction. This plan is generally adopted in the confined spaces of a station, but in Broadway and Park-gate rail will run off the rails. And, lastly, the third plan, which is generally adopted at present, is one that unites the advantages of the first and second. It is composed of double switches, arranged in such a manner that there may be always at least two sets opposite each road; and the switches being always brought back to their original position, by a counterbalance weight, there is no danger of running off the rails. This latter plan is much preferable, as regards public safety.

In assessing of changes and crossings in a level, the Commission has given its attention to some questions which are of great importance as regards security in travelling. For instance, when a railway is carried across a deep valley, which can only be traversed by means of long tunnels, or through deep cuttings, or across rivers of greater or lesser width, it will be understood that it would be much more dangerous to run off the rails at such places as when travelling on a level road, although attended at all times with much danger. In order to prevent this, as much as possible, counter-rails are generally employed, placed either inside or outside the line of rails, and more or less elevated above the ground. The Commission has thought, that in certain cases, the counter-rails may be useful, adding besides, that when used, it is advisable to place them inside the rails. If the counter-rails are properly placed, the flanges of the wheels are gained; and, besides, if an axle were to break, the wheel, instead of being dragged outside the rails, would have a tendency to run inside, which is an evident advantage as regards safety.

Lastly, the Commission has had to examine whether, as regards safety of transit, there should not be a limit to the radius of the curves, and what this limit should be: but it was not long in perceiving that nothing positive could be decided on this point, and that it would be impossible to determine in all cases, a limit to be adopted. This limit, as presented in the railway books, appears suitable and sufficient for preventing accidents.

II. On the influence of the state of the materials, as regards safety of transit, and the precautions to be taken for that purpose.

If the state of the rails, and the materials of which the railway is composed, have a direct influence upon transit, the machinery employed in working it, viz.—the locomotive engines and carriages, is also worthy of serious attention.

Experience has proved, that by forming the upper surface of the rails of a slightly convex form, the oscillation may be much diminished, and the friction of the flanges of the wheels upon the rails will be reduced in proportion. They are, in fact, scarcely in contact, and consequently, the rails may be made about a third of an inch wider, which greatly facilitates the progress of the train. To effect this, the wheels, or, more properly speaking, the expense of the railway, but by their adoption the chances of accidents will be greatly diminished.

The next question to be discussed relates to the axles. This subject is one that is of great importance, and from most of the serious railway accidents having been accompanied, if not caused, by the breaking of an axle. The Commission has examined the axle, successively, in all possible positions—first, in the perpendicular position, and secondly, in the horizontal position, to the different kinds of work to which they might be adapted. As regards the manufacture of axles, the Commission is of opinion, that this manufacture is now conducted on as perfect a plan as possible, as well as straight as possible. The material is wrought by the hammer, and the cranked axles, which are always larger, are made of forged iron; but in order to give them the desired form, only one method appears to have been thought worthy of being employed. This method consists in putting a number of iron bars together to form a parcel of about two feet square, and these, having been heated in a reverberatory furnace, are submitted to the action of a powerful hammer, beaten on all sides, in order to weld the bars together: the bar thus made, is afterwards heated, and thence passes through the muffle to the intended axle, keeping a sufficient width for the cranked part. Those parts of the axle which are to receive the wheels, are first wrought into the required form, and then the cranks (which do not require to be rounded) are brought to their proper shape.

The form to be given to the axles is not material. It has been proved by experience that axles nearly always break inside the wheels, and at or near the nave. It is therefore advisable to make this part much thicker than the general section is, in order that it will not itself break. The general section is also not of sufficient thickness to take great shocks, or to the smaller ones, or in the form of a truncated cone, the apex of which would be equal to the diameter of the body of the axle.

The Commission had to inquire whether it was advisable, before employing the axles, to test their strength; and their opinion was, that this trial was not desirable, but that there might be certain modes of trial which would not injure the metal, and which would nevertheless expose the defects: such, for instance, as re-heating to a cherry red—an examination of the portions detached from the ends of the axles, &c.

In a word, the essential test of the axles should be to call to mind the importance of which may be easily understood; and they ought to be also obliged to keep registers, in which all the axles received should be carefully noted, together with all the circumstances of their reception, and a statement of the proofs to which they had been subjected.

When working on railways, the axles are subjected to strains of different kinds, and to shocks and vibrations, sometimes of a very violent nature, which might possibly cause them to break. Accidents of this nature have not infrequently happened upon railways; but, in most instances, the circumstances have not been truly investigated, nor the appearance of the fracture considered; except in some cases (fortunately very few) in which the breaking of the axle has been caused by a heavy shock. But in the two cases, the broken portions of the axle had been so twisted, that no conclusion could be arrived at from the appearance of the fracture. It is, besides, generally impossible to determine whether the breaking of the axle was the cause of the accident, or merely the effect.

From these circumstances, the Commission has been unable to discover any documents of a nature sufficiently conclusive to determine the probable time that axles would last; but it has no hesitation in declaring that they are deteriorated in quality by use. It may be concluded, from isolated but well-verified facts, that, after a certain time, depending upon the effective work accomplished by each, the axles will break. Is this owing to any molecular change in the material? It is impossible to determine this point, and the Commission thinks that every Company ought to be obliged to keep a register, in which should be entered, independently of the particulars of the time of receiving the wheels, the number of miles, &c., the number of wheels broken by it.

The documents extracted from these registers would doubtless be of great utility for solving the important questions relative to the duration of axles; but the fact cannot be denied that this will furnish no result until after a certain time has elapsed, and, therefore, it would be advisable to make some experiments as to the means of determining, at any time, the amount of alteration which has taken place in the axles, and either to restore them to their former state, or limit the period of their use.

After ascertaining the average weight which axles have to support, and the strain they undergo, the following experiments were proposed to be made:—On analysing the strain upon axles, it was found to consist, 1st., of bending, 2nd., of crushing, and 3rd., of bearing upon that point, in consequence of the position of the centre of gravity, or the action of the springs of the hinder axle in the six-wheel engines. This strain being thus defined, even supposing that the parts upon which it acts are as near as possible to the point of support formed by the wheels, tends, nevertheless, to bend the axle in a vertical direction.

2nd.—A twist or strain, arising from the conoidal form of the peripherals of the wheels, and inequality in the inclination of the rails; from which it happens that the axles, if not perfectly straight, will be inclined, and touch the rails at the same part at the same time, and consequently, each of the wheels slip alternately on the rail; if the twist resulting therefrom is not too violent, it keeps all the molecules in a permanent state of vibration.

3rd.—The shocks arising from inequalities in the road, caused by the undulations of the rails, and the momentary depression of the rails at their point of juncture when a train passes. These shocks increase in violence, in proportion to the length of the train, and act in a direction at right angles to the axis of the axle.

4th.—Another kind of shock, arising from the oscillation of the train, which acts on the axle both in the direction of their length and at right angles thereto, increasing in force in proportion to the diameter of the wheels on the axles.

In order to appreciate the effects of these four kinds of strain, the Commission is of opinion, that the first series of experiments to be undertaken, should be to inspect a certain number of axles which have already worked for a given time upon railways, and minutely examine their interior texture. As, however, these experiments could not lead to perfectly satisfactory conclusions from the want of points of comparison, the Commission is of opinion that it would be advisable, at the same time, to commence experiments upon axles.

These experiments might be made by taking an ordinary locomotive and, with the help of some one like the trial trip described above, to apply to an engine, and giving it a rotary movement, similar to that which it would acquire if employed upon a railway. By placing the wheels of this axle upon a frame, consisting of another axle, furnished with wheels, trestles, &c., and set in motion by a steam engine, the first class of action to be observed will be obtained.

All the other motions might be obtained by these means; and also, by a suitable construction of the wheels of the frame, the twisting of the axles, the crushing of the same, &c., the axles might be examined arising from the oscillation. By this method of proceeding, the axle submitted to experiment will be exposed as nearly as possible to the same injurious action as when in use; only, instead of advancing upon a railway, the railway will present itself to the wheels. The Commission, wishing to ascertain the expense of the above experiments, arrived at the following results:—
Fires can only arise from two causes:—1st. The sparks escaping from the chimney of the locomotive; &nd. Portions of incandescent or ignited fuel falling from the furnace, which falling pieces, even should there be no wind, are driven along by the current of air produced by the rapid movement of the train.

As regards the sparks which issue from the chimney, the Commission observes, that since railways were first worked, the chimneys of locomotives have always been furnished with a woven wire guard, which stops the sparks, and in all but the few largest axles, furnished with their wheels, the expense of which will be about 90l.

Lastly.—The working of the apparatus will require a certain amount of power, constant attention, and the renewal or repair of some parts of the mechanism, such as the brass bearings for the axles, or the tyres of the wheels.

In conclusion, the Commission is of opinion that, in order to make experiments in a suitable manner, an outfit of at least 900l. will be required. It is evident that short experiments, and for a short time, but this does not appear to be a sufficient reason for abandoning them.

It was observed by the Commission, that in locomotive engines there were many parts subjected to considerable strain and violence, the rupture of which would be of minor importance, and that they might therefore, without much inconvenience, be allowed to remain in use until nearly worn out: of this kind are the rods which connect the locomotive to the tender, and also the bolts which serve to fasten them. By manufacturing several similar pieces with rare, pure, and tough materials, the two or three that in case of breakage of axles, in order to prevent any accidents arising therefrom. Plans have been proposed for this purpose by a great number of inventors, which it may be as well to make mention of here.

These plans will be divided into two categories; the first of which consists in the employment of wheels running on the rails in front of the engine, and serving as guides. The second consists in the employment of guides on the rails, the rods of which, being attached to the framing of the engine, keep the train on its course. The Commission was of opinion that these plans appeared to the Commission susceptible of useful employment. The guide-wheels would have the inconvenience of preventing the engineer from perceiving the breaking of the axle in time to stop the train.

With regard to the guides, if they were made as proposed, in the form of drawbars, they would cause shocks and serious accidents; they also would not offer any resistance to the oscillations of the engine; if made light, they would readily be broken when subjected to a violent shock; and if heavy, they would evidently facilitate the running of the train off the rails.

As regards the working of railways, another not less important question occupied the attention of the Commission. On the occasion of the Versailles accident the general opinion was, that nothing fatal would have happened if the locomotive "Matthew Murray" had been mounted on six wheels. This opinion, however, may be the subject of some amendment, as one of the first precautionary measures was to prohibit the companies in the environs of Paris from making use of locomotive engines with four wheels. Before, however, this measure was made general (the immediate cause of which was the continued burning of anthracite in certain companies besides those in the environs of Paris), the Commission thought proper to inquire into its as regards safety, and for this purpose took an account of the number of accidents which had happened upon railways worked with locomotives, either of six or four wheels, and the conclusion they came to was that, as regards public safety, the six-wheeled engine possessed some advantage over the four-wheeled engine, especially when the two driving-wheels are provided with flanges; this advantage is not, however, so great at present as to do away with the four-wheeled engines. The attention of engineers must be especially directed to the improvement of the six-wheeled engines, and there is no doubt that when these engines have undergone the improvements which may be suggested, they will be preferred.

The parties in favour of the four-wheeled engines brought forward, in support of their opinion, the fact that, in six-wheeled engines, the centre of gravity of the wheels was always in front of the axles, and that, therefore, in case of the train coming to a standstill, it was easier to hold, on railways worked with locomotives, either of six or four wheels, and the conclusion they came to was that, in six-wheeled engines, there is no practical impossibility in bringing it upon the axle itself. The front axles, besides, not only the only ones of the engine to be feared; the cranks of the fly-shaft, and the rough ground, are much more to be feared in a six-wheeled engine, may have serious consequences in a four-wheeled.

With regard to the advantage attributed to placing the framing inside, it is, perhaps, safe to observe, that this arrangement does not apply particularly to four-wheeled engines, and that nothing conclusive can be arrived at as regards the safety of the engines fitted up in this manner. It does not appear certain that this will prevent the running off from the rails on the breaking of an axle.
The Commission adds, that it will be better to have both engines exactly alike, and that the principal point to be observed when two engines are employed is, never to allow the hindmost one to be driven at a greater speed than the foremost, and also to take care that the driver of the front engine has the driver of the other engine in view.

The next question discussed by the Committee was, whether, as regarded safety, the position of the engine in front or behind the train was material. With respect to this, it appeared evident that the engine-driver, if placed behind, has a better view of the road; and in the event of the engine getting out of gear, if placed in front, there would be great danger of his not perceiving any obstacle. The Commission was therefore decidedly of opinion that the locomotive ought never to be attached to the hindmost car of the train.

On comparing these plans, the Commission remarked, that as regarded the first, independently of the disadvantage it possessed of causing unpleasant shocks in starting, serious accidents might be occasioned, in the case of a violent shock, by permitting the carriages to run over each other. It was, therefore, considered that the best mode of uniting the carriages would be by rigid fastenings acting upon springs. By this means, in case of a collision, they offer the resistance of a sort of spring, and there would be no danger of the carriages running over one another.

The only disadvantage of this plan would be, requiring more power from the locomotive; but this is a minor consideration, when the safety of the passengers is assured. The Commission, therefore, was of opinion, that the carriages should be united in such a manner as to allow of the buffers being always in contact.

Another no less important question was, whether vehicles with cast-iron wheels should be employed between the different axles and the carriages. This was decided in the negative, as it appeared that cast-iron wheels, running with great speed, would soon wear, and were liable to break; in which case, the train would be almost sure to be thrown off the rails.

The Commission having thus decided upon the best means of forming the trains, as regarded the safety of the passengers, the subject next to be considered was the best means of regularizing the speed of trains, and freeing them as much as possible from danger of accident, to which they might be exposed.

The usual causes of accidents may be resolved into one, viz., a sudden shock, produced either by the locomotive coming into contact with some obstacle; by the breaking of an axle; or by running off the rails.

As regards the breakage of axles, accidents likely to occur therefrom may be most readily prevented by the promptitude and intelligence of the engine-driver.

With regard to shocks and sudden stoppages, what tends most to increase the danger is the speed at which the train is travelling; in order therefore either wholly or partially to obviate them, it is desirable to find out the best means of slackening the speed at pleasure. For this purpose brakes were proposed; by the application of such brakes to one or more of the carriages of the train, and by that means diminish the speed.

The brakes most commonly used upon railways may be divided into three classes;—(1) Brakes acting on one wheel only of each axle, and pressing on one side of the wheel;—(2) Brakes acting on one wheel of each axle, but pressing against both sides of the wheel;—(3) Brakes acting on both wheels, and on one side of each wheel.

Neither the first nor the second ought to be used, as they have a tendency to dismantle the wheel opposite to that on which they act; and the first, especially, has a tendency to destroy the parallelism of the axles, which might occasion serious accidents.

The third class possesses neither of these inconveniences. It is true that, by acting on one side of the wheel only, the whole of the pressure will be exerted upon the pivot of the axle; and although this pressure is equal to the weight supported by the wheel (and consequently the distance of the centre of gravity is not greater than in ordinary circumstances), the best plan would do no better that by which a pair of wheels would be acted upon on both sides simultaneously; the efforts of inventors should therefore be directed to this object.

With respect to the third class, the Commission was not sufficiently informed upon the subject to be able to recommend any one of the proposed plans, and it appears that careful experiments would be necessary to decide the question. The following are the facts to be considered in making experiments:

1st. What is the time necessary for enabling the person having the management of the brake to produce sufficient pressure on the wheels to stop them, including the time necessary for signalling? 2nd. What is the necessary distance, and what distance will have been travelled, before a carriage, travelling at various speeds and provided with efficient brakes, can be stopped?

This experiment ought to be tried many times, under various atmospheric conditions, in order to test the effects of dryness, dampness, or heat, or the effect of throwing sand on the rails, as was proposed and practised on the railway from Saint Etienne to Lyons; the experiments should be made upon levels as well as inclines.

3rd. What is the time necessary to elapse, and the distance to be run over, in order to stop a train composed of a locomotive and tender, and eleven passenger-cars, going at the maximum speed of the engine? In considering the atmospheric influences, the carriages being provided with brakes, and driven at various speeds, making use,—1st. Of the tender brake, the steam being shut off,—2nd. Of one, two, or more of the carriage brakes, the steam being allowed to act independently of the motion of the engine;—in fact, employing all the means known for stopping. The Commission, in considering the question as to the propriety of skidding all the carriages, is of opinion that it would perhaps be advisable, when proceeding at a speed of 30 miles an hour, to use the tender brake for one train, and, for another, to stop the carriage brakes in turn; but generally, in a train composed of a locomotive, tender, and seven or eight carriages, one only of the carriages is provided with a brake, and the Commission wished to ascertain which carriage it should be applied to.

It was remarked that, in case of stopping, pushed forward by the one behind it, especially when connected loosely by chains; it therefore appeared advisable to provide the last carriage with a brake, which should act at the moment of stopping, and, by thus offering a resistance, the force of which may be mathematically calculated, tighten the connecting chains or rods of the front carriages.

Should any apparatus be used to deaden shocks? And if so, what possible height could it occupy?

On this subject, the Commission is of opinion, that if it were possible to throw the whole or a greater part of the force of the shock upon any inert body, the safety of the carriages would be much increased; and as the shock most likely to occur would be by the carriages being pushed from behind, the Commission considers it best to place the brake between the tender and the passenger carriages.

Several kinds of apparatus adapted for this purpose, were presented. Some of them were composed of metallic springs, which would be gradually compressed by the motive power of the train. Others were composed of air-springs acting upon the same principle.

With regard to the former, they would be the most efficacious, in proportion to the time they allowed the train to run while compressing the springs; but, at the same time, the length of the springs must not be such as to cause danger of running off the rails when traversing curves. On the other hand, it will be understood, that it is advisable to construct them so as to offer the greatest possible resistance to the train; their weight must not, however, be greater than that of an ordinary loaded carriage. In order to produce the desired effect, the apparatus should be so constructed as to allow the train to bear the greatest possible compression without incurring any danger in traversing curves; and offer the greatest possible resistance with the least weight.

With regard to the air apparatus, it would not act so efficiently unless made of very large dimensions, so as to present a large body of air to be compressed; this kind of buffer is therefore indispensable, from its bulk. In fact, as the density is in an inverse ratio to the volume of air, the apparatus would not act until the piston, meeting with resistance from the air, would be carried at the end of the stoppage, and then it would not offer any efficacious resistance to a shock of any considerable violence.

It appeared to the Commission, that an apparatus offering great resistance would not act so efficiently as one which would be broken by the shock:—it would give way.

It was thought that it would be advisable to propose a prize to the inventor of any apparatus, which, after being in use for some time, was found to act efficiently.

There are some preliminary arrangements, as regards safety, to be considered. One precaution which has been adopted consists in interposing between the tender and the passenger-carriages as many empty carriages as possible: this precaution may, in most cases, preserve the passengers from injury.

IV. Of Rules to be enforced by Law in Working Railways.

The subject to be considered, as regards safety in railway transit, is the working with perfect regularity, and subject to fixed rules, which must never be infringed; it is clearly the duty of Government to legislate on this subject.

By the present laws, railway companies are empowered to frame by-laws for working, but they are obliged to submit them for the approval of the higher authorities. This is a salutary regulation, and the companies ought to be bound to inform the Government, in good time, of the hours fixed for the departure of the trains, as well as the termini as the intermediate stations.

Express trains must be used as rarely as possible, and only when they are absolutely necessary: their approach must be signalled along the line, and the engine-driver be informed not to exceed a certain speed. This might happen from two trains meeting on the same line. On railways, by which a great number of persons travel, there are always at least two lines of rail, and the only likelihood there is of one train running into the other is when the engine on one might be put out of action. This might be avoided if the officials were to adhere to the times fixed by the authorities for departure from the termini, and those fixed by themselves for the intermediate stations.

Independent of the shocks which may happen when the trains are in motion, passengers have sometimes been seriously injured from shocks...
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REVIEW.


The object of this book is a novel one. It is to advocate the superiority of the high-pressure over the low-pressure engine; and the omission of all exceptions in favour of the latter kind of engine leads to the inference, that the author recommends the adoption of the former under all circumstances, and for all purposes.

Dr. Allen tells us that he is a practical manufacturer of engines; that he has been engaged for thirty years, without interruption, in studying this subject; that he has made a large number of engines of various dimensions and varieties; and has been in the constant practice of experimenting with a view to their improvement. A man who brings forward his opinions thus authenticated by long experience, has a right to demand some attention to them, and will generally have something to say which is worth listening to. This is the case in the present instance; but while full credit is to be given to our author for his practical knowledge, it must be premised that he has confined his attention almost exclusively to engines worked by high pressure, and consequently, so far as the general principles of engines are considered, they are not more qualified to speak respecting their advantages and capabilities than respecting those of low-pressure engines. Possibly, had he studied the latter more, he would have thought better of them.

These considerations apply exclusively to Dr. Allen's practical knowledge—his theoretical opinions are to be criticised independently and abstractedly. We shall find that his physical conceptions, though often clear and vigorous, occasionally lead him into serious errors. The translator of this work acts out with high professions of the necessity of theoretical accuracy, and laments the aberrations of the unlearned in a manner which some of his readers will appear amusing. He is very astute respecting the unhappy frequency of blunders arising "from the practical methods adopted by ignorant men," and complains that "unhappily, in most cases, the unfortunate public have to suffer the consequences of the blunders of the engineer unless the engineer has a knowledge of principles to guide him, and a capability too of reasoning on those principles." After this wholesale condemnation of engineers, it might have been hoped that Mr. Pole would have at least avoided the errors which he denounces, and that he would not have published in an English form several notions previously at variance with the said "knowledge of principles." He professes to correct his author's mistakes, but the worst of them are passed over uncorrected, and apparently unobserved.

Of the two Parts of the work before us, the first is theoretical; the second refers to details of construction. We shall for the present confine our attention to the former, in which the author examines the objections brought against high-pressure engines, and replies to them, and then proceeds to a serial account of the advantages peculiar to these engines.

The objections may be considered first—they are principally these five:—

1st. The danger of explosion: 2nd. The loss of heat: 3rd. The replenishment of that power which arises from condensation: 4th. The consumption of oil and grease for lubrication: 5th. The wear and tear of metal from the rapidity of motion. We will take these objections in their order.

The first objection—respecting the danger of explosion—may be considered to be of a two-fold nature: for we have to ascertain primarily whether a high-pressure boiler is more likely to explode than a low-pressure boiler; secondly, whether the results of an explosion are more disastrous in the former case than in the latter. Our author does not make this distinction; but it is obviously necessary for the complete examination of the subject. In comparing the probabilities of an explosion occurring in either case, we must, of course, take into account the composition of the steam, pre-supposing that, other things being equal, the metal of the boiler is always made of a thickness proportional to the intended steam pressure; that is, that a boiler intended to bear a pressure of four atmospheres, is made twice as strong as one intended for a pressure of two atmospheres, &c. Unless this supposition be made, an accurate general comparison of the probabilities of explosion would be impossible; and, moreover, the precaution is one so palpably necessary, that no man of common prudence would neglect it. This being premised, we proceed to our author's first view of the case.

"Every boiler may become supercharged with steam when the quantity drawn off is less than the quantity generated, and when the safety-valves, in
consequence of imperfections in their action or condition, do not properly perform their duty. Therefore, in so far as similar safety apparatus are used for both high and low-pressure boilers, they must be liable to similar interruptions in their working. Experience has shown this very often, and it has been found that the vertical escape-pipes of high-pressure boilers, which act as escape-pipes when the boiler pressure is too great, (these are wasting in marine engines,) are not always secure. If then an overfilling of the boiler with steam is equally possible in both high and low-pressure boilers, both are liable to damage from this source; and in the event of the metal is adapted to the working pressure, and therefore the proper elasticity for which the vessel is constructed must be exceeded when such an occurrence happens. But there is an advantage on the side of the high-pressure engines, for the elasticity must be greater than with the low-pressure engine, before it overcomes the pressure at which the boiler is proved (usually three times the working elasticity) and therefore a much longer time will elapse before absolute danger arises. For example, at such a pressure, the best tanks of low-pressure steamers exceed the time required for the pressure to rise to 24-atmospheres, than it would to reach 18 lb. per square inch in a boiler working at 4 lb. ; and these would be the points at which danger may be supposed to arise in the respective cases. This gives a key to the experience of late times, that as great a proportionate number of low as of high-pressure boilers have exploded, as well in England as in America and France; and that among the latest instances, the accidents with the former have reached an alarming extent.

This extract brings us to the first allegation, that it takes a longer time to overcharge a high-pressure than a lower pressure boiler. The general truth is not stated with sufficient precision; it may be explained by the following example. Too great an accumulation of steam, rather than seven times as much water would be required as would be necessary for filling it with the former or high-pressure steam. Now, it has been ascertained that the pressure in the boiler has no influence on the rate of vaporization—that is, with a fire of given intensity and a fire-box of given dimensions, the same number of pounds of water will be converted into steam in a given time, whether the boiler-pressure be one atmosphere or six. Coupling this consideration with that of the preceding paragraph, we arrive at the conclusion that the micromegaring a boiler which can only resist a pressure of one atmosphere, takes about one-seventh of the time required for overcharging a boiler which will bear a pressure of eight atmospheres. In order to the accuracy of this conclusion, it is requisite however to suppose nothing altered but the boiler pressure, and that the capacity of the boiler, the intensity of fire, and the dimensions of the fire grate, are in all cases the same. With this proviso (which is not stated by Dr. Albani,) we may establish the general conclusion, that a low-pressure boiler is overcharged in a shorter time than a high-pressure boiler.

Our author then proceeds to consider the causes of explosion, and details the various hypotheses which have been suggested, such as that of the generation of an explosive gas from the decomposition of the water—the generation of hydro-electricity—and the sudden conversion of water into steam by coming in contact with overheated parts of the boiler. The latter of these hypotheses is by far the most probable; but there is one important point of agreement in them all, namely, that the ultimate or inducing cause of an explosion is the sinking of the water too low in the boiler, and the consequent over-heating of the metal. To this point, therefore, attention must be confined, when the safety of high-pressure and low-pressure boilers is considered. We have simply to ascertain which of the two is most liable to be overheated. One of the principal causes of the evil is "Too much evaporation, either general or partial, of scale or earthy sediment in the boiler. These substances being bad conductors of heat, prevent, when in large quantities, the proper distribution of caloric to the water, or at least injuriously retard its transmission. The heat of the metal then increases to too great an extent, and may frequently rise to incandescence. Sometimes it happens that the layers of deposit arrange themselves in such wise as to leave interstices to which the water cannot penetrate: now if any of the adjacent portions become cracked, the water will suddenly find its way upon the hot metal, and will cause a local explosion, if the incandescent spot be from the fire-boxes affected, but for a considerable distance round, and consequently increasing the contact of the water with the heated metal. This produces a rumbling commotion in the water, which, if the incandescent spot be large, may be in the highest degree injurious. This condition is called by some authors the secondary burning of the water, and is usually augmented the pressure, and hence again increased danger may ensue, particularly as the spot overheated will have been rendered more susceptible of damage. It has often been remarked that explosions were immediately preceded by the rumbling noise alluded to above. The high-pressure engine has in this respect also an advantage over the low-pressure, in that the sediment, when the elasticity is great, seldom attaches itself firmly to the sides of the boiler, but collects in a loose state, and is easily removed." The comparison proceeds in a fair manner as follows—"Boilers which are fitted with imperfect water gages or feed apparatus, are particularly liable to the evils of a partial exposure of the fire surface, for these defects are but too common, particularly with high-pressure engines. The same liability to danger is also incurred where internal fire-tubes are inserted, or where the water space is too flat and confined, and is exposed in an injurious manner to the fires. When tubes are immersed in such a state, the path for the descent of the smoke is considerably obstructed, and the exposed space between the tubes is before soon left uncovered by an accidental slight depression of the latter; and if the water chambers are too confined, the water will be often driven out during violent abubition. Marine and locomotive boilers are particularly liable to this. A steam boat boiler which burnt at Hull (an account of the explosion of which will be found in the Civil Engineer and Architect's Journal, August, 1835, p. 285) furnishes an example of such an improper make. Both imperfections were united in its construction, and the collapsed fire-tubes showed that the metal of these parts had been overheated in consequence of the water being driven out of the too contracted surrounding chambers, and that by such overheating the parts were weakened, and at last suddenly gave way to the pressure. It is much to be regretted that marine boilers are usually made so as to fill too small a space, and to hallow a very space; because the ship's motion renders them particularly liable to the exposure of the fire-tubes: the use of sails increases the mischief, for when the ship has lain over on one side for some time, her righting or careless will throw the water on any part of the fire, and so the metal becomes overheated, and thus danger may ensue in proportion to the length of time the parts have been exposed and the degree of exposure. Hence we find the majority of explosions occur on board steam boats, and proportionately few on ships.

Now since all marine boilers, as well for low as high-pressure, are liable, if injudiciously constructed, to similar dangers of the kind we have named above, no conclusion to the prejudice of high-pressure engines can be drawn from such accidents. Indeed of late years a general comparison has been in favour of the high-pressure system. One reason why low-pressure boilers must, under the evils above-mentioned, be less secure than high pressure, is that in the former the abubition is much more violent, and the water thereby more liable to be expelled, whereas under a great elasticity the bubbles of gas are not easily driven away, and the abubition goes on more quietly, and therefore the danger is lessened. The common chest form of low-pressure boilers with straight sides tends to increase the liability to the exposure of parts heated by the fire, especially if not heated by internal fires, as is generally the case with marine boilers. The large flat surfaces easily bulge out by an increased pressure within, and the consequent augmentation of cubical content causes a sinking of the water surface; after which the restoration of the elasticity to its original degree may throw back the water over the spots it formerly left, and thus the said danger is at hand.

The last mentioned evil is not enlarged upon in a manner corresponding to its importance. It may be demonstrated that boilers with flat sides are subject to much greater strain than those which are curvilinear in every part. If the boiler be of the form known in geometry as a solid of revolution without flat ends (that is, if every section perpendicular to its axis be a circle,) the elastic pressure within will not tend to bulge it. We think it may be shown that, in this case, the tension of the metal is direct or tangential, and that there are no transverse strains, analogous to those of a deflected beam or girder. But where flat surfaces are exposed to the action of steam, there is a tendency to make them bulge out, like the sails of a ship. In this case, the metal is subject to transverse strains, and in consequence of the tendency to bending, will be subject to forces of both extension and compression (like a deflected beam); these forces greatly exceeding those arising from direct tension in the solid of revolution. It will be seen therefore that boilers with flat sides have a great disadvantage—in addition, it must be observed, to the weakness at the angles,—from the imperfect connection of the plates.

Another cause of danger in low-pressure engines, which Dr. Albani insists upon, is their great size.

"The greater the content of a boiler, the greater surface it must offer to the pressure of the steam, and the greater danger it must be subject to. This truth is so self-evident, that it is incomprehensible how it should be so neglected. Neglect of this cause is truly astounding. I have not unfrequently seen them as large as 5 or 6 feet in dis...

* Vide "Echo du Monde savant," No. 24, p. 178. Up to the year 1834, only twenty explosions had occurred in America with high-pressure engines, while thirty-two had happened with low pressure; and it is well known how common the high-pressure engines are in that country, particularly in the Western States. At a later date, the proprietors of steam boats in North America have stated, in a memorial to Congress, that since the more general introduction of high-pressure steam, the number of accidents has not only not increased, but become lessened in an extraordinary degree,..
meter. Such boilers ought indeed to be named explosives, and the legislative restriction as to the amount of pressure to be used with them is, as far as it goes, a salutory measure. Still better it. A 'law' would if it began at the other end, and limited the size of the vessels instead of the elasticity of the steam within them; for such an enactment would be free from the objection of discouraging the use of high-pressure steam, now promulgating so much advantage to industry. We can scarcely hope, however, for the full realization of our wishes in this direction. A philosophic view of the general view of the system; for, as I shall hereafter show, the high-pressure engine cannot be made to display its advantages with steam under about six atmospheres' pressure. A compulsory enactment restricting the size of the generating vessels would tend much against the promotion of the principle of boiling such high pressur, and, by producing a necessity for acquaintance with the working of the engine, would undoubtedly further its real improvement.'

The comparison is not, however, here stated quite fairly. It is true, that all things else remaining the same, the tension of the boiler increases with its size; but then we set out by supposing the strength of the material increased in like proportion. The author himself insists that it be presupposed, in *limines*, that the thickness of the metal be proportioned to the tension to be resisted; and, as we have already said, it is absurd to institute a comparison on any other terms. In overlooking therefore to the great size of low-pressure boilers he should condemn—not their weakness (which is supposed to be provided against)—but the great weight of metal required to make them sufficiently strong.

The relation between the thickness of the metal and the dimensions and pressure of the boiler, may be easily determined in most cases; and we intend to lay before the reader, in a separate paper, the means of calculating, with great facility, the proper thickness of a boiler of given form and size, in order to sustain a given pressure. For the present, however, we may observe, with Dr. Alban, that when the plates of a large boiler are increased to a thickness proper to its dimensions, they may become so thick as to be liable to crack from the sudden application of heat. This is a source of danger altogether independent of those hitherto considered—it must be prevented either by making the plates of metal of superior temper and tenacity; or by gradual and careful heating; or lastly, by reducing the size of the boiler, and consequently, the thickness of its plates. Dr. Alban must, however, recollect that, in respect to this danger of cracking, low-pressure and high-pressure boilers are frequently on a par. He says—

"It is indeed customary to give to boilers of great size a proportionate thickness of metal, but this helps the case very little; for experience has shown that thick plates, especially if of cast metal, are more liable to crack by the action of the fire than thin ones; insomuch as the temperature of their two sides, exposed respectively to the fire without and the water within, does not quickly assimilate; whereby unequal expansion and contraction causes it. Moreover, a difficult matter to determine is what the proper strength of the metal is: what is the proportion of the tensile or breaking point to the heat resisting point? For all these reasons, and there is a great difference of opinion among those who have given their attention to this point. It must also be noticed, that thick vessels tend more to retard the transmission of heat to the water than thin ones, although this fact seemed to have escaped the notice of engineers."

But how extremely unphilosophical is it to urge this as an argument against low-pressure boilers exclusively? A boiler of large dimensions and low pressure may require the same thickness of metal as a boiler of small dimensions and high pressure.

The *second objection* against high-pressure engines—the loss of heat—we must, for the sake of brevity, dismiss with the following brief consideration, which, in fact, embraces the sum of our author’s arguments. By a well-known property of steam, ascertained by Watt and many others, the sum of the latent and sensible heats is constant at all pressures, and therefore the same fire will evaporate equal quantities of water in a given time, whatever be the boiler pressure. Now, it may be demonstrated mathematically that steam acts with most effect when used at a high pressure and worked expansively. Consequently there is, *evaporis puribus*, a greater economy of fuel when the steam is at high pressure.

The *third objection*—the relative advantage of that force arising from condensation—is stated correctly by Dr. Alban, except in that he under-estimates the amount of power obtained in practice by condensing the steam.

"Partly through imperfect condensation, partly through the working of the air and cold water pumps, and from other causes of the same description, the useful effect of low-pressure engines is reduced from about 17 lb. per square inch absolute pressure upon the piston, to about seven, as made available. And here, so far as pressure is concerned, the high-pressure engine offers a gain of from 4½ to 5 lb. per square inch, or one-third of the atmospheric pressure. . . . . . . The objection loses in weight as we use steam of higher pressure, and at seven or eight atmospheres is scarcely to be considered, because the surface of the piston becomes proportionately less as the elasticity is increased, and therefore the loss of the vacuum is less to be felt; while the advantages of the system are increased by such increase of elasticity. When the pressure used is too low, for example, only two or three atmospheres, the compression of the steam, as is most common, the loss may be important; and the advantages of the high-pressure system are not sufficiently developed to cover it. For instance, an engine of 10-horse power at two atmospheres’ pressure, will require about twice as much steam as a condensing one of the same size, to produce the same effect; and the want of a vacuum must be supplied with steam of a double elasticity to produce the same effect. Here, therefore, a power of ten horses will be sacrificed by the want of the vacuum; that is, as much as the whole power of the engine. In an engine of five or six atmospheres’ pressure, the comparison would be the same, but the vacuum of a high-pressure engine would be less, so that the comparison would be in favor of the high-pressure engine. For when the atmosphere is reduced to the pressure which the engine can produce, the equality of the comparison will be destroyed. The mere saving of the power of a high-pressure engine is the saving of the power which the high engine can produce; for the pressure which the steam is capable of producing is the same whatever be the size of the cylinder.
resistance, and consequently diminished total pressure required), and there is no reason whatever why any required strength may not be given to these parts; so that if there should be apprehension from the unequal action of the piston when expansion is used, the strength may be increased at pleasure. Can the gradually diminishing force of the steam of an expanding engine do more mischief than the great shock which must occur in low-pressure engines, owing to their increased resistance? Then every one knows and also understands the necessity of having the parts of a condensing engine at the moment when the air-pump discharges its contents, at which instant the whole pressure of the atmosphere is suddenly thrown upon the area of the pump.

The parenthesis in the above extract involves a serious error. Even supposing we admit the "prejudicial resistance," and consequently the "total pressure," to be less in the high-pressure than in the low-pressure engine, it by no means follows that the main springs in individual parts are diminished. Those springs arise not merely from the external resistance, but also from the momentum of the working parts—or, to use mathematical language, they depend upon both the effective and impressed forces. For instance, a grindstone, though suffering no retardation from the friction of its axle, might revolve so fast as to be torn to pieces by its own centrifugal force. Similarly, the parts of a steam-engine may move backwards and forwards so fast, as to be fractured by excessive strains: these molecular strains being, moreover, far more dangerous where the motion is reciprocating than where it is rotary.

With respect to friction and attrition, also, it is undeniable that both increase with increase of velocity. If a drill, for instance, revolve slowly on a plate of steel, it will make no impression—if it revolve very fast, it will wear away a hole for itself immediately: the same considerations apply to the rubbing parts of steam-engines. The review has, however, already extended to such a length, that we must not at present pursue the subject any further.


Gordon, though an Englishman by birth and education, executed the greater part of his architectural works in Ireland. Those by which he is best known are the Custom House, Courts of Law, and King's Inn, Dublin.

He evinced early in life a strong predilection for mathematical and engineering drawing—purposes for which some of the most celebrated architects have exhibited great aptitude. His professional career commenced under Sir William Chambers, from whom he acquired, besides his architectural knowledge, a vast stock of general information: for his preceptor was a great traveller—borne a Sweede, he had travelled much in the East, visited China, and wrote a book on its architecture—had resided several years in Italy, and minutely informed himself respecting Roman architecture. He commenced his career as a surveyor's assistant; obtained the first of the architectural medals given by the Royal Academy. This achievement took place in 1769, the year after that body was instituted, and is described in the following terms:

"As soon as I read the advertisement for the distribution of these premiums, I was like a person electrified. I hurried to my friend Paul Sandby, who soon assured me that I could have no chance of success as a competitor for the gold medal in architecture; inasmuch as I was not eligible to be a candidate: the advertisement requiring that all the candidates should be students of the Royal Academy. This restriction certainly appeared a formidable obstacle to my becoming a competitor on the occasion. I had hitherto been a surveyor's assistant: my attention was not directed to the fine arts, and I soon determined how I should act: I immediately entered my name as a student of the Academy, and attended all the lectures given by each professor. This was my only alternative."

The Academy gave ample time for the candidates to prepare their respective productions. I commenced instantly to arrange my ideas on the subject given, which was a triumphal arch, commemorative of the Seven Years' War.

The day at length arrived when the candidates were to send in their designs, and I was so informed, to my very great gratification, that my design was declared the best, and that, consequently, I should obtain the gold medal.

On the day fixed for the distribution of the medals, but before they were actually delivered, the architectural class were required to attend a Committee of the Academicians in a private apartment, in order to test their respective powers in impromptu composition. The different subjects were deposited in a case, out of which each candidate drew his envoi, in which the subject was written. That which came to my hand was a park-gate, or rather an ornamental entrance to a park. Having first arranged the general design, and it was more admired by the Committee than my triumphal arch.

"When the medals were being distributed I was congratulated by many of the members, but particularly by Sir William Chambers, who expressed his satisfaction at having me instructed in my profession."

Gordon next obtained the second of the premiums offered by the merchants of Dublin for a new Royal Exchange, and it appears from the biography that the award of first premium was influenced by private interest—a circumstance by no means unparalleled, as (we doubt not) many of our readers could attest. The next premium gained by Gordon was one of 100 guineas for the "new Bethlehem Hospital." This was the last public work for which he competed in England.

In 1779, he received an invitation from Lord Carlton to go over to Ireland, which he accepted, and was then appointed architect of the New Custom House. They made matters in Ireland more peculiar to themselves, as Gordon found out to his cost: for on his arrival, the opposition of individuals to the removal of the Custom House had become so strong, that it was actually necessary that he should secure himself for several months. The foundations of the new building had scarcely been commenced before the mob were instigated to destroy the fences surrounding them. The architect received letters threatening him with personal injury, and in consequence always visited the works with a good cane sword; and "having been in early life a good swordsman (says he), I am determined to defend myself to the last." There were other difficulties besides those of a personal nature which the architect had to contend with. The labourers had stoned down two feet below the surface when they came to water, which four men emptied with scops as they continued to extend the line of trenches, which were carried on in short lengths, and, for convenience, of different depths. It became necessary to make dams across parts of them with sods, and to empty the water from the lower to the higher dam, until it was at last sent off in a drain prepared for that purpose, our pumps not being then ready. The ground was opened first at the north and continued round to the east front; then to the south end, when the spring was coming on; and we were obliged to stop below the surface, which filled up as fast as it was cast out. It extended for a considerable distance. Inch and half sheeting piles, about seven feet long, were driven down with a maul, to keep up the bank, and sods were fitted in between it and the piles, which prevented the sand from being washed out, thereby enabling the men to clear out the trenches to the depth required. The general texture of the ground was gravel, mixed in some places with a layer of blue clay and sand, under which was a hard strong gravel. When the trenches were thus prepared and cleared out, the rough mosaic then proceeded to carry on the first bench or course with all possible expedition with the stone black, and immediately filling in with earth, in order to give less water to the pumps. In the meantime another length, and to the same depth, was thrown up, and the additional number of men was set to work. In this manner the whole was continued until all was brought up to the level of the ground.

The quay wall or road on the south front was an old embankment, made in the year 1752, and at some feet was badly constructed; the walls of black stone; its foundation laid on the surface of the sand; on the side next the river it was twelve feet high, but on the inside only eight; the filling between the walls was a sand used for ballast; the walls of the foreshore were constructed; the tide not only soaked under them, but filtered in several places through the joints of the masonry. It was, therefore, deemed most prudent to commence with the north-east wing, after the portion of the store-room, it being less liable to be incommodeed with water from the river.

Directions were now given for excavating that part of the centre of the south front for the cupola and portico; and as this advanced so near the river, you would be certain of the tide, the water being only a few inches under the floor. The tide, which was the only water that now gave us any trouble, for the springs were now pretty well dried and kept under. The pumps hitherto used were but thirteen or fourteen feet, we now used two of eighteen feet in length. As the ground lowered in its texture towards the river, becoming more loose, with small sandy gravel, like that of the south-west angle, to which depth we bad sunk, we deemed it prudent to bore it to five places which were near the angles of the front of the portico, but particularly where the walls were of the depth of eight feet below the surface, and it appeared to be much of the same substance as that already described. A pile ten feet long and one foot square was driven down in the centre to nine feet depth; but after twenty strokes of the ram it could not driven no further, which assured us that we had gone down to firm ground.

Upon consulting with the principal artificers on the spot, it was thought advisable to resist from staking any more, but to make an artificial foundation, in order to sustain the great weight of the cupola; but whether by piling or otherwise was submitted wholly for my consideration. This part of the work had long occupied my thoughts, and to it I had given every
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attention, my conjectures having led me to expect great difficulties on this subject. I had nearly made up my mind as to the means I should adopt, and was the more strongly confirmed in my intentions, having remarked a circumstance which had not escaped me, even in the earliest stages of the work, when the first observations made it very certain that the water, after the pile had been driven, I perceived a small stream of water arising up close all around it, as if it had pierced a spring; and recollecting an observation in Laloby's account of Westminster Bridge, that piles sometimes leak, which suggests the question of the proper ways to get rid of the water, I was now apprehensive of just such an impediment. The great expense of preparing the piles, and the very long time it would take to fill them properly, if they should be required, presented a strong objection to the use of them. I therefore gave directions to have a grating of Memel timber prepared, the timber to be one foot square, to have the upper ones notched down three inches in the ground pieces, which were to be bored through, and then driven in the ground. The grating was partly levelled; the interstices of the grating to be filled in with hard sound stock bricks, up to the level of the timbers, swimming in mortar composed of pounded roach lime and mortar well mixed, which answered nearly as well as tarms; over which was laid four-inch 5r plank fastened down on the grating with oak treenails, which was all completed. The foundation walls were then set out on the 17th of September. The part directly under the cupola was laid with rough blocks of mountain granite in regular courses; in the first course was sunk an iron chain of flat bar, four inches wide and two and a half inches thick, into collars which were run with lead, but the bars were only covered with a cement of wax, resin, and stone dust. The rest of the foundation was done with the usual black stone, and was carried up to the 16th October, 1792, thereby completing the whole of the foundations in one year and four months from the opening of the ground."

Another of Gandon's works consisted in several extensive additions and alterations in the Irish House of Lords—a large edifice, now converted into a bank. On the east side of the building a Corinthian portico was erected, in the construction of which many local difficulties, arising from the declivity of the ground, appear to have been overcome with great ingenuity and sound architectural taste. The dome, which was part of the original work, was destroyed by fire under circumstances which indicate that crochets respecting ventilation have been fostered by other parliaments besides our own.

"This dome was subsequently destroyed by fire caused by the following circumstances. A man of the name of Nesbitt, a smoke doctor, had been introduced to the Speaker, and recommended to his notice as a prodigy, in producing the greatest heat with the least possible portion of fuel. He was, therefore, sent to warm the House of Commons; and was suffered to cut into the walls, in order to lead fires into copper tubes, which he proposed to place on the angles of the dome. These tubes, from their nature, were very liable to be choked, and were often observed to be on fire, and large flakes of burning soot to fly out from them, to the great alarm of the neighbours, who gave repeated information of the fact, but to which no attention was given. The windows of the dome were also left very frequently carelessly open; the burning soot was driven in by the wind, and, resting on the framing, the wood work caught fire. On the 4th of January, 1792, totally destroyed the dome, during the sitting of the house. An inquiry was afterwards made as to the cause of the fire, but the real facts of the case were suppressed, and—the inquiry ended in smoke!"

The foundation stone of the Courts of Law, or Four Courts as they are called, was laid in 1796; the erection of this building was impeded by the same factious opposition which attended Gandon's other works. The last public edifice erected under his superintendence was the Hall and Library and other offices of King's Inns, an ancient legal society constituted in a similar manner to the Inns of Court in London. This was the only building which Gandon left unfinished; the completion of the work he assigned to other hands on his retirement from professional life. His architectural labours extended over the long period of sixty years, and he died in 1834, at the age of eighty-two years.

Gandon's works appear to be characterised by the same merits and the same defects as those of his preceptor, Chambers. Judged by external appearance only, his works exhibit symmetry and unity, and impress the mind by their grandiose combinations; but their great defect is the presence of admissible incoherent ornaments. Gandon was essentially a Romanist, and it is said that he had a great regard for Chaucerian architecture, from the Romans and Brevittata. The laborious "of Missian" Stuart and Revett were very recent and little known; and, until their time, there was an almost entire ignorance of Athenian, or pure trabeate architecture. The first volume of the Antiquities of Athens was published during Gandon's apprenticeship to Sir W. Chambers, and its appearance caused a great sensation. Still less was known of Pointed architecture— as Gandon himself shows in an essay at the end of the biography. It is not therefore to be wondered at that the dependance of decoration on construction was in his day little attended to.

The biography before us is well arranged, but there is too much gossip in it; notices of people of no note, and of transactions not worth recording. The architectural accounts are exceedingly meagre, and it is surprising that so technical or illustrative description of Gandon's works has not been given. This omission greatly diminishes the value of the work. However, many of the observations show great taste and discernment, and the authors have the credit of recording the honours of one who in his day and generation laboured earnestly for the advancement of architecture.


The third series of this work is no means inferior to the preceding parts of it. The conductors seem to have kept steadily in view their object of furnishing a complete set of illustrations of all known styles of architecture, from the earliest monolithic to the latest Italian and bastard Classic structures. Among the plates before us we have several illustrations of Celtic monuments, details, &c., of the arch of Septimus Severus, the tomb of Cecilia Metella, and the church of St. Ignatius at Rome. There are also numerous illustrations of St. Peters, at Rome, and St. Paul's, at London. We were especially pleased with the view of the interior of the church of St. Front, at Perigueux, which displays in an extraordinary degree the possibility of producing beautiful effects by the simplest means. This church, a postamentum of the Christians of the fifth century, and the pointed arch is remarkable for its severity; the interior has scarcely a single moulding or other ornament, and yet the effect is extremely impressive, simply because the architecture is 'faithful.' It would be absurd to recommend the massive arches and piers of this church for modern imitation; but it is far better (say we), that the architecture should be, as here, without ornament, than that it should be covered with the adeddichments finery stuck upon buildings which by modern courtesy are called "Classic."

The letter-press of the series before us is not satisfactory—the descriptions are far too concise; and another defect is that they are published on loose sheets of paper, so as to be liable to be lost before the series is completed. Moreover, these "Sybille leaves" are always dispersed (in the copies sent us, at least) in a most irregular manner. The history of Stonehenge accompanies the plates of Cologne Cathedral, and the description of the Temple of Yesta follows the views of a vile Parisian church and the pointed arch is illustrated with a most curious mixture of eras, and might easily be remedied—mention them because the work is a good one, and deserves all the care that can be bestowed on improving it. The following account of triumphal arches may serve as a specimen of the letter-press. The writer remarks, rather simply, that "the Greeks do not appear to have built any triumphal arches"—for which circumstance two very sufficient reasons may be assigned: first, that they could not, if they would, have done so; secondly, that they would not have done so if they could. The Greeks were ignorant of arch construction, in the first place: in the second place, they never made a single architectural member do duty for a whole building; and consequently had they employed arches at all, would have made use of them to support arches, and not have displayed them for mere show.

"Triumphal arches are isolated portals erected at the entrance of towns, on public places, roads, or squares; they are generally intended to commemorate a victory, sometimes also to perpetuate the memory of the real or supposed virtues of a prince, or to do honour to persons who have rendered great services to the state. In this last case they might more properly be denominated honorary arches. Not to mention here the great number erected for this last purpose in China, where arches called Pay-louu are often raised in honour of the most humble virtue, we might name a host of these monuments consecrated to civil virtues, such as the Arch of Tacitus, the Arch of Trajan, the Arch of Constantine, and the Vittoria Arch in Rome for the improvements be made in the port, and bearing a dedication in which the name of the Emperor is associated with those of his wife and sister. We learn also from ancient inscriptions that monuments of this kind were occasionally erected in honour of the gods. It is very probable also that many of these arches answered a twofold purpose, being at the same time triumphal or honorary monuments, and gates of towns. We must be careful not to confound the subjects of the present article with the structures which are merely town-gates, like those of St. André and Arroux, at Autun, in the Department of the Saône et Loire, though they present a close analogy with triumphal arches. It is equally necessary to distin-
guish those arches with four fronts, called Janus Archs, erected in market-places as a shelter for buyers and sellers, and of which a very beautiful specimen is still extant at Rome, in the Forum Boarium.

The Greeks do not appear to have built any triumphal arches. All those in Greece or Asia Minor belong to the period of the Roman domination. The Romans must therefore be regarded as the inventors of these edifices, which, at first, were nothing more than wooden structures raised across the streets of the cities; but they were later replaced by stone constructions. The temporary and temporary constructions undoubtedly supplied the original model of the form and decoration of triumphal arches. The descriptions in ancient authors inform us that it was usual to place musicians and men bearing trophies on the tops of these monuments, while the spoils of the enemy and representations of battles covered the sides. Such were the nature and object of the structures, that the architect was afterwards required to produce in solid materials calculated to endure for centuries.

The first permanent triumphal arches were erected in the time of the Roman Empire, but they had no pretensions to splendour. Rostovtzev says of them: "Primo rudes et simplices fuerunt cura premia virtutis esse non ambitionis lenocinia. (Antig. Rom. I. x.)" The Arch of Romania was rudely built of bricks; that of Caracalla was a more elaborate structure. These were followed by the Arch of Constantine, which was a noble example of the art of the period. The Arch of Titus was also built of brick, and was erected in honour of the Emperor Titus, who had defeated the Jews and captured Jerusalem in A.D. 70. The Arch of Constantine was a larger and more magnificent structure, and was erected in honour of the Emperor Constantine, who had defeated the Goths and other barbarian tribes in the east.

The Arch of Titus was a simple structure, consisting of three arches, each 140 feet high, and each surmounted by a statue of a Roman emperor. The Arch of Constantine was a more elaborate structure, consisting of five arches, each 150 feet high, and each surmounted by a statue of a Roman emperor. The Arch of Titus was erected in honour of the Emperor Titus, who had defeated the Jews and captured Jerusalem in A.D. 70. The Arch of Constantine was erected in honour of the Emperor Constantine, who had defeated the Goths and other barbarian tribes in the east.

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Smeaton and Bridgley were accompanied and followed by a number of able men in rapid succession; amongst whom Jessop, Whitworth, Mylne, Yeoman, Hennah, Golborne, Riddett, Nennie, Ralph Walker, Chapman, and Smeaton, with others of distinguished capability, acted as the leading members of the enterprise. Each new member was to be paid, before he entered, more or less according to his several capacities, great skill and invention of their own, in addition to that acquired from their predecessors. Favouring by the command of great funds (which had been most generously contributed by the inhabitants of the town where Smeaton's name is so well known and respected), he was enabled to acquire the best workmen and materials, new and improved machines, steam power, and greater influence over the public mind, their operations were conducted upon a scale of magnitude, utility, and importance which had never been the case in an age in which they distributed and advanced the prosperity of the empire.

ENGINEERING WORKS.

Canals.—To attempt to enumerate all the various public works which then crowded each other in rapid succession, constituting the character of the profession, and entitling it to public confidence, would be both difficult and fruitless, as they are well understood. It will suffice to point out some of the most important. The Forth and Clyde Canal by Smeaton, (1768) length 24 miles, depth 8 feet, locks 19 feet by 74 feet, top-width of canal 60 feet; the Ellesmere by Jessop and Telford, with its magnificent aqueduct across the Dee near Llangollen, consisting of 19 arches 40 feet span, the centre being 120 feet above the Dee, with a total length of 1020 feet, and a width of 12 feet, the piers of stone, and the side of the arches of iron, the work proceeding from the top of Wassell Beck to Telford, 22 miles long, depth 16 feet, locks 40 feet wide by 175 feet long, 8 feet rise, top-width of canal 110 feet; locks intended for a depth of 20 feet; commenced in 1806, opened October, 1830; the first and last of which, together with the Glasgow and Berkeley Canal, may be cited as the works in which sea-beating countries extend the benefit of ship navigation into the interior of the country, without the delay and expense of transhipment of cargoes until arriving at the warehouse; and they are to be considered as the works already executed (Jessop and Whitworth), Lancaster and Kennet and Avon (Rennie). On the Lancaster navigation the canal is carried across the Lune by a stone viaduct of 5 semi-circular arches, 75 feet span each; the total length of viaduct is 730 feet, height 65 feet; and by the Union, the Shrewsbury, New Birmingham and Liverpool, Carlisle, the Grand and Royal Canals, Ireland, amongst many others may be quoted as examples of artificial canals for vessels, so as to enable them to continue their navigation inland from the great rivers and estuaries. The total length of canal navigation now in operation in England, Scotland, and Ireland, amounts to about 8,000 miles.

The most advantageous speed for boats on a canal is about 24 miles per hour, at which rate an average horse is capable of drawing about 20 tons without injuring his physical powers; when this is much exceeded, the ratio of resistance approaches the cube of the velocity. The speed must be diminished in proportion, and the horse exerts his powers to great disadvantage. Large canals, where practicable, on account of the trade and other circumstances, are preferable to small ones, as they are worked more economically. Various contrivances have been made to obviate the necessity of locks in overcoming excessive lifts or declivities, amongst these may be mentioned the inclined plane of Bridgewater's and the Tamar and Shrewsbury canals. Double locks, side ponds, hydraulic lifts, by Woodhouse, Salmon, Congreve, Underhill, Green, and others; but extensive reservoirs and feeders are indispensable in most districts where great traffic, and great water, are used to pump back the water to be used over again in case of deficiency.

Steam Dredging.—The improvement of the River Clyde, begun by Watt and Golborne, received fresh stimulus under Rennie and Telford, from the application of steam power to the dredging-machine by Grimshaw, in 1796, and Bentham in 1803; thus forming a new era in the means of improving river navigation and harbours, since which this important department of engineering has been carried to an extent which could not otherwise have been attempted. Steam-dredging machinery is now generally adopted with success, more particularly in rivers where their beds and channels can be excavated to a certain degree of uniformity, and where the inclination of the tidal and fresh-water currents can be reduced to such an extent, by the removal of obstructions, as will enable them to keep the channel open. As success in this direction has been attended by the clearance of the Lagan, the Boyne, the Newry, the Liffey, and the Shannon, in Ireland; the Clyde, the Leith, the Don, in Scotland; The Tyne, the Wear, the Ouse, the Thames, the Dee, the Ribble, the Severn, and others, in England; and the harbours of our coasts, and to the docks of our cities, by steam-dredging, in addition to other means, to a greater depth than could be obtained without such an important aid.

STONE BRIDGES.

Westminster Bridge, by Laxley, in 1140-47, may be considered the first example of extensive structures of this kind. It consists of 13 semi-circular arches (the central arches 114 feet long; it was originally intended for a wooden bridge, and was partly commenced on this principle; it was a great work at the time, but as might have been expected, contained defects, particularly in the foundations, which at that time were not imperfectly understood, and have suffered much by the scour of the current; it will probably be rebuilt in a short time. Caissons, or water-tight chests, were first introduced there for the purpose of found-
The introduction of cast iron for the construction of bridges commenced about the year 1779, when the Severn, near Coalbrook Dale, by Darby, was the first; it consisted of a circular arch 100 feet span, and a versed sine of 45 feet, approaching nearly to a semicircle; the height of the springing is 10 feet above the springing. The height of the soffit is 56 feet; the banks of the Severn being high, this form accords well with them. It is formed by five ribs of cast iron, with perpendicular spandrel pieces, resting upon them to support the roadway. This, for a first attempt, is a happy one; the roadway is then free.

Thus was followed by the bridge over the Wye, at Sunderland: the design for this was said originally to have been made by Thomas Paine, the well-known political writer, and was cast at Rotherham, being 100 feet across, for erection in Autumn 1779. It was subsequently employed in constructing Sunderland Bridge, under the direction of Wilson, in 1790, the idea having been suggested by Rowland Burdon. The curve of the arch is that of a segment of a circle, the length of the chord or span is 200 feet, and the versed sine or rise 30 feet, the total height from low water to the underside of the soffit of the arch is nearly 100 feet. It consists of six ribs, each composed of 105 cast iron radiating pieces, connected at the top and bottom by the circular pieces which form the curve of the arch; these ribs are united in their transverse direction by tie-pieces; the spandrils are filled in with cast iron circles, touching each other at their circumferences, and supporting the roadway, which consists of a strong frame of timber, planked over and covered with a cement of lime and lead, and planked.

The centre deserves notice on account of the difficulty and confined nature of the situation, which rendered it necessary to preserve a constant passage for ships with their standing rigging; this was effected by a perpendicular flange being placed upon piles and the ridge-pole being carried upon them, at the same time serving as an outside carp, on each side for the vessels. Upon the top of this perpendicular framing, the transverse framing or centre for supporting the arch was fixed, and answered its purpose well. Some time after the removal of the centre, the roadway was raised to a width of 12 feet, and the whole arch was turned from the eastward, forming a curve having a versed sine of about 15 or 16 inches; if this had continued to increase, it would no doubt have soon occasioned the downfall of the structure; it was, however, very skilfully remedied by the addition of a transverse framing on the inside, which was strengthened by wedges and screws, so that ultimately the whole was brought back and secured in its original form and position, where it has since remained in a substantial state without alteration. The width of the bridge is 80 feet; it consists of five arches of stone, 20 feet span, and 20 feet rise, and from 42 feet to 87 feet wide. This bridge, for boldness of the design and construction, as well as for its elegance and lightness, must be considered a work of peculiar merit; particularly if the period in which it was constructed be remembered.

About the same time, the bridge at Buildwas, across the Severn, by Telford, was erected. It consists of a single arch, segment of a circle, whose chord or span is 130 feet, and versed sine or rise 27 feet, the depth of the springing is 45 feet above low water, on a cast arch of stone, 24 feet span, and 27 feet rise, and from 42 feet to 87 feet wide. This bridge, for boldness of the design and construction, as well as for its elegance and lightness, must be considered a work of peculiar merit; particularly if the period in which it was constructed be remembered.

I will conclude this division of the subject with the celebrated bridge across the Dee at Chester. It consists of a single arch, the segment of a circle 200 feet span, with a versed sine or rise of 42 feet, which is the largest stone arch upon record; the arch stones at the crown are 4 ft. 8 in. deep, and 7 feet at the springing, and the abutments on both sides of the river are founded on new red sandstone. The centre for building the arch was remarkable for its simplicity, strength, and rigidity, by which means the greatest effect was produced by the smallest quantity of timber, and any changes in the superincumbent superstructure were prevented by the force of the current from the foundation of the Old Bridge, the whole of which had to be removed by dredging, before the coffer-dams for the piers and abutments could be commenced, otherwise it would have been extremely difficult, if not impracticable, and would have made them watertight; the difficulty was further increased by the Old Bridge being left standing, to accommodate the traffic, whilst the New Bridge was building, and the restriction in the moulding of the arches was an exact copy of the Dee bridge. The arch is composed of large blocks of white granite from Scotland and Devonshire; great accuracy in the workmanship was also indispensable. The piers and abutments stand upon platforms of timber resting upon piles about 30 feet long. The masonry is from a feet to 10 feet below the bed of the river.

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has succeeded so well that it is worthy of adoption elsewhere. The span- 
drils are composed of cast iron diagonal pieces, connected together in a similar manner, and the roadway is formed by solid plates of cast iron resting upon the span-drills, and joined together by iron cement. The pier and abutment are of the same kind as described above, excepting that the bear- 
ing piles, and surrounded by sheathing piles, driven sufficiently deep 
below the bed of the river. The masonry is tied together by vertical 
and horizontal bond stones, so that the whole acts as one mass in the position to resist the horizontal thrust. The ribs of the bridges, which 
were commenced in the centre, and were continued regularly on each side 
towards the piers and abutments, upon which a cast iron bed and connect- 
ing girders were laid, and the plates were laid on the class of iron enameled to receive the arches; was the last segment of each rib was fixed in its place, three 
cast iron wedges, each 9 feet long and 9 inches wide, were placed behind 
each rib, and nicely adjusted and fitted to them; these having a very slight 
tension, were then concurred by its own weight, and the wedges were 
were nearly lifted from the centres, so that the wooden wedges upon which 
the segment pieces rested were easily removed by a few blows of a ham- 
mer; the arches were thus relieved from the centres in a very simple 
and efficient manner, and the work proceeded as before. The无需 
was commenced in 1818, and the bridge was opened in 1819.

Whilst upon the subject of cast iron bridges, we must not omit the 
Swell or Turning Bridge. The invention, if it may be termed, is, it is 
believed, due to England, and was first made of iron about the year 
1825. They were now universal over large rivers, the extent of 60 feet span, in preference to the old lifting bridge. Since the introduc- 
tion of the railway system, cast iron bridges have become very general, 
and have been particularly serviceable, being formed of girders, where the 
height was sufficient to admit of the bridge being left open when required 
for navigation. The value of wrought iron in roofs and other building pur-
poses has induced R. Stephenson to propose that material for constructing 
the bridge to carry the Chester and Holyhead Railway across the Menai 
Strait, of which he estimates the cost of the iron alone at $8000, 14 feet 
wide, 30 feet deep, and 1500 feet long, supported in the middle by a 
stone pier built upon a rock in the middle of the strait, with two other 
piers at the low-water mark on either side, leaving four openings, each of 
300 feet each side; 60 feet above the lowest point of the water, to admit of 
masted vessels sailing under it. Cubitt has also proposed to 
adopt wrought iron on a great scale, for constructing land-plat- 
forms at Liverpool, where the difficulty of building docks or quays, which large 
steamers cannot approach, at all times of tide, render works of this kind 
necessary to accommodate the immense traffic frequenting Liverpool. 
The landing platform designed by Cubitt, and now in course of construction, 
consists of a wooden frame, 50 feet wide, 12 feet deep, and each of 
1200 square feet of wrought iron, each 80 feet long, 10 feet wide, and 
6 feet deep; it is connected with the shore by two bridges, each formed of 
two hollow wrought iron beams, 150 feet long, carrying the platform of the 
bridge; the attachment of the beam at the ends of the bridge is in such a 
way as to admit of the bridge being both vertically and horizontally, to accommodate itself to the rising, falling, ebbing, and flowing of the tide, which rises about 
30 feet.

Suspension Bridges.

The invention of one or suspension bridges has been said to be im-
portant from China and India. The first of the kind in England was that 
across the Tever, at Middleton, consisting of two common chains stretched 
across the river, and secured to the adjoining rocky banks; the span was 
70 feet. To Capt. Sir Samuel Brown, however, who had previously 
tried experiments for ships, was attributed the introduction into England 
of the improved system of the bar link, which is now so 
generally adopted. Brown, in 1818, first constructed a large model of 100 
feet span, capable of supporting a carriage and horses, indeed adapted for 
general purposes. In 1829, a smaller model of 200 feet span was 
constructed, and in 1832 another, over the Great Western 
Union bridge, for general traffic across the Tever, near Berwick; the span was 
450 feet between the supporting towers, which were of masonry. He 
subsequently built another, of smaller dimensions, across the Tever, at 
Drygarn, in 1834, and the same model was carried over the 
Feather river in the Fens, and others, and applied the same principle with 
effect for landing-piers at Brighton and Leith. This system was afterwards 
carried out to a far greater extent by Teiffel, in his great suspension 
brige across the Rhine at Bonn, and has been adopted by the 
Cor. The suspension bridge is the first to determine with precision the absolute and relative strengths of materials, under the effects of tension and compression. He subsequently 
made above six hundred experiments in 1827, on the friction of plane and 
round surfaces, with and without augments, under the different circumstances of time, surface, and pressure, which were published in the Philosophical Transactions, in 1836. In 1830 he also made experiments on the 
frictional resistance of water, and on the same subject the same year at 
Sippers' works, New York, and Wood, and others, have since carried these experiments to a greater extent.

Concrete, a mixture of gravel, sand, lime, and other cement, has been 
extravagently well known to the ancient, and in connection with the 
unnatural value of the natural stones, Pozzolana, was applied with the greatest 
success in the numerous mills and other submarine works, and its use has 
been still continued in Italy to the present day. It is said to have 
been used in a portion of the foundation of St. Paul's, where it was defec-
tive. Semple also alludes to it in 1776. Its use appears to have been
Tunnels.

Subterranean tunnels have been much used in inland navigation, particularly in the Duke of Bridgewater's canal, some miles of which, at Worsley, are made under ground; in the Hexcastle Tunnel, by Brindley, on the Trent and Mersey Canal, in 1770, which was rendered more convenient by Telford, in 1806, by adding another parallel to it, of larger dimensions; in the Huddersfield canal, where there is a tunnel 2380 yards long; in the Brunston Tunnel, on the Grand Junction Canal, and many others; all of these have been described in the Bridges and Tunnels under Rotherhi, by Sir Isambard Brunel, which, for magnitude, boldness in the design, and ingenuity in the means of construction, as well as the extraordinary difficulties by which the work was attended, will long remain a lasting monument of the genius and perseverance of that celebrated engineer. This extraordinary work was commenced in 1825; it consists of two arched openings 1200 feet in length, 14 feet span each, 16 feet 4 inches high, separated from each other by a pier 4 feet thick, having sixty-four pairs of ribs and a cover, 50 feet diameter, at the crown; but this was intended hereafter to be carried out to the surface the adjoining streets, at such a moderate inclination that carriages could easily pass through it from both sides of the river. The crown of the tunnel is about 16 feet below the bed of the river. In order to carry into effect this large and difficult work, unusual means and precautions were necessary. The ordinary wooden centre framing scarcely presented sufficient strength and connexion for that purpose. Brunel accordingly invented a cast iron frame (which he termed a shield) sufficiently large to embrace the whole width of the tunnel, and divided into thirty-six compartments, each sufficiently large for a man to work in, yet capable of being closed to prevent the access of water when required; the whole was impelled forward by powerful screwing machines mounted on the tunnel bed. The shield was finished, the contrivance was perfectly successful; and although the works were twice stopped by the irruption of the Thames, nevertheless the cuttings were stopped by bags of clay and other materials, and the structure completed in the space of one year and a half, and opened to the public in 1843. The whole was constructed with bricks set in Roman cement, and case inside with the same material; and it gives every prospect of permanence and solidity.

The system has been previously proposed at Rotherhi by Trevethick, and had advanced to so small a distance under the river, when it was abandoned; also one by Dodd at Gravesend, which was scarcely commenced. A tunnel was also carried to a considerable extent under the Severn, and is described by Pugin. The size of the tunnel was not given.

Tunnels form part of the works of almost every considerable railway, and the art of constructing them with accuracy and expedition is now brought to great perfection. Amongst the most remarkable tunnels executed upon railways, may be mentioned that at Kilsby, 3298 yards long, on the Birmingham and London line, by Stephenson; that at Box Hill, 3196 yards long, on the Great Western Railway, by Brunel; and that on the Manchester and Leeds, 3900 yards long, by Locke. Several others of great length are now in progress.

**Harbours.**

In the construction of harbours, Smeaton, as already observed, had pointed out the proper course, in his reports on Lynn, Wells, Aberdeen, Dundee, Dunbar, Port Patrick, Sandwich, Scarborough, Sunderland, York, Dover, Chatham, Plymouth, and London. The first improvements were designed by La Bible in 1744; it had been partly executed by others, and continued with little success through a tedious succession of years, with various changes of plan, until 1774, when it was placed under Smeaton's management. The plan of the New Admiraal, designed by Higgins, Pauley, Donaldson, Smith and Godwin for their valuable experiments and treaties upon this important subject.

Additional strength has been given to brick structures, by the introduction of bands or arches in the Tunnels and Canals; this improvement was first generally introduced by Smeaton. I. Brunel.

*From the valuable researches of these authors it appears, that the hydraulic cements contain considerable portions of silica and alumina, and in some cases metallic oxides; and, where natural hydraulic cements cannot be obtained, they may be produced artificiately, by the combination of these ingredients in their proper proportions.*

*This system was latterly always adopted by Rennie and Telford in preference to the upright wall, as being better adapted to resist waves, and it has been invariably successful, wherever it has been properly carried into effect.*
of Ardrossan, the Troon, Peterhead, by Telford, Sobraobur, by Chapman, Hartlepoo, and others, are worthy of remark.

In the improvement of natural harbours, may be mentioned Sunderland, Newcastle, Liverpool, Newhaven, Leith, Belfast, and others. The principle generally adopted has been to confine and direct the tidal and fresh waters, by piers, in proper and sufficient channels, whence they are discharged into the ocean, so as to enable them to act with greater effect in counteracting the force of the waves. The piers are constructed of stone, brick, or iron, and the entrance of the waters is regulated by gates, sluices, or weirs. The assistance of the employment of those inferior auxiliary, the steam-drudging machines, which ought to be attached to every harbour. It must not omit to mention the breakwater in Plymouth Sound, by Rennie and Whihey, which is of iron, and the famous breakwater in the Tyne.

The depth of the work, except a portion of the masonry, which is granite, has been built of limestone, brought from the adjoining shores. The intention of the work was to protect the Sound against the heavy swells, which formerly so often obviated the entrance of the harbour. The entrance is about 150 feet wide; the quay and river front being concave, and the foundation for a certain width, laid inclining at right angles to a tangent from the curved face of the front of the wall; the remainder of the foundation was horizontal, and the back or land side of the wall was vertical. Thus there was both a front and a back wall connected together by cross walls, forming one mass; the inverted arches or domes under the hollow spaces being filled with chalk and gravel concrete, and the whole resting upon a well-connected platform of piles and cross-beams and planking. By thus distributing the same quantity of material over a greater area, the vertical pressure per square foot was reduced, and the desired stability was obtained upon this very difficult and treacherous foundation. Rennie has previously tried, with success, a wall of a similar principle, and under similar circumstances at Grimsby. General Bentham also tried a similar principle, about the same time, which was not so successful, in consequence of an unsuitable form and construction.

Another class of harbours, called Floosting or Wet Docks, for receiving merchant and coastwise or ocean shipping. The first introduced at Liverpool about the year 1716, and wet docks have been also constructed in almost all the principal ports of the kingdom—viz., London, Bristol, Hull, Leith, Sunderland, as well as for the Royal Navy at Portsmouth, Plymouth, Sheerness, and Chatham. The West and West India Docks, by Jessop, Rapkin, and Ralph Walker; the New docks at Greenhithe; St. Catherine's, London, by Telford; the New Docks at Liverpool, by Hartley; at Hull, by James Walker; at Cardiff, by Cubitt; at Newport, by Green; at Southampton, by Giles; and the great works now in progress at Birkenhead, by Telford, are ample examples of this class of works. The design for the wide-mouthed basins, the great breakwaters, and Chatham, is worthy of remark. This magnificent design consisted of six capacious basins, with a total surface of 600 acres within the walls, the largest being 4,000 feet long, and 1,000 feet wide, and covering 67 acres; the whole area covered with each basin, 2,000 acres, and in front of the same, and on the sides, provided with quays, dry docks, buildings, slips, and storehouses; steam machinery for manufacturing cordage, blocks, anchors, flour, and bread, sawing and converting timber, pumping, and working engines; in fact, for almost every operation connected with the docks. The basin was carefully arranged and disposed, that the required operations should succeed each other in an orderly manner, and from whence making a canal, 12 mile long, 300 feet wide, and 30 feet deep, to the deep water in the Medway at Gillingham, by which means vessels of war of the largest class could come to the Dockyard with the whole of their stores and passengers on board. The works have been for many years been shortened, and the shallow water of the Medway avoided; thus Chatham Dockyard would have been rendered the most convenient and extensive by Europe, and its proximity to London by a railway would have rendered the yards even more useful than at Woolwich. The estimate for this work was only £700,000, whereas since that time fully as much, if not more, has been spent upon Woolwich, with a very inferior result; indeed, it is not even too late to undertake this plan for Chatham now, and would well repay the expenditure. In designing and carrying into effect this important class of public works, so as to render them successful, a thorough knowledge of the nature and operation of tides, winds, currents, soundings, and all the departments of hydrography, physical geography, and geology is necessary, and in these sciences much is due to the exertions of Beanfellt, Bullock, Washington, Denham, Buckland De la Boë, Lyell, Greenough, Sedgwick, Murdock, Phillips, and others.

Reverments, or Retaining Walls.

These, until near the latter end of the last century, had been usually built with horizontal foundations and courses, the interior side being almost vertical, and the exterior with a flat face and very little batter, or in many cases vertical. The curved face retaining wall was first introduced, with the foundation and courses inclining from the horizontal, so as to conform with the radius of curvature; this form of wall is preferable, in many cases, to the old, as combining greater strength with a less section, and being more convenient in other respects, and was commonly used by Rennie in his various works, when applicable.

To whom the introduction of this improved form of wall is due is difficult to ascertain with accuracy; but Rennie, Ralph Walker, and Jessop were amongst the first who brought it into use. A further improvement was made in the retaining walls used at Sheerness in 1815 by Rennie, where the foundation being composed of soft alluvial mud and quicksand, to a great depth, more than usual precautions were necessary to render the walls substantial and secure. The object was effected by enlarging the base, and making the interior hollow, like a cask, with the bottom in the form of an inverted dome, or river front being concave, and the foundation, for a certain width, laid inclining at right angles to a tangent from the curved face of the front of the wall; the remainder of the foundation was horizontal, and the back or land side of the wall was vertical. Thus there was both a front and a back wall connected together by cross walls, forming one mass; the inverted arches or domes under the hollow spaces being filled with chalk and gravel concrete, and the whole resting upon a well-connected platform of piles and cross-beams and planking. By thus distributing the same quantity of material over a greater area, the vertical pressure per square foot was reduced, and the desired stability was obtained upon this very difficult and treacherous foundation. Rennie had previously tried, with success, a wall of a similar principle, and under similar circumstances at Grimsby. General Bentham also tried a similar principle, about the same time, which was not so successful, in consequence of an unsuitable form and construction.

The Cofferdams which Rennie employed for constructing the walls at Sheerness are worthy of remark, as being the most extensive and difficult that had been constructed up to that period. The bottom being soft mud to a considerable depth, piles of 60 feet to 80 feet in length, were necessary, and when driven and braced in their places as far as practicable, chain bars and raking-shores from the land were requisite, in order to counteract the alternate pressure forwards and falling outwards, occasioned by the baseness of the foundation and the heavy shocks of the waves to which they were exposed. In order to break the effects of the sea during storms, he employed a series of old men-of-war hulls, to act as floating breakwaters; these were meant to certain extent, so long as the wind from the places, but as times, during heavy gales, they dragged their moorings, and driving against the dams, occasioned considerable damage; upon the whole, however, they were useful.

In order to give greater security to the dams, and to prevent leakage, a considerable quantity of grooved and tongued ashlar-piles were employed, fastened together for the whole of their length, in the manner of the stone columns, another good example. The late Peter Swart was amongst the first who introduced cast and wrought iron dams, for piling in general, and for wharfs; it has been since employed by Walker, Sidney, Stevenson, and others, in many situations, with great success. At the Alban Mills, already mentioned as the first steam-mill constructed in 1765, by Watts and Rennie, on the banks of the Thames, close to Blackfriars Bridge, the foundation being soft mud and moving sand, inverted arches were formed upon the ground, between the foundation and the sand, and the whole, by this means, was obtained support by the same weight resting upon an increased base.

(To be continued.)
REGISTER OF NEW PATENTS.

ELECTRICAL TELEGRAPHICS.

Josee Nott, of the city of Cork, gentleman, for "certain Improvements in the Mode of operating and controlling the Electric Machines and Arrangements of the Parts of the Apparatus, so as to produce certain Electrical Effects by the use of the Electro-magnets Only," to wit: By certain novel arrangements of apparatus, by which electrical and visible signals can be given through the agency of electro-magnetism. In the present invention, the apparatus is mounted on a carriage, and can be moved along a track at will.

In Plate VI, fig. 1 represents the external appearance of the apparatus, as seen in front; fig. 2 is a vertical section, taken transversely through the apparatus, and shows the internal arrangement and the working parts of the apparatus, as they appear if the second-plate and front part of the case are removed; and fig. 3 is a horizontal section of the apparatus, taken below the magnets, showing the mechanism by which the course of the electric fluid may be altered from the electric telegraph to the signal-bell.

In the front of the box or case, a circular dial-plate, fig. 1, is fixed, on which are four series of letters, which are pointed out by the long arm of the index; and also two concentric circles of numerals, indicated by the short arm of the index. This plate is graduated on its face into ninety-six equal divisions, formed in a circle; and to each, one of the letters or one of the numerals refers. Upon the outer end of an arm a, passing through the centre of the dial-plate, a index b, is affixed, which is carried round upon the face of the dial-plate by successive actions of the mechanism, produced by the electric fluid; each successive action moving the index over one space of the graduated circle, so as to enable the operator to leave the position of the index on the letter or numeral which will indicate the word required to be communicated. These actions of the mechanism are effected by the movement of the electric fluid, of a key or lever, rising or falling at the touch of the operator, as in a piano-forte.

The electric fluid is derived from a galvanic battery near the apparatus, as at A, B, fig. 4, and passes, by wires, to the coils of the electromagnets, as shown in fig. 3; and in the same plane, nearly concentric with these wires, is a ratchet-wheel d, fixed upon the arm e, which latter passes through the centre of the dial-plate, and carries the hand or index b. Two lever arms e, e, are supported by fulcrum axles, turning in the brackets j, j, which arms cross each other, and their movements are rendered simultaneous by connecting link g, fixed upon the axis of the ratchet-wheel d. To the extremities of the inner arms of these lever arms are fixed, by joints, which are pressed against the periphery of the ratchet-wheel by delicate springs, causing the pallete h to move against the wheel, and, by the rising and falling of the arms, these pallettes move the ratchet-wheel in the round-the extent of action of the pallettes being limited by two latch-stops i, i, which give rise to a dead-rest movement of the index, as it is carried round the dial-plate. The extremities of the pallettes bear upon slight springs k, k, fixed to the back-board of the instrument.

A third electromagnet E, E, is fixed to the back-board, figs. 2 and 3, and is intended to give motion to the machinery of the signal-bell, attached to the back-board by flexible links, as shown in fig. 3. When this armature is attracted by the magnets, it will be drawn up into a horizontal position, and, in rising, the extremity of the arm will take into the fork at the end of the lever m, and cause the hammer n, to strike upon the bell or gong P.

The means by which the electric fluid is conducted from the battery, through the wires of the electromagnets, to the corresponding apparatus at the distant station will be clearly understood by the following description:—Two wooden cylinders G, G, are supported on horizontal axles, by standards fixed in the top of the box, and the opposite ends of the axles are connected by two separate strips of metal, as conductors, are passed nearly round the circumference of each of these cylinders, leaving unoccupied a conducting portion on each cylinder between the ends of the strips. Upon the support I, I, eight eightspring 1, 2, 3, 4, 5, 6, 7, 8, which are wound round the inner surface of the cylinders G and H. The springs 2 and 3, are connected by a conducting strip of metal, fig. 4, and the springs 6 and 7, are also connected in like manner; the latter being perfectly detached or insulated from the former, and consequently the whole leads to the stud K, where it is held fast by a binding screw; and to this stud K, the end of another wire 10, is soldered, which passes under, and is connected to the operating flange-key L, and, bending down, terminates immediately under the current in fig. 1. The wire 10, is soldered to the evert spring 3, and is brought round into communication with the mercury in the cup 11. On the key L, being depressed by the finger of the operator, the pendant end of the wire 10, will be brought into contact with the mercury in the cup 11, when the electric fluid from the battery A, will be instantly conducted from the pole A of the battery, through the wires 9, 10, 12, to the spring 3, and from the spring 3, through its conductors, over the current in the copper wire band on the cylinder H, to the spring 3, and from that spring, by a wire 13, to one pole of the electromagnet C, as shown in fig. 2. The electric fluid will then pass through the coils of that magnet C, and thence, by a wire, to the core of the electromagnet D, and through the coils of that magnet D, this magnet will then descend from its other pole by the wire 14, to the stud L, fig. 4; to the under part of which is soldered. Another wire is attached to the point c, a binding screw, from which it proceeds to the telegraph at the distant station. The cause of the current of electricity is by that means conducted through the electro-magnets of such telegraph, which is precisely similar in construction to the apparatus above described. The armature e, e, and不断的 part of this stud M, conducts the electric fluid to the evert spring 3, from where it passes, as before into the cylinder H, to the evert spring 3, and from that spring by a wire 18, to the stud N, from the binding screw of which another wire 19, soldered or connected to the under part of this stud N, leads the current of electricity to the other pole A, of the battery, and thus the electric circuit is complete.

It will now be seen, that when the finger of the operator depresses the key J, the pendant end of the wire 10, being thereby brought into contact with the cup of mercury 11, will cause the electric fluid from the battery to pass through the circuit, as before described, in proceeding through the coils of the electro-magnets C and D, develops a powerful attractive force, which, acting upon the lever armatures e, e, attracts the arms of those levers toward the poles of the magnets, and, in so doing, raises the pallettes i, i, one of which being fixed to the arm e, and the other to the armature b, thereby causing that armature to move in such a direction as to cause the index to be indicated upon the original position, as shown in fig. 3; and the other pallette will move the ratchet, and thereby cause the index-hand to pass over another space or division of the dial. A repetition of the touch upon the key J, produces the same effect, repeated, and extending to another space or division of the dial.

In commencing the telegraphic communications, it is desirable, in the first place, to indicate whence it proceeds, which may be done by giving one, two, three, or any other indication, by going over another space or division of the dial, and so on,—the operator resting when the hand b arrives at any letter or number upon the dial which he wishes to have noted; and by a succession of these movements and rests, the letters or symbols of any desired word or words may be indicated at the distant station.

In effecting this at the remote station, a current of electricity is conducted in the way above described; but a slight change in the position of the cylinder G, H, of the apparatus is made.

It has been already stated, that the wooden cylinders G and H, have metallic conducting bands placed partially round them; which bands leave non-conducting portions on the periphery of the wooden cylinders. The application of these bands to the operator is enabled to change the current of the electric fluid from the telegraph to the bell by a simple movement. At figs. 2 and 3, (which represent the conducting wires in connection with the telegraph,) it will be seen that the evert springs 1 and 3, are brought against those parts of the cylinder G, over which the metallic bands do not extend; and consequently, the current is not passed; but if the cylinder G, H, were turned round simultaneously about a quarter of a revolution, the metallic bands of the cylinder G, would be brought into connection with the springs 1 and 3, and at the same time the springs 4 and 5, would become insulated, by having the non-conducting parts of the cylinder H, brought into contact with them. This is effected by the movement of a sliding-bar P, in front of the apparatus, shown at fig. 1; each bar is attached to a parallel lever P, fixed upon the outer end of the axles of the cylinders G and H; and at the centre of the bar is an erect index q. If the bar is slid to the right, so that the index q, points to the mark R, referring to the bell, then the cylinders G, H, will be turned round about a quarter of a revolution, which means being thus in a position to communicate with the telegraph. But if the bar is slid to the left, so that the index q, points to the mark F, referring to the telegraph, it will be seen that the bars will be set in such a position as to communicate with the bell. Two other series of bars, I and J, may be set in the same manner, the one enabling the telegraphic current G, to be transmitted to the local bell, the other to be transmitted to the local telegraph.
explained. The position of the cylinder G and H, being such as to carry the electric fluid through the coils of the alternating magnets E, the lever armatures l, will be drawn up into a horizontal position, and in so doing will cause the hammer p, to strike the goos or bell F.

The patentee next describes several appendages which he proposes to adapt to the electric telegraph. Firstly, of a commutator, or pole changer, for reversing the direction of motion of the current; and secondly, a rheostat, for changing the direction simply of the electric current; those being for the purpose of separating any number of intermediate stations from the telegraphic circuit, or of connecting any of those stations with each other. A, in fig. 8, which is the commutator, and B, the rheostat, and fig. 6 a top view of the same. A is a block of wood, and B a wooden cylinder, turning upon an axle mounted in standards. Upon the periphery of this cylinder seven strips of copper are arranged, as shown in fig. 7, which are divided into two sets, and are connected with the electric current in the manner before described. One of these strips of copper, c, is imbedded transversely in the periphery of the cylinder; the other six strips, b, d, e, are also imbedded, and are connected around the periphery of the cylinder. These latter stripes are interspersed to reverse the direction of motion of the electric current: the strips d and e are directly connected by two wires with b and c; and the strips d and e are alternately connected with b and c, by two wires crossing each other, one of which, f, forms a communication between b and c; and the other wire g, between b and d. These wires, f and g, are insulated from each other, and deeply imbedded into the cylinder, and they are covered by a transverse piece of ivory h. Four erect strips, a, are also attached to the back of A; their upper parts project against the periphery of the cylinder. A handle is attached to the axle, for the purpose of turning the cylinder round; and an elongation of the handle forms a pointer, to indicate the extent to which the cylinder is turned. Two arms are attached to each of the strips, for the purpose of connecting this instrument with the telegraphic wires. Thus, if the direction of the electric current be reversed, by turning the cylinder to the right or left, the direction of the electric current may be changed, or, in other words, the points of the battery may be reversed.

The commutator is shown in horizontal view at fig. 8, and in vertical section at fig. 9. A is a circular block of wood, in which two permanent magnets are imbedded, their poles extending upwards, as at N, S, N', S', &c., and one of these, n, is a soft iron core, saturated in a horizontal position by the vertical coil C, as shown before. When an insulated copper wire e is coiled, the ends of which extend at right angles to the bar, and are bent down so as to touch the surface of the mercury in the cell, as is supposed to communicate a current of electricity (say from London) to the mercury in the cell, the electric current will be conducted by the wire e, to the mercury in the cell y, and from hence pass on by the wire e, to the place of its destination (say Birmingham), and thence through the remainder of the telegraphic circuit, back again to its starting point.

As the electric fluid thus passes, the bar a becomes magnetized, and its ends are attracted by the poles of the permanent magnets, S and N', as shown at fig. 8. If, for example, the current of electricity is required to be cut off from the telegraph at Rugby, and directed, say towards Birmingham, the pole of the battery being represented by means of the apparatus shown at fig. 5. The direction of motion of the electric current being thus reversed, it will, in passing through the wire d (fig. 8 and fig. 9) be attracted by the reverse ends of the magnets, that is, N and S'; by which means the electric fluid and wire will be brought from the mercury cup y, to the mercury cup x, and the current will then, instead of proceeding through the wire e, as before, take its course through the wire f, and so on, to Birmingham; by which means the telegraph at the Rugby station is electrically thrown out of the circuit.

When the circuit of the telegraphic apparatus is required to be closed, the key J, fig. 1, must be depressed. In order to keep the circuit closed, the draught of the G is pulled out, when drawn down a small lever b, into the position shown by dots in fig. 2. This lever b, keeps the key in a depressed position, and the instrument is thereby prepared for receiving communications from a distant telegraph.

At figs. 10 and 11, a modification of this rheostat is shown, in which the electric-magnet E is placed on one side instead of the horizontal plane. The advantage consists in the facility which it affords of changing the local direction of the electric current, without interrupting the current itself in such a manner as to remove the coils from the manner in which the wire of the electric-magnet is coiled. Upon the cylindrical bar there is a separate coil of insulated wire; the length of the wire of each of these coils proceeds from the extremity of the bar to its middle, and then returns, by one extremity of the bar, to the other extremity of the bar, along the ends of the bar. The wire, forming the coil, is made of copper. Beginning at one arrangement, one of these coils is destrokrum, and the other sinistrorsum relatively to the side of the bar at which the electric current enters the coil. These coils are therefore supposed to be broken off in two different directions, and pass from the bar, thence through these coils simultaneously, the electric current would flow in the same direction through both coils, and consequently, the polar unity of the resulting electric-magnet would be reversed, so obviously, if the speed of the electric current enters either coil from the same side of the bar, all of the polarity results, and a corresponding motion is communicated to the bar, by the influence of the permanent magnets, as will be subsequently described; and when the electric current enters either coil from the opposite side of the bar, the polarity, and, consequently, the motion of the bar, is here reversed. In these alternating motions, when the bar becomes horizontal as in the drawings, the bar being immersed in the mercury cups, and therefore, without interrupting the electric current, its reversed local direction may be changed, by depressing either end of the bar, as will be seen by the following description of the several parts of the instrument.

Fig. 10 is a plan view of the instrument, and fig. 11 is a vertical section. A is a block of wood, forming the base, and B B B B two permanent magnets, their similar poles opposite in the same vertical plane, and fixed to the base A. The bars S and S' are immersed in the mercury cups E and H. The rounded part of this bar is a double coil g of insulated wire, and the bars S and S', the left hand, is a single coil j of insulated wire in the mercury cups E and H. Round one-half of this bar a double coil G of insulated wire, the bars S and S', is immersed in mercury cups C and D. Two mercury cups L and H, at the same side of the bar, are both connected by the wires P P' on the current-entering wire U, of the telegraph. The electric current now passes through a sinistrorsum coil, the extremity Y of the wire e, in the small plate at the north pole, and the other, Z, a south pole. This extremity Y of the bar is then connected with the other end of the small plate, for the attraction by the pole S'; it therefore descends, and releases the ends of the coil G, from the mercury cups H and I. The telegraph is then thrown out of the electric circuit.

If the direction of motion of the electric current be now changed, the current-entering wire U becomes the current-entering wire, and the stud E is now connected with the new current-entering wire. The electric current then passes through the stud T, to the mercury cup M, and thence through the coil K, to the mercury cup L, from which it passes through the coil K, and the electric current, in this case, passes through the coil K, from the opposite side of the bar, which is thus rendered dextrotronum; the polarity of the coil K is therefore reversed, the end Z becoming a north pole, and the end Y a south pole. This end Y and the end X of the coil K are now connected with the other end of the small plate, for the attraction by the pole S1 of the permanent magnet, and attracted by the pole N1. The extremity Y of the bar is therefore raised from its inclined position, as in the previous direction, and releases the ends of the coil K, from the mercury cups L and M, at the same time that its other extremity, being depressed, immerses the ends of the coil G, in the mercury cups H and I, and this immersion takes place before the ends of the coil K leave the mercury cups L and M.

As the stud R is now externally to the telegraph connected with the current-entering wire, the electric current, instead of passing through the telegraph, branches off to the stud R; it then passes to the mercury cup L, thence through the coil G to the mercury cup H, and so on to the main wire V. The telegraph is thus cut off, and the electric current taking place, put out of the circuit; and as the electric current now passes through a sinistrorsum coil, the bar retains its position, until the direction of motion of the electric current is reversed, to bring the telegraph again within the circuit.

Fig. 12 represents, in elevation, one of the posts for supporting the circuit-wires of the telegraph along the line of communication. This post is of wood, and is to be sunk about five feet into the earth, the sunk portion being imbedded in Roman cement. A wooden lantern-shaped box is put is put up, 16 inches of the upper end of the post, so as to protect this portion of the post (which is to be well varnished from the humidity of the atmosphere. The box is made in two parts; the cover is of a pyramidal form, and is tightly fixed on the post; the case is made to slide up and down upon the post, and is fastened to the cover, so as to completely envelop the varnished portion of the post, and the embedded lamp, which is a square, and is in two wires. No metal whatever is used in the construction of this box. Each of these is a single insulated lighting conductor, passing down to the earth, is attached.

The patentee claims, Firstly, the construction and use of the direct action electric-magnetic telegraph described; and particularly the arrangement of the letters or symbols on the dial plate; and the means applied to communicate direct circulatory motion to the ratchet-wheel, and the index, by the alternate motion of two jointed lever armatures, working simultaneously, by being connected one another, in the prolongation of the vertical diameter of the wheel; the Index of the other armatures forming the pallets of the escapement, and taking into the teeth of the ratchet-wheel; their ascending and descending motions being regulated by the lever and plate, which form the escapement; he also claims this escapement, whether it be worked by two wheels, or by one lever only. Secondly, the adaptation of the electromagnets of the telegraph, as before described and represented in the drawings, whereby they form what may be called a magnetic circle, and attract the extreme and mediate ends of the armatures simultaneously, when the electric circuit is closed; and by the proximity of the bell-electro-magnet and
its armature, one edge of which is always in contact with the poles of the said magnet, the reactive force of electrical induction is brought to bear so as instantly to destroy the attractive force of the electro-magnets of the telegraph, as soon as the electric circuit is opened. Thirdly,—the arrangement of the machinery of the signal-bell of the telegraph, as before described for throwing the telegraph current out of the electric circuit, and bringing the striking machinery of the bell into the electric circuit, and vice versa; and also of permanently closing the said circuit by means of a lever and draw-stop. Fifthly,—the means of communicating with all the stations simultaneously, or throwing any of the said stations out of communication, at pleasure, by the employment of the commutator and rheostat, as hereinafter described. And, lastly, he claims the said improvements, however they may be varied in their constructional details, so long as the general arrangement of parts, as above set forth, is retained.

STEAM ENGINE REGULATOR.

Mozia Pools, of London, gentleman, for "Improvements in regulating the velocity of steam engines."—Granted June 29; Enrolled December 29, 1840. (With Engraving, Plate VI.)

The improvements relate to an apparatus to be used in connection with a governor of a steam engine; firstly, to the mode of employing the force of compressed air forced into a chamber by means of a double-heat valve-pump, worked by the engine, so that the air in the chamber may be kept in a more or less compressed state according to the resistance of the engine. The piston, moved by the reflected force of the compressed air, communicates with a valve, to regulate the opening of the throttle-valve, through which the steam passes to the steam-cylinder, by which the engine is kept in a uniform state, whatever be its variation. Secondly, to the stop which is disposed to the one described, the difference of which consists in using the pressure of the atmosphere acting upon a piston, to press it into a vacuum in place of compressed air; so that the same apparatus, by reversing the action of the valves (causing them to open outwards, instead of inwards) might be used practically for either purpose.

The engraving, Plate VI., shows a vertical section of the apparatus; a is the air pump with piston, worked by a rod connected with the driving shaft of the engine, entering the top and bottom of the cylinder; c, c, wind-boxes or ports with valve-heat; d, condensed air passage; e, condenser air cylinder; f, pressure piston; g, piston-rod, passing up through the conical standard h, to lift a counter-balance weight i, which is connected with the throttle-valve of the steam-pipe; j is a small regulating valve, and k a regulating tube, with a regulating cock n, worked by the action of the governor o, through the intermediate rod and lever p.

The apparatus is worked in the following manner: the driving-shaft of the engine giving motion to the piston of the air-pump a, and at each upward and downward stroke of the engine, the air of the air-pump is drawn into the chamber d, and lifts the piston of the small cylinder e, together with the weight h, which is kept suspended by the elastic power of the spring g. The condenser air cylinder f is then condensed, and the steam-valve j is closed, while the throttle-valve k is opened by the pressure of the air in the chamber e, or the condenser air cylinder f, the steam thus entering the steam-pipe j, passes through the cock n, worked by the governor o, and enters the throttle-valve k, and is conducted to the engine through the rod p, and the valve of the engine, when the governor is arranged to work in the reversed manner, to cause the steam to return to the condenser air cylinder f, and the air pump d, andgenerally to maintain the engine in a uniform state, whatever be its variation.

CHANDLER SUSPENDERS.

John Finlay, of Glasgow, ironmonger, for "Improvements in raising and lowering Gas and other Lamps, Lustres, and Chandeleirs."—Granted February 24; Enrolled August 30, 1840.

This invention consists of a method of supporting, by atmospheric pressure, such gas and other lamps, lustres, and chandeliers, as require to be raised or lowered, in the following manner:—

There is to be attached to the ceiling of the room from which the chandelier is to be suspended a rod, carrying at its lower end a piston, constructed in the manner hereinafter described. The chandelier to be suspended is attached to a tube, which is made to slide air-tight on the said piston. A vacuum being produced in the tube beneath the piston, as hereinafter particularly described, the pressure of the atmosphere supports the said chandelier; the area of the piston, and diameter of the tube in which it slides, are proportioned to the weight of the chandelier to be supported.

Fig. 1 is an outside view of a gas lamp slide, of 1½ inch diameter, inside measure, consisting of a gas tube, attached to the ceiling of the room, from which the lamp is suspended, by means of atmospheric pressure being brought into operation by means of a vacuum in the cylinder at 18, on the under side of the piston, 15; the position of the piston and of the tube are denoted by the dotted lines, 3 is a screw for attaching the slide to the lustre, the weight of which should be about twelve pounds. 2 is a tube placed within the roof tube 1, which conveys the gas to the arms of the lamp, and is made fast at the screw 3. Fig. 3 is an outside view of the roof tube, with the piston, 5, cut off lower end. The tube, 2, indicated by dotted lines, projects beyond the under side of the piston. 15 is a shoulder, and 17 a helical spring, for preventing the lamp tube from sliding off when the lamp is drawn down. Fig. 3 is a section of fig. 1. The piston is shown midway in the cylinder, and the exhausted or vacuum portion of the cylinder, 6, represents oil, put on the top of the piston, for lubricating the tube, and keeping the leather cups, 8 and 9, which form the packing, air tight. 16 are two small holes, drilled through the body of the piston, which holes are covered by a valve formed of a leather washer, 10, on which the brass washer, 11, is pressed by the spiral spring, 12. The object of holes and valve is to produce and maintain the vacuum by which the pressure of the atmosphere is brought into operation; for when the lustre tube is raised, the air which is included between the bottom of the piston, 5, and the bottom of the said tube, is compressed, and elasticity causes it to raise the leather, 10, and the brass, 11, and escape through the oil, 6. When the tube has been raised to its fullest extent, until the bottom of the said tube is brought into contact with the bottom of the piston, 5, the whole, or nearly the whole of the air is removed from under the said piston, and the spring, 12, forces down the leather valve, 10. On drawing down the lustre tube the oil, piston, and valve, prevent the re-admission of air under the said piston, and the vacuum existing there causes the lustre tube, and lustre attached thereto, to be supported by the pressure of the air external to the said tube. If from any cause air or oil should have descended below the piston, it may be made to escape through the holes by the raising of the lustre tube, which, as soon as the pistons, 5 and 6, and the oil, 6, are raised above the level of the air, oil, and gas, 14, and 16, and 17, and the gas is admitted through the holes, 18.

SEWAGE MANURE.

William Higgs, of Westminster, chemist, for "the means of collecting the contents of sewers and drains in cities, towns, and villages, and for treating chemically the same; and for applying such contents, when treated, to agricultural and other useful purposes."—Granted April 26; Enrolled October 28, 1840. (With Engraving, Plate VI.)

The invention consists, firstly, in the construction of tanks or reservoirs in which the contents of sewers and drains in cities, towns, and villages are to be collected, and the solid animal and vegetable matters therein contained solidified and dried as hereinafter described. Secondly, in the construction of buildings over such tanks or reservoirs in which the vapours and gases, evolved from the collected mass of sewage below, may be collected, retained, condensed, and combined with chemical agents, a hereinafter described, and also in the arrangement of spars or bars on which the salts, formed by the combination of such gases with other substances, may rest or crystallize. Thirdly, in the construction and arrangement of machinery and apparatus to be used in distributing and depoiling chemical agents over the mass of sewage collecting and collected in the
tanks or reservoirs above mentioned. Fourthly, in the use and application of chemical agents for the purpose of precipitating the solid animal and vegetable matter contained in sewage water, and also for the purpose of absorbing the same, contained in the sewage water, and the animal and vegetable matters therein precipitated or precipitated therefrom.

The first part of the invention relates to the construction of tanks or reservoirs. Fig. 1 is a transverse vertical section, and Fig. 2 a plan, of three tanks or reservoirs, in which the mass of sewage is to be collected; also a section of buildings to be erected over the tanks or reservoirs in which the vapours and gases arising from the tanks are to be collected and condensed, or combined with other gases, as described in the sewers, through which the sewage matter is to be passed, communicating with the tanks B, in such a manner that the sewage water will run freely into them. The sewers A have sluices C, opened or closed at pleasure, so as to allow the necessary flow of the sewage water and matter into the tanks as may be desired.

The tanks or reservoirs, B, may be constructed of brick, stone, or other suitable materials, and of any number, form, and depth, as may be found most suitable and convenient, according to their local position and the quantity of sewage matter to be treated or operated upon. It is preferred that each tank should be made in the form of a parallelogram, the sides to which shall be three times the length of the ends, and varying in depth from twelve to fifteen feet. The bottoms of these tanks or reservoirs must be so constructed as to drain down to some one or more places where a filter or filters is or are to be placed for draining and drying the solid matter in the tanks, and with proper drains under such filters for carrying off the water passing through them. It is preferred to construct the bottoms of the tanks with double inclined planes, and with drains running down the centres of the tanks, and into which the water in the tanks will drain. Over each of these drains, are placed horizontal pipes, or other similar filtering material, to be supported upon grating. The drains under the filters must be made to communicate with a cistern or other receptacle for receiving the filtered water, and so that the water may run freely from them into such cistern or receptacle.

The sewage water from time to time poured into the tanks B, after being deprived of the solid animal and vegetable matter contained therein, is to be let off through the floodgates, C, into the waterways, C', so as to leave the precipitated animal and vegetable matter, remaining in the tanks, to be afterward deposited or treated as hereinafter described. The floodgates, C', must be placed about three feet from the bottoms of the tanks, so as to leave a convenient space below the level of the floodgates.

When a constant quantity of animal and vegetable matter has been collected in a tank, the floodgate is closed, so as to prevent any further flow of sewage into the tank until after it has been emptied of its solid contents. The filtered water contained in the cistern, or other receptacle, must then be pumped up from time to time, or got rid of in some other way, so that the drains under or communicating with the filters may be kept free from water, and the filters so left free to act efficiently.

In order to facilitate the process of depriving the solid matter in a tank of its moisture, a partial vacuum under the filters is formed, so that the pressure of the air upon the contents of a tank may have the effect of drawing the water contained in it down through the filters into the drains below; and for the purpose of producing and keeping up such a partial vacuum, the operator either uses an air-pump for exhausting the air in the drains under the filters, from time to time, in the same manner as air-pumps are generally applied to such purposes; or he produces and keeps up such a partial vacuum by means of the pump by which, from time to time, the filtered water is to be pumped out of the receptacle.

The tanks B may be subdivided into two or more compartments by divisions, B'. The line E, E, fig. 1, represents the ground line, or level of the ground, showing how much of the building is to be raised above ground.

The second part of the invention relates to the buildings above the tanks already described. Fig. 1 shows the walls of a building erected over a set of tanks. G, the roofs furnished with a number of openings H, through which the air may escape. I, are ceilings, furnished with one or more of Day's Patent Archimedian Ventilators J, or other similar machinery, for setting an upward current and drawing off the vapours and gases evolved from the tanks, and carrying them up into the chambers K, to be condensed or combined with some chemical agents or matters, as hereinafter described.

In the chambers, K, are fixed a number of uprights of wood, C', and to these a number of spars are secured in a longitudinal position, on which the salls or other substances formed from the vapours or gases may rest and attach themselves, as hereinafter described.

The third part of the invention relates to the construction and arrangement of machinery and apparatus to be used in distributing and depositing chemical agents over the mass of sewage collected in tanks or reservoirs, which arrangement consists of trams or rails, fixed along the edges of each side of the tanks or reservoirs L, or running parallel therewith.

The operator will, by these means, be enabled to distribute the chemical agents or substances equally over the whole or any part of the surface of the contents of the tanks or reservoirs, as may be required. And for the purpose of more equally distributing the contents of the wagon over the surface of the matter in a tank, the bottom of the wagon may be constructed like the hopper of a flour mill, and have motion given to it in the same manner, or any other similar means may, if thought fit, be adopted for making the bottom of the hopper self acting for the purpose of distributing or throwing down its contents into the tank below.

The fourth part of the invention relates to precipitating all the solid animal and vegetable matter contained in the sewage water from time to time run into the tanks, and to cause the vapours and gases arising therefrom to be condensed, absorbed, or combined, with some other substances in the chambers above. For this purpose, hydate of lime, commonly termed slaked lime, is preferred, being the cheapest and most efficient chemical agent for effecting it.

For the condensation of the vapours and gases arising from the mass of sewage, it is proposed to use chlorine gas to unite with and condense all such vapours or gases as are composed of ammonia, or sulphuretted hydrogen, which are evolved whilst sewage matter is collecting or under the chemical treatment in the tanks or reservoirs. Hydrochloric acid gas, and some other chemical agents, may perhaps be capable of effecting the condensation or absorption of the various vapours and gases arising from sewage water, but chlorine gas is preferred, because of its efficacy and the facility and economy with which it may be obtained.

The solid animal and vegetable matter remaining in a tank after the greater part of its water has been drained out of it by means of filters, as before described, ought to be dried so as to prevent the chemical decomposition of it, and render it fit for being transported to distant places, for application to agricultural or other useful purposes. This solid matter ought first to be formed into pieces of suitable shapes and dimensions, and then dried by any means which may be most convenient according to circumstances.

SHIPS' LOGS AND SOUNDING MACHINES.

Thomas Walker, of Birmingham, stove maker, for "Improvements in ships' logs and soundings."—Granted June 22; Enrolled December 29, 1845.

These improvements relate to apparatus for registering the speed of vessels and sounding depths at sea. The first log apparatus consists of a vessel by external or internal rotators. Fig. 1 shows the rotatory placed on

[Figure 5]

Fig. 3.

[Figure 4]

Fig. 4.

[Figure 5]
assess whether the log reaches the bottom or not, by collecting particles of dirt or rubble therefrom. The action is as follows.—The log, on descending rapidly through the water, causes the blade B, to rotate, which is transmitted to the tooth and pinion-wheels, g, and from thence to the hands or indicators i, i, which revolve until the log has reached the bottom, when it is necessary, in order to keep the hands or indicators in the position last indicated by the motion of the rotator, to employ the stop, k, which is put in action by the pressure of water when the log is being withdrawn, thereby preventing a retrogressive movement of the hands.

GODDARD'S IMPROVED ANEMOMETER.

It consists of a double vane, shaped like a truncated cone, the small ends being fixed to a brass tube about 1 inch in bore; this tube, penetrating the roof, rests on a hollow socket fixed into a table, which supports the instrument; immediately above the table the tube passes through a solid cylinder, whose base is cut oblique to the axis, thus forming a solid, turned a hollow, the tube forming its axis; so that as the wind shifts its quarters, vane, brass tube, and hole, all revolve together in the plane of the horizon: beside this rotating hoop, a brass piece is placed vertically upon the table, and has a sill in it, so that a slide, containing a pencil, may rise and fall as the thick or narrow part of the hoop comes in under the sliding pencil, the former being the case with a north wind, and the latter with a south wind. Therefore it will be understood that the pencil is lifted to the top of the scale at north, and depressed to the lower end by a south wind; the east and west occupying the mean or middle, it will be readily seen that the east and west are in the same place on the scale; but in order to distinguish them from one another, a pencil (below the former pencil in its lowest excursions) is made to mark in the eastern semi-circle, and remains inactive on the western. This is the minute hand.

To the minute hand of a clock is attached a light lamp, which, being connected with another pencil by means of a beam (similar to that of a steam-engine) placed in the same slider, only above the highest limits of the direction-pen and its auxiliary, alternately raises and depresses it, according as the minute hand points to 30 or 60. This is the time-pen; inside the brass tube an iron rod passes, connected at the upper end with a fan wheel, which the wind turns in proportion to its velocity; and to its lower end with an endless screw, which, concomitantly, a motion to a few simple wheels, gives a slow rotating motion to a cylinder, upon which a sheet of paper is fixed; upon this cylinder, and whose axis is vertical, all the pencils describe their evolutions. The office of the two first pens is to record the direction, and of the last the time and miles of wind; it being previously ascertained how many revolutions of the fan-wheel correspond to a mile or ten miles of wind.

The advantages of this anemometer are stated to be:
1. That the time of time is five times greater within an equal compass of paper than Mr. Ostley's.
2. That the register of direction is fully eight times as large, with equal sized sheets, as that of the ordinary construction.
3. The data registered are more comprehensive than those of Whewell's, Osler's, or Foster's, etc.

1. Miles of wind blows during the day.
2. Miles of wind blown in each direction.
3. Miles of wind blown between any given periods.
4. Hour and minute of the highest gust.
5. Hours in which most wind has blown.
6. Times of calms, and length of continuance.
7. Velocity of wind at any hour.
8. Time occupied by the wind going any certain distance at any period of the day.
9. Direction of wind at any minute.
10. Mean direction.
11. Direction of longest continuance.
starting from the mouths of dragons, which will soon be, if the new architect does not rectify it, planted across the arch of the opening of the chapel; this piece of work has been so long inapparent, and has been so imperfectly done, that it will be disposed like a calvary, as still exists in certain rural churches, particularly in Brittany. I simply announce these facts: they speak, sufficiently for themselves, without their having need of a commentary.

In the choir is the south of the nave some ancient wood-work was pressed into service, of which—

"Two bass-reliefs were missing; to replace them, they have modelled two pieces over in paper-maché, a Presentation of St. John Baptist, which is thus formed thrice repeated. All the little statues which were destroyed, have also been restored in paper-maché. This wood-work, of which the execution is admirable, is now fixed over with oil-paint (peinture varie) so that one can longer appreciate the talent of the sculptor over the work and the miseries of the staffs have had the same fate. Some panels of the wood-work offered no subject; they have caused marquetry work to be imitated there by the pencil—everywhere and always the intention to deceive the eye, under a false semblance, doors, which came from Gallion, which passed for a château d’œuvre. They have employed the pieces to make a frame for the painting over the principal altar, benches for the choir-boys, and desks for the canons. "In a sculpture of the Nativity in this choir, they forgot, while restoring it, to place Our Lord in the middle..."

"The choir is now furnished with the real monuments of some Abbots of St. Denis; they are the only ones which the revolution has not destroyed. But before they found here the right of asylum, they have been compelled to suffer rude outrage."

"They also devised the faces of the men or woman who were taken from a boss of the ancient cloister, a blasted and twisted face, recently illuminated with a drunkard’s red."

"Four or five Apostles of the Sainte Chapelle which had been carried to St. Denis, they have drawn out the two hands above as on the same day. These twelve figures, executed in plaster, are placed against the pillars of the winter choir."

"A glazed enclosure guarantees the canons from every current of air, it is a real frame of glass, set in plaster foreground, and paper-maché mouldings. The poor royal church is cruelly exposing its past magnificence."

"We have not to talk either of the high altar, nor of the stalls of the great choir, nor of the mosaic pavement of the sanctuary; they have none of them any architectural pretensions; let us leave them in peace. The choir is paved in black and white squares, just like the vestibule of a bourgeois house."

"At the entrance of the choir, against a wall of marble and beautiful green marble, a column anachronistic like those of the twelfth century, crowned with capitals of the thirteenth, carries a wooden platform, on which repose, in airless of gilt bronze, the relics of the three martyrs, and which serves at the same time as canopy to the seat of the first dignitary of the chapter. They have also cut up by slices some precious wood-work of the chapel of Gallien to compose with a niche for the armchair of the primate, which has remained empty since 1830."

"Chapel of the Apse.—If we run over the chapels ranged round the apse, we again find failures which either do not exist, or have been destroyed; the Pristiceps, displays all its magnificence in the whole circuit of the sanctuary..."

"At the height of luxury they have spread with full hands on the borders of the tables of the altar, nay pieces of glass picked up in the stalls of the Boulevards. "In the chapel of St. Benedict, St. Genevieve, and St. Eugene, under the tables of the altar, great tombs of stone, which appear to contain bodies of the saints, are each fairly composed of a huge block, of which the exterior alone has the form of a sepulchre..."

"In the Chapel of St. John Baptist, a cross of the fifteenth century, a very rare monument extracted from the ancient crypts of the Innocents, is now placed on a balustrade. This cross finds itself exalted on a column channeled in chevron, in the style of the twelfth century; it is sustained by a bar of iron, without the aid of which it would immediately fall upon the pavement. The Virgin and St. John the Evangelist ordinarily accompany, as is known, the representation of Christ upon the Cross; they thought of placing there the statues of these two personages. It was not very difficult to procure a St. John; but there was a want of a suitable Virgin. What was to be done in this penury? The work was done on the spot, as they had no other designs. The Innocent Apostle was condemned to the punishment of decapitation, and on his masculine shoulders they adjusted the head of a woman with tearful eyes. On the façade, they had travestied the Virgin into a man; they wished to give her some revenge. But unappallingly is in spite of the feminine head and veil, we travellers, or rather we road goers, recognize the poor Apostle, by the book which he carries, and the barrenness of his face..."

"We trust the reader will pardon us such minute details. We have reserved the strongest for the last. They had in their hands the front of a monstrosity, a table in stone, a monstrance made of bronze for people who have seen Rome, and know a little of their catacombs. The front of the tomb, in spite of its purely funereal inscription, has become the front of an altar. If we complain of it, they answer us that it is seen at Rome in all such cases, the marble has been placed, a mere copy of a new one, with Monograms, Fish, and Devices of Albertine origin. It is covered with the grottoes of St. Sebastian. In order to render the illusion more certain, and the parody less imperfect, they conceived the idea of expressing in a lively manner, the defect of paganism, and this is the way they set about it. At the sale of a defunct antiquary, of do not know what illustrious society, they purchased a little marble vase perfectly intact, sculptured with an eagle, and decked with an epiplax. This nothing important vase was destined to become a reliquary. A primitive Christian could not have seen without terror upon an altar, the eagle of the persecutor, and the names of the Di Mares; two strokes of the chisel therefore dealt justice to these pagan emblems, and on the frieze of the eagle, they traced a cross, which they took care to make as awkward as possible, in order to make it pass for the work of a primitive Christian, fanatic and malevolent. It is thus that St. Denis they make a joke of the Christianity of the catacombs."

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SOCIETY OF ARTS, LONDON.

Jan. 14.—JOSEPH PAYNE, Esq., in the Chair.

The first communication read was "On a new Condensing Rotary Steam Engine," by Messrs. CORDES and LOCKE. Models and drawings of the invention were exhibited.

This is an invention belonging to the numerous class of rotary steam engines, but differs from them in two respects. 1st. That whereas they have extensive rubbing surfaces, which require great accuracy and careful packing, and are attended with much friction and loss of power, the newly invented engine has no packing and scarcely any friction, being nearly a wheel or vanes revolving within a case, and receives impact from the steam as it passes from the cylinder to the condenser. 2nd. That whereas the common engine, revolving at high velocities, has to encounter great resistance, the wheel of this engine is driven by a large and very slow paddle, worked by a triple pump, separated from the machinery of the engine. The proof which the patentee offers of the excellence of the engine, consists in the results of certain experiments, made on a large scale, in pumps and in direct compounding, and the results of one of which experiments, it was made to appear that the same general useful effect was obtained from the new as from the old engine, but with a much simpler and cheaper apparatus. The paper concluded with the account of a series of experiments, in which the engine was used as an auxiliary to a common engine, with a gain of one-third more power.

Mr. CORDES gave an interesting account of the working of the engine, and the results of the various experiments that had been made; after which Mr. LOCKE described the mechanism of the engine, Mr. E. Newton, Mr. Rotch, and other scientific gentlemen and engineers, bore testimony to the ingenuity of the invention. The cost of constructing an engine on Messrs. Cordes and Locke’s principle is stated to be from £15 to £20 per dynamometric horse-power, exclusive of boilers, the weight of engine per horse-power not exceeding 4 cwt.

ROYAL SCOTTISH SOCIETY OF ARTS.

Dec. 14, 1848.—DAVID MACLAGAN, M.D., F.R.S.E., President, in the Chair.

The following communications were made:

1. "On the Means of Preventing Accidents to Railway Trains." By J. STEVENSON, Esq., Teviotdale. The members were of opinion that preventing collisions, and for rendering them less fatal when they do happen, prevent collisions, he proposes a break of a much more effectual kind— not rubbing on the tyres of the wheels, but pressing down upon the rail, and at the same time lifting two of the wheels off the rail altogether.

This he proposes to be worked from the last carriage in the train, and gradually to be taken up by the next break in front, and so on to the locomotive. In this way there would be no danger of the carriages in the after part of the train running into those in front when the brakes are applied— To render collisions less fatal, if they should happen, he proposes to have one of the luggage vans, both in front and in the rear of the train, fitted up as buffer wagons, with a set of very strong springs at both ends of the van, so that it will not be destroyed on the stroke, still continuing the usual buffers in all the other carriages.

2. Description and drawing of an "improved Railway Indicator and Alarm." By Mr. ANDREW CARRICK. He proposes that a lever be attached to the locomotive (with a rule joint to prevent its action on reversing collisions), and that when it shall come in contact with a short inclined plane at a certain distance from each station, when the engine should be slowed. The lever is pushed upwards by the incline, and strikes a bell, which gives notice to the engine, especially in foggy weather, immediately to take the steam off, as he is approaching a station.

3. Description of an "Ink to be used in Writing to the Blind, with some remarks on whether the Roman Alphabet should be used, or one of existing alphabets by the Blind." By ROBERT FORSY, Esq. The ink is of a peculiar kind, composed of common ink, acetate of lead, and gum arabic, by writing with which on common paper, the letters, which must be of a tolerably large size, are easily felt and read by the blind. This was proved by a large blind school to read perfectly in fifteen minutes, and Mr. Forsyth has not yet professedly done. Mr. Forsyth also goes into the question, whether it would not be better, in writing to the blind, to have an arbitrary character of easier formation with the pen than the Roman alphabet."
labor on the face, without first measuring them. It is very true that builders, to suit the convenience of some architects, give a price for stone per foot cube, including beds and joints; but before they do so, they first calculate from an average, in the best manner they can, the value of the sawing and setting, and then add it to the price of the stone. The only way to escape from such practices, which save a little trouble to M. Karsiu, doing the work, allows a clerk of the works to measure the stone work, and dispenses with the employment of an experienced surveyor. In the same manner, it might be advocated that buildings should be taken at so much per foot cube, and doubtless this method would save much trouble—but what dependance could there then be in the correctness of the value of the work and labour done?—Ed. C. E. & A. Journal.

The Papworth Testimonial.—Several architectural friends of Mr. Papworth, on his retiring from the profession as an architect, at the age of 70 years, met at Mr. Donaldson's house, in Russell-square, on Monday, the 25th ult., to present him with a beautiful Silver Insketand, "as a tribute of their respect and esteem for his talents as a distinguished architect, and for his worth as a man." The testimonial was presented, with an eloquent oration, by Mr. Cockrell,—the lateness of the month prevents us giving even a brief outline of it, or Mr. Papworth's reply.

INSTITUTION OF CIVIL ENGINEERS.

Jan. 19.—Annual Meeting.—Sir John Rennie, President, in the Chair.

The following gentlemen were elected officers for the ensuing year: President, Sir John Rennie; Vice-President, Sir John Loudon, Bart.; Secretaries, T. M. Rennie and J. L. Lock & Son; Treasurer, Sir J. Macneil, J. Miller, W. C. Mylne, T. Sopwith, R. Stephenson, G. P. Bidder, J. Cubitt, Captain Coddington, and C. Holtzappfel.

Telford medals were presented to Messrs. Barlow, Stoll, Harding, Williams, Parkes, and Ritterband; and premiums of books to Messrs. Turnbull, Heppel, and Robertson.

Council Premiums, consisting of collections of books of considerable value, were presented to Messrs. Barlow, Stoll, and Harding, in addition to the Telford medals. Succinct memoirs were given of the deceased members, Messrs. Crane, Deville, Handlely, and Wissland.

The Report, which stated that the Institution was in a most prosperous condition, entered fully into a description of the alterations of the building during the recent repairs. The principal works appeared to be the remodelling of the basement story, putting a portico at the entrance, and balconies to the first and second floors, and enlarging the theatre. Thanks were unanimously given to Mr. T. H. Wyatt, the architect, Mr. Grisseel, the builder, and Mr. Manby, the secretary, who superintended the execution of the works.

The President's Address.—Sir J. Rennie, after alluding to the stimulus the profession had received from the number of public works recently undertaken, and the high position which the Institution had obtained from the successful labours of its various members, impressed on them the necessity of still further exertions, in order to support the scientific character they had acquired. He then said that all the work having been made in railroad travelling and steam navigation, and made some valuable remarks on the formation of barbours and the drainage of extensive districts of marsh lands. The president then remarked upon the appointment of civil engineers by government into these projects which had been submitted to the Health of Tows Commissioners, and observed, that if the same system had been pursued with regard to railways, the public would have derived infinitely greater advantages than they were likely to do from their present system. Sir J. Rennie concluded his able address by thanking the officers and members of the Institution for their kindness, attention, and support which they had on all occasions extended to him.

Thanks were voted to the president, vice-presidents, and other members of the council, and to the secretary, and the meeting adjourned.

NOTES ON FOREIGN WORKS.

Machine Manufactories in Germany.—The construction of the manufactories established at Esslingen (Württemberg) proceeds rapidly. On the 1st of May last, the building 1,000 feet by 60 feet, was begun, and one half in of the work now completed, and workers are already employed in the carriage department. For removing the single engines, some new water-works are being erected, the establishment having a 100 horse water power at its disposal, the annual expense being about 50,000 florins (approximately £1,500,000, English), and employ 500 workmen. It will shortly be completed, and then Württemberg will not only produce her own locomotives, wagons, and other railway requisites, but it is said that even the Roman lines will be supplied by it. A standing weapon to French rivalry, and the government has assisted it with every facility and aid desirable. The same gentleman was also the founder of the Karsiuahure manufactory, commenced in 1857, which has since 1843 produced an immense quantity of railway implements. It now employs 800 workmen, and since its erection
has constructed 70 locomotives, and 90 are now in hand, for the lines of South Germany, Switzerland, Hanover, Prussia, &c. If the making of turn-tables, bridges, and other structural parts of railways, be taken into account, the activity of these two establishments may be easily calculated. Occupying, jointly, 1,100 workmen, and producing 5,000,000 ft. ($366,000) of iron last year, they may vie in importance with those of Bethnal Green, which have been discovered at Povey, which has filled our antiquarians with envy.

An Italian Model Railway.—The line between Lucca and Pisa has been lately opened, and the communication between the two cities takes place twice a day. For the recreation of the humber classes—five times a day. The line was constructed under the direction of M. Dohlmeyer, a German engineer, and is built in a very workmanlike, sterile manner. Even the carriages of the last class are done every other year, and the road is laid down in that Asiatic climate. The prices are not higher than on the other Italian lines, and the road passes through all the luxuriant olive groves of the Luccese. A person is now able, during one day's stay at Livorno, to see the whole of Pisa, and return to Lucca, having seen the evening to Civita Vecchia,—a forced way of travelling, it is true, but one in accordance with the rapid progress of our times. A steam communication between Livorno and Corsica has existed for some time past; and another with Elba is projected. The line to Florence progresses very slowly—which, however, is rather creditable to the Tuscan government, as the rural communities raise some objections to the intersection of their communal roads, and which the grand duke does not wish to cut through in an arbitrary manner.

Great Scientific Prizes in France.—Our French neighbours regret very justly, the falling into disuse of those prize decrees, instituted by Napoleon, towards which, not merely monetary graspingness, but legitimate emulation, was once aspiring. Still, the prizes proposed every year for the advancement of science are greater in France than in any other country. We now have a return of the French Academy of Sciences' prize of 3,000 francs, "Is the intervention of water, in the state of combination, necessary for effecting chemical reaction between acids and their bases?" This important question has been treated by M. Frémy in his interesting memoir "On the behaviour of acids and bases, deflected by the experiments of this philosopher, that all anhydrous acids (i.e. those deprived of water) cannot combine with bases; which signifies that they have lost their quality of acids. He then proves that the carbonic, sulphuric, phosphorus, and other acids, combine very well, in their anhydrous state, with bases. And it is only those compounds which are both acids and bases in their turn, which require the existence of water for displaying their chemical affinities or action.

The Great Fire in Berlin.—The Berlin government have definitely decided on a line to Köpenick, which will be begun next spring. It is said that this resolution has been hastened by that of the Russian authorities, who intend to construct a line from the Interior to the Prussian frontiers.

Freie-Pallaszera at Rome.—The present severe winter has imparted to the capital of the artistic world a strange appearance: the palaces of the Emperors, the Colosseum, triumphal arches, and temples, are covered with a thick coat of ice, and the wide plain of Latium, from the mountains up to the Mediterranean, is covered with a crust of snow, which even the midday rays of the sun are unable to melt.

Impregnability of Continental Railways in the Winter Season.—All the lines in the north of Germany have been, more or less, interrupted by the late severe frosts; as, for instance, the Berlin and Silesian, as well as the Berlin and Hamburg, which has been opened only recently. It is not improbable that such a season may have been the cause of the recent decision of the Prussian government to construct a line to Köpenick, which will be begun next spring. It is said that this resolution has been hastened by that of the Russian authorities, who intend to construct a line from the Interior to the Prussian frontiers.

Destruction of a high-road near the Rhine by an Earthquake.—A most extraordinary phenomenon, caused by the upheaval of the earth (similar to those which sometimes occur in South America, &c.), has lately taken place at Unkel, on the banks of the Rhine. In this neighbourhood, there exists a quarry of basalt, from which the stone is taken for the high-road. Between this and the Rhine, there is a large gap, which has been formed by the weight passing in the middle of the field. This plain has now been converted into a mount, and the road thrown up 100 feet into the air. The locality resembles a place blown up by the bursting of a mine. Some minutes before the explosion, two places, a terrible roar was heard, like the approach of a hurricane, which caused the mariners, who were passing at the time, to hasten away. This, however, was not heeded by a cartman, whose vehicle, with a load of 5,000 killogrammes, was rolled like a pebble, lifted up in the air, and thrown 100 feet beyond the road. To the north of the basalt stratum extends a vineyard, on a high elevation of ground: this mountain was ripped asunder, at the same time that the plain was upheaved. The appearance of the spot is altogether extraordinary and curious. One of the large churches, of good style, have been lately erected here, likewise two large public fountains, with antique figures and bas-reliefs. Broad footpaths have been laid in the most frequented streets, as far as Portillo, and the square before the church of St. Francisco cascaded, which has been very uncomfortable to the public. High-walled, broad quays line the shore, up to the Villa of St. Lucia;

still, landscape admirers say, that the former rocks and gravel, hiding the sea were more picturesque. An artistian well is being dug in the gardens of the Palazzo Reali, and huge iron gates are being erected, on the grand pedestals of which the two bronze horses, presented hither from St. Petersburg, are to be placed. A large heap of splendid gold coins of the Venetian Republic, has been discovered in the garden of the Villa of St. Lucia;
the end of a practical engineer in this department. Mr. Lloyd, chief engineer at Woolwich Dockyard, is named for the appointment of the steam marine branch, with offices at the Admiralty. Mr. Bigg is appointed second assistant to the chief engineer at Woolwich Dockyard, the increase of the works requiring the addition of a second assistant to the department.

The Tubular Bridges.—The platforms and workshops required for the construction of the Cornish Bridges are in progress. The platform at the Menai Straits will be 1060 feet long. The works will be superintended by Mr. Edinw. Clerk, the resident engineer, whose neatness and correctness in the experiments and other labours connected with this undertaking has been very satisfactory. The New Planet.—Mr. Adams's mathematical investigations are now published as an appendix to the Nautical Almanac. A very clear paper on the subject of the controversy has recently appeared in the Philosophical Magazine. Mr. Adams's discovery is now an established fact, and all further discussion should be abandoned without even the appearance of personal recrimination. Note : toll usilio tempus aget.

Dr. Morse's System of Cerography.—By this invention a map may be drawn as quickly and as well with a pen and ink on paper, as a ground as this perfect as a common copper plate etching ground, and in a few hours, perhaps in a few minutes, obtain from it a type-metal plate, which shall print every point, line, and letter of the drawing under the common printing press as rapidly as newspapers or wood-cuts are printed. Several maps were drawn by Dr. Morse were sent upon the table, whereupon a beauty far exceeding any wood engraving. In particular, the writing on the lines representing water, and which can hardly be done at all in wood, is effected in a manner little inferior to copper-plate. Already, in America, the demand for the most extensive and expensive works, is greater than can be taken off without increasing the number of hands employed in the process. The discovery will add to the heads of the many at the cheapest possible rate. Geographical Society, Jan. 11.

An analysis of Bohemian glass, by Dr. Rowley.—This is the glass so valuable for its infusibility in the manufacture of the combustion tubes used in ordnance. A specimen was found present to the extent of 1/4 of the potash, the glass appears to be essentially a silicate of lime and potash, in which the oxygen in the silicious acid is to that in the bases as 6 to 1. It gave 78 per cent. alkali, 27 per cent. potash, 8 per cent. lime, with small quantities of aluminium, perrico, zinc, magnesium, and oxides of manganese, to make up the 100 parts. Chemical Society, Dec. 1.

COVENT GARDEN THEATRE.

We have had an opportunity of watching the progress of the alterations of this house, from the commencement of the works on the 3rd of December last to the present time, and have been surprised to see such a gigantic concern proceed with so much rapidity. During the two months the works have been in hand the whole of the interior of the theatre, from the ceiling to the foundation, has been taken down; two walls, varying from 3 to 4 bricks thick, and 22 feet high, have been carried up in cement from the floor to the front of the house, and the bases of the house, and the walls erected cast iron columns, 10 ft. 4 in. in front, and 11 ft. 6 in. apart at the back of the boxes, and 6 in. to 8 in. in diameter, from the level of the tier of boxes up to the ceiling, which supports five tiers of boxes. The walls and stairs, surrounded with brick walls, carried up from the level of the ground to the upper tier of boxes and gallery, have been built, and all the stone steps prepared, and the balconies, grand staircase, and the entrance halls and lobbies have been completely changed and re-constructed. When we tell our professional readers that these works have been executed within the short period of two months, out of which three weeks were occupied in pulling down the old interior, we think they will be surprised; and, we must observe, that all the works have been carried on with the greatest dispatch. We are quite mistaken, however, in this respect, as the work has spread that part of the works had failed during the progress. This, we can positively state, is not the case. If there be a fault, it is that too much materials have been used; but when it is recollected the necessity of having saved all the work without waste, this additional strength will not appear superfluous. The decorations will be superbly grand, and are commenced.

From our last view of the premises on the 22nd of this month, we have no doubt of the work being completed, with all the decorations, by the middle of March. Too much praise cannot be awarded to Mr. Albera for his persevering labours in directing the works and labours of from 600 to 700 men, constantly at work night and day. During the progress of taking down the interior fittings, it was discovered that the plates, 9 inches by 6 inches, in the main wall of the building 4 feet thick, were entirely perishable, although they appear to have been of sound Brussels timber when put into the building. These timbers, to the extent of from 600 feet to 900 feet run, have been removed, and replaced with brickwork pinned in with cement. We firmly trust this will be a warning to architects against using large timber plates and bond timber in brickwork. When the whole of the works are complete we will give our readers some detailed account of the extent of the works, to show what may be done by perseverance in a short period.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM DECEMBER 31, 1846, TO JANUARY 21, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.


George David Moore, of Bridge-row, London, engineer and printer, William Cooper, of Saint Paul's Churchyard, bookseller and printer, and Thomas Wansbrough, of Southwark Square, Surrey, tailor, for "Improvements in the manufacture of caps, bonnets, book-covers, and hangers, and hanging cords or bands, labels, theatrical decorations, and coach."—Dec. 31.

Edward Jones, of Great Goldsmith-street, Southwark, engineer, for "Improvements in steam-engines."—Dec. 31.


Clement Augustus Klaat, of Saltford, Lancaster, manufacturer chemist, for "certain improvements in the mode of preparing and using dyeing in the dyeing and printing of woollen, cotton, and silk fabrics."—Dec. 31.

Adrien Cheneau, of Clichy in Garenne, near Paris, for "certain improvements in the treatment of metallic oxides and other compounds, and in apparatus for the same."—Dec. 31.

Charles Dowse, of Camdon Town, Middlesex, gentleman, for "Improvements in apparatus for cleaning, decorticating, to hats and caps, and memorandum and other books."—Dec. 31.

John Clegg, of Oldham, Lancaster, machinist, for "Improvements in looms for weaving."—Dec. 31.


Joseph Barrow, of Sheffield, York, manufacturer, for "certain improvements in the manufacture of knives."—Dec. 31.

Pierre Louis Therese Thièry, of No. 40, Passage Chelsea, Paris, for "an improved instrument for drawing off the milk from the breasts of women, and for relating and protecting the nipple both before and after childbirth."—Jan. 7.

Charles Rumbold Ledham, of Cranven-street, Strand, chemist, for "Improvements in the manufacture of white lead."—Jan. 7.

Joseph Benoît Pietert, of Old Compton-street, Middlesex, engineer, for "Improvements in steam-engines."—Jan. 11.

John Chubb, of St. Paul's Churchyard, London, and John and Rember, the elder, of Wolverhampton, Staffordshire, book-makers, for "Improvements in latches, latch-locks, and other latches for latching and un latching."—Jan. 12.

Douglas Pitt Gamble, of Crewe End, Middlesex, gentleman, for "Improvements in electric telegraphs."—Jan. 12.


John Britton, of Liverpool, Lancaster, chemist, for "certain improvements in machinery or apparatus for printing, ruling, and damping paper for various purposes."—Jan. 15.

Lionel Campbell Goldsmid, of Rue Mogador, Paris, Esq., for "Improvements in applying riders to ships and other purposes." (A communication.)—Jan. 24.

John Fry Poole, of Bolton-le-Moors, Lancashire, book-keeper, for "certain improvements in machinery or apparatus for splitting cotton and other fibrous substances."—(A communication.)—Jan. 24.

Joseph Seraphin Fosco, of Rouen, France, banker, for "Improvements in the manufacture of soap."—Jan. 14.

Alexander M'Dougall, of Edgware, Middlesex, gentleman, for "Improvements in the manufacture of glass, and in treating products obtained in the manufacture of glass."—Jan. 14.


Henry Oxton, of Reborn-hill, London, engineer, for "Improvements in railway vehicles and apparatus connected with railway carriages."—Jan. 16.

Frederick Leonard, of Chester-street, Kensington-town, Surrey, engineer, for "Improvements in obtaining motive power."—Jan. 16.

John Minton of London, gentleman, for "Improvements in rotary engines, and in moving carriages up inclines, and in propelling vessels."—Jan. 19.

John Bond, of Regent Street, Middlesex, gentleman, for "Improvements in certain implements in the cultivation of land."—Jan. 19.

Edward Vickey, of Sheffield, Yorkshire, machinist, for "Improvements in machinery for cutting fires." (A communication.)—Jan. 19.

Towers Shears, of Bankside, Southwark, for "Improvements in cutting staves for the purpose of producing staves inlays, which improvements are applicable to the production of other oars and models."—Jan. 19.

Thomas Dektin, of Kings Norton, Worcester, engineer, for "Improvements in the construction and arrangement of machinery to be used in cutting, stamping, and pressing."—Jan. 21.

Thomas Goulot, of Cailea, France, engineer, for "Improvements in rotary steam-engines."—Jan. 21.

George Beadon, of Tuxton, Somertown, commander in the navy, and Andrew Smuth, of Princes-street, Leicester-square, Middlesex, engineer, for "Improvements in warping and veiling vessels, which improvements are also applicable to moving other bodies."—Jan. 21.

To CORRESPONDENTS.

Sir Howard Douglas has sent a valuable paper on the Strength and Stability of Hungerford Bridge, which we regret being compelled to postpone till next month.

In reply to the inquiry respecting the dimensions of the model experiment upon at Millwall last month, we refer to the number for October 1846. The dimensions there stated were the same as in the recent experiments, except that the thickness of the bottom-plate which has no cellular compartments, was doubled for twenty feet on either side of the centre.
ARCHITECTURAL CARVING.

(With an Engraving, Plate VII.)

Fig. 1.—Roof of Ravensworth Castle Dining-Room.

Fig. 2.—Stone Window—Carlisle Cathedral.

Fig. 3.—Inlaid Stone Paving—Great Malvern Church.

To our strong consistent advocacy of the introduction into architecture of real materials, which in modern times have been supplanted by counterfeit, one of the most obvious objections is—where is the money to come from to produce such an architectural effect as we are enabled to do by the aid of compo, papier mache, composition, and such productions? The ornamental work of the Italian facade architecture exemplifies the nature of the effect produced. Abstract reasoning is wasted on these reasoners: perhaps a reference to the practical effect of their doings may throw light on the subject. No doubt they succeed in producing a momentary effect on the spectator when the building is first cleared of its scaffolding—but how long does cheap splendour last? Let the unbiased spectator walk up Regent-street—Regent's-park—on the terraces at Brighton—and view the motley appearance of the buildings; some of one tint and some of another; one half of a pediment light stone, the other half a dark stone tint; the divisional line of two houses continued down to the ground through the blank windows, and half a column to each;—and let him take into account the weather-marks of the winter months, and the peeling off here and there of the dishonest integument, and he shall allow that these patches and stains are as motley as the rags of poverty,—it is but a beggar's dress which is held up for his admiration.

It is not to be inferred that, because we condemn the imposture when unsuccessful, we condemn it because it is unsuccessful. Deceit and trickery are not the less detestable because they are occasionally practised as well as to escape detection. These plaster-clad edifices have a multitude of faults besides the patchwork. To take one of the most practical arguments as most suited to the capacities of those who constitute our opponents—the stucco usually disguises wretchedly inferior brickwork, of bad materials imperfectly put together. The vile pretenders assume the appearance—the strength of stone masonry, while they have not even the ordinary stability of
brickwork. They are like the feeble beast in the fable, who indeed himself with the skin of the lord of the forest.

Not unfrequently they are prostrated in ruin, the result of their own pretensions. Some of these vile showy structures in the new metropolitan streets have recently fallen in this manner. We are not destructionists, but we rejoice greatly at the intelligence. If one would compare the mere workmanship of plastered and unplastered houses, let him compare those of Regent-street with the adjacent Hanover-square. In the latter place, the honest homely bricks show themselves plainly, as if they had nothing to be ashamed of. But an honest builder could have taken no pride in his work when “running up” the neighbouring linen-drapers' palaces. Decelt begeta dishonesty: a good bricklayer will soon become a bad one when he knows that his work will be concealed by white alime. He has no gratification in doing his work well—he shirks it and cheats his employer.

To assist the architect in carrying out the system we so strongly advocate, has been brought to his aid in rendering the productions of carved work less costly than when produced by manual labour. It is our intention to direct attention to the merits of such works. We have already noticed the Patent Architectural Carving Works, in Euston Road, 2006, and explained the machinery. The experience of two more years has enabled the proprietors to adapt the machinery to works that were not originally so produced. In the show-rooms may be seen architectural perforated panelling for gallery fronts, parapets, ceilings, roofs, and wainscoting, latticework, furniture, church screens, and other works, generally possessing the merit of correct design and perfect workmanship. One of these elegant screens we have shown in an Engraving (Plate VII). It has been lately erected at Great Malvern church, in the archway of the chancel, and is entirely executed in wainscot by the aid of the machinery of the Patent Carving Works, at a very small cost; its length is 16 feet, and height nearly 12 feet.

The annexed wood engraving (fig. 1) is another happy example of the application of the labours of the same Works; it shows the truss of an open timber roof, 30 feet span. There are eight of these trusses, together with the moulded purlings, ridge piece, cornice, rafters, &c., all executed in oak, for Ravensworth Castle dining-room. The roof is 30 feet span, and 70 feet long.

Another specimen, in a different material (fig. 2), exhibits the head of a window. This was executed in Caen stone, for Carlisle Cathedral.

Fig. 3 is a specimen of laid stone paving, which was also executed by the carving machinery for Great Malvern church.

The Company have recently executed various other works, among which we may mention the flooring of Sir Robert Peel's Picture Gallery, and a beautiful stone screen for St. John's Church, Stratford, in Essex, which has excited great admiration.

It will be seen from the drawings we have given, and the prices, that ornamental architectural works, of a highly ornate style, may be produced in real materials, at about the same price as the counterfeit, when we take into consideration the cost of staining or painting, graining, and so forth. Much may be done if the architect will devote his attention to the subject, and get rid of the prejudices which he has been led into by a false education—let him well study proportion. More is produced by this in a public building than all your exuberances of enrichments, which are too often applied as if the structure were intended to be the show-building of a plasterer or artificial ornament manufacturer.

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NOTES ON ENGINEERING,
No. VII.

THE FORM AND EQUILIBRIUM OF ARCHES.

The object of the present paper will be to explain a few theorems respecting the equilibrium of arches, which are very simple, and of great practical importance. They may, however, be prefixed by a notice of the authors who have already written upon the subject.

It may be considered certain that the medieval architects, notwithstanding their extraordinary skill in constructing arches and flying-butresses, and in determining the position and dimensions of piers and buttresses, derived their rules from experiment, and not from theory. This opinion rests upon the authority of the most eminent architectural writers of the present day, among whom may be cited Professor Willis, who fortunately is able to combine two very different kinds of knowledge, which are both necessary for the examination of the subject—archaeology and mechanical philosophy. Parent and De la Hire, who wrote about 150 years ago, seem to have been the first who endeavoured to give a mechanical theory of the arch; and since their time, the number of writers upon the same subject has been extremely numerous, and has included some of the most eminent mathematicians in Europe.

It would occupy too much space to notice the labours of these authors, or even to enumerate their works. But a sufficiently distinct notion of them may be obtained by considering them divided into two distinct classes, who investigated the theory from two altogether different points of view. The first class—the earliest and the most numerous—directed their attention chiefly to the conditions to which the component stones of an arch must be subjected in order that they may not slide upon the surfaces of mutual contact. The second class consisted of those who neglected this idea of sliding altogether, and confined themselves to the conditions necessary to prevent the joints from opening. The first class includes the names of Couplet, Bernouilli, Belidor, Coulomb and Bosois, continental writers, who have been followed by Hooke, Gregory, Hutton, Emerson, Whewell and Gwilt, in this country. Many of these writers have considered the arch as composed of perfectly smooth voussoirs, and sustained independently of friction—in this condition the arch is said to be "equilibrated."

Now this theory of the arch, though long in vogue and sanctioned by the highest authority, has been found practically insufficient for the purposes of the engineer. As a matter of fact, the voussoirs of arches have always so great friction that they never slide upon each other. The old theory, therefore, aperceived about an accident which experience showed to be never likely to occur. Consequently the investigations, though frequently exhibiting extraordinary mathematical research, and leading to very beautiful results, could scarcely be of any direct value to the practical engineer; and accordingly, a writer, who has taken the highest position in this country for his practical applications of mechanical principles—Professor Moseley, has in his writings entirely excluded the speculative investigations just mentioned, and has confined his attention to the statical conditions necessary for preventing that accident which may and does occur—the opening of the joints.

In this pursuit we shall endeavor to follow him. It has unfortunately happened that though his principles are characterized by extreme acuteness, the results are frequently too complicated to be of value to an engineer. Now what will be here attempted, is to establish a few general propositions which are frequently unknown or misapplied, and to give some methods by which the form and thrust of arches may be calculated—not with anything like the generality and precision studied by Professor Moseley, but with accuracy quite sufficient for ordinary purposes, and with perfect facility of computation to all who are acquainted with common arithmetic.
There are three conditions to be considered as affecting the equilibrium of the arch—1st. The form and dimensions of the intrados or internal lower curve of the arch; 2nd. The form and dimensions of the extrados or external curve of the arch; 3rd. The weight and disposition of the loading. The first condition of course includes the rise and span; the second, combined with the first, is equivalent to a determination of the depth of the voussoirs; the third includes the external forces to which the system is subjected; for we suppose that not only is the weight of the loading known, but also the manner of its distribution—that is, whether and in what degree its specific weight or density varies in different parts of it.

But, it may be asked, is not this enumeration of the conditions of equilibrium imperfect from the omission of the form, number, and position of the joints? The answer to this question is important, because it exhibits in the strongest light possible the distinction between the ancient and the modern theory of the arch. It is manifest that the extrados and intrados, which have been enumerated as two of the "conditions," simply define the depth of each voussoir and the form of its upper and lower curved surfaces: the lateral dimensions of the voussoir, and the form of those surfaces of it which are in contact with the adjacent voussoirs, are as yet left indeterminate. Consequently it is not known how many joints there be, or even whether there be any joints. Neither is the direction of the joints ascertained; they may be plane converging joints, or they may be "jogged," or all vertical, or all horizontal—(as an instance of the latter case may be cited the Treasury of Atreus at Mycenae, where the stones are not wedged together, but are merely disposed in horizontal courses, each resting upon and over-lapping that beneath it, the whole being hewn in such a form as to give the structure the appearance, but not the mechanical proprieties, of a dome).

It is as well to consider these objections in limine. The answer then is this. The theory which Professor Moseley has exclusively, and Professor Whewell and other writers partially, adopted, and which we are endeavouring to set before the reader in a new form, presupposes that the stones are sufficiently coniform to be incapable of sliding past each other; but further than this no consideration is paid to the form of the bed-surfaces. The mutual friction of the voussoirs is so great, that there is not the least difficulty in so shaping them, that the arch shall not fall by their sliding past each other—that accident, as has been said, is never known to occur. So that the precautions under this head being perfectly obvious, the theory does not at all deal with them, and, as we shall see further on, is independent of the form and direction of the joints—or to speak more precisely, the theory shows how to ensure the stability of the arch, whatever may be the inclination of the beds, &c., however numerous, or however few they may be; so that the structure should stand even if intersected by infinite number of joints running in every possible direction—provided always that they were sufficiently convergent or joggled, so that the voussoirs could only fail, if they did fail, by opening, and not by slipping.

The reader who approaches the subject for the first time will not perhaps perceive at once the full effect of these observations. But his attention is now directed to them, as he will be left hereafter to apply them for himself to the cases particularly discussed. Returning now to the three "conditions" which have been enumerated, we find that they give rise to four distinct problems—three of the problems arise from combining any two of the conditions as data to find the third, and the fourth problem arises from the combination of all three conditions considered as known data. The four problems are these—

1. Given the distribution of the loading and the intrados to determine the extrados proper for stability.
2. Given the distribution of the loading and the extrados to determine the intrados proper for stability.
3. Given the extrados and intrados to determine the distribution of the loading proper for stability.
4. Given the extrados, the intrados, and the amount as well as distribution of the loading to find the consequent horizontal thrust of the arch.

It will be observed that the absolute weight of the loading is taken into account in the fourth problem only; in the other problems the relative weight is alone considered; in other words, the form of the arch is connected not with the actual amount of the external forces, but with the relation or comparative amount of those forces, as they vary in different parts of the structure. It may perhaps be as well to recollect that in this respect there is an analogy between the arch and the other two contrivances employed for spanning the interval between piers or abutments—namely, the catenary and the girder. For respecting the catenary, it is known that if a heavy cable and a fine thread, both of the same length, span the same distance, they will assume the same form; and this similarity of form will be observed either when the cable and the thread are each of uniform thickness throughout its length, or when (the thickness not being uniform) the law of variation is the same for each. Also the form of the girder of uniform strength, or the variation of the sectional dimensions of a girder that it may be equally strong in every part, depends not on the actual amount of the load, but on its distribution or comparative weight in different parts. This digression will not appear superfluous when it is considered how much the physical conception of a subject like the present is cleared by a distinct apprehension of its relations to kindred subjects.

We shall take the fourth problem first, because it is the simplest. Here, however, as elsewhere, it is simply intended to show how much may be done by very simple calculations—the discussion of the problem in all its generality, and with perfect accuracy, will not be attempted.

**Thrust of Arches.**

The thrust or horizontal pressure of the arch tending to push its abutments outwards is the distinguishing characteristic of that structure. This kind of force does not exist in the other contrivances for spanning the intervals between abutments. The suspension chain, attached at its extremities to the summits of two towers, exerts at those points a horizontal force inward, equal to the tension of the catenary at its lowest point. In the beam or girder, the forces of tension and compression are equal and opposite, and there is, therefore, no external horizontal force on the abutments.

The following method will explain the cause of the horizontal thrust of the arch, and serve in estimating its amount. Let the accompanying diagram represent the half of an arch, and its own load considered as a separate statical system. And to make the case simpler, let us suppose the load on the half arch sustained entirely by it, and not supported in any way by the contiguous portions of loading on either side of it, which are supposed to be removed. The half-

![Diagram of Arch](image-url)
Let it also be supposed that the half arch removed had the effect of exerting on the half arch represented certain pressures, of which the resultant is a force $P$, acting at some point $d$ in the crown. $P$ will be wholly horizontal. If the two halves of the arch be similar and similarly circumstanced. For, if every part of their mutual pressure were vertical, it must act upward on one half arch; and in the opposite direction, or downwards, on the other half arch. And this is evidently inconsistent with the hypothesis that both half arches are similarly circumstanced.

The other forces of the system are its pressures upon its abutment. These pressures will have a single resultant, acting at some point, $c$, and by equalizing the vertical and horizontal forces, it follows that the components of this resultant are an upward vertical force equal to the weight of the system ($W$), and a horizontal force equal to $P$, but contrary in direction.

Now, the tendency of the weight $W$ to turn the half arch about the abutment may be considered the cause of the force $P$ at $d$ being called into existence. As no horizontal forces but those mentioned are supposed to act, the horizontal force $P$ exists in every part of this arch.

Draw $a$ horizontal, and $G$ vertical from $G$ the centre of gravity of the system; this latter line is that in which the weight of the system acts. Draw also $c$ vertical.

The vertical distance of the upper force $P$ from $a$ is equal to $c + d$, and the horizontal distance of the force $W$ from $a$ is $a$. The moment of $P$ about $a$ is therefore $P \times c + d$, and that of $W$ is $W \times a$; these moments are equal to each other.

\[ W \times a = P \times c + d, \text{ or } P = \frac{W \times a}{c + d}. \]

If, therefore, we knew the exact value of $ab$, $cd$, and the total weight $W$, we should be able to get $P$ at once from the above simple equation. But, in fact, we do not know the exact point $a$, which is the point of application of the resultant of the forces at the springing; neither have we ascertained the exact point $c$. All we know of either point is that it is somewhere between the extrados and intrados at the springing and vertex respectively.

It is not necessary, however, for our purpose to define either point for the limits assigned for its position are generally small enough to define $P$ from the above equation with sufficient accuracy for practical purposes. By referring to the equation, it will be seen that the greatest value of $P$ is derived from giving $ab$ its greatest, and $cd$ its least, possible value; and conversely, the least value of $P$ is derived from giving $ab$ its least, and $cd$ its greatest, possible value. The real value of $P$ lies between these limits.

1st. The greatest value of $P$ is derived from giving $ab$ its greatest and $cd$ its least value; which conditions are satisfied by supposing $a$ to be in the extrados at the springing, and $d$ in the intrados at the vertex. Hence, from the equation we get this rule—The greatest value of the horizontal thrust is derived from multiplying the total weight of the half arch by the horizontal distance of its centre of gravity from the springing of the extrados, and dividing the product by the least height of the arch, or the height of the vertex of the intrados above the springing of the extrados.

2nd. The least value of $P$ is derived from giving $ab$ its least, and $cd$ its greatest value. Hence, $a$ must be taken in the intrados, and $d$ in the extrados; and the corresponding rule will be—Multiply the total weight of the half arch by the horizontal distance of its centre of gravity from the springing of the intrados, and divide the product by the greatest height of the arch, or the height of the vertex of the extrados above the springing of the intrados.

Having obtained these rules we may proceed to practical illustrations of them. It may however be first observed that their accuracy depends entirely on the supposition that the half arch does not sustain horizontal pressures from the effect of the loading; if it did, the horizontal thrust $P$ at $d$ would no longer be equal to the $P$ at $a$, fig. 1.

Let us take the case of a half arch, $a' c' d'$; supporting a mass of masonry above it, as in the accompanying figure 2. This would be the case of a gate-entrance, or arch beneath a tower. If the tower be lofty compared with the rise of the arch, we may suppose $G$ the centre of gravity of the half load centrically situated. This hypothesis saves the trouble of calculating the position of the centre of gravity of that part of the masonry which is situated in the spandril of the arch: the weight however of that portion must be included in the total load $W$; taking $G$ in this position, then the rest of the calculation is very simple. Draw the vertical line $b$, indicating the direction in which $W$ acts. Then, as we have already shown, the greatest and least values of the horizontal or lateral thrust are respectively,

\[ \frac{a+b}{c+d} \text{ and } \frac{a' + b'}{c'+d'}. \]

Suppose, for example, that the weight of the masonry $W$ is 20 tons; that by measurement $e' d'$ the least rise of the arch $= 8$ feet, and $a b = 4$ feet, (the span of the arch being about four times as much), then we get immediately the greatest value of the thrust $= 20 \text{ tons} \times \frac{a}{c} = 10$ tons. And suppose it to be also found by measure that $c' d'$, the extreme rise, is 9 feet, and $a' b' = 3.5$ feet, then the thrust $= 20 \text{ tons} \times \frac{a'}{c'} = 9 = 7.5$ tons.

Now it will be observed that between the greatest and least value of the thrust so obtained $(7.5$ and 10 tons), there is a considerable discrepancy, namely, upwards of two tons. But it is to be remembered, that methods here explained, though founded on exact principles, are merely approximative; and, moreover, we have purposely chosen a much more unfavourable instance than will generally occur in practice.

In making a section, as in the above figure, dividing the arch and its loading into two parts, it is virtually assumed that the part of the loading which is represented in the figure is not subject to forces arising from its connection with the part supposed to be removed. That, in general, this hypothesis is nearly correct, will be allowed when it is considered that the masonry of the superstructure is laid on gradually in successive horizontal courses, and that each stone is supported in its place by those below it, and has no tendency to roll over or move sideways. Where the workmanship is accurate, there will be little strain between the two halves of the load, except from "setting" or similar accidental causes, the nature of which precludes specific calculation.

The above method of determining the thrust cannot apply except when the form of the structure is such as to allow of a tolerably accurate guess as to the position of the centre of gravity of the load sustained by the half arch. This can only be made where the specific gravity of the loading is uniform, and the structure is so lofty compared with the rise of the arch, that the mass contained in each spandril is too small to materially affect the centre of gravity. Where, however, the rise of the arch is considerable compared with the dimensions of the superstructure, we may resort to the following method, which will be found very convenient, and which will have the advantage also of determining the thrust when the loading is heterogeneous.
Let $ABFH$ represent the vertical section of the half arch; the part of the load below $B$ (in the spandril) bearing a considerable proportion to the part above $B$. And to take all the variations of circumstances at once, let us suppose that it has been found necessary (from considerations which will be referred to hereafter) to load the arch with heavier materials in one part than in another, for instance, with light sandy ballast near the vertex, and heavy granite rubble towards the springing.

Instead of taking the load as before, as a single mass, consider it made up of several portions, as in the figure. Let the part in the spandril be taken as two (nearly) triangular masses or prisms, $AEC$, $CDB$. The forms of the rest of the loading will depend upon the nature of the superstructure. But where the upper line, $FGHB$, is a horizontal straight line, we may consider the rest of the loading as rectangular masses, $EFCG$, $DGB$.

One of the advantages of this hypothetical division of the loading is that it enables us to estimate the effect of variations in the density of the ballast. For example, $AEC$ may be one kind of ballast, $CDB$ a second, $EFGA$ a third, and $DGB$ a fourth. The first operation in the calculation will be to find the weight of each portion as nearly as possible. This will easily be done (the form of the arch and superstructure being already determined) by estimating the cubic content of each portion, and multiplying this quantity by the weight of each cubic foot of the material employed. It is scarcely necessary to observe, that the weight of the voussoirs themselves must be included in the lower or triangular portions.

The weights being found, there will be very little difficulty in ascertaining their effect or moment in producing the thrust. Let $g$ be the position of the centre of gravity of the lower triangle. By a known property of the centre of gravity of triangles, $ag = \frac{1}{2} EC$. Now, $ag$ is equal to the horizontal distance of the centre of gravity from $A$, and therefore determines the moment. Hence the weight of the triangle $AEC$, multiplied by $\frac{1}{2} EC$, is the moment of that portion about $A$.

Similarly, in the triangle $CDB$, if $g_s$ be the centre of gravity, $eg_s = \frac{1}{2} DB$. Therefore, the horizontal distance of $g_s$ from $A$ is $EC + eg_s$; the moment of the triangle $CDB$ is, consequently, its weight multiplied by $(EC + \frac{1}{2} DB)$.

The two parts $EFGA$ and $DGB$, being rectangles, their centres of gravity may be considered as situated in the centres of those figures. Consequently, $Dg_s = \frac{1}{2} FG$; and $Dg_s = \frac{1}{2} GH$. On the whole, then, if we call the first mentioned weight $W_1$; the second, third, and fourth, $W_2$, $W_3$, $W_4$ respectively, we have for the sum of the moments, the expression

$$W_1 \times \frac{1}{2} EC + W_2 \times (EC + \frac{1}{2} DB) + W_3 \times \frac{1}{2} EC + W_4 \times (EC + \frac{1}{2} DB)$$

Adding these moments together, and dividing by the height of the arch, the result or quotient is the amount of the thrust.

This method, like the one first explained, merely suffices to indicate the limits within which the value of the thrust lies. There will be, as before, a maximum and minimum value, but the difference between them will be very small, except where the voussoirs are of great depth compared with the other dimensions of the arch. The maximum will be determined by estimating the horizontal distances of the weight from the springing of the extrados, and by giving the rise its least value, namely, the vertical height of the vertex of the intrados above the springing of the extrados; and conversely, for the minimum value of the thrust, the horizontal distances of the weight must be measured from the springing of the intrados, and the rise must have its greatest value, namely, the vertical height of the vertex of the extrados above the springing of the intrados. With these limitations, the following is the general rule for calculating the thrust:

Consider the loading as composed of triangular and rectangular portions. Multiply the height of each portion by the horizontal distance of its centre of gravity from the springing. The sum of the products divided by the rise of the arch gives the value of the horizontal thrust.

To take an instance in illustration of the rule, suppose that in the last figure, the rise of the arch is 19 feet, and $EC = 8$ feet, and $DB$ also $= 8$ feet, in this case the rise of the arch will be about 9 feet less than the span. Also let $W_1 = 4$ tons, $W_2 = 2$ tons, $W_3 = 5$ tons, and $W_4 = 5$ tons. The moment of $W_1$ will be $4 \times \frac{1}{2} EC = 8$. The moment of $W_2$ will be $3 \times (EC + \frac{1}{2} DB) = 24$. The moment of $W_4$ will be $5 \times EC = 40$. The moment of $W_3$ will be $5 \times (EC + \frac{1}{2} DB) = 40$. The sum of these moments is 95, and this quantity divided by 19, the rise, gives 5 tons for the value of the horizontal thrust. If the above admeasurements be supposed to correspond to the maximum value of the thrust, a second calculation must be made, as above explained, with the admeasurements corresponding to a minimum value. The true value will lie between these two results.

Of course, where further accuracy is required, the load in spandrels may be considered as divided into three or more triangular portions, with as many rectangular portions above them. As the divisions are perfectly arbitrary and hypothetical, they may not only be of any number most convenient, but also the intersecting lines may be taken wherever they afford the greatest facility of calculation. In a four-centred arch, for instance, a vertical division may be made where the segment of short radius ends and the segment of large radius begins; or if there be an abrupt change from a heavier to a lighter loading, the vertical line at the place of change may be adopted in the calculation.

It must be carefully borne in mind, that the whole of these investigations presuppose that the only external forces are vertical weights. Where the loading rests firmly on the arch, and has no tendency to slide down the side of it, the hypothesis is strictly true; but in the case of a series of arches, as in bridges, the spandril which adjoin at each pier are filled up simultaneously by throwing in the ballast, till it reaches the intended height of the roadway. In this case it is clear that unless the ballasting were rammed hard, or concreted, the removal of the portion in one of these spandris would cause the portion in the other spandril to slide down. Here, it is obvious that the two portions of the loading exert a mutual horizontal pressure, by which each prevents the other from slipping. This horizontal pressure must, in considering the equilibrium of each half arch separately (as
has been done above), be reckoned among the external forces of the system. The thrust of the arch is uniform in every part of its haunch where there are only vertical forces. But were the horizontal external pressures just alluded to exist, the thrust of the arch will be greater at the crown than at the abutments—being greater than we have calculated it at the crowns, and less than we have calculated it at the abutments. It seems impossible to calculate the amount of this alteration, for to ascertain it we must know the mutual pressures of the contiguous portions of the building, the friction of the materials, and the degree of cohesion produced by ramming or settling—effects utterly beyond calculation. It may be observed, however, the ballast will generally be so firmly compacted that the part of each spandril, even if unsupported, would in most cases have little tendency to slide; and therefore where this precaution is used, the above methods will answer all practical purposes.

Sometimes the voussoirs of two arches, which spring from the same pier, do not rise independently, but are built together, and press upon each other at their extradoses for some distance as they rise together from the pier. It is clear that for the purposes of our calculation, the springing of each arch must be reckoned to commence from that point where the adjacent arch ceases to affect it. Wherever the spandril of the contiguous arches are connected near their springing by small inverted arches (as in Blackfriars bridge), the modifying effect of these subsidiary structures must be taken into account. The thrust in such cases can only be reckoned for that portion of the main arch which is not affected by the contiguity of the other arches.

The general conclusion from the above reasoning is, that the smaller the rise of the arch in comparison with its width, the greater cæteris paribus will be the lateral thrust (of course these conclusions cannot be applied to the platebands or flat arch, where the depth of the voussoirs is so great, compared with the other dimensions, that the methods given above are totally inapplicable). As instances of this truth, may be cited the lofty Pointed arches of cathedrals, which frequently sustain enormous weights without exerting great lateral thrust. But it may be as well to refer, in passing, to an erroneous notion which is frequently entertained, that because high Pointed arches can sustain great weights, they therefore ought to do so for the sake of their stability. An idea of this sort is expressed in Prat's Principles of Mechanics, and is supported by very confused and perfectly inapplicable reasoning; as has been already said, and will be proved hereafter, the form of the arch depends not on the amount of the loading, but on the distribution of it.

To return from the digression—we easily see that the limiting cases of the general conclusions just stated respecting the thrust of the arch are these. If the arch were quite flat (the voussoirs not being of appreciable depth), a finite load would produce an infinite lateral thrust: again, were the arch so lofty that its span could be considered inappreciable in comparison with its rise, the greatest load would produce no horizontal thrust at all. In fact, this last hypothetical case is equivalent to that of a weight sustained by vertical posts or columns.

The consideration, that the thrust of the arch depends only on the rise and span—that the form does not affect the thrust (except indirectly, by influencing the position of the centre of gravity of the load)—forms an appropriate introduction to the investigation of the lateral pressures of groined vaulting. In plain cylindrical arches, the thrust determined above is distributed in lines parallel to the axis of the arch throughout the whole of the springing. Consequently, it acts on the piers of a bridge (to take an instance) along a surface of which one of the dimensions is the breadth of the roadway, and may in general be considered as uniformly distributed. But if we take the case of double or intersecting groined arches resting, as supposed in the following diagram, on four detached piers, the amount of surface over which the thrust will be distributed is diminished with the diminution of the horizontal dimensions of the piers. In this case also the double arch will exert a double set of thrusts. Supposing the plan a rectangle, and that the arches and the distribution of the loading are perfectly symmetrical. Let 

\[ \begin{align*}
  a, b, c, d, & \text{ be the four piers,} \\
  k & \text{ the keystone or boss. Also let } P \text{ be the thrust arising from the arch of which the axis is parallel to } f g \text{, and let } Q \text{ be the thrust arising from the arch of which the axis is parallel to } e d. 
\end{align*} \]

We may suppose that the forces at } a, b, c, d, \text{ are all equal to } P, \text{ and the forces at } e, f, g, h, \text{ are all equal to } Q, \text{ since we have supposed the two halves of each arch to be under exactly the same circumstances.}

Now, if we take moments about } a, c, \text{ for the half arch, of which the axis is parallel to } a, c, \text{ no other moments will appear in the equation but that of the pressure at the crown of this arch, and that of the weight resting upon it. Hence the strain } P \text{ is determined by the rules already laid down for single cylindrical arches—that is, it is equal to the moment of the weight divided by the rise of the arch. In the same way is the pressure } Q \text{ determined. And hence we arrive at the conclusion, that the total pressure on any one of the four piers, may be considered to be made up of two component forces—the thrust of each of the two arches considered separately and independently of the other.}

It may so happen that the form of the groining materially affects the position of the centre of gravity of the loading. There will not however be generally much difficulty in estimating the moment of the weight by methods analogous to those already described.

This is as much as it seems necessary to say at present respecting the thrusts of arches. Of the means of resisting these thrusts, or of fixing the dimensions of the buttresses or piers which sustain them, mention will be made hereafter. In conclusion, it may be observed, that though these methods are confessedly approximative, they appear quite as much entitled to confidence as others of a more elaborate nature. M. Garidel bas, with wonderful ingenuity and labour, formed tables of the thrusts of arches (Poussées des Voûtes), calculated from a long mathematical formula, analogous to that arrived at by Prof. Moseley. Respecting, however, all long mathematical formulae applied to practical mechanics, we are convinced, from considerable experience, that the following strictures are correct—first, these formulae are too difficult to be employed by the engineer; secondly, if he could employ them, it would not be worth his while to do so—for they generally neglect some practical circumstance which entirely destroys their accuracy. In the case, for instance, of M. Garidel's tables and Prof. Moseley's formulae, both proceed on the supposition that the materials of the voussoirs are perfectly onyielding and mathematically adjusted. If, by the slightest settling, the point of application of the resultants of the forces at the crown and springing be altered, the whole investigation fails. It is also obviously impossible to estimate rigorously the effect of the cohesive forces between the contiguous portions of loading resting on a series of arches; and the heterogeneity of the materials is an insuperable obstacle to any but approximative calculation.

H. C.
ON THE DESTRUCTION OF MOUNTAINOUS FORESTS AS THE CAUSE OF LATE INUNDATIONS.

The dreadful disasters which have, of late, visited several of the French Departments, have induced the secretary of state for public works to order the subject to be investigated by competent persons; and we desire the following particulars from the reports of Messrs. Blanqui, Massié, and Bubichon:

In several parts of the départements d'Isère, des Hautes et Basses Alpes, and du Var, especially in the mountainous regions, the destruction of forests has not only caused the disappearance of vegetable fuel, but even springs and courses have vanished, and the soil has been carried off by the force of torrents. About Grémole, this inconvenience has reached so far that the peasants are obliged to pluck their bread on the excrescences of cattle, &c. The abuse of out-wooding, tillage, and pastures, deprive the soil of mountain-slopes of all cohesion, and no resistance whatever is offered to counteract the action of floods or heavy rains. The rapid slope of mountainous terrains increases this evil, and the loose and detached soil rolls, in the form of a torrent of black lava, into the valleys, where it spreads over plains which are either already cultivated or at least fertile. Oftentimes, a whole mass of earth is thus detached from a mountain, which thereby becomes visibly indented. Nothing can equal the scene of such terrible interruptions. Immense beds and layers of pebbles and débris, to the depth of many yards, cover the plains, and neutralise and destroy for ever the fertility. Trees and other vegetation vanish under the pressure of these débris; and the beds of rivers and streams, gradually heightened, reach at last the piers of the bridges, which are carried away.

Such are the effects of out-wooding a terrain. And as the forests consist, in the above-mentioned parts of France, merely of underwood, and are generally composed of fir (coniferous) trees, which do not grow again from their roots when once cut, the evil will become irrecoverable if no remedy be devised for it. In several localities, not a tree has been left; and as the peasants, therefore, have recourse even to the shrubs and brambles, M. Blanqui thinks that, fifty years hence, France and Piedmont will be separated from each other by a desert, as in the case of Egypt and Syria!

The diminution of springs and sources is seriously felt in the départements of the Basses Alpes and du Var, in some of whose ravines and slopes all vegetation has also vanished. If a gale floods such localities, torrents sweep these desolated places, which neither cultivate nor fertilise them. As population increases and accumulates in other places, even the steep slopes of mountains are put under tillage, which still more augments the existing evil. The measures which have been hitherto resorted to, to bar these inundations, are—says M. Blanqui—both inefficient and unsystematic. The owners of the lands on the banks of rivers and torrents quarrel and litigate, instead of combating against the common enemy. Nothing can be more strange than the aspect of these isolated, ill-concerted works—here and there an embankment, a wall of piled-up stones, a coffer-dam of wood, or some patches of masonry. M. Blanqui thinks that none but government, aided by the combined efforts of competent surveys and scientific systematic construction, can properly stay these yearly-increasing devastations: as both for the re-plantation of out-wooded terrains and the embankment of the rivers, the skill and capital available by private persons, will ever be insufficient.

In the Pyrenees, also, the out-wooding of terrains, inundations, and scarcity of crops, have gone hand in hand. The area of forests which belonged to the crown, at the end of the sixteenth century, was equal to 250,000 hectares, which, in 100 years, was reduced one-half; and, at the end of the last century, amounted merely to 40,000 hectares. The out-wooding of private forests has been on a great scale as those belonging to the crown. Thus, the outskirts of the Pyrenees, which once yielded a superior kind of timber for naval and structural purposes, are now scarcely sufficient to supply to the inhabitants the necessary quantity of fuel. Tillage has also been carried out to a senseless degree; and after the slopes have been put under cultiva-

tion, even the very crags of the mountains are taken possession of—and here also, every inundation, however slight, sweeps all traces of vegetation and soil into the bed of the Gourone, and the Mediterranean.

We broach this subject the more eagerly, as ample allusion has been made thereto in the “Atti dei Selvatici d’Italia,” Florence, 1844, 4to.—whence it appears that the same causes, and the same pusillanimity and insufficiency of remedies, exist in nearly all the mountainous parts of the Italian peninsula.

J. L.—Y.

ON THE PHYSICAL IMPROVEMENT (ATHLETISING) OF ARTISTS.

“Mens insana—sine corpore sano.”

History ought to be, and can be, the teacher of every one—not merely the warrior and statesman, but of every one; for history does not comprise merely the fates of such men, but of all men. We do not think that our “young architects” (artists) have ever directed their thoughts to those unobtrusive, but unrepeatable lessons and hints, which history has so extensively placed before them. Let us not speak of Greece and Rome—where it is known that even Plato danced at some public festive games; but some point blank to those prototypes of modern art. Where was Raffaele born—how did he pass his earlier years? Why, his cradle stood on one of the most commanding situations of the Appennines, and in youth he became a wanderer to and fro Urbino, and to and fro a host of monasteries and castles—where he saw nature, men, and manners. But we will at once transgress to the putting down an axiom: “that there never was a great man, whose bodily and physical powers were not adequate to the part he had to perform.” Sir Christopher Wren, who would have been considered nearly worthy of apotheosis in former times, attains the age of ninety-two—so bad proof, indeed, that he must have been a man of pith, stamina, muscle, and nerve. And again, to transgress from artists to all kinds of men,—Sir John Herschel and James Watt both attained the age of eighty-four; the former a knapper as well—and a soldier to boot. Most of this class of people, when young, had neither carriages nor railways at their command; and wherever they wanted to go, they had to go per pedes Apostolorum. Take, therefore, the journeys of Raffaele amidst the hills and dales, the forests and bushes, and the freshness and the sun of the Appennines, and that of many—nearly all—of our young men now. Born in Chancery-lane, or the Bull Ring at Birmingham—with a view on some ricketty, lumberly, smoked, brick easement. When children, walking down this street and another; and when young men, loitering from a dusty, dark, cheerless office in Fleet-street, to the coffee or eating house; and so on. The greatest feat they may subsequently perform, is to go on business to Manchester or Liverpool—stowed in the wooden case of a railway carriage.

"Take it easy for you. This is what you call life!"

makes Goethe exclaim Faust under nearly similar circumstances.

And then, the working man’s sanitary association exclaim, “Why is there so much disease amongst us?” We know it—they do not. Young people’s physical powers, if not (we would say terribly) used, will be terribly abused: these our present pigmy generation—despicable in all and every respect. But to revert to the artist. Training and knowledge are as one thing—they produce the procy man of business. So far so good: such men must also exist. But, if the aspirations of the nation have to be raised above that, we cannot accomplish it but in the manner in which it has been before accomplished, cannot but to be accomplished, and has been so accomplished in Egypt, Asia Minor, Greece, Rome, Italy, Flanders. It is mere chimeras to think that the mind can soar above, while the body is dwindling—crumbling down to the very soil, into the embraces of which it is hastening headlong. The thing cannot be done; we are
not mere spirits, mere minds—but, as Goethe has it, both are the same. It is well known, that several of the great artists of medieval Italy were great fencers,—cheap athletes, indeed, accessible to all means. And then our young men must betake themselves again to the stuff of the Grecian wise and good—to the knapsack worn by Cornelius, Overbeck, &c. Even a constitution and mind, somewhat damaged in Chancery-lane, may recover on the hills of Scotland or Wales, or amidst the luxuriant scenery and sunny skies of Southern Europe.

J. L——T.

INSTITUTION OF CIVIL ENGINEERS.

[FAÇADE OF THE NEW BUILDING.]

We present our readers with a view of the new façade of the Institution of Civil Engineers, from the design of T. H. Wyatt, Esq.; as will be perceived, it is of the Italian style, and is faced with Caen stone, and forms an admirable specimen of street architecture. For the proportions of the openings of the doors and windows, Mr. Wyatt was compelled to be guided by those of the old brick elevation that was taken down. The frontage is 30 feet.

The building of the Institution has undergone, during the late recess, a complete metamorphosis; the theatre has been reconstructed and considerably enlarged, it is now 45 feet by 29 feet. The floor which was formerly nine feet above the ground line, is now reduced to that level; the seats of the president and council face the entrance, and those of the members are arranged in concentric curves, rising gradually up to the level of the entrance. The area of the theatre is increased full one-third, giving accommodation to nearly one hundred persons more than the former room. The height to the ceiling is twenty-two feet. The evening lighting is partly through the inner skylight, by means of a gas ring, and by six gas burners provided with the means of conveying away the products of combustion. In the day-time, a skylight over the entrance, and three windows at the north-east end, afford ample light.

The ventilation is provided for by a shaft rising from the centre of the ceiling to a large cowl on the roof, and an ample supply of warm or cold air can be admitted, through apertures in the skirting, from Price’s warm-water apparatus, according to the temperature of the theatre.

Above the theatre is a well-lighted room, for receiving the models and drawings, and affording accommodation for taking copies of them. The access to it is by a lateral staircase, from the ante-room, and also across the lead flat from the principal staircase.

The house department has likewise been considerably altered, and adapted to hold occasional conversations. The two rooms on the first floor, which form the libraries, have been thrown together, and by fixing a temporary staircase from the back window, a communication will be formed with the theatre, on the ground floor, for public occasions; the false floor for the raised seats will be removed, leaving a level floor the whole extent, and on the same level as the council-room and office, which will form, at those times, refreshment rooms, by this arrangement there will be a suite of rooms on the ground floor, 114 feet in length, and 29 feet wide.

There have been also alterations made in the other parts of the premises, and every attention made to the warming and ventilation, to render the building both convenient to the members, and suitable for the important occasions of the conversations.

The alterations have been conducted under the guidance and immediate direction of Mr. Manby, the indefatigable secretary, and the works executed by Mr. Grissel, the eminent builder, from the designs of Mr. T. H. Wyatt.

ON WATER AS FUEL.

This seemingly strange idea originated in an occasional remark of Sir Humphrey Davy—that on the problematical exhaustion of coal, men will have recourse to the hydrogen of water as a means of obtaining light and calefaction. As the gas used for lighting consists of hydrogen and a little carbon—it is only the latter which would have to be added, after the water had been decomposed into its elementary parts. M. Jobard, of Brussels, was the first who extracted from water a gas, of twice as great an illuminating power as that obtained from coal. This gentleman produces hydrogen gas by the decomposition of water, passing through vertical retorts filled with coke, being in a state of white heat. And at the moment of the hydrogen being thus formed, it is mixed with a little carbonate acid gas, obtained by the distillation of oil, tar, or naphtha, or other coarse substance, hitherto useless in the gas manufacture. In the Bulletin de l’Académie Royale, M. Jobard’s method has been amply detailed. He says that at the expense of one pennyworth of oil, a light may be obtained during twenty hours, equaling that of ten tallow candles. Even conceding that M. Jobard’s discovery has not quite attained the object of using water for light, fuel, &c.—still, it has done something towards it. Those ideas lead us to a calculation of Prof. Faraday, that the elements of a single molecule of water contain 800,000 charges of an electric battery, consisting of eight troughs of two inches in height, and six inches in circumference. At the present state of these inquiries, the human mind is startled; because if we should ever be able to elicit and make them available, the power of the mightiest steam engines would dwindle to nothing—and thus, ends would be attained by the means of things seemingly truding and worthless, which cannot now be accomplished by any sacrifices or expense.

J. L——T.
STABILITY AND STRENGTH OF HUNGERFORD BRIDGE.

In the pamphlet entitled ‘Metropolitan Bridges,’ etc., it is intimated that, at the tops of the piers of Hungerford Bridge, there exist horizontal forces, represented by c—a, by which those piers are continually strained; and which, in consequence of the concussions produced by the vibrations of the Bridge, may ultimately destroy them. Concerning these forces some explanations will presently be given; but as, in a well-written paper which appears in the Civil Engineer and Architect’s Journal for December, 1846, an attempt has been made to show that the danger which might arise from these forces is obviated by the friction rollers under the saddles to which the chains of the bridge are attached at the tops of the piers, and believing that there is ground for considering the effect of the saddles in diminishing the strain to be very small or nothing, we feel it incumbent upon us, first, to say a few words on this subject.

It is much to be regretted that experiments on the friction of cylindrical rollers are as yet too few to allow any precise determination of its value to be founded on them, yet such experiments are not wanting; and from those of Coulomb principally may be obtained approximations which will suffice for the present purpose: it may be admitted, in fact, agreeably to many of the experiments made by that distinguished philosopher, that the friction of rollers varies inversely as their diameters, and directly as the pressures which they support. Now, suspending equal weights on opposite sides of a cylinder by means of a string passing over a pulley to which the cylinder served as an axle, and then applying on one side additional weights sufficient to overcome the friction, Coulomb found the values of that element for wooden cylinders of different kinds and sizes; reducing these, by the first part of the rule above mentioned, to cylinders four inches diameter, which is the size of the rollers under the saddles of Hungerford Bridge, the friction of wooden rollers is nearly one-hundredth part of the weight. This agrees with the experiments made by Mr. Babbage on wooden rollers, if as usual we estimate the power requisite to draw a body horizontally on a sledge to be one-quarter of the weight of the body. But all these experiments having been made with cylinders compressed by weights which are comparatively small, the above estimate is far less than it would be under the enormous pressure to which the rollers supporting the weight of a suspension-bridge are subject.

The experiments of Coulomb on iron axles turning between cheeks of copper give for the friction of metallic rollers a value bearing a much higher ratio to the pressures than that of wooden rollers: the diameter of his axles was 1.46 in. (English), and the friction, without grease, was one-twelfth of the weight; this value, increased in the ratio of 1.46 to 4, gives, for the friction of iron four-inch rollers, one-fifteenth of the weight or pressure. It would seem, therefore, that the friction of such rollers, even in circumstances far more favourable to the freedom of their motion than those of the rollers under the saddles on the piers of Hungerford Bridge, cannot be estimated at less than the quantity last named. Now the pressure in the vertical direction, arising from the weight of the suspending chains on the tops of the piers on each side of the centre of Hungerford Bridge, being estimated at 850 tons, it must follow that the friction and inertia of the rollers are together equivalent to nearly 57 tons; or strains at the tops of the piers, to that amount, may take place before the saddles will move. What has been said must be considered as independent of the increase of resisting power in the rollers, arising from the probable alteration of their figures and the indentation of the planes on which they rest, in consequence of the great pressure to which they are subject, each of the twenty-five rollers under the saddle bearing one-twenty-fifth of the weight on that saddle, or above 17 tons. The resistance arising from the force of cohesion may also, in time, become sensible under such pressure. The estimate of the friction of rollers on the pier of a suspension-bridge which, in the paper referred to, is derived from that of a railway carriage, is by no means admissible: as well might it be assumed that the body of a railway carriage, if moving on rollers four inches diameter, would have only half the friction which it has on its wheels. A railway carriage may be considered as moving on rollers whose diameters are ten or twelve times greater than those of the bridge rollers; and, if any comparison could be made between cases which are so much unlike, it should be inferred that the friction of the Bridge rollers, instead of being half that of a railway carriage, should be ten or twelve times as great.

By an oversight, it was stated in the pamphlet on ‘Metropolitan Bridges,’ etc., that the side chains of Hungerford Bridge have the same drop or deflection as those in the centre; whereas, the side chains, being carried below the level of the road, the droop is greater, while the horizontal length or span is nearly equal to that of half the centre chain: the inference drawn from the difference of the parts of the chain, is, however, correct; the value of a being still less than that of c. This is manifest from the approximate formula which is given in the pamphlet; since a² is small when compared with b², and the whole numerator is divided by an increased value of dx. But if the weights suspended from the central and side chains be taken into consideration, the value of a relatively to c will be much less than that which would result from merely substituting the augmented value of c in the formula above alluded to.

For the weight of half the chains and roadway between the piers being estimated at 500 tons, while, between either of the piers and the abutment on the land side, the weight of the chains with the portion of roadway which they in part suspend, and in part support, is about 360 tons: then, still, for simplicity, considering the curves as common catenaries, and using the correct formula for horizontal tension, viz., c = a² — b² 2c, in which c, the length of the chain between the points of attachment (in this case, the length between the highest and lowest points of the curve), may be taken to express the weight of the chain and loading between such points, it is evident that a will be less than c, both on account of the smaller value of c and the greater value of x.

It is, therefore, very correct to say that there exists a force of considerable intensity, expressed by a—c, which is constantly acting towards the river at the top of each pier, and which may ultimately be the cause of its destruction. And though it should be admitted that motion may take place in the saddle so as to prevent the pressure of the strain towards the middle of the river, yet the effect of such motion would be far from equalising the contrary strains. In the actual state of the Bridge, the horizontal tension of the side chains at each abutment is about eleven-twenty-fifths of the like tension of the centre chains; and a movement of the saddle to the extent of eighteen inches towards the river, while it would diminish the horizontal tension of the centre chains by about one-eighth part of its value, would increase that of the side chains by one-hundredth part only; and this is the whole extent to which the compensation alluded to in the Civil Engineer and Architect’s Journal for December (p. 365, col. 1.) would amount. It may be observed, that a strain which would cause a movement of the strain towards the river to the extent of eighteen inches, must be accompanied by a descent of a descent of the central part of the centre chain as much as six feet vertically.

The effects of the strains at the pier heads may, obviously, with propriety, be determined by the parallelogram of forces as explained in the fifth page of the ‘Reply,’ addressed to the Editor of the Civil Engineer and Architect’s Journal; and of such resolution of forces an instance occurs in the description of a Jib-Crane, which appears in that Journal for December, 1846, p. 367. It is not, however, to be supposed that a pier of brick or stone is overturned as if it were a vertical rod, capable of turning on a joint at its lower extremity in consequence of the strain. The lever may, in some such structures; but continual pressures and accidental strains at the head of a pier have tendencies to destroy the adhesion of the materials, and cause the pier to fall in ruins in consequence of a fracture taking place; at the point where the fulcrum of the lever may be situated. The position of such point will depend upon the construction of the piers, and those of Hungerford Bridge are not solid in all their height, but each is perforated at a certain distance above the roadway by arched openings at right angles to one another, so that the top of the tower with the saddle is supported only on the four portions of the side-walls at the angles.

This construction renders the towers far less strong than they would have been if solid, and makes it very probable, that, in the event of undulations of the bridge producing a pressure even less than that value of a—c which has been above found, fractures will take place in those portions of the side structure.
If more strength, unaccompanied by equilibrium, could have assured stability, this bridge ought to have stood, a monument of elegance. But though here, as in Hungerford Bridge, there was an effort made, by permitting the chains to slide on the tops of the piers, to produce a compensation for an excess of pressure on the bridge, yet experience has shown that such compensation does not take place; and it is evident that, in consequence of the great friction, the horizontal pressure towards the river, is allowed to take effect at the tops of the supporting piers or columns; that pressure, (a — a' above,) combined with the normal or vertical pressure of the chains, produced a resultant force which overthrew the piers.*

It is remarkable that the project for the bridge was sanctioned by the approval of a commission constituted of engineers, in the department of Osmudes, and that its construction was superintended by two engineers specially appointed for the purpose, as well as by the distinguished projector himself. It is painful also to reflect, that the failure of the bridge pressed so heavily on that talented individual as to cause his premature death.

The writer of the article in the Civil Engineer and Architect's Journal, endeavours to show, that the dangers which may be apprehended from vibrations, undulations, sudden additions of weight, and rushes of people, are rather imaginary than real, and treats this question as one purely statical, considering the bridge as a rigid, solid, inflexible structure. But it is clear that the preceding cases, as well as those of North Yarmouth and Broughton, the catastrophes that occurred, arise from the dynamical effects of oscillations and undulations; these the writer entirely rejects, on account of the difficulty of investigating and determining mathematically the effects of the forces, which ought to be taken into account, from the mutual action of the flexible bodies on each other. There is no doubt that it is extremely difficult to investigate these dynamical effects, and to assign precise values for them; but are we therefore to reject them altogether, in determining the strength which should be given over and above that which is required to sustain the statical pressure, and are we to make no allowance whatever for the additional strains which the dynamical effects produce? It might as well be said, that no considerations, with the respect to the tossing of winds and waves of the sea, ought to be made in erecting Piers. Light-houses, &c., because we cannot estimate exactly their dynamical amounts.†

The above is Sir Howard Douglas's rejoinder to the remarks made by us upon his former paper in this Journal. As might be expected of two disputants who set out, open to conviction, and determined that the discussion shall never disregard topics foreign to the question, there remains now but little difficulty in the conclusion between us. We think that he has made out a strong case of negligence and false case for the necessity of determining, by actual experiment, whether the "shifting saddles" be really efficient for their proposed object. At the same time, we still think the horizontal friction overrated: it is difficult to suppose that the rolling friction of wooden cylinders can be less than that of iron cylinders, and the experiments of Coulomb on iron axles, included (we presume) the effect of rubbing friction, and therefore are not strictly analogous to the case before us.

The fact is we are contending in the dark. To make anything like an accurate estimate of the friction of the Hungerford Bridge saddles, we must not content ourselves with the confessedly inadequate experiments which have been hitherto made, but ought to make a direct experiment upon the Bridge itself. When the consequences of the failure are considered, it will not be considered unreasonable to ask that this inexpensive investigation should be undertaken. Even supposing it asserted that the saddles move with the greatest facility when the Bridge has its extreme load, the mere fact of satisfying the public mind would be ample remuneration for the trouble and cost incurred. Not only ought the Bridge to be secure, but every one ought to be satisfied that it is secure. As far as we know, Hungerford Bridge has never been in any way abused by heavily loading it.

By analogy, from what little is known of rolling friction from former experiments, it certainly still seems to us that the statical effect of the friction of the saddles would be small. But friction, like other forces, may be of the nature of impact. A crowd suddenly running from the side spans to the

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* The piers rest upon the natural gravelly bed of the river, like those of Westminster bridge, surrounded by sheet piling driven, it is said, fifteen feet; an expedient which has not, however, prevented the subsidence and ruin of the two middle piers of Westminster bridge. Though the towers of Hungerford bridge were erected in wooden derricks, there is no piling undertaken.

centre span of the platform would produce a sudden or impulsion horizontal force on the top of the pier which could never be estimated from statical principles. There is, moreover, the special action of the rollers becoming, from long disuse, settled and fast in their place, by indentation, the accumulation of rust, or other foreign substances, &c. from not being called into action under ordinary circumstances, they might be ineffectual just at the time when they were wanted. This point ought also to be examined experimentally.

We have confined our attention almost exclusively to the stability, and have said little of the strength, of the Bridge. The following seems a simple and satisfactory method of ascertaining the tension of the main chains at the points of suspension. If \( t \) be that tension, \( l \) the load borne by each half of the main chain, and \( \theta \) the inclination to the vertical at the point of suspension, we have that:

\[
l \cos \theta = \frac{l}{t}, \quad \text{or} \quad t = l \sec \theta,
\]

whatever may be the form of the chain. In other words, we may ascertain the tension of the chain at its highest point, by multiplying half the total load by the secant of the angle at which the chain is inclined to the vertical at that point. The advantage of this method is, that it is independent of any assumption respecting the form of the catenary, and is strictly true, if we suppose what, in fact, is the case, that no part of the load is sustained by the platform itself resting on the pier. In answer to an application for the value of the angle in Hungerford Bridge, we were promised the particulars by Mr. Breetel, but subsequently found that he had been too much engaged to send them. Probably, the subject (the more question of a few hundred lines) was too trivial to engage his attention.

There are many points in Sir Howard Douglas's paper on which remarks might be offered, but, for the sake of brevity, we refrain from making them; though, in one or two cases, our arguments seem to have been somewhat misunderstood. However, there can be no doubt that, if the traffic of Hungerford Bridge should appear likely, from a change of circumstances, to be heavier, the question of the suspension of the attention of those who have more power than ourselves to demand information upon it. The inquiry which Sir Howard Douglas has personally undertaken (notwithstanding great obstacles), has, we believe, been most minute and laborious: such exertions can no possible object but the public security and the advancement of engineering science, and ought, therefore, to be appreciated in proportion to their disinterestedness.

The powerful effect of the accumulation of rust and concretions is frequently exhibited in a striking degree in the second or subsidiary safety-values of steam boilers. These values are especially exposed to injury from long disuse, are often clogged and stick fast, notwithstanding the very great pressure exerted to open them.

**HISTORY OF ENGINEERING.**

**By Sir J. Rennie, President of the Institution of Civil Engineers.**

(Continued from page 55.)

**DRAINAGE.**

In works of draining extensive districts of low marsh or fen lands, the Romans, with their usual energy and ability, effected much, and the Paride, Caesar-like, and the embankment of the Thames, amongst other works, are good examples. After they left the country, it relapsed into its former state of barbarism, and so remained for ages, until the art of drainage may be said to have been lost. Upon its revival, the Dutch from necessity have become extremely skilful, and were celebrated throughout Europe at a remote period, almost before engineering commenced in Great Britain. On account of the proximity to England, and their experience in these kind of works, when it became a question of draining the extensive districts of low marshy land on the east coast of England bordering upon the Humber, the Witham, the Ancholme, the Welland, the Nene, and the Ouse, it was natural that recourse should be had to those who, from their skill and experience, had already acquired such reputation as the Dutch; accordingly we find, in the reign of Charles the First (when it was determined to drain the great level of the fens, afterwards called the Bedford Level, from the name of the Earl of Bedford), Cornelius Vermuyden came over from Holland, and after draining the level of Hatfield Chase, adjoining the Trent, and acquiring considerable celebrity and influence, was knighted by the king. He planned great works in 1640, at the Bedford Level, for Francis Earl of Bedford, but the execution of Vermuyden's plans were prevented by the Civil War, and were afterwards carried into effect by William, the successor to Francis, Earl of Bedford, after much discussion and controversy, and were successful in draining the level to a certain extent. The plan in 1651 consisted in placing a sluice across the River Ouse, at Denbigh, about 15 miles from the sea at Lynn, where the Ouse enters the Great Wash, so as to exclude the tidal waters, leaving the channel of the River Ouse, above that sluice, for discharging the fresh waters only; these it was proposed to conduct from all parts of the land by small lateral drains, and to the river Ouse, at Denbigh, having the sluices at their junction with the river, to prevent the floods from entering them and covering the adjacent lands. He also cut a new channel, 30 miles long, called the Bedford, or Hundred-Foot River, for a part of the water, from the river Ouse to Denbigh, and the old channel of the Ouse, at Earl, where another sluice or slacker was placed for preventing the tide from going beyond that point.

Vermuyden considered that by adopting this plan, and having on the frontage lands to get rid of the enemy to drainage, the tide; and then, having only to deal with the fresh water, he anticipated no difficulty in accomplishing the complete drainage of the land. For a time the plan answered tolerably well, and effected considerable improvement in the drainage; but he overlooked the important facts that the tidal waters formed the most important agent in keeping open the channels of the rivers, in preserving a good outfall for the drainage waters to the sea; that by excluding the tidal waters, the channel of the rivers would suffer, in proportion to the quantity of water which was thus abstracted from them, and that thus in time they would become incapable of effectually discharging the drainage waters; that the outfalls of the rivers would also suffer in the same proportion, and then the marsh-land districts would have their channels filled with mud and slush, and become inefficient, and so it happened with the Bedford Level. The mouth of the channel of the River Ouse, which is the chief outfall for the drainage of the district where the Bedford Level is situated, being deprived of its supply of fresh water, served as a natural sewer for the country, and was obstructed by shoals that the land waters could not pass off to the sea. In proportion as the drainage became defective in process of time, as it necessarily did become, the fresh waters were stopped in the hundred-foot river, with a lift of 4 or 6 feet, for raising the water out of the lateral canals into the river. In 1713, Denver Sluice was undermined and blown up by the floods, and the tide recovered, to a certain extent, its ancient receptacles, and proper measures had then been adopted, both the drainage and the navigation would have been restored to an efficient state; but the sluice was rebuilt after a few years on the old system, and the drainage and navigation became deteriorated as before. During the past century the drainage had been restored to an efficient state; and has occupied in succession the attention of the ablest engineers of the day; among whom may be mentioned the names of Perry, Elatopp, Grueydi, Colborne, Armstrong, Kindley, Smeaton, Jessop, Changman, Robert and William Telford, Rennie, Telford, Walker, G. and J. Rennie, Cubit, Rendel, and others.

Amongst the most remarkable operations of this nature, may be mentioned the works upon the river Ouse, for the purpose of improving the drainage and navigation, which had become seriously affected by the accumulation of sands at its mouth, and the abstraction of the tidal waters above-mentioned. The principal defect existed immediately above the town of Lynn, where the river took an extraordinary bend almost at right angles. The basin of the river, under a general confluence of several small streams, almost a semicircle, the diameter of which was only 23 miles; independently, moreover, of this circuitous course by which so much fall or inclination of the current was lost, the channel was so irregular and disproportionate in width, that a much enlarged width, with shifting sands, and fresh waters were unable to force their way through them; thus the drainage waters were penned up above, and being unable to get off, formed a stagnant pool, which during floods frequently broke the banks and inundated the surrounding country, the channel, moreover, being deprived of its natural scour, silted up in the same proportion. In order to obviate this great and growing evil, the ablest engineers of the day were consulted, and they unanimously concurred in the opinion, that the only sure means of providing for the removal of the sand in the Ouse, by making the shortest channel between its two extremities. This plan was first proposed by Bridgeman, in the year 1794, and was subsequently recommended by the various engineers of the day who succeeded him. In the year 1798, and again in 1807, after a careful examination of the whole body of Commissioners to carry effect this cut, which was called the Eau Brink Cut, the expenses of which, estimated at about 80,000L, were to be defrayed by a tax of 4d. per acre on the middle and south level of the Bedford Level, amounting about 30 per cent. of the revenue of the Ouse. This great work was to have been carried into effect by Robert Mylne and Sir Thomas Hyde Page; but they disagreed as to the proper form and dimensions of the cut, and referred the matter to Captain Huddart, who was authorized to carry it out; some years, however, having been spent in litigation, that the tax which was levied to pay for its execution was exhausted. In 1817, another Act of Parliament was obtained, empowering certain Commissioners to raise a special and temporary duty on the lands for which the tax was supposed would be collected by it, and the carrying out of the work with its branches was intrusted to the late Mr. Rennie, as the principal engineer. The Eau Brink Cut, which was executed according to the plan of Huddart, and was opened and opened on the 19th of July, 1821, and very beneficial effects, as had been anticipated, immediately followed; the extraordinary wet winter of 1821 which succeeded, proved its success beyond doubt, for soon after the cut was opened the low water line in the Ouse, immediately above it, fell five
feet, which necessarily produced a corresponding increase in the fall or inclination. Thus it is, when the river scours away and removes the obstacles in the bed of the river, and to discharge a greater quantity of water at the same time, as well as a longer period for discharging it, to the great benefit of the country drained by it. The tideway, being formed where the river has taken its various course of the old channel, and being confined in one mass in the new direct channel, acted with greater effect; finding their way upwards, and becoming united with the fresh waters in enlarging and deepening the channel, and by the time it opened up, the river had formed the drainage and the navigation derived benefit from this great work. The improvement was carried still further, in adding one-third to the dimensions of the cut, particularly at the upper end; by this means an additional fall of 7 feet 6 inches in the full of the current at the upper end. The effect of these improvements has been to increase greatly the produce and value of uplands of 300,000 acres of land drained by the Uske, which otherwise could have been unproductive. The measure, like almost all other great improvements, encountered great opposition at the time, and in order to tranquillise the fears of some and satisfy the prejudices of others, various minor interior works were provided, such as locks and weirs, for passing up the water, most of which, but for existing prejudices, it would have been better to have dispensed with, and to have removed Denver sluice, raising the banks on the various rivers above, so as to have restored them to their natural state, and thus by admitting a greater quantity of tidal water, to communicate to their channels, and thereby have enabled them to carry off the drainage waters more effectually.

A similar operation was executed by Telford and Reenie, on the river Nene, in 1852, at the Nene outfall, which commences about five miles below Wistaston to 12 miles above Sleaford, a length of nearly 20 miles where it joins the great estuary of the Wash. The beneficial effects of this work have been very extraordinary; the low-water mark has been lowered 10 feet, and a district of 200 square miles has been completely drained and brought under cultivation, which formerly for the great part of the year was better than a stagnant marsh; the navigation has been so much improved, that the tide rises 14 feet at Wisbeach, and vessels of 200 tons are now enabled to come up to that town, where previously the river was only navigable for small schooners; and at Sutton Bridge, 8 miles lower down, vessels of above 600 tons can arrive where formerly there was only water for vessels of 500 tons.

The river was thus improved, so as to enable it to carry off the tidal and fresh waters, an extensive plan for the interior drainage was designed and carried into effect by Telford, in 1850. It consisted of one main drain of proper dimensions, with two subsidiary drains of smaller capacity, all of which drain the low lands, and have been designed to discharge all the water from the low fen-land districts into the upper end of the new outfall, by means of a capacious new sluice with self-acting gates, which continues to discharge the water from the drains into the Nene, as long as the level of the water in the drain is higher than that of the river; but whenever the water in the river is higher, the sluice-gates close and prevent the river water from entering. This plan of Telford's resembled one previously proposed by Reenie for the same object, but which was upon a smaller scale, and was accompanied by the important addition of catch-water drains.

In 1860, Reenie proposed and carried into effect a complete system of drainage, for an extensive district of fen-land, called the East, West, and Widdulph districts, into which the river flows, about 10 miles above Boston. Reenie at once perceived the defects of the Wash as a means of drainage and navigation, and decided that until the river was improved by shortening its course and increasing the capacity of its channel, the complete drainage could not be effected. This plan he proposed, but the opposition was so strenuous that he was obliged to abandon it, and to carry his main drains into the river below the town of Boston; he divided the drains into two classes; one set he technically termed catch-water drains, which range along the side of the hill, and the other set, which divided the low lands, intercepted all the high land waters, which, descending with great velocity, would soon have overwhelmed the low lands, in addition to the water falling upon them according to the extent of their surfaces. These two classes were carried into the Nene, and into the main drain, which discharged the waters, by a self-acting sluice, into the Nene immediately below Boston; the low land waters thus freed from the high land waters, were conducted by separate drains into another main drain at the town of Boston, which was carried 4 miles more fall. By this means both classes of waters were discharged without interfering with each other; means were also secured of discharging all the water by the lower drain at Hobhole, in case it should be found necessary, which was the case of necessity in the making of the main drain for that object. The district was thus completely drained, and from a stagnant marsh was converted into corn-fields.

The Wash being left to itself, became silted up in 1827, as had been foreseen, and two tidal rivers flowed above 3 to 4 feet at Boston. The channel was then improved as recommended by him, and the river is now in such a state that vessels drawing 12 and 14 feet arrive at Boston, and the whole country drained by the Wash has been proportionally benefitted.

He proposed a similar plan for the improvement of the Great Bedford Level in 1811, the cost of which he estimated at 1,108,180£; but unfortunately for that district it has never yet been carried into effect, although it would have amply repaid the outlay. The origin of the above systems, it is explained, was due to the anxiety felt that the Romans employed catch-water drains, and the Caesars-drakes is quoted as an example: it is, however, by no means clear whether it was not merely a navigable canal to connect the Nene and the Wash; at all events, the system, if employed, was on an extensive scale, and the Roman work is in modern times, is due to him. He also proposed the drainage of the Halsefield Chase and Anchoile districts, and Romney Marsh, Holderness, and other districts upon similar principles, where drainage had been tried and had not resulted in the desired improvement.

After mature consideration and experience, it appears that the safest and most certain principles of drainage and navigation are:—The improvement of the channels and outfalls of the rivers, as far as may be practicable, for the free admission and discharge of the waters, and that with less waste of water, better proportion and capacity for the low land, and catch-water drains for the high land waters; and according to circumstances, the drainage and navigation may be combined or kept separate.

Catch-Drains.—Where natural drainage could not be effected, or was only imperfectly applied, recourse was had to windmills and scoop wheels, as still used in Holland; these were always adopted until 1830, when Watt's steam engine was successfully applied by Reenie to work a large scoop-wheel, for draining Rottlands Fen, near Ely. Subsequently this valuable system has been applied and extended by Glynn, Field, and others, to the great improvement of fen-lands, by draining the water lower beneath the surface than could be done by windmills, which are now in use. Additional machinery has been added when required, whereas the windmills can only be employed when there is wind; and it frequently happens that calms prevail during rainy weather, at the very time when the mills are most wanted.

Whilst carrying out the improvements of the outfalls and mouths of rivers, it is sometimes necessary, and may be converted into fine arable land, fit for agricultural purposes, by accelerating the natural accumulation of warp, or alluvial matter, held in mechanical suspension by the water, and which, from the absence of powerful current, are carried away without producing any benefit. The works for this object and for improving the drainage and navigation, if properly conducted, consist generally in regulating and confining the channels of the rivers, through the sands below high-water mark, one or more wooden and other light works adjacent to them; in proportion as the deposit accumulates, the works are raised until vegetation appears, and the general make of boats can navigate with safety, and then the land is embanked from the sea. The system of warping or artificially silling bad land where the levels will permit, has been practised for many years along the Trent, Ouse, and Humber, with considerable success. The operation consists in admitting, through sluices and canals made for the purpose, the water charged with alluvial matter in suspension, to the lands to be warped, which are surrounded with embankments, and after having deposited the alluvial matter the waters are conducted away again to the sea, the process being repeated as often as the alluvial matter is insufficiently warped, and thus lands which, in some cases, are situated several miles from the rivers, and were comparatively worthless land, have become extremely valuable. If these operations are judiciously conducted, in a state such as the river, where the alluvial matter is accumulated upon them, may be greatly improved, and the land gained during the operation will, in many cases, simply repay the cost of draining it. In Holland, and other countries, there is a great field open: much depends on the plan and other works of nature, as the judgment and skill is required in selecting the districts, and in properly applying the system, but its consequences are so important that it is well worthy of the attention of engineers. A scheme of this kind upon an extensive scale is about being carried into effect at the mouth of the Ouse and Nene, where above 50,000 acres of land will be gained, and great improvement will be effected in the drainage and navigation of the extensive districts drained by the Ouse and Nene. The same principle is applicable, in some cases, for converting shingles into effective breakwaters.

MACHINERY AND MANUFACTURES.

The improvement and extension of machinery and manufactures by new inventions and applications have been immense since the time of Steam. Previous to that period wood was almost exclusively used in the construction of machinery. Desaguliers, Lenepol, Gravesande, and other writers, have given descriptions of the best specimens of mills and machinery in use at that time, and it is worth observing, how much the modern construction, when compared with modern machinery for similar purposes. The introduction of cast iron by Smeaton, in 1754, was a great step in advance. He began by employing cast iron for the axle of one of his earliest windmills, 1785; then in 1790, he cast and fixed the main-wheel attached to the iron for boring cannon at Carron; cast iron afterwards became universal in machinery, and is now regarded as the most perfect material for that purpose. He also proposed the drainage of the Halsefield Chase and Anchoile districts, and Romney Marsh, Holderness, and other districts upon similar principles, where drainage had been tried and had not resulted in the desired improvement.

[The difficulties here are peculiar, in consequence of the coast being surrounded with a broad belt of loose siltage, which renders it necessary to carry the drainage water through the sea banks by close tunnels, with valores at their outer extremities, so as to be forced upon the hydraulic pressure of the water. In such cases, it is well worthy of remark: it was formed in the Dutch manner by stakes wattled together, and permanently required repair; it has since been faced with stone piling, as an inclination of about 6 to 1, which stands well, and renders effectually the heavy seas to which it is exposed.]

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wards was generally adopted for axes, but as some of them, which were improperly made, gave way, the application of cast iron in other machinery was in consequence made, and wrought steel, in blacksmiths' forge, was introduced into the drive mills. The Albion Mills, constructed by Rennie, in 1784, and worked by Watt's steam-engine, may be considered as the first complete example of the employment of iron in every part of machinery, except for the teeth of some of the wheels, made of hard wood, for working the cotton and teeth of other wheels; that example also showing the true form of teeth, with a fine pitch, and adequate depth and breadth and adjustment with each other, so as to work well together with the least friction, and the use of cast steel, in place of wrought, for the shafting of machinery.

The great improvement effected in the design, proportion, and construction of millwork, together with the steam-engine, enabled machinery to be driven with greater velocity, increased action, and diminished friction, and thus greatly increased the productivity of water power. Watt's improvements, with the addition of an equalising valve to the steam-engine, made it possible to twist or rewind wool, in order to combine them together, which is a very simple operation, compared with forming the short detached fibres of cotton into a thread, without the aid of the hand to guide them; and to accomplish this with the least possible labour: it was very ingeniously overcome by Hargreaves and Arkwright in different ways, both of which were combined together by Crompton in the muslin, in 1771. Arkwright's water-spacing was subsequently simplified into what is technically termed threading, through his preparing machinery of 1775, occasioned a complete revolution in the arts of manufacturing, and led to the establishment of the factory system, with its self-acting machinery. A somewhat similar system had, however, been introduced in the Silk Mills at Derby, nearly half a century before; but inasmuch as much less attention was paid to the threads of silk as compared with those of cotton, and the less important power was able to twist or rewind wool, in order to combine them together, it is said, with extreme difficulty.

All these improvements, together with a multiplicity of other ingenious and contrivances connected with the factory system, were completed and brought into extensive use in the short period of 30 years. Machinery for printing calico was introduced by Peeli, and perfected by others. Watt, in 1787, introduced chemical bleaching, which was afterwards carried to great perfection by Tennant. Cartwright, in 1787, invented cloth-washing by power, although it was not brought into use until twenty years after, and, in 1790, he invented machinery for combing and preparing long wool, in place of the hand operation, which required a great amount of labour. The power required was great, and the work of carding cloth by teasels was perfected, and Harmer invented machinery for shearing it in 1787. This has since been carried to greater perfection by Lewin. Bramah, in 1796, introduced the hydraulie press, which furnished the means of compressing a number of cards in a form of cloth which could be accomplished by no other means, and its general adoption has been of great service. Self-acting machines for making button-hanks were invented by Heaton. Boulton's large manufactory at Soho contained many inventions besides those of Watt. He invented machinery for coining money by steam-power in 1790, and erected a complete establishment at Soho, where, for a long time, he executed contracts for coining money for the British, and various foreign governments. His plan for stamping the pieces consisted in exhausting the air, by pumps worked by a steam-engine, from vessels properly adapted for the purpose, and connected by valves with air cylinders, having pistons working the balances of the coining-presses. By opening a valve, air is exhausted from within the cylinder, and the atmospheric pressure acting upon the piston, turns down the screw of the press which stamps the coin; by re-admitting air, the piston rises and with it the screw, thus producing an alternating rise and falling motion so as to strike from 50 to 60 pieces per minute; as the screw rises and falls, it works a feeding apparatus for supplying blank pieces, ready prepared for stamping, and as fast as one piece is stamped it is pushed off the die, and is replaced by another. The apparatus for cutting out the blank pieces is of a similar description; the whole is self-acting, and, as it is carried out, there is no necessity for the care of a man. The improvements were introduced into the Royal Mint, at Tower Hill, which was constructed in 1810, under the direction of Messrs. Boulton and Watt, who furnished the steam-engines and the coining machinery. The rolling machine by Boulton and Watt was a true perfection of its kind. Improvements were also made in the Royal Mint, by Boulton and Watt, who erected similar establishments, with rolling-mills by Rennie, at the two latter places.

The whole of the above ingenious and valuable inventions, except power-weaving, had been fully carried out and brought into successful practice before the end of the last century. The brilliant results which were obtained from these inventions excited, in an intense degree, the skill and ingenuity of a host of able mechanics in the various departments above mentioned, and gave rise to the establishment of a new class of manufactures, the high profits derived from manufacturing by machinery, while the prices of the articles continued the same as those formerly produced by manorial labour, occasioned a readiness before unknown to adopt all new machines, as well as to extend and improve them.

**Water-Wheels.**

The general introduction of self-acting machines induced the construction of new extensions of midland, and rendered necessary the use of more powerful and better regulated prime movers. Water-wheels were employed as the moving power at the early establishments of Cromford, Belper, Matlock, Bakewell, L anzac, Callow, Darwen, &c.; and when the governor of Scarborough, who was applied to water-wheels by Street, at Belper, the power of motion and power were regulated with a degree of uniformity almost equal to that of the steam-engine, and was rendered as perfect a moving power as its nature admitted of. Rennie, it is believed, first applied the descending shuttle, by which the flow of water is regulated over its upper edge, so as to obtain the full benefit of the fall, instead of passing under the shuttle as formerly, whereby some of the fall is lost. He improved the construction of the wheel, increased the width and diminished the depth of the water at the fall, and regulated the velocity of the perimeter from 3 feet to 5 feet per second. By these means nearly 75 per cent. of the power was realised. Street's improvements in water-wheels, executed by Hewes, consist in making them with slender iron arms and oblique tie-rods, and sometimes with teeth, the arms of which are alternately rising, forming pins with nearly the same velocity as cranks of steam-engines, and rendering them almost equally applicable. In this department Donkin and Fairbairn have also taken a conspicuous part.

The application of a modification of the horizontal water-wheel, by Forney, has latterly been introduced into this country from France, with, it is said, considerable success. The governor had been applied to windmills by Hooper, in 1789, and soon after Watt adapted it to his rotary steam-engine, which was then new, and adapted the same to steam-engines, and its application to the water-wheel, or steam engine, and all its accessories, one vast and complicated machine. A new school for mechanics was thus formed, in which far greater power than had ever before been applied to machinery, was to be found. To meet the requirements of the trade, there arose at this time a number of manufacturers of machinery of form and complexity, with some parts minute like clock-work, requiring every gradation of force to drive them, and corresponding strength in some for resisting the largest and others the smallest impulse. A new and extensive field of inquiry was opened up, in which were brought forward artists of every description to contribute their aid, as to one common stock of knowledge, for the advancement of the new system of mechanical engineering, as well as for the development of processes, as for the multiplication and improvement of those previously invented. The ingenious and valuable labours of the great mechanical men of the last century have been most ably continued by their successors, many of whom are, or have been, our contemporaries, and who with a greatly extended sphere of application, have advanced in the career of improvement with an almost unparalleled rapidity.

Many new machines have been invented, and most of those in daily use have been rendered self-acting or automatical, so as to require no further aid than the superintendence of a man. Machinery has become manufactured, directing their progress through the machine, and disposing of them afterwards. The power-loom, invented by Cartwright, in 1784, was afterwards improved by Austin, Miller, Horrocks, M'Adam, Lane, Bowman, and others, and its employment greatly extended.

**Rope Machinery.**—Machinery for making ropes and cordage was invented by Cartwright, Grimshaw, Chapman, and others, and subsequently carried to great perfection by Huddart, as exhibited in the establishment of Huddart, H摩托, and Huddart, at Manchester. This ingenious and valuable invention consisted in regulating and adapting the lengths of the different yarns, or threads composing the rope, so that each might bear an equal strain, which could not be done on the old system. To effect this, a series of rollers are placed on the rope, or yarns which compose them, were placed in a frame of a crescent form, and the yarns from these bobbins were conducted through holes in a vertical guiding plate, having those holes arranged in concentric circles; and then absence passed through a series of rollers and points to a single hole in the required gauge, and so on to a large reel mounted in an oblong frame, to which a rotatory motion about a horizontal axis, was communicated for twisting all the yarns together into a strand, and also a circular motion of the reel at
right angles to that of the frame, for winding the strand upon the reel, as fast as the wire were wound off the bobbins; a guide was attached which regulated the winding. The whole was worked by one of Watt's steam engines. By this beautifully-conceived piece of mechanism, the whole of the yarn were twisted into a strand of the required dimensions. The pitch and tension were such as to allow for the gradual increase of the angle of twist, and the employment of warm or cold register cordage accordingly. The cables were formed by a larger machine, combining three of the above-described frames together, each having one of the strands to form the cable wound upon its reel. The engine of the day was a single cylinder with a small power, as in the first case, were vertical, and all mounted in one large frame, which received a rotary motion, about a vertical axis of its own, and carrying round the minor frames combined within it to twist the three strands, which strike through the several wire and wound on in the minor frames, as fast as the three were twisted together into the intended cable, which was drawn upwards between pairs of grooved rollers, disposed above the centre of the main frame, and the entire machine conducted away by the same machinery and cased up for use. Nothing could be more striking than the spectacle of one of these magnificent machines, resembling a great vortex in motion, pursuing its silent yet resistless course, producing the means of securing at anchor the gigantic vessel of war against the raging tempests of the ocean. This magnificent machinery, after returning a handsome reward to its ingenious inventor, and the enterprising capitalists who erected it, was bought by Government, and erected at the Royal Arsenal, Deptford. Chapman's and Curry's machines, as well as a new machine, lately introduced at Portsmouth from France, said to be the invention of Hubert, are worthy of notice.

Dyer's machines for making cards, for cotton and wool, and others for cutting cards, and for making the reeds; the card-making machinery; miles of Eaton, Roberts, Smith, and others; those for weaving bobbinet lace, by Heathcoat, Morley, and others; Holdsworth's, Dyer's, and other improved machines for preparing cotton rovings; Marshall's, P. Fairall's, and other machines for preparing wool rovings; Stoddart, Deering & Co.'s, and other machines for preparing wool rovings; and the steam engine and machinery factories of Boulton and Watt, Pawlett, Bury, the Butterfly Company, Stephenson, Hawthor, Donkin, Hall, Fairbairn, Hig, Napier, Miller and Ravenhill, Maudsley and Field, and other establishments, are now making great progress in the invention of self-acting machinery, well calculated to improve, expedite, and economise the manufacture of the various articles for which they were intended. Amongst the same class may be mentioned the curious inventions and improvements of the Pat, Dole's, Crompton, Townowood, Ibotson, Kneun, Nicholson, Tilloch, Congreve, Stanhope, Cowper, Applegath, Spottiswood, and others, for making and drying paper, and printing by steam; Oldham's various contrivances for printing bank-notes; the England printer, Deering & Co.'s, and other printers; Less's, Ray's and F. Perkins's, and other machines for engraving on metal plates; Holling- drake's method of casting copper under pressure, for engraving; Brunel's block machinery, executed by Maudsley, at Portsmouth, by which every operation is performed, from the sawing of the rough piece of wood until the perfect completion of the block for naval purposes; his saw-mills at Chatham and Woolwich; Bramah's planing machine at Woolwich; Wil- kinson's machine for boring large cylinders, are splendid specimens of machinery; neither must we omit Watt's simple operation of making small lead shot, by pouring melted lead through holes in a cullender at the top of a lofty tower, when they assume a spherical form in cooling, as they fall through the air, and finally into cold water below. Leaden bul- lets are now made in a spherical form by solid castiug machines by Napier. The manufacture of crown and plate glass has been improved, and promises great extension; in this latter branch, Green, Pellatt, Chance, and others, are making great progress. The universal and rapid transmission of news and other electric messages by wires has also rendered a corresponding activity and means of supplying the increased demand for it absolutely necessary; and additional means of making machines have been invented. Self-acting turning lathes, with slide rests, planing machines for metals, also for screwing bolts and nuts, were introduced by Fox; mortising machines, similar to those of Brunel, were adapted by Sharp and Roberts for metals, and shaping machines by Penn; these have been improved by Whitworth, Nasmyth, and others, by whose means also a few have been made in their present state. Another ingenious adaptation of machinery for sweeping roads and streets, and which, from its efficiency, is coming into general use; and to the latter we are indebted for the steam hammer and steam pile-driving machine, which serve materially to economize and obtain a levelling of the streets far back as 1801, had applied steam for driving the piles of the coffer-dam for the London Docks; it has since been applied at Sunderland for a similar purpose: but for the steam hammer and steam pile-driving machine, which enters materially to economize and obtains a levelling of the streets.

The invention and application of these various new and ingenious contrivances, furnishes a striking illustration of the great state of the art in all departments; and it is almost impossible to form an idea of the great economy and accuracy which without them could never have been attempted.

With the advancement of machinery, the art of founding in iron, which commenced at Carron, soon became an indispensable part of machine making. In this department Boulton and Watt took the lead, in consequence of the great improvements they made in the frame, the casting of the engines, the breeches, etc., and, in the West India Docks; but it was not adopted. Oil's American machines for excavation have been tried, but are not as yet much employed. The invention and application of these various new and ingenious contrivances, furnishes a striking illustration of the great state of the art in all departments; and it is almost impossible to form an idea of the great economy and accuracy which without them could never have been attempted.

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tion of the steam engine (which had then begun to develop its extraordinary powers) to the York Buildings Waterworks by Savery, in 1710, and subsequently by Watt, in 1774, was the foundation of the system which has been subsequently applied at Chelsea, Shadwell, Stratford, London Bridge, and the New River Waterworks. As soon as Watt had brought his improvements into operation for pumping water, his engines were applied at each of the above waterworks, and a comparison between them could easily be made; and soon showed the superiority of Watt's engine in every respect. They were thus applied at Shadwell and Chelsea Waterworks in 1778, at London Bridge and Lambeth in 1780, and at the London and Blackfriars New River Waterworks in 1787. The old engines was to pump the water into a cistern, at the top of a high tower, and from thence it descended through pipes, to the districts and buildings where it was required; the engine was thus always kept to its full load, and when the demand was over, it was idle. With the new vessels were afterwards added to the pumps at Chelsea, and subsequently became general; the air in the vessels being compressed, acted by expansion and conduction on the water, so as to force it with regularity through the pipes, without going up to the cisterns. Several who had constructed water-wheels for pumping at Stratford in 1763, and at London Bridge in 1767, where towers were employed, afterwards became the principal proprietors of the Deptford Waterworks, and in 1778 constructed a water-wheel for pumping water from the Ravensbourne without a tower. The machine is still in existence, although steam engines have been subsequently applied. About 1810, Boulton and Watt's improved pumping-wheel engines were adopted, whose engines, when developed, and efficient, were to pump the water to cisterns on the tops of the highest houses, hence decomposing the high service. Stone pipes were tried at the Grand Junction Waterworks, but failed, and iron pipes were substituted. Filtering reservoirs were added to this and large scales were constructed at Clerkenwell, by Simpson in 1820, and subsequently at other places, with complete success, and are now ordinarily employed. The water is now generally taken from the Thames above the town, where it is least adulterated. The old waterworks lower down the river, viz., York Buildings, London Bridge, the Borough, and Shadwell, have been abandoned, and several places chosen at Rotherhithe, with Brentford, higher up the river, and at Old Ford upon the river Lee; the river water is received into capacities settling, or filtering reservoirs, and afterwards conveyed to reservoirs, basins, and cisterns, by high-pressure engines, and the water thus supplied is used in and around London and in the metropolis, but in almost all the principal towns of the kingdom, before the system can be said to be complete. The removal of Old London Bridge, by which a fall of about 8 feet at low water has been gained, has been immense advantage in improving the drainage of the metropolis; and it only remains for the system to be carried out further, by moving the shoul and regulating the high and low water channel of the river, by dredging and other means, but to be cautious in contracting the width. It is greatly to be desired that this important work should be speedily carried into effect, upon a general scientific system, which, if properly done, would confer the greatest benefits upon the extensive and populous districts, draining into and bordering upon the Thames, as well as the navigation of this noble river, upon the proper maintenance of which the health of the metropolis, and the adjoining populous vicinity, depends. In the improvements of sewerage, Cubitt, Barry, Donaldson, Gwilt, Hardwick, Naish, Smirke, Soane, Walker, Bennie, Roe, and others, have been conspicuous.

Gas.

It is difficult to point out with accuracy the date of the invention and introduction of that invaluable substitute for daylight, or artificial lighting, commerce, and in business transactions by gas. It is impossible, at the present moment, to assign the time of the invention of the gas, the Thames, above Windsor, by Beannie; also from the Colne and Wandle, and Darent, and elsewhere, by Telford, Rainville, and others, who have long been engaged in the business, and sooner or later may be effected with advantage to the metropolis.

SEWAGE.

Connected with the supply of water for domestic purposes, we must not omit the important subject of sewage, or surface drainage, upon the due operation of which the health of the community so much depends. Sewers appear to have attracted notice at an early period, and during the reign of Charles II. the first Act of Parliament was passed for improvements of sewers, to levy rates for, and to see them properly carried into effect; but until under ground or covered sewers were adopted, all the surface water from the adjacent hills and country, which in its turn, as the refuse from the buildings, was discharged into the streets and gutters, and eventually became the centre of the town, accumulated, and occasionally remaining stagnant for a considerable period, produced a degree of effluvia and malaria extremely prejudicial to the health of the inhabitants. This was remedied to a certain extent, by covering over the open drains; but the bottom of these were not low enough, and the want of surface drains continued. By degrees, covered sewers, of enlarged capacity, entirely of brickwork, were introduced; the importance of the subject has been now duly appreciated and studied; sewers were laid out upon a general and enlarged system; main, subsidiary, and surface drains, and cesspools of a proper form, construction, and capacity, adapted to each other, and to the several districts where they are to be found, have been constructed and developed. The subject is still under consideration, and improvements are being daily effected, although much still remains to be done in the form, capacity, inclination, distribution, and arrangement of sewers, not only in the metropolis, but in almost all the principal towns of the kingdom, before the system can be said to be complete. The removal of Old London Bridge, by which a fall of about 8 feet at low water has been gained, has been immense advantage in improving the drainage of the metropolis; and it only remains for the system to be carried out further, by moving the shoul and regulating the high and low water channel of the river, by dredging and other means, but to be cautious in contracting the width. It is greatly to be desired that this important work should be speedily carried into effect, upon a general scientific system, which, if properly done, would confer the greatest benefits upon the extensive and populous districts, draining into and bordering upon the Thames, as well as the navigation of this noble river, upon the proper maintenance of which the health of the metropolis, and the adjoining populous vicinity, depends. In the improvements of sewerage, Cubitt, Barry, Donaldson, Gwilt, Hardwick, Naish, Smirke, Soane, Walker, Bennie, Roe, and others, have been conspicuous.


* There are nearly 500 miles of covered sewers in the metropolis.
The employment of lamps for Lighthouses promises important results; for there, almost any reasonable degree of cost and trouble in perfecting the light, so that it may be rendered more distinctly visible at greater distances at sea, will be amply repaid; in this class may be mentioned with praise the oxy-hydric light of Drummond, and the Bude light by Garway. Latterly, the cateoptric and dioptric system of Fresnel, which consists in an ingenious and scientific construction of the lenses, and an adaptation of the compound argand burners to suit them, has been introduced into several of our first-rate harbours, with very good effect. It is the more remarkable, as the taste and judgment of the master and mates of ships that visit an anchorage, are such as to decide which is the best,—the system of Fresnel above mentioned, or the old argand system with the parabolic polished silver reflectors; both plans have been well executed by Wilkinson and by Davie.

In the latter part of Lighthouse, Messrs. Stevenson's and Walker have done much, and recently Gordon's cast-iron Light-houses\(^3\) appear, for certain situations, to merit attention.

Roads.—In proportion as the wealth and commerce of the country increased in the latter half of the last century, so it became absolutely necessary to improve the communications by roads. To meet this requirement, roads were built in different towns and districts of the empire, for supplying them with provisions, fuel, and the necessaries and luxuries of life, with greater facility and economy, as well as for expediting commercial and general intercourse; in fact, all the operations of life, as the necessary consequences of the public seeing and feeling the beneficial effects of what had been effected, and convinced of the practicability and advantage of proceeding further in the cause of improvement, would not rest satisfied until those improvements were made; accordingly, the improvements of roads attracted general attention. Originally, roads were mere footpaths, or horse tracks, across the country, in the most convenient and shortest direction between the desired places, but wholly unsuited for wheeled carriages; by degrees, it became practicable for wheeled carriages to be used, and were maintained in a very defective state by local taxes on the counties or parishes in which they were situated; nevertheless, nothing in the way of effectual mode of roadmaking was attempted, until turnpike trusts were established by law, for raising or levying special taxes from persons using the roads.

Several Acts of Parliament for these trusts were passed previous to 1765, but in the early part of the reign of George III. many more were necessary, to meet the increased demand for roads. Its introduction and extension was in a great degree due to our honorary member, the Earl of Lonsdale, who is ever alive to improvement; and to his lordship's exertions we are indebted for the present system of metropolitan roads, which has proved so beneficial.

Carriages.—The great improvement in roads, which was accompanied by a corresponding improvement in the carriages and breed of horses, produced an extent of travelling commensurate with the increased facilities afforded. Coaches were first introduced into England in 1660, about the time of Elizabeth. Public or private coaches, were only introduced in London in 1625; and stage or public travelling coaches, not until a much later period: in fact, there were few roads upon which they could pass, and for the most part they were either stopped at by the highwaymen, or were compelled to take the road in the dark. Its introduction and extension was in a great degree due to our honorary member, the Earl of Lonsdale, who is ever alive to improvement; and to his lordship's exertions we are indebted for the present system of metropolitan roads, which has proved so beneficial.

In seasonable weather, the distance between London and Edinburgh was reduced to three days and nights by this conveyance. At this time, the speed and comfort of the journeys were far superior to the coachmen and horses; and the passengers were treated with the utmost kindness and attention. The roads were then in a much better state than they are at present, and the horses and carriages were much superior to the modern. The roads were then in a much better state than they are at present, and the horses and carriages were much superior to the modern. The roads were then in a much better state than they are at present, and the horses and carriages were much superior to the modern.

ace had reached its utmost limits, and, if any improvement was to be obtained, it was requisite to obtain it from a different source. In the race of improvement, the stage coaches were not behind the mails; and we have only to mention the Brighton, Oxford, Cambridge, Southampton, Shrewsbury, and other coaches, to prove that the system was carried to the highest degree of perfection of which it was capable. In 1812 there were 24,481 miles of turnpike roads in England and Scotland, and 8,000 miles in Ireland; and since that time they have much increased.

Paving.—When the turnpike-road system was introduced, the pavement of the metropolis was improved by the substitution of square blocks of granite, in place of the rounded boulders, or large irregular pebbles, which had been previously used. The old blocks of stone were cut into small, regular blocks by the method of experiment, being laid on concrete, with the joints grouted with lime and sand, in order to insure the greatest stability amongst the blocks. M'Adam's system was introduced in some streets where the traffic was light, but it did not equal the granite paving. Wood blocks in different forms, hexagonal prisms, or cubes, or rhomboids, with the grain placed vertically, or nearly so, have been introduced for paving, the blocks being either connected by wooden pegs, or merely laid upon a bed of concrete. This system was borrowed from Russia, and patents have been taken out by Steed, in 1839, and many others, for different forms of the blocks; it has the advantage of diminished noise and friction, but its great defect is that of being dangerously slippery in particular states of damp weather, and it appears in consequence likely to be abandoned. Asphalte, a natural brittle, bituminous substance, found in volcanic districts, was introduced from France for foot pavements, in 1836; it is brought to a semi-liquid state by heat, then mixed with sand and gravel, and spread over a bed of concrete, and when cold, forms a compact and durable pavement. Flats, or flat granite paving-blocks have been in use since 1837, and better laid, and a more uniform appearance has been improved; the great difficulty, however, in keeping it in order in London and great towns, is occasioned by its being constantly broken up, to lay and repair the numerous gas and water-pipes; and it is desirable that separate tunnels or subways should be employed for conveying them, as was suggested by Williams and others, a few years since.

* The transport of goods was equally defective as to speed, and was comparatively as costly as that of passengers; at times, goods were from four to five weeks, and seldom less than thirty-six hours in going from Liverpool to Manchester, at a cost of forty shillings per ton; whereas at present they are conveyed in three or four hours, for three shillings per ton.

(To be continued.)

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SOCIETY OF ARTS, LONDON.

February 3.—W. F. Cooks, Esq., V.P., in the Chair.

Mr. Digby Wyatt read an Essay "On the Art of Mosaic, Ancient and Modern."—The author commenced by stating that the most cursory glance at the subject will shew that the ornament or mural decoration, has been connected with most of the noblest efforts of architectural genius at all ages; and as it is the wish of many at the present time to effect the revival of this art, he would endeavour to convey as clear an idea as possible of the several parts of this branch of art, and the difficulties that need be encountered in this graceful handmaid to the science of decoration. The first part of the essay took for its subject the existence of such an art occurring in the 6th verse of the first Chapter of the Book of Esther, wherein an account of the riches and luxury of the Palace of Abasamur is mentioned, and that passage clearly establishes the fact that the Persians were acquainted with the art, and it is supposed communicated to the Greeks, from whom the Romans obtained their first specimens. Cimabue divides the art into four principal varieties, called tessellata, secé, lignum, and verniculation. The first, the opus tessellatum, probably the most ancient; this kind of mosaic consisted of small cubes of marble, seldom averaging more than $\frac{2}{3}$ of an inch square; the best specimens of this description of tessels occur at Pompeii, in the Vatican. The second division of the art, the opus secé, was also applied to pavements, and it is in this description of mosaic that the simple yet magnificent pavement of the Pantheon at Rome is executed. This variety of mosaic was formed of thin slices of different coloured marbles, cut into slabs of a given form. The glass tessella was more generally employed in mural decoration, and according to Pliny, was used in the decoration of the baths of Agrippa, behind the Pantheon; it consisted of figures, fruits, ornaments, &c., by means of small cubes of vitreous composition, composed of alumine and some metallic oxide to colour it. No specimens of this description of mosaic has ever been discovered in this country. The description with description of mosaic, or opus vernicium, is subdivided by Cimabue into the various arts employed in large pavements or ceilings to represent the figures of gods, centuries, &c. The opus medium was a much more fine kind of work, and was generally applicable to walls. The third division, opus minor or opus verniculum, was the finest and most elaborate of all the ancient Roman mosaics, and consisted of the most delicate patterns, formed entirely by mosaic pieces of marble and fictile work, many of the stripes being only the 20th of an inch

across. The most beautiful specimen that has been presented to us is the one usually named by the name of Pliny's domes (a copy of which in mosaics was exhibited). There is one kind of mosaic which the author has observed in Pompeii, and which he considers may not be inapty termed the opus uncertain of mosaic, composed of all sorts and kinds of marbles put together in singular shapes, and when united into a mass with cement and laid on the floor prepared to receive it, it is exposed to a polished face by friction. In completing the sketch of this art under the Romans, the author stated that the preparation ordinarily made by them for the reception of the mosaics, consisted in their first placing a layer of large stones or flints, but with very little cement, on the ground; upon this was placed a course of concrete composed of small stones, and then placed with great strictness upon this a third layer of cement was placed, the tesserae or mosaic were then placed, and over the whole was poured liquid cement, to perfectly fill up the interstices between the cubes.—During the reign of the twelve Cesars pressure was applied to these, during seven years (a.d. 138) to that of Caracalla, the arts appears to have lost in quality; after the year 220 it became obscured by the clouds which swept the Roman empire.

From the time of Constantine three varieties arose, which obtained universally in Italy from the 4th to the 14th century, and during nearly 1000 years changed but little either in principle or design. The Emperor Alexander Severus (a.d. 222 to 235) brought with him from Alexandria great quantities of porphyry and sepiolite, which he caused to be worked into squares and triangles, and variously combined, thereby laying the foundation of this art which formed the pavement of all the rich Italian churches. We have an interesting specimen in Westminster Abbey referred to the year 1292.

The author, after tracing the history to its decline, and giving some account of the encaustic tiles, proceeded to state the circumstances which had of late years led to its partial revival; he also gave a detailed description of the processes of manufacture employed by Messrs. Singer and Petter, and Messrs. Mintons and Co., and concluded by urging on architects and the public generally the applicability of the manufacture to the purposes of decoration.

The meeting adjourned after passing a unanimous vote of thanks to Mr. Wyat; for his communication, and the specimens of ancient and modern works of art in mosaic. There were some fine Florentine mosaics contributed by Mr. Brown; modern glass mosaics of encaustic workmanship executed by Mr. Pether and Mr. Singer; encaustic tiles by Messrs. Mintons and Co.; and a large collection of elaborate coloured drawings contributed by Mr. Blackfield, Mr. Wyatt, and Mr. Owen Jones.

ROYAL SCOTTISH SOCIETY OF ARTS.

Jan. 25.—DAVID MACALPINE, M.D., F.R.S.E., President, in the Chair.

The following communications were made:

"Description of Pottery made by the Cibchraw Indians, with an account of a Chemical Analysis of Fragments of it." By John Macalpine, Esq.

The Pottery exhibited before the Society, and referred to in Mr. Macalpine's lecture, was shown by Mr. Blackfield, of Blackfield, Cana-

da West. It is of a brownish black colour, the outer surface being reddish. It is exceedingly hard and difficult to fracture. The vessel is ornamented around the edges with a design evidently copied from nature, and some-

what resembling the lines of the shell, but the surface being covered with a scratched-like net-work; indeed, the design as a whole resembles much that which exists on the pottery occasionally found in the Druidical tumuli of our own country. There are small crystal-like parti-

cles distributed throughout its mass, which vary in size from one-hundredth to one-twentieth of an inch in diameter. These particles are pure silicates, and were probably obtained by pulverising quartz or some other natural variety of silicate of iron. The pottery also contains organic matter to a considerable extent, of vegetable origin, and was prepared to a great extent with the same intention as straw was added to the Biblical and Egyptian varieties of sun-burst pottery, viz., for the purpose of increasing the adhe-

siveness of the particles. A portion of the pottery submitted to chemical analysis gave the following results:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1.06</td>
</tr>
<tr>
<td>Organic matter</td>
<td>0.91</td>
</tr>
<tr>
<td>Silex acid</td>
<td>0.30</td>
</tr>
<tr>
<td>Sesequi-oxide of iron</td>
<td>14.60</td>
</tr>
<tr>
<td>Naphthene</td>
<td>0.29</td>
</tr>
<tr>
<td>Lime</td>
<td>4.99</td>
</tr>
<tr>
<td>Selenite</td>
<td>0.08</td>
</tr>
<tr>
<td>Potash and Soda</td>
<td>0.68</td>
</tr>
</tbody>
</table>

The amount of oxide of iron stated is rather high, as the iron present, though calculated as the sesqui-oxide, does not exist as such in the pottery, but is there, almost totally, as the protoxide, except in those parts of the pottery which possesses a red colour.

From the results of the investigation made on this interesting piece of manufacture, some conclusions were drawn to the following effect:—First, that the pottery had probably not been made by the use of any one material found native, but was manufactured from a mixture of pulverised silicate, ferruginous clay, and organic matter; secondly, that the heat employed for baking the pottery, when made, was one of no high temperature, as, had it
been so, the protoxide of iron would have been thereby converted into the sesqui-oxide; and, moreover, all the organic matter would have been destroyed. The red appearance of light might have been due to this protoxide of iron having been thrown into a common weed or other fire, the influence of which being in contact only with the outer surface, had confined its chemical action to that part.

Description and Drawing of a Stove made by Mr. James Macdonald. The stove in question is but not in use in the present room, and the heat that it causes is not sufficient to warm the air of the room, nor is there a rise of water, which injures the middle of the pond, or aseptic, and are raised and shut with difficulty. Those of a better construction are expensive, and can only be made by skillful persons. This advice can be made in practice in the case of the vessel indicated in any size and strength by increasing its proportions. The concern amount of timber may be used, except the edges of the planks and their ends, where they fit into the frame. A strong frame of wood is built into the sides of the vessel from the bottom, whether it be on the top. Planks are laid in, one above another, to the required height; and if it be wished to increase or diminish the height of water in the pond, it is only necessary to put in, or to remove a plank at the top; the water then always escapes from the top of the plate in places of from the bottom.

Feb. 8.—George Tait, Esq., V.P., in the Chair.

The following communications were made—

ROYAL INSTITUTE OF BRITISH ARCHITECTS. Feb. 8.—Bellamy, Esq., in the Chair.

A paper on "The interior forms of Buildings with reference to the Laws of Sound," by Mr. Scott Russell, was read.—Mr. Russell, in commencing his remarks, said, in excuse for interfering with what might be considered and treated as a mere professional matter, he must avow that he was not a di-
carry science forward, yet, by combining particular departments to classes, it indeed narrow views. He thought much good resulted from the professors of different sciences mixing together and interchanging opinions. It was difficult to say whether one, and no matter how important a man was, never had done so,—as Michael Anagnos, Leopoldo da Vinci, and others. If in anything extra-professional aid was needed by architects, it was in the arrangement of buildings with reference to the transmission of sound, where all were awfully at fault. All architects admitted that nothing was more difficult. Mathematicians, when applied to, gave widely different forms as the best. Even an ear-trumpet was not better made by the most profound mathematician than by the merest rule of thumb; and if it were so difficult to arrange an instrument by which sound might, with every advantage, be conveyed to one individual, how much more must it be to arrange a room so that every one in it might hear what was said. The problem was to enable 1 or 1,000 to hear equally well. The waves of sound were generally thought to be like the waves of water, and he had been led to investigate the latter, and, in so doing, had arrived at some conclusions not generally entertain.

Mr. Russell then proceeded to explain a curve which he had discovered, and recommended for the sectional arrangement of the seats, and the mode of obtaining it, but which we find difficult to convey without diagrams. It was in no case necessary to put the position of the speaker, and to decide how much of the noise of the people would reach the English. He had thought an area 18 inches high and 3 feet broad sufficient. Drawing then a series of radial lines from the middle of the mouth to the listener points decided by these dimensions a curve was obtained for the rise of the seats, which was found to be of great excellence.

The second principle he would allude to was the spontaneous oscillation of air in a chamber, which was the source of much trouble, but might be turned to good account. A long chamber of air, if caused to oscillate, continued to do so; and would produce a noise in the organ-pipe. Thus a gallery, 64 feet long, would produce the note C; and if 32 feet long, it would be an octave higher. Every chamber, in short, has a voile. A speaker should find out the key-note of the room, and speak in it if possible. This fact opened the question whether we could improve rooms for hearing by attention to the dimensions and proportions. Length, breadth, and height showed in harmonious proportions, or the sound produced would fail. There was a more intimate connection between music and architecture than is now generally admitted. Simple multiples for the proportions were desirable; as, for example, 48 feet long, 24 feet wide, and 16 feet high, and so on. Incongruous sounds, he said, neutralise each other, and give to speeches and recitations a greater sense of authority. Incongruous forms made the worst apartments for hearing. The lecturer was then proceeding to speak of the third division of his subject, reflection of sound, but was invited to postpone the consideration of it till the next meeting.
Reference was made to a drawing exhibiting a variety of the same building in each style, entering into a comparison of the different results accompanying various colonnades, and stress was laid on the rectilinear and statical simplicity very nearly all Greek edifices, in opposition to that of curved and picturesque grouping in the enlarged sphere of action of the Roman imperial artists.

The author defended the revised standard for each order, on the ground that they justly were possessing all the antiques (of which they really saw very little) to be barbarous, and in trying to bring them to a correspondence with Vitruvius,—each publishing his own opinion,—had, in which case, it was agreed to and exposed the fault of making their illustrations formulations—to be applied without change on any occasion, at any height, in any situation, for any purpose. He examined the practice of the great masters and the pupils in the modern schools; he could add several instances to the store of the architect, the use of the niche, of pediments, of balustrades, of sculpture (of all sorts) as mere decorations, of the armory style, of the dispositions of the basements and attic stories as features, of spires and turrets and bell towers, and of an extraordinary luxury of internal and external architecture.

The paper closed with the observations that, with Chambers, Mylne, Dance, Holland, and Soane, the rake of architects in one style or another were being concurred, by exposure to the caprice of patrons for a command, to summon up the resources of any style—clothes even an impracticable ones, and that the current of taste was undeniably tending towards an art altogether different from that of the Greeks in its construction, or else to that of Palladio and Chambers.

INSTITUTION OF CIVIL ENGINEERS.

Feb. 9.—Sir John Rennie, President, in the Chair.

The Institution met for the first time in the new theatre, and a paper by Mr. W. E. Newton was read, giving a description of the canal em- ployed by Mr. Horne "for the construction of the permanent way on the Philadelphia and Reading, and other railways in the United States." The method was a deviation both from the systems of the longitudinal and the transverse sleepers, crossing each other and spiked together, in sections with wooden treads or from plate, in such circumstances, forming an extended platform, upon which their longitudinal bearers were laid, supporting bridge-shaped rails with wrought iron chairs. The paper gave an account of several deviations from the general system of the rails-work of iron laid in blunted, &c., and also a detail of the amount of traffic conveyed along the railway; whereas it appeared, that within one year and five days from its being opened for general use, 1,400,000 tons of goods had been conveyed along it, without any prejudice to the efficiency of the tolls, where time was measured, it was improved, and in the general features of the construction for high speed, as the rails, which weighed only forty-four pounds per yard, and which were of a bridge form, could not resist the impact of the driving wheels at great velocity, the junction of the driving wheels would become loosened, and there would be too much deflection between the bearing points.

Feb. 9.—Sir John Rennie in the Chair.

A paper was read on the "Holder or Great North Holland Canal," by Mr. G. B. W. Jackson, Associate. This canal was constructed by the late Mr. J. Blanken, engineer, during the six years between 1819 and 1825, for the passage of frigates and first-class merchantmen, and extends from Amsterdam to the Nieuwe Waterweg on the Texel. The state of the navigation through the Esbyer Sea, in the early part of the 17th century, having become so defective, in consequence of accumulated sand-banks and shoals, that vessels were necessarily made to remain over the shallows at low water; for there was both extreme loss of time and inconvenience, the Dutch Government deemed it necessary to consult Mr. Blanken on the possibility of remedying the evil. That engineer accordingly projected the above canal, which has three divisions, the sum total being only 3 feet 8 inches above the sea-tide, its length is fifty-one miles. It is 128 feet 7 inches broad at top, 50 feet 10 inches at bottom, and 20 feet 6 inches deep. The pile-driving and boring experiment undertaken by him to ascertain the probability of success, show that the original sea seen above, being only 3 feet 8 inches above the sea-tide, and the north of Holland, is to be met with at 48 feet under the present surface of the ground; and as the foundations of the locks were laid nearly at that depth, the result of the experiment was considered to afford sufficient ground to believe that the canal was safe. The locks are 150 feet long, and 30 feet wide; the interior of the canal in Holland is exceedingly treacher-ous, and it reflects great credit on our foreign neighbours that they were able to overcome the various difficulties with which they had to contend.

The constructions generally consist of stone arches. The arches are of arches, of the end arches, and in the contour of the sides, the use of square columns, and in the lower part of the arches, and in the contour of the mouldings, is the use of square columns, often allowed to be predominant, and in deceasing the circular pillar to a more pilaster, and to the practice of superimposition.
ing on two boats, so that when the bridge is required to be opened, both boats are withdrawn, one towards each shore. The Willem lock is 297 feet 6 inches long, 61 feet 5 inches wide; the height of the lock walls being 32 feet 5 inches, and the gates being each 29 feet 6 inches by 29 feet 4 inches.

The total cost amounted to one million and a half pounds sterling. The time required by vessels to make the passage from Amsterdam to the Hel- der varied from a few hours to several days, the time depending on the weather conditions and the speed of the vessel. In some cases, with six relay of horses each hour, making it in ten hours, whilst large East Indians require two, three, and four days, according to the wind.

The details of construction of the whole of the works were given very clearly and in illustrated drawings. In the discussion which ensued, it was stated that the only canal in this country which could be contrasted with that of the Helder, was the Caledonian canal, which was projected upon a report by Watt, commenced by Jessop, and in a great part constructed by Telford, a few years previously to the Helder canal. The principal difference between the two consisted in the nature of the ground through which they were cut, the former being excavated entirely out of alluvial deposit, whilst the latter had to be cut out of hard granite and in some cases rock. An interesting account was given of the mode of forming the spot for the entrance-lock at the Inverness end of the Caledonian canal. The object was to carry the water out into deep water. A large mass of earth was deposited in the sea to the full extent intended. Upon this mound, a heavy load of material was laid to consolidate the mass. After settling for a considerable time, the upper mass was removed, the excavation was made for the lock-pit, and the construction was effected with complete facility, with the aid of mercury and a few hundred pounds of silver, or of those still more fearfully explosive compounds, the chlorides of nitrogen and of iodine. Prof. Faraday showed, that, if the explosion of gunpowder were really instantaneous, it would be useless for all its purposes. It has, however, been observed in the chamber of a gun, that after a rapid explosion, the flame occupies full time for its action, after which the gun can bear, whilst an accumulating, safe, and efficient momentum is communicated to the ball, producing the peculiar effects of gurning. This manageable action was contrasted with the effect of a morass of nitrocellulose, which consists of innumerable particles, and the inferiority of the gunpowder was felt in the extremity of a long stick. The parts immediately in contact with the iodide were shattered.—i.e., the end of the stick was shattered, and the morcell in the plate, covered by that substance, was drilled as if a bullet were fired through it. Hence the use of the compressor, whereas the comparatively gradual action of gunpowder lifts and projects those weaker substances, wadding and shot, which give way before it.

Mr. Aplsey Pellatt delivered a lecture at the Royal Institution on Feb. 19, on "The manufacture of ornamental glass." He explained that the refractive pellucid colourless brilliancy of flint-glass was owing to the presence of lead; and that of clear glass, of soda or potash, most resembled rock-crystal or the diamond; and in this branch of the trade, especially as regarded table and chandelier glass, the British glass-manufacturers were pre-eminent, and superior to their continental rivals. The entire manipulation in the making of a wine-glass, but barometer-tube drawing, patent pillar moulded vase, were explained in detail both from large diagrams and from the practical exhibition of these processes by two workmen; a furnace having been fitted up by Mr. Pellatt in the theatre of the Institution for the express object; also salt-cellar was pressed by a new machine, bottles blown and moulded, spun-glass drawn, &c. During these operations Mr. Pellatt explained the conditions of whetting off by the application of the sudden contraction of the cold iron tools, so that a slight blow sometimes sent them high in the air. The wine-glass imitating the blowing of the blower's crown; that a punt might be applied to the reverse end for shaping and finishing the bowl. The punt is a solid iron case, with a little hot glass adhering to it for handling glass pieces; which, by partial melting of the glass in the course of manufacture, is again removed by a tap when it is no longer required. The peculiarity of glass welding by contact (impossible if the slightest film of sulphur intervene), and various manipulations, were detailed, particularly the projecting moulded pillars which possessed the refractive and brilliant effect of cut glass; and although invented and introduced a few years since by Mr. James Green as a novelty, it was found, on comparison with a Roman specimen of glass dug up in the city of London, the property of Mr. Roach Smith, apparently to have been manufactured by some name applies to those into the fragments having a perfectly even interior, with a projecting pillared exterior.

The difference of glass made by hand and in moulds was stated by the lecturer, as well as the distinction between moulded blow-offs with cut scollop edges, which were far superior in the interior polish, as contrasted with articles, such as dishes and salt-cellar, pressed in moulds by mechanical power, as introduced by the American system, whose interior
ON THE NATURE OF HEAT.

Mr. Grove gave a lecture at the Royal Institution, Feb. 5th, on "some Considerations of the Nature of Heat."—After a sketch of the existing theories of heat—the emissive, the etheral, and the dynamic—Mr. Grove announced himself an advocate of the last, viz. that which regards heat as molecular motion. He then goes on to explain the phenomena of what is called "latent heat" have always been considered a stumbling-block in the way of this theory, and a strong argument for the materiality of heat. Mr. Grove considered that all the phenomena of latent heat might be accounted for more simply by the dynamic theory, and that the greatest difficulty in applying this theory was the necessity of excluding, was associated by long usage with the phenomena, and also of employing terms which had become engrained by custom on the expansive effects of heat. Thus, in expounding a new view, although more simple in itself than the received ones, we are obliged to avails of received terms, to which, while we use them, we object. Excepting the case of certain substances which expand in freezing, and which expansion is accounted for by their crystallisation, making the body occupy more space, by leaving interstices between the crystals, Mr. Grove stated that all the phenomena in which the so-called latent heat is concerned were mere expansions and contractions; and that what, according to that theory, would be called absorption of heat, was mere extension of the substance said to absorb the heat. Thus, suppose a given quantity of water to be heated by a given amount of heat; the fact is, that the water expands, the mercury contracts; at a certain point, viz. that at which the water is said to have reached its boiling point, the attraction of the molecules of water is so conquered by the repulsive force, heat, that the free action of the vapour; here its molecules being less attracted, and having consequently a less attraction to the body of liquid, are so much more readily expanded, and exhaust much more expansive force from the heated mercury: this, therefore, loses expansive force, i.e. contracts or shrinks; and the more in proportion to the readiness of expansibility of the substance which is the imputation of the expansive force. So, if the caloric force be supplied by other means, such as apparent combustion, say of coal and oxygen, i.e. chemical action, the expenditure of fuel will be in proportion to the expansibility of the substances heated; so that the same quantity of water will require the same quantity of heat to expand to the same degree. If, again, the same source of heat be applied to the two substances, water and mercury, say to a thermometer immersed in water, both gradually expand, but in different degrees; at a certain point the attractive force of the molecules of the water is so far overcome that the liquid becomes vapour; at this point the heat of force, meeting with much less resistance from the attraction of the particles of steam than from those of mercury, expands itself upon the former: the mercury does not expand, or expands in an infinitely small degree, and the steam expands greatly; as soon as this arrives at a point where circumambient pressure causes its resistance to further expansion to be equal to the resistance to expansion in the mercury of the thermometer, the latter again rises; and so both go on expanding in an inverse ratio to their molecular attractive force. Again, if the steam be not allowed to expand, as by confining it to a metallic chamber, say a metallic chamber, then the mercury of the thermometer immediately rises. Thus heat is regarded as a purely mechanical effect; and indeed it can be made to reciprocate with mechanical action. If by mechanical pressure we cause a substance to contract, this gives out heat, i.e. causes surrounding bodies to expand; and, vice versa, if we mechanically rarify or expand a substance, cold is produced, i.e. contraction in surrounding bodies. The theory was also applied to the increase of specific heat in bodies as their temperature increased, and to many other points; and the whole subject was experimentally illustrated.

Mr. Grove next passed to the consideration of the effects of heat, viewed as repulsive force, upon another mode of molecular attraction, viz. chemical affinity. A vast number of compound bodies are decomposed or resolved into their constituent elements by heat; and these effects may be accounted for by supposing the heat so far to alter their molecular composition as to remove them from the spheres of their affinity. In other substances, however, chemical combination is produced by the application of heat; and though by certain hypotheses these latter effects may also be accounted for by the repulsive action of heat, Mr. Grove seemed to consider these hypotheses rather strained. Water, up to a recent period, been considered not only indecomposable by heat without the aid of some other powerful chemical affinity, but the elements of water are united by the action of heat; and in phenomena connected with the nature of water with each other, or with other gases. Mr. Grove however has proved, and experimentally showed on this occasion, that water is capable of being decomposed by heat; thus forming no exception to the general antagonism of heat and attractive force.
STAINED GLASS.

At a meeting of the Decorative Art Society, on the 27th Jan., Mr. E. Cooper, "On Stained Glass Windows," observed, that in the Italian, or Venetian, style, with Gothic embellish- ment, took place during the reign of Henry VIII., as seen in the church of Bishop West, at Ely, and in Wodeley’s hall, at Hampton Court, whilst, in- deed, the pure Italian architectural design by Torregiria, in the tomb of Henry VII., was, not in the windows, the statues, and organs, that King’s College Chapel, Cambridge, belong to this period. Some specimens of Italian decorations, in the paintings by Holbein, at Hampton Court, were also referred to. He enlarged upon these circumstances, lest he might have spoken to a general impression of the revival more especially attributed to Inigo Jones. A detailed description of the windows at King’s College, Cambridge, followed; and the east window of Saint Margaret’s church, Westminster, was, in his opinion, de- signated, as an example of the taste in this window which was the correct notion of those at Cambridge. It was said, that this had been ex- ercised at Gouda, in Holland; at which place may be seen some of the finest examples of stained glass in existence; they are in the style of the Dutch art. Much of the detail was said to be valuable, although a confused effect arises from the ornamental portion overpowering the figures.

Mr. Cooper also remarked, that the windows of the sixteenth century have a peculiar character in the imperfectly attained perspective effects, and the attempts to reproduce textures by painting; hence exhibiting a disconnected interests; principles of their art. He observed, that the glass should be supported by draperied or diapered back-bounds, admitting depth in colour. The windows of King’s College chapel might be considered beautiful, rather from the rich colours of the glass than from the artistic merit in the application of colours to the design, which can only be made out after some little study. During the 16th, 17th, and 18th centuries, one uniform tone of colour pervaded the back-ground; and as one of the finest examples of this class, the window of the north transept of Canterbury Cathedral was referred to. It displays a glowing brilliancy not subsequently attained.

The royal Elizabeth, stained glass was largely introduced in mas- sions, exhibiting heraldic devices and mottos. The 17th century led to a novelty of windows in Van Linschoten’s designs in Lincoln’s-inn chapel being a good example of this art’s productions. Others were enumerated, which belong to the 18th century, but they were not considered worthy of commendation, having been, for the most part, treated as an oil-painting, and with a preponderance of shadow on a transparent medium. At the present day, Mr. Cooper observed, there is a return to the practice of mediaeval glazing, in the employment of flashed glass and pot-metals together with minute lead-work. The east window of Saint James’s Church, Pic- cadilly, he thought creditable in respect of glazing and richness of tone in the colours; but a higher degree of artistic merit might have been readily attained. A proper gradation of colour in the composition had not been observed; the most elevated figure, viz., that of the Saviour ascending, being most enriched in respect to colour, the next figure should have been represented in drapery of the most admirable description. Much controversy and criticism had taken place upon the character of this window. He said that he could not detect any Gothic details in the window, and that the borders of the glass, as designed by G. Romano, and others, and may be seen in Gruner’s work. The borders of mosaic-work impart a Byzantine feeling, while the various symbols and emblems introduced were commonly employed by the early Italian Christians. He considered that we may expect success in direct imitations of the mediaeval works, as seen in new windows in the Temple Church, where the colours and glazing are alike, good, and the tableaux, or subjects, being small, do not render any impropriety of intensity conscientiously objectionable.

The east window of the new church in Wiltos-place was sent noticed as a misunderstanding of this kind of decoration. It is not yet completed; but in the lower portion a failure was said to be clearly indicated. The intentions of the designer, the writer supposed to be akin to those prevalent during the last century, when the introduction of that figure and separate subjects illustrative of history was aimed at; but omitting the principal charm arising from the harmonious and rich glow emanating from a combination of full-toned colours. The figures in this window were worse than light and white grounds, producing a spotted effect from their size, and also precluding the possibility of readily making out the subject; added to which, each figure, or group, is surrounded by ta- bernacle work in pale yellow glass, feebly contrasted with the lines of the borders, which are too heavy. Sometimes two rules should be observed,—either a rich general effect should be produced (the design or subjects being subordinate), or the subject should be well defined, and sufficiently large to be still understood in any part of the building. Neither of which was considered in the present case.

One great cause of failure at the present day was attributed to the art being regarded as a mere trade; and it was contended, that were artists of eminent talent to devote to the principles which regulated the application of colour to this material, we might soon realise our brightest expectations. Much might be hoped for from the great advance taking place. More information will be communicated to the abbot of Westminster, that he believed he had not yet been applied to stained-glass windows. One was, to introduce "lights" in the representation of objects. Shadow had been freely used, but he argued, that dark shadowing constitutes a great fault. This was brought out in a paper on light and shadow. By using flashing glass and a partial removal of the coloured surface these might be produced. Another plan by double glazing was mentioned, using two plates of flashed glass of different colours, and subjected to certain modifications by grinding or acid. Specimens illustrating these considerations were exhibited.

By these and other means that might be suggested, together with an avoidance of aerial perspective, a superior pictorial effect would result; and it was pointed out, that the present belief in the recession of light and shadow was the natural conclusion of all the characteristic features in the design and colouring peculiar to each of the centuries which had been passed under review.

CENTRAL SUN.

At the Royal Irish Academy, Sir W. Hamilton announced the presumed discovery, by Prof. Müller, of "a Central Sun," and exhibited Prof. Müller’s essay on the subject (Die Central Sonne, Dorphi, 1845). The following report, containing a sketch of the results arrived at, and which was briefly stated to the meeting, we take from the Dublin Evening Post:

"By an extensive and laborious comparison of the quantities and directions of the proper motions of the stars in various parts of the heavens, and the important internal and external conditions of the disturbances, and with the theory of universal gravitation, Prof. Müller has arrived at the conclusion that the Pleiades form the central group of our whole solar or sidereal system, including the Milky Way and all the brighter stars, but exclusive of the more distant nebulae, and of the stars of which those nebulae may be composed. And within this central group itself he has been led to fix on the star Alcyone (otherwise known by the name of Eta Tauri), as occupying exactly or nearly the position of the center of gravity, and as entitled to be called the central sun. Assuming Bessel’s parallax of the star 61 Cygni, long since remarkable for its large proper motion, to be correctly determined, Müller proceeds to form a first approximate estimate of the distance of this central body from the planetary or solar system; and arrives at the (provisional) conclusion, that Alcyone is at least 4,000,000 times as far removed from us, or from our own sun, as the latter luminary is from us. We would therefore, according to this estima- tion, be at least a million times as distant as the new planet of which the theoretical or deductive discovery has been so great and beautiful a triumph of modern astronomy, and a striking confirmation of the law of Newton. The same approximate determination of distance conducts to the result that the light of the central sun occupies more than five centuries in travelling there and returning here; and that the light of our own sun, with the earth and the other planets, is thus inferred to be describing about that distant centre—not indeed under its influence, but by the com- bined attraction of all the stars which are near us—being estimated to have a total mass of about 177,000,000,000, each equal to the total mass of our own solar system,—is supposed to require upwards of 18,000,000 of years for its complete description, at the rate of about eight geographical miles in every second of time. Of the completeness of this view of the spatial relations of the two parts of the Milky Way, which are confounded with each other by perspective in the portions most distant from ourselves. Professor Müller has acknowledged in his work his obligations, which are those of all inquirers in sidereal astronomy, to the researches of Sir William and Sir John Herschel."

Dressing with Engine Aashes.—On the farm of Daldorph, the property of Archibald Buchan, Esq., of Catrine Bank, Scotland, there are drains made 28 years ago, and filled with engine ashes, which are still in full and efficient operation. The depth of drain is 36 inches, and the width between each 13 feet. The bottom of the drain is cut 3 inches wide, and the sides 10 inches. The soil is a firm clay. These drains promise to be as efficient half a century hence as they are at the present time.
LIST OF FOREIGN BOOKS LATELY PUBLISHED.

Czyzynski, J., Kopermik—Ceramic and his Works. Paris: 8vo. 6s.


Vignera, E., Irrigator—Practical and Legal Handbook of the Irrigator Paris: 12mo. 2s. 6d.


Zittel, F., Deologie—Geological and Historical considerations on the last Cataclysms of the Globe. Paris: 12mo. 2s. 6d.


Ray de Magou, Elements—Critical Examination of the Cosmos by Humboldt, with a new system of the Universe. Paris: 8vo. 8s. 6d.

Vendome, A., Genie—The Genius of Art; Studies on the most celebrated Painters, Sculptors, etc. Paris: 8vo., plates. 9s.

Bdissier, L., Histoire—History of Monumental Art in the Ancient and Middle Ages, with an Essay on Glass Painting. Paris: gr. 8vo., plates. 21s., [A very important work.]


Richer, Chemins de Fer—The Great French North Line, from Paris to Ostend and Cologne. Paris: 18mo., 2 charts on steel. 6s. 6d.

Annuarie—Annuaire of the Ecole polytechnique, up to the year 1846.

Andrev, Systeme—Atmospheric Railways, after the system of—Paris: 8vo., plates.

Blouard, M., Cours—Course of Hydraulic constructions at Sea-port, delivered at the College of Roads and Bridges. Paris: 4to., Atlas. 21s.


Futemoy, T., Notice—Notice on the Construction of the Tunnels of St. Clou and Montrevel, with general observations on submarine passages, and the dimensions and prices of sixty-six tunnels in France, England and Belgium. Paris: 8vo., plates. 8s.


Prus, C., Tables—Tables on the tracing of Converging Curves (c. de raccourcissement). Paris: 12mo. 5s.


Application of the Properties of actual Celerity to the different require-ments of Stability of Vessels and Dressage, by General Count L. Paris: 4to.


IMPROVEMENTS IN THE PORTABLE FORGE. C. V. Queen, Peeksville, New York.

The forge is provided with shutters, which slide around to enclose the fire-place when not in operation. The forge fan is provided with a pipe which communicates with the bellows, and from this pipe there is a branch provided with a valve, so that air can be admitted to the fire, when the bellows is not at work.


It consists in attaching two screws to cog wheels on the deck of the vessel, which mesh into a large cog wheel on the drum of a capstan, the movement of the screws taking the form of a screw, and the motive power in the sliding frame of the prepeller, the sides of which frame are bored out cylindrically to a certain depth, to admit the screws to pass therein, and to protect them from the action of the salt water deposits and rust, which would otherwise prevent their working.

IMPROVEMENTS IN WATER WHEELS. William Dripps, Castaville, Pennsylvania. consists in making the aperture in the wheel, for the introduction of the water to the bellows, to extend through the outer or cylindrical perimeter thereof, near the top, and then spirally down through, between the buckets, to the bottom thereof, in the manner described, in combination with the funnel-shaped inner rim and curved bucket; and also the combination of the sliding frame, and segment valves connected therewith, by rods or stems of unequal lengths, for letting on the water by degrees.

IMPROVEMENTS IN FISH frames of bridges. Nathaniel Rider, South Bridge, Massachusetts, relates to the mode of producing the camber of the truss, by dissension wedges, or apparatus, applied between the ends of the bars of the upper stringer, or chord, in combinations with the cast-steel and cambering chain, made and applied to the lower or other suitable part of the truss. The wedges are applied at the junctions of the pieces composing the upper of the arch, and below the arch there is a chain made in two parts, and connected by a swivel screw, for the purpose of shortening the chain which supports the arch.

IMPROVED METHOD OF INDICATING THE HEIGHT OF WATER IN STEAM BOILERS. George Faber, Canton, Ohio; consisting simply in attaching a magnet to the axis of motion of a wheel or lever, to which the float is suspended or attached, to communicate motion by attraction and repulsion, to an index needle turning on a axis outside the boiler, and separated from the magnet by a steam-tight plate.

IMPROVEMENTS IN THE STEAM ENGINE. R. F. Loper, Philadelphia, Pennsylvania; consisting in rotating two crank shafts with equal velocities and in opposite directions, by means of a connecting rod, extending from the cross-head of a steam engine to the two crank shafts, the centre of vibration of the cross-head being centrally between them. The claim is for connecting the two ends of a reciprocating engine with two crank shafts on opposite sides, and at equal distances from the centre of vibration, by means of a connecting rod or lever turning on the cross-head, and reciprocating with it, and taking hold of the cranks on the two crank shafts, by which they are caused to turn in opposite directions, and with equal velocities, as herein described.

IMPROVEMENTS IN THE STEAM ENGINE. William A. Lightbait, Albany, New York; consisting of the arrangement and disposition of the steam chest, side pipes, condenser, exhaust pipe, bed plate, and air pump, in combination with the cylinder lying horizontal upon the solid keelson or frame, said cylinder being in the hold of the vessel, below the deck beams. Second, the mode of working the valves whole and half stroke, by the combination of the eccentric wheel, eccentric hook and branch hook, the heart cam and side hook, together with the hollow rock shaft, substantially as described, in combination with the cylinder in the aforesaid horizontal position.

IMPROVEMENTS IN THE WATER WHEEL, William Lamb, Whitestown, New York, consists in the construction of water wheels designed to run under water, with one, two, or more floats so placed in relation to the shaft and body of the wheel as to form a short transverse section of a screw of one, two, or more threads respectively—to be made of any suitable material, and of a shape that may be moulded and cast whole, or to be made of wood, or part of each—in combination with a coiled or scroll truck, so made as to bring the water in contact with one side of the wheel, and conduct it around the wheel in the direction the wheel runs (except what is discharged in its pass- age) the trunk being diminished in size gradually by drawing in the side or sides, or by gradually raising the bottom, or both, so that the size of the trunk at any given point, shall be adapted to the quantity of water remaining in the water wheel, not being limited in the width of the floats; said trunk to be made of metal or wood, or part of each, and of a size and form best adapted to the circumstances.
REGISTER OF NEW PATENTS.

SMELTING COPPER ORE.

THOMAS BELL, of Don Alkali Works, South Shields, for “Improvements in smelting copper ore.” Granted July 23, 1846; Enrolled Jan. 23, 1847.

These improvements relate to obtaining sulphuric acid from copper ores during the roasting, by placing the ore in powder on the shelves of a common roasting furnace, to which a roasting kiln is attached by a flue, which enters two feet from the bottom, from 150 to 200 feet in length; in this kiln copper ore, in lumps, is put; near the end of the flue there is a jet of steam, which increases the draught; coke, anthracite coal, or charcoal, may be used instead of bituminous coal. The top of the kiln is arched over, and a flue passes through the top into a vitriol chamber. Near the end of this flue also there is a steam jet. During the roasting of the ore, sulphuric acid is formed, which, in passing through the flues, is mixed with the aqueous vapour, and partly becomes condensed into sulphuric acid; in this state it passes into the vitriol chamber, and collects on the floor; at the same time, the uncondensed sulphuric acid gas and steam, on passing into the vitriol chamber, meet with nitric acid gas, produced by acting on nitre, or nitrate of soda, by strong sulphuric acid. But that portion of the sulphuric acid which escapes condensation is afterwards condensed in columns of coke, previously exhausted, as described in a former patent (Nov. 5, 1845), “for improvements in the manufacture of sulphuric acid,” or by means of a high chimney.

AREA GRATINGS.

RICHARD MARTIN, of Portsea, Southampton, gentleman, and WILLIAM HENRY MOORE, of Southsea, gentleman, for “Improvements in gratings of metal or wood, for the fronts of houses and general purposes, for the admission of light and ventilation.”—Granted May 30; Enrolled Nov. 28, 1846.

This invention relates to constructing gratings of wrought or cast metal, or wood, as shown in the annexed engraving; fig. 1 is a plan of part of a grating, and fig. 2 a section. The bars are fixed in the frame in such a manner that the top of one bar shall lie on the bottom of the next bar. The length of the frame is regulated by the number of bars; it is 3 inches deep, and 3 inch thick. The length of the bar depends upon the size of the required grating; the depth of each bar is 3 inches on the top side, and 3 inches on the under side; the thickness is 1 inch on the top edge, gradually reduced to 3 inch in the middle, immediately on the under side; this thickness is reduced to 3 inch, and then gradually reduced to 3 inch at the bottom. The distance from one bar to another is 3 inch at the top, which is increased to 3 inch at the bottom.

HOUSE PAINTING.

HAROLD CREESE, of Brixton-hill, Surrey, paper stainer, for “Improvements in the preparation of paints and colours for decorative and other similar purposes.”—Granted July 23, 1846; Enrolled January 23, 1847.

The invention relates to the preparation of colours, whereby they are rendered suitable for painting “flattening or dead white;” the colours so prepared will be free from any offensive smell, dry quickly, and be ready to receive a second coat within an hour after the application of the first. The improvements consist in combining shellac, gelatine, and animal or vegetable oil, with an alkaline base, and incorporating this mixture with ordinary paint, in the following manner:—Boil 2 lb. of well-bled shellac and 1 lb. of borax, or other suitable alkaline base, in five quarts of water until dissolved; the boiling to be continued until the solution is reduced in bulk to about one gallon. To one quart of this solution, from half a pint to a pint of pure gelatine, according to its strength, and four drachmas of alcohol are added, and gradually incorporated therewith by the application of heat. The mixture is then added to the remaining portion of the solution, together with the requisite quantity of white lead to give it a body, and a small quantity of well-bled oil; the latter ingredients being added in the proportion of 9 lb. of white lead and two ounces of oil to each quart of the solution. This mixture is ground in an ordinary paint mill, and afterwards thinned with a solution of shellac: it is then ready for use. The preparation is applicable to all colours used by painters, excepting a few containing iron.

GAS APPARATUS.

AUGUSTUS WILLIAM HILLARY, Esq., of Chelsea, gent., for “Improvements in the manufacture of gas.”—Granted July 23, 1846; Enrolled Jan. 23, 1847.

The objects of the improvements are, first, for separating the condensable matters from the gas at one operation; secondly, for converting bituminous matters into gas; thirdly, for decomposing the condensable matters, by passing steam over them in the heated tubes; fourthly, the obtaining from the pitch, tar, &c., matters capable of enriching the gas. These objects the patentee proposes to obtain by the arrangement of apparatus, consisting, first, of a retort, which is of oval form in front, with one end rounded, and within which are placed, lengthwise, three parallel tubes, reaching nearly the whole length; the ends of the tubes towards the back are open. The tubes contain, to about three quarters of their length, twisted plates of metal or other suitable material. From the centre one of these tubes, which is larger than the other two, a tube rises to a considerable height, and then turns downward again in the ordinary manner of refrigerators, the end dipping into a condenser. This condenser is a rectangular receiver divided into eight compartments, each of an oval form in front, with one end rounded. The tubes above mentioned dips into the first of these compartments, from this again another tube passes to an equal height with the first, and dips into the second compartment, and so on throughout the several compartments to the last in the series; from which a tube passes into the hydraulic main. From the ends of the two latter tubes above described, two smaller tubes rise and enter the front of the condenser; these tubes have such a form that by a bend in the horizontal portion, it acts as a syphon, and prevents the gas rising from the retort by these channels to the condenser. From the back of the condenser there is a syphon, which can be opened or shut at pleasure; this syphon, if required, will conduct the tar and ammoniacal liquor to the furnace.

When the charge of coal in the retort is being decomposed, the gas and vapours formed pass (by the middle tube above described) up and down the series of pipes in the refrigerator, depositing the tar and other condensable matter in the condenser, from which the fluid matters, viz., water containing ammonia and tar, are drawn off. After the two syphons first above mentioned, into the two tubes within the retort; here, coming in contact with the heated metal plates, these waters, the patentee states, are decomposed; the metal becoming oxide of iron by the decomposition of the waters vapour, at the same time that the free hydrogen unites with the carbon of the pitch and tar, it forms a superior gas. Coal contains besides sulphur, ammonia; the steam passing over the oxide of iron formed in the tubes, enables it to absorb a larger quantity of sulphur. In this manner the metal is converted into sulphur and ammonia and iron, and the gas sufficiently purified for ordinary purposes; but if it be used in private houses, it is to be further purified by passing it through sulphuric acid, diluted with three proportions of water, and then through lime before entering the gasometer.

PROPELLERS FOR STEAM VESSELS.

PETER CLAUDIUS, of Leicester-square, Middlesex, gentleman, for “Improvements in methods of an apparatus for propelling and exhausting and compressing air and aeroiform bodies.”—Granted July 23, 1846; Enrolled Jan. 23, 1847. (Reported in the Patent Journal.)

This invention relates to propelling vessels from the stern. With this view, the patentee employs a horizontal propeller shaft, attached to the pistons of two steam cylinders; the ends of these shafts, which pass through stuffing-boxes into a watertight casing, are affixed to frames or chains, subdivided into twelve or more compartments, for the reception of an equal.
number of swing floats, which open one way, to admit of little resistance to the return stroke. These propellers, which move in a line vertical with the rudder of the vessel, are actuated by the compression, by the pressure of the steam piston, forward in the direction with the line of motion of the vessel or boat; the mode of reversing being the alteration in the direction of the float boards to the required direction. The patentee claims under the first head of his description the mode of, or apparatus for, propelling boats or vessels from the stern by suitable means hereinafter described.

The second part of the specification relates to the mode of an apparatus for propelling vessels or boats by the means of circulatory revolving paddles. In constructing the float boards according to this plan, the paddle wheels are placed in the cylinder next to the cylinder of the steam engine. The steam is directed into the cylinder under the paddle wheels, which revolve at the required speed by the medium of the water current, by which the paddle wheels are actuated. The paddle wheels are placed in the cylinder under the paddle wheels, which revolve at the required speed by the medium of the water current, by which the paddle wheels are actuated.

The third part of the specification relates to the construction of vessels or boats formed with bottoms of double curved and double bilges, the object of which is to enable those on board to sail the vessel or boat when necessary; for this purpose the patentee employs an air-pump in connection with a bulk head or longitudinal channel in the hold of the vessel or boat; each boat or vessel having double curved bottoms, with double bilges, are formed like two boats or vessels placed side by side; these double curved bottoms are boarded over, forming the floor of the vessel or boat and between which an air-pump and suitable apparatus is employed to drive the bilge water out, or to keep it in; the action of opening outwards as well as inwards causing the water (by a pressure of air from the air-pump, on the surfaces of the same, between the bulk-head or longitudinal channel in the hold of the vessel or boat.)

The fourth part of the specification relates to the mode of, or apparatus for, constructing vessels with double curved and bilges, for purposes of ballasting, or driving the bilge water from the vessel or boat, through suitable valves in the bottom of the vessel or boat.

The patentee claims under this third head of his invention, the method of, or apparatus for, constructing vessels with double curved and bilges, for purposes of ballasting, or driving the bilge water from the vessel or boat, through suitable valves in the bottom of the vessel or boat.

The improvements relate, first, in the application to wood mosaic, and tessellated work, in general, of the principles here described, to each separate square or tessaer. Second, to the mode of putting together and forming such work when the tesserae is square, with such elastic and easily-compressible material surrounding each square or tessaer, as shown in figs. 1, 2, 3, 4, 5, 6. It is further intended to include in the application of mosaic, these pieces being regulated according to the design intended. Then sheets of cork are taken and carefully cut or prepared to a thickness in proportion to the size of the square or tessaer, (about \( \frac{1}{16} \) ) the cork is then trimmed or fitted to the length and width of the before-mentioned pieces of wood; and pieces of wood and sheets of cork are then glued or cemented alternately together, forming them into different blocks, each blocks being regulated in number by the number of the compartments into which the intended design or pattern may be divided; for instance, in the design or pattern shown at fig. 1, the full design or pattern, it will be seen, is divided into, or consists of, five compartments, and there are, consequently, five of these blocks, similar to figs. 2 to 6, each block being confined to its distinct compartment of the full design or pattern, as shown at fig. 2, 3, 4, 5, 6, in fig. 1; and in forming and making up these blocks, the different coloured and description of pieces are to be arranged in the order required to form the pattern. These blocks are next cut up, arranged, and prepared, after the following manner:—when it is desired that the mosaic should be hung or covered with the grain or fibre of the wood vertical, or natural, so first cut the blocks so arranged, in half, in the direction of the dotted line, d fig. 2, and then cut each of the halves into separate planks, or pieces of the required thickness, in the direction of the dotted lines, d, d, b, b, as shown in fig. 2; and when it is desired that the mosaic should be prepared across the grain or fibre of the wood horizontal, then cut the blocks so arranged across, in the direction of the dotted lines, c, c, c, as shown in fig. 6. Afterwards plane those separate planks or pieces to the exact size of the square or tessaer of the work, and then proceed to make up the block of the full design or pattern, as shown at fig. 1, in the following manner:—take the plank from each of the separate blocks, 2 to 6, and then glue them together, in the order of the pattern and of the numbers of the blocks, with other sheets of cork cut and prepared, and of the thickness as before described, alternately together; then continue on as before, repeating the making up of the full design to the desired length of the block, as shown at fig. 1, as to which, about thirty inches will be found a convenient length. The block thus obtained is then to be sawn in the direction shown by the dotted line, d, d, d, into sheets of the thickness desired, (say \( \frac{1}{4} \) in. thick), and each sheet will present precisely the same design or pattern, and each square or tessaer be surrounded by the cork so introduced in the work as before mentioned, and be in a state for use according to the purpose for which it is intended, excepting that, in case wood be to be artificially coloured is intended, the sheets, or such parts of them as are intended to be artificially coloured, will first require to undergo that process, which is well known, it being at this stage of the manufacture that it is preferred to colour the wood when it is artificially coloured.

This mosaic and tessellated work is applicable to flooring, paneling, and veneering, for building purposes; also to all purposes of cabinet work, furniture, and useful and fancy articles for which veneers are now commonly used, and in the finer sorts, where the square or tessaer does not exceed three-fourths of an inch, may be used as a veneer covering. While used for...
the purpose of making floorings and wainscoting, or panellings against walls, it is preferred, before fixing it, to fasten each sheet of the mosaic, so prepared, upon a separate suitable groundwork or foundation; for this purpose a double set of thin boards, glued or cemented together transversely to each other as to grain, does extremely well.

When used as a loose covering, it is fastened on to a thin surface of papier mâché, or felt, or a preparation of India rubber and cork, known by the name of kampotle, or other suitable material. The material we have named throughout the description already given of this invention, as the surrounding material for the square or tessera, has been confined to cork, and which is the material preferred by the patentees; but any other material which may be of an elastic or easily-compressible character, such as caoutchouc in its various states of preparation, or soft leather, papier mâché, felt, gutta

percha, and other materials partaking of the like properties, will answer the purpose; some of the materials here referred to for surrounding each of the squares or tessers, may also be applied in a fluid, or soft, or plastic state, and poured or pressed in between the squares or tessers, instead of being applied in the way described.

In diagonal work, where the tessera of the mosaic is otherwise than square, it is to be made up in the usual way of preparing and forming inlaid work when made up into blocks, except that the elastic and easily-compressible material before described all round each tessera, is introduced; and where combined with work in square tessera, as shown at fig. 7, the principle of making up the pattern is applied, when formed of square tessera as already described, as far as it may be practicable.

![Diagram of Atmospheric Railway Tubes](image)

**ATMOSPHERIC RAILWAY TUBES.**

WILLIAM WARWICK, of Ashton-terrace, Coronation-road, Bristol, civil engineer, for "certain Improvements in the manufacture and arrangement of parts and apparatus for the construction and making of atmospheric railways."—Granted Aug. 11, 1846; Enrolled Feb. 11, 1847. (Reported in the Patent Journal.)

This invention relates to an improved method of manufacturing the traction tubes for atmospheric railways, in which the driving pistons work these tubes, which are of cast iron or other suitable metals, made in the ordinary manner, but differ only in the construction of the longitudinal valve, which is formed of different segments (answering a double purpose, by forming the top portion of the traction tube as well as the longitudinal valve), each segment being formed by layers of flexuous material, such as India-rubber, leather, or other elastic substance, placed between metal plates of given lengths, admitting by its flexibility a free passage to the piston rod. Fig. 1 represents a transverse vertical section, and fig. 2 a plan view of the top, showing the longitudinal valve: a a is a cast iron tube, or traction pipe; b is a metal segment of the longitudinal valve; c c is the outer segment or flexible portion of the same; d d are four lifts, two of which are attached by their ends to one side of the segment, l, and the two alternate ones to the other, so, by which it will be seen that, as they press upon the flexible substances, c c, they keep the joint, indicated by the dotted lines, hermetically sealed; e e is a lifting valve wheel, which travels with the piston on the frame, f f; g is a piston motion rod, which is attached to the carriage, when motion is given to the piston by an external atmospheric pressure; the wheel i raises, as the piston advances, the alternate segments of the valve, shown by the dotted line k, forming an open channel for the transmission of the arm j; k.

![Diagram of Metal Rollers](image)

**METAL ROLLERS.**

THOMAS PAYNE, of Handsworth, near Birmingham, gentleman, for "Improvements in the manufacture of rolls for rolling iron and other metals."—Granted August 4, 1846; Enrolled February 4, 1847.

This improvement relates to the mode of rolling iron and other metals. Heretofore the rolls have been cast with necks or axles at their ends, which are liable to be broken when in use; and it has also been attempted to cast rolls on to bars of iron, to strengthen the axles or necks; but in such cases the inventor states that bars of iron so used are much injured, and being weakened, are unfit for such purposes. The patentee proposes to cast the rollers of any given size required, hollow, so as to admit of the shaft or axle being passed through, and fixed therein by keys or otherwise; ears being taken in casting that the hollow space within a roller is cast or formed truly, so that the shaft when introduced shall fit accurately, allowing spaces for

passing through the semicircular bearing i, and over the rod or hinge, k k. The inventor states that he does not confine himself to the whole of the details herein given, so long as the important peculiarity of his invention be retained; but he claims the use of an atmospheric tube, divided longitudinally into two parts, whether connected by hinges or not, and forming a complete tube, ready for exhaustion when closed, the longitudinal connection and joint between the top and bottom parts of the tube being effected without having recourse to the elasticity of the material of which the tube is composed, or the intervention of an elastic or flexible material, to form a hinge, as at present used in the construction of Clegg and Samuda's, closing entirely by the weight of the upper parts, without the assistance of springs or other mechanical contrivances. He claims also the longitudinal ribs forming the abutment for the top valve, or the other half of the tube.
driving in wedges or keys at the end of the roll, which keys should be securely retained from moving by shrinking wrought iron collars on the shaft or axles; the working journals are turned in the wrought-iron shafts, after keying on the rolls, and the surfaces of the rolls turned; by which means of manufacturing rolls for rolling iron and other metals, the inventor is enabled to obtain them with stronger necks or axles. The wrought-iron shafts or axles are passed through hollow rolls, which the inventor prefers to be cylindrical openings in the cast-iron rollers; but he does not confine himself thereto, as other shapes may be used. The claim is for the manufacture of hollow cast rolls for rolling iron and other metals, and fixing thereto wrought-iron shafts or axles, as described.

GAS METERS.

ALEXANDER ANGUS CROLL, of Suffolk-street, Clerkenwell, for "Improvements in gas-meters."—Granted May 13; Enrolled November 13, 1846.

The improvements relate to the use of a tumbler apparatus for actuating the valves of dry-gas meters with one partition, which approaches to and recedes from the plane of attachment to the side of the meter, but does not pass through the same; so that the flexible material whereof the diaphragm is partly formed is bent only in one direction. The improvements consist in the application of an apparatus for working the valve, which depends for its action upon the use of a tumbler, so formed, that on being moved to a point just beyond the horizontal or central position, the tumbler will fall over and instantly change the position of the valve.

Fig. 1. Plate VI. is a vertical section of the improved meter; fig. 2, a vertical section, taken at right angles to fig. 1; fig. 3, a horizontal section, taken on the line A B, of figs. 1 and 2; and fig. 4, a plan, top plate removed; a, the material, in which the tumbler is to be applied over the horizontal, is secured, but simply advances to and recedes therefrom; hence the bending of the flexible material will only be upon one surface. The diaphragm is supported in a vertical position by the frame d, which is jointed to it, and the upright rod e, supported by the arm f, which is fixed on the vertical spindle g; the diaphragm is guided in its movements by the rods h, h, the lower ends of which are connected by short links to the part a, and their upper ends are suspended by a horizontal rod i, inserted through them, from two arms j, j, fixed to the upper side of the cylindrical portion of the meter. Upon the top of the spindle g, is fixed an arm k, carrying a roller, which, being moved to and fro within the inverted arch l, on the tumbler tube m, will cause either end of that tube, alternately, to be raised from a depressed position to a point beyond the horizontal, when the weight, preponderating at the other end, will occasion the instantaneous descent of that end, and this movement is communicated to the valve by the means hereafter described—the tumbler tube falls on a spring n, at either side, and thus any shock is prevented. The tumbler-tube contains quicksilver, but shot may be substituted, and the tumbler apparatus may be otherwise varied, and yet retain the same character.

o, is an arm, fixed to the tumbler, and provided with a fork p, which acts on a plate or arm q, on the axis of the valve r, and by this means the position of the valve is changed at each movement of the tumbler, which, as will be readily understood, derives its motion from the reciprocating action of the diaphragm, communicated to it through the agency of the parts d, e, f, g, h, and i. The valve r, is contained in a valve-chest s, (to prevent the gas coming into contact with the works in the upper part of the meter) into which the gas enters from the supply pipe through the passages t, u, by the movement of the valve, the gas is alternately admitted d on either side of the diaphragm, and, after acting upon it, proceeds through the passages v, w, to the pipe leading to the burners. The motions of the diaphragm are registered by means of a dentil or driver x, on the upper part of the spindle g, taking into a ratchet-wheel y, connected with an ordinary registering apparatus or index.

* The description of this patent was accidentally omitted in last month's Journal; the engraving is there given.

IMPREGNABLE SOLUTION FOR STONE.

FRANCOIS TETCHINNE, of Red Cross Square, Cripplegate, feather merchant, for "Improvements in treating stone, to render it hard and impregnable, and in colouring the same." (A communication.)—Granted Aug. 6, 1846; Enrolled February 6, 1847.

The improvements relate to rendering soft and porous stone impregnable to moisture, and coloring the same by immersing the stone in a boiling solution consisting of coal tar, pitch, bitumen, tallow, and other fatty substances, in the proportion of 58 parts tar, 16 bitumen, 9 tallow, and a small portion of linseed oil. The ingredients are boiled in a suitable vessel, and when they boil the stone is placed on a frame, and lowered into it. The period allowed for the stone to be soaked through is from 8 to 48 hours, according to the size; or if it be only desired that the solution should penetrate the surface, two hours will be sufficient for every inch in depth. Some description of very porous stone will not become filled by a long continued boiling: for such stone there is to be added to the above mixture carbonate of lime, such as chalk or marble, iron rust, granite, and potters' clay, in fine powder; this latter mixture is to be applied to the surface of the stone with a hot iron. If it be required to have the stone of a light colour, instead of that of resin of the lightest colour, mixed with turpentine, oils, and all kinds of gum, in the proportion of 15 parts resin to 80 of turpentine, and if the stone is to be of a clear white colour, add white lead, zinc, and carbonate of lime—any other colour is desired, add to the last compound the dyestuffs usually employed by painters.

CLARKE AND VARLEY'S PNEUMATIC PILE-DRIVER.

The pneumatic pile-driver, which has been erected on the premises of the inventors, is of the full working power, being 36 feet high, the air tube a 17 inches diameter, and the monkey weighing 16 cwt. The engine and air-pumps at present in use are very inadequate to the proper working of this powerful machine, and the air-pumps are only 10 inches diameter—still, even with these, a vacuum is obtained, sufficient to raise the monkey to the summit in one minute; and, by opening a valve below the piston h, for the admission of air, it instantly descends; yet such is the perfect control under which it is held, that it can, by the operator at the valve, be arrested in its descent at any part of its fall. There is no time lost in the starting of the engine; the chain is run off the pulley above the monkey with the piston being constantly attached, and can be, of course, lengthened or shortened, according to the height of the fall required. The diameter of this tube being 17 inches, the area is nearly 227 inches; and thus allowing only 10 lb. pressure to the inch, this diameter of piston, h, would raise a monkey of considerably greater weight.—Mining Journal.

The Art of Glass Painting has sustained a loss by the death of M. S. Frank, who died lately at Munich, aged 77. He was one of the first who made experiments for re-securing several ancient methods of glass staining, which had been lost during the lapse of centuries. Thus, he had been called, in 1816, to Munich, to assist the establishment of the Royal Institution for Glass Paintings.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL. [March,

PROGRESS AT THE NEW HOUSES OF PARLIAMENT.

Our readers will be glad to know what is the actual position of these works; and we are enabled to satisfy them, having recently had occasion to make a journey to London, that the House of Lords and the adjacent apartments proceed apace; and the House itself begins to assume its finished appearance. The details are most gorgeous. No works of modern times can compare with them; yet the impression is one of moderation. The woodwork is nearly completed and fixed, and the heraldic painter is busy. He is now chiefly employed in inserting the arms of the Lord Chancellors, which are in process of being placed on the upper part of the panels along both sides of the chamber. The black spaces of the walls, to be afterward painted white, are temporarily hung with crimson drapery, powdered with golden crowns, roses, &c. The reporters' gallery fronts the throne, and is almost as prominent and ornamental an object as her Majesty's seat. The brass railings of the gallery are fitted. The leadings in the corridors for Lords and Commons. The many doorways ingeniously form part of the lower paneling of the jambs of the windows. Mr. Barry seems to have heated the rooms without Dr. Reid's aid. We found them of a very agreeable temperature. No stained glass has yet been permanently fitted. Some has been tried;—and the effect is said to have been excellent. It is, we believe, in preparation by Mr. Hardman of Birmingham. The ante-chamber of the House of Lords, next the throne end, is almost completed;—so is the public hall at the opposite end. In the first, the style of decoration is almost as elaborate as that of the House of Lords itself. Above a fireplace, we observed a large panel of sculptured wood-work, representing Queen Philippa pleading for the burgesses of Calais. It did not impress us very favourably, on a hasty glance. The position of Edward III., with his crossed legs, looked graceful. In the public hall, we were struck with the magnificence of the floor; on which Minton's Encaustic Tiles—in colours of red, yellow, and cobalt—are in process of laying down. In the central red and white rose of marble, surrounded by brasswork enamelled: and the borders of the tiles are judiciously marked by lines of black Derbyshire marble. The outer gates of the House of Lords are visible from this hall. They are of brass,—and very beautiful is their workmanship. The remaining doors and walls of stained glass are fitted. These are the only parts of the building which give an idea of what the whole will be when finished.—The House of Commons is very backward—not even roofed in. The central tower is beginning to be seen above the surrounding buildings; and the graving of the arch of the Victoria Tower is turned.—Atheneum.

REVIEWS.


Of the former editions of this work we have already given favourable reviews. The present edition has had its value considerably increased by numerous improvements and additions. It is a thick quarto volume, handsomely printed and illustrated by seventy folio steel plates, which occupy the greater part of its bulk. These illustrations are not merely showy useless specimens of steel engravings, but have been got up with regard to direct practical utility as well as clearness and neatness of execution. It might have been of advantage, perhaps, to have made the letter-press explanations more copious. They contain notices of the construction, cost, dimensions, &c., of the different railway structures represented. There are 48 drawings of works on the Birmingham Railway, consisting principally of bridges, retaining walls, and details of tunnel works. Among the subjects of the plates for the Grand Junction Railway, is the aqueduct for the central canal; for the South Eastern Railway, the timber pier in Folkestone Harbour, and the reservoirs and tanks at Tonbridge; for the Greenwich Railway the large 26 feet tunnel at Greenwich with details. As another series of illustrations of "Railway Practice" is promised, one or two hints for slight improvements may, perhaps, be allowed. In the present work many of the engravings are insufficiently explained, and of several no explanation whatever is given. The specifications for contractors, from which copies extracts are made, are not always trustworthy, as alterations in the plan of operations sometimes occur during the progress of the works. At all events, it would always be more satisfactory to state where the best and cheapest methods can be adopted, and the differences in the undertaking, than to copy out the specification. The latter plan is the easiest, but not the most useful. Lastly, there ought to be a good index, referring not only to the plates; but to the letter-press also. In reality, however, these drawbacks are very slight, for the work is indeed admirably illustrated, and quite worthy of the expense and labour bestowed upon it. To the practical engineer, so large a collection precedents of railway construction must be of great and permanent utility.


This book does not fall within the scope of our Journal, but from what we can see, seems to contain some well written familiar and humorous essays, by the well-known Edinburgh writer, Mr. R. Chambers. The essay on English ingenuity and enterprise, in a new point of view, is particularly good.


This is a small work by the Mathematical Master of the National Society's Training College, Battersea, and is intended to lead the pupil, by an easy transition, from the principles of arithmetic to those of algebra, and is the best adapted for the purpose intended of any that we have seen.

An Introduction to the Present Practice of Surveying and Levelling; with an Appendix. By a Civil Engineer. London: J. Williams & Co., 1846. 8vo.

The author has treated the subject in a clear and simple manner; his method of keeping the Field book is good. The Appendix might have been left out, as it adds to the bulk of the work, without any adequate advantage. The method of getting up a survey is well explained. The work is illustrated with nine plates.

NEW CORN EXCHANGE, BIRMINGHAM.

It has been determined to erect a new Corn Exchange in Birmingham, immediately behind the St. George's Coach Office, in High Street, between Carr's-lane and Castle-street. The plans have been prepared by Mr. E. Allen, the architect; the building will consist of a hall, 110 feet long by 49 feet wide, lighted by a semi-circular roof, surmounted by a lantern, extending the whole length of the hall. The room will be 60 feet in height, and will be divided into side compartments by pillars, between which stands and tables, intended to be let to farmers and dealers, will be placed. It is to have a glass roof of semi-circular shape, as the best suited to admit the greatest quantity of light. According to a local paper, this spacious room will have two doors, one leading from a vestibule, with columns and ornamented ceiling, at the entrance of St. George's-court, in High-street, the other with a still larger vestibule at the Castle-street entrance. A porch, ornamented with pillars of the Roman Doric order, will form the High-street entrance; that by Castle-street, which will be the principal front, will be enriched with eight columns, and ornamental recesses leading to the vestibule and to the floor beneath, which it is proposed shall be appropriated to the exhibition of agricultural implements. The building is of the Roman Doric order, in cement. The extreme length of the building will be 167 feet, the width varying from 37 to 40 feet. The builder is Mr. Briggs, and the cost will be 8,000l.

MOULDED BRICKS.

"In a country like ours," says a correspondent of the Barry Herald, "where there are no quarries and so many clay pits, and where consequently stone is so dear and scarce, and bricks, both red and white, so common, I rather wonder that brick is not more used for the finer mouldings, in the place of stone. In former times, and it might be equally so now, mouldings of all kinds were highly ornamented, frames to windows, porches, chimneys, &c., were made of brick. Besides being much cheaper, and quite as durable as stone, they had this advantage,—that the most intricate patterns could be made nearly as cheap as the plainest; and also that any colour might be used, if not in the brick itself, yet on the outside
having decreed the erection of the church of St. Clotilde in the Gothic style, whose piers are rapidly rising, and promise to be a new ornament to the Old Town of Notre-Dame.

Cornelius and Humboldt.—It is now certain that M. Cornelius was obliged to decline the offer of undertaking the frescoes for the internal decoration of the Houses of Parliament at London; previous engagements at Berlin left him, indeed, no alternative in this respect. He has on the other hand, provided the sketch of a pageant for the International Exposition of 1851, which he intends to present to M. Humboldt as a token for his great work "Cosmesis." The drawing represents the Genius of Science lifting the veil of Nature, personified under the image of a beauteous maiden. The different branches of knowledge are appropriately shown to be at each other's service. Much yet remains unrevealed, a sphynx is seen, to which the Genius points as the object of future inquiries. On the reverse, a likeness of M. Humboldt will be engraved.

Restoration of the Cathedral of Speyer.—This summary of the old church is to be restored by order of the King of Bavaria. The cathedral, one of the oldest in Germany, bears the marks of the mediæval style, and vies in size even with that of St. Peter's at Rome, the Duomo of Florence, the Cathedral of Milan, and the cathedral of St. Paul, London. The German press speaks highly of the grandeur of the style in which the restoration is contemplated: the architect is the well-known Gartner, of Munich. The frescoes are entrusted to M. Schraudolf, who has already exhibited his powers for the decoration of Come, and those of the paintings of the vaulted ceiling of the huge choir are already sketched, and the gold ground of Byzantine style completed; and the rich ornamental work of Schwarmann shows how this thinking artist knows judiciously to keep to himself and his work to the great ensemble to be achieved. The spring will see the completion of the tower, and the lateral choirs and nave will follow in due succession. The principal painting will represent the Life of the Virgin Mary; and that in the southern choir the Life of St. Cyprian and St. Wet; for the northern choir by the master himself. The figures who, as we have seen, is, in the 13th century, in that very same cathedral, the second Crusade! The figures will be either painted on the gold ground, or be separate fresco paintings. This restoration will add much to that wreathe of art and art beauties, by which the banks of the Rhine are so attractive to every sensible mind.

A New Rudder for Large Ships.—M. Fouque, maquinor of the French navy, has submitted to the minister of marine the plan of a new rudder, which has been applied on board the corvette La Recherche. The commander of this vessel having certified to the secretary of state, that it was impossible to cut the wood in several instances, and also on account of its solidity, to those in general use, his excellency has given orders to apply M. Fouque's rudders to two vessels of the Port of Toulon, destined for long voyages, in order to try their effect under different climes and latitudes.

Moor of Swinemünde, Prussia.—The government is doing everything towards making this harbour convenient to their own and foreign shipping, as its situation is most advantageous. A large dyke has been constructed, by which the hitherto shallow and sandy embouchure of the Swine has been deepened to upwards of 30 feet, and made accessible even to ships of 40 feet water, the bed of the river having been extended 70 feet, from Swinemünde to Stettin. Fortifications, also, in case of war, are cosa templated.

Gas Lighting at Nürzburg.—We extract the following as a curious specimen of German tenders and contracts : The gas-manufactory to be erected will be situated in the space of the former two occupation houses for each week of delay in completing contract £230. The persons hitherto employed in the lighting of the city, to be retained by the new company. The city will require, in all, 550 lights, and a length of pipe of 75,000 feet; the sixth part of the lights to be employed as candelabras, each to cost £7; the lanterns, £2.10s. Each light for public use to be calculated to burn 1,400 hours a year, and 6,000 cubic feet of gas to be kept in reserve. The conducting pipes, which will be subject to a pressure of ten atmospheres prior to being used, are to be calculated for 6,000 lights, at 43 English cubic feet of gas to be consumed per hour. Each flame of this size has to possess (as ascertained by Rumford's photometer), seven times the quantity of light of a man to light up a whole room; and it must be fixed at a rate of 3.3 feet (12), for the yearly calculated burning space of 1400 hours. Private individuals pay for 1000 cubic feet of gas at 55 years, 6s. 18.7, and quantities of gas are also to be had by the gas meter. If purchased without contract, any number of cylindrical five lights costs £7 7s. 10d. not exceeding ten, 47s. 6d. from forty to sixty, 100, and so on." It is said that the burgomaster of Nürzburg is a very good calculator; and so it would appear from this contract, of which we have only given the most important part.

One of the most enterprising and audacious operations of art collectors. —A very considerable theft of Pompeian antiquities, frescoes, and bronzes, has been of late discovered in the Museo Borbonico, at Naples. This questionable acquisition was destined for the London market, and was already on board ship for exportation. The thieving of travelling collectors, however, throughout Italy is quite astounding. The antiquities are much dearer in Rome and Naples than they are in the Strand or Wardour-street.

The Meeting Mountain near Vinzel on the Rhine.—Prof. Nörgéрат, of Bonn, has delivered a lecture on this curious phenomenon (ante p. 67),

NOTES ON FOREIGN WORKS.

State of the Gallery of the Louvre, and of French Art in general.—M. Clararac, conservator of the antiques of the French national gallery, has lately died—a loss much to be regretted. The cost was the author of the catalogue of antiquities, most valuable also, on account of the fine and accurate drawings (cabinet des dessins of the Louvre), which the ancients constructed their buildings and ornaments. It is true, that M. Clararac owed much to the notes of his predecessor, M. Visconti—still, the digestion and arrangement are his. The French press blame much the choice of the sculptor, attributing it to court influence and bias in the House. They complain also that no care is taken of securing new acquisitions to the Gallery, and speak of antique bronze Silens, &c., purchased lately by either millionaires or Englishmen. These general complaints have become frequent. The most recent is the choice of a most mediocre catalogue (analogous to that common-place index of the British Museum), is placed in the mast-public position with that of the lamented M. Clararac. The very exhibition of the Royal Academy, and still more its recent decisions, are threatened with a most determined opposition; and the first painters have resolved on submitting no more to such a tribunal, and not to send any more pictures to the exhibition. It has been a matter of surprise, that men like Ary Scheffer, Delacroix, Decamps, &c., should have quelled under the dictation of a secret tribunal; and it is quite natural that they, and other painters and sculptors, have resolved on forming an exhibition of their own—that of the artists of Young France. Amongst the most telling members of this opposition is one, of a strong and original mind—M. Barye, the sculptor. His groups in bronze, candelabra, &c., are highly spoken of—and it must be much regretted, that he is not in the position for exerting himself on some larger work, being neither a knight, nor a P.R.A., nor a.L.A.

The Paintings and Carvings of St. Benoît, Ghent.—This celebrated ancient edifice seems to have become, of late, a sort of art-fair, out of which anything was sold to the highest bidder. In consequence of which, the Belgian legislature have decreed, that no public establishment should be allowed to sell objects of art! It is said, that a speculator had, at first, sold some Van Eycks to a German museum for 400,000 francs. One of the most celebrated Flemish carvers was Frans Flamand, whose bronzes, terra-cottas, and carvings in wood, are admired in many collections. The two famous altar-pieces of St. Benoît are now in Paris. They also had become the object of judicial litigation between the settlers and the public authorities. They resemble, rather, small chapels, being 12 feet by 15 feet. They are crowded with ornaments of architecture in the Flamboyant or the Florid Gothic style. The one is of 1594, and represents the Life of St. Benoît, the other, the Life of St. Cuthbert. Most of the figures are worked out in ronde-bosse or Alto-relievo. The second altar-piece represents the Life of St. Benoît, or St. Bézcio, consisting of six very complicated compositions. The style of these carvings, enveloped in festoons and garlands of flowers, foliage, and vegetal interlaces, is very interesting, combining the stile of Catholicism with the more lively forms of the Renaissance. The present state of wood carving in France is not encouraging. Except the choir of St. Vincent de Paul, executed by M. Dupont, and the work of the kind that he met with. It is not the fault of art, as France possesses some superior statuary—but of the public, who have become, it seems, insensible to all but the most flashy and tawdry productions of art.

The Violin of St. Cecilia.—This gentleman, to whom the thorough restoration of that huge building has been intrusted by government, at an expense of one million francs, has been attacked in various ways, of late, by the opponents of Gothic architecture. To this, he has, peremptorily, and firmly, and most justly, retorted, that every real and genuine style of art is good, if properly, judiciously, and gradually carried out. The lovers of Gothic architecture have, moreover, lately gained another triumph, in consequence of the municipality of Paris and and burnt in. White brick round the windows, or at the corners of houses, proves a good foil to shaped slates; red brick to white, and vice versa. I shall mention one or two instances of the use made of the brown brick, as a cladding of the houses, one of the first buildings of this class, was erected by Brandon, Duke of Bedford, about the year 1600, who resided there with his wife, a king's sister and widow. Though hardly a remnant even of the ruins remains, yet it appears that the use of the brown bricks was herelangs. They are of a very hard and compact white brick, which retails its original sharpness, and some of them, having the Duke's crest in relief upon them, still ornament a bridge of the same date as the hall. The other instance is the West Stow Hall, built by the same duke, the gatehouse of which is a noble specimen of brick building. As an example of the use of brick moulings in churches, I may name Laxworth Thorp, a doorway of which church has its moulings and circular arch, formed of red brick.
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by which he has proved that no volcanic agencies—fire or hot vapours—have occasioned the fall of the mountains, but that the phenomena were caused, however, by very complicated causes, resulting from the upheavals of mountains or hills composed of basalt or basaltic conglomerations. Large sections were exhibited by Prof. Nögerath, which he will, no doubt, publish.

Neapolitan Railways and Steamboats.—The activity and progressive tendencies of the railways in the kingdom of Naples have been very great of late. Even ancient Nola is now reached by a side branch of the great Apulian line. An especial communication with Cabalabia has been established; so much so, that the fine gulf of Palacastro, Cosenza, Cagnano, and the bay of Squillace, become, in the course of time, of the utmost importance to the commerce of the country, and not only towns and inns, but clubs and festivities, increase; and last but not least, agrarian, historical, and archeological societies, and the latest works on Calabria by Spinelli, Grimaud, etc. are rapidly producing results.


NOTES OF THE MONTH.

Gradual Elevation of the Land at Plymouth.—Attention has recently been drawn to elevations or depressions of the land, with reference to the measurement of the mean sea level. In our own immediate neighbourhood, Derry, Dunmore, and Dripsey Point, on the coast of Devon, are near the bed of the sea, and the bottom of some of these elevations may be seen. If we land upon the N.E. point of the Mewstone, there is a bank of debris resting upon a stratum of rolled pebbles of all sizes; this raised beach being sheltered from the breakers, remains as an evidence of a change of the relative levels of the sea, and has a beached form taken place. Passing from the Mewstone to the mainland, and coasting round the Sound, we find a succession of these beaches in the cliffs, about 15 or 20 feet above high-water mark; they may be seen at Bovisand, under the Hoe, near Redding Point and Cawsand. But we have no evidence of elevations, submarine limestone rocks are everywhere perforated and honeycombed by Pholadus. About low-water mark and downwards they are everywhere found alive, but higher up we find them much more confined as high as high-water mark in some localities be seen. These animals can only live below the mean level, requiring to be altogether under water, or at least covered by every tide. Now, when we find the empty cells of these creatures in the solid limestone rocks under the citadel, but at such a height as would preclude the animals from living in them, we can only infer that the rocks have been raised, or that the sea level has been depressed. Many of these cells may be seen in our locality. The writer had occasion to land a few days ago near the Blockhouse, and directly under the battery at Devil's Point; here he observed that there had been a fissure in the limestone, and a portion of the rock had been removed, leaving a vertical section of the solid limestone exposed to view. This part of the rock is covered with the shells of various sorts of shells, and on this occasion, the writer examined and thereby leaving proof that our shores have been rising slowly and imperceptibly; the place is easily accessible, and anybody may see the spot referred to. If the land be still rising, our harbours will become more shallow; the system now pursued of similar plates exhibiting tied and sounding will ultimately settle the point, if engineers will only have the liberality to admit the possibility of further as well as future observations being made correctly.

Thermalic Drawing.—A scientific correspondent of the Liverpool Journal has given the following ingenious mode of transfixing the forms of natural objects or the patterns on ribbons to paper:—Saturate common writing paper with porter, coffee mixed with sugar and cream, or a solution of asch, then place the object whose form is to be transfixed on the prepared paper. If the object is large, use hair to hold it in place. This is the effect of being formed by hot water and compressed to the centre of the axis, and thrown off in a direct line with the plane of the vessel's course, thereby rendering the propulsion superior in efficiency to the common paddle-wheel, being uniform and continuous without drawback from the edge of the blades to the top. The blade exists in the area of surface as compared with the screw; as less than one-half of paddlewheel area will work more efficiently with the same power.

Harburg.—Dec. 19.—"Mr. George Giles, who during the last eight years has been actively engaged in constructing the Hamburg-Bergedorf railway, in the new sawmill and warehouse at the navigable water, canals, bridges, &c., quitted us on the 16th inst., to enter on a more extended field of professional occupation in England. Previous to his departure, he had already been occupied in the execution of experiments of high calculation in which he is held by all branches of our government as a large amount to the prosperity of the country. Our Seamen presented him a decree of that venerable body, expressive of their unbounded thanks for his serious exertions on their behalf; this was accepted as a token of the large measure of affection of the special interest in which he has found their grateful recollection of Mr. Giles's heroism, enterprise, and skill in conducting a series of explorations at the dead-fall fire of the 5th of May, 1855, which devastated nearly the one-fourth part of our ancient city. On the 14th inst., a large meeting of gentlemen, comprising senators, members of the board of works and board of exchange, the directors
of the Hamburg-Bergedorf railway, a'd several others of our most indus-
trial citizens, invited Mr. Gires to a grand dinner at Strelit's Hotel, on
which occasion they presented him with a handsome piece of plate, and an
address, testifying their high appreciation of his professional and private
worth; expressing at the same time their deep regrets at his retirement from
among them."—Humberg Paper.

King's College Engineering Society.—A Society has been instituted by
the students of the Department of Applied Sciences, King's College, Lon-
don, for the purpose of the reading of Essays, the taking of the various
scientific publications, and the conducting of experiments connected with the
Department. There is at present a small library, quite inadequate to the
purpose, and we are surprised the Council of the College have not provided
the students with a better one. The students have been much assisted in
the formation of the Society by Mr. M. O'Brien, M.A., Dean of the
Department, and by the other Professors.

The Royal Academy.—In the Architectural department the Gold Medal
and the Discourses of Reynolds and West, will be given for the best design
for a Gothic church, the whole comprised in one general and regular com-
pound. The Church is to be built in double elephant will admit, and to consist of a plan, elevation, section, and perspec-
tive view. A Silver Medal will be given for the best figured drawing of
the entrance and interior of the Temple Church.

Photographic Portraits.—Continued improvements are being made in
photography. The Art has now reached the stage of the work of Mr. Kil-
burn, who has opened a establishment in Regent-street. His impres-
sions on view are among the most perfect that we have yet seen. The
principal improvement is in colour, which, in Mr. Kilburn's portraits, has
not the prevailing defect of faintness, but possesses the depth and body of
a finished painting. This quality renders a portrait valuable as a work of
art, which is otherwise rarely the case—the likeness being generally the
only recommendation. Indeed, the process of colouring requires the same
care and skill as in an ivory miniature; but in this attention ill bestowed,
for the distinctness thus given to the subject has hitherto been a great
desideratum, the polished surface of the picture in most cases requiring a
peculiar direction of the light in order to distinguish its details.—Daily
News.

Westminster Abbey.—It is stated that the Dean and Chapter of West-
minster have very laudably determined on restoring to the tombs of Queens
Eleanor and King Henry V. the rich old conventional iron-work, taken
down on the recommendation of Sir Francis Chantrey, sold at so much a
pound, to an ironmonger. The reparation has been successfully re-engaged,
and we are glad to learn that the Dean and Chapter, and allowed to rest in an adjoining vault. This iron-
work forms an integral part of each monument—the sculptor and smith
working generally, working in medieval times, in the same spirit and to
the same end. Chantrey's reason for recommending the removal of the whole of the
iron-work throughout the Abbey was, that it too often served as steps or
ladders to the Westminster boys to mutilate noses, &c., merely from want
lessness; and to over curious collectors to climb to portions of monuments
otherwise beyond their reach. In most parts of the chapel the head of the
monuments, the iron-work was erected merely for protection, and not unoften disfigured the
monument it was placed before. Here the recommendation was judicious,
but when it was extended to medieval monuments, a piece of barbarism
was committed. It was recommended to the Dean and Chapter, and the same subject was read at a late meeting of the Freemasons of the
Church, by Mr. John Brown. He stated that in the Blaise chapel, in the
Abbey, is deposited the iron canopy which formerly surmounted the beau-
tiful tomb of Queen Eleanor. A piece of a story of writings that is
mentioned that "since the coronation, a considerable improvement has been
affected in the interior appearance of the Abbey Church, by a general
cleaning of the monuments and the removal of the iron-work which screened
them. Now, at this coronation, which must have been that of George
the Fourth, the iron-work not only of the tomb of Queen Eleanor, but that of
Henry V., were placed in the dark recesses of the Blaise chapel, where
they have been seldom viewed by parties who have visited the Abbey.
The tomb of Henry V. is at the east end of the chapel; the head of the
king, which the vergers say was made of silver, was taken away in the
time of the troubles. Neale says "all the damage in the Abbey was not
done in the time of the troubles."
Aberdeen.—The greatest activity prevails at the present time on nearly all the large lines. From the Stonehaven line, a large number of men have already been employed. The contractors for the bridge to be erected over the Muir of Fetteresso have already commenced operations. On the contract extending from Glenfinnan station to Blackhill, there are at the present time nearly 200 labourers employed, and four of the cuttings are nearly finished. By the 1st of this month the works on the Caledonian Railway will be proceeding rapidly, and there are a great number of men employed; and, on what is termed Toraso's contract, there are 900 men employed on both the lines. The contractors for the line from the town of Droikeys, in the county of the town of Droikeys, in Irland, fxn-aparatus, for 'improvements in machinery for crumbing, braking, and preparing fans, hemp, and other flaxaceous materials requiring such treatment.'—Feb. 1.

German Railways.—The Deutsche Algemeine Zeitung of the 27th of January, contains a review of the statistics of German railways, of which the following is an abridgment:—At the commencement of the present year, the entire length of all the German railways which are regularly open to circulation was 802 geographical German miles, of which 26 are tram-lines, 173 belong to various governments, and 419 to private companies. Out of the 173 miles of state lines, Austria possesses 64; Baden, 24; Bavaria, 32; Brunswiek, 126; Hanover, 122; Hess, Damstadt, nearly 61; Wurttemberg, more than 5; and Frankfort, somewhat more than 5. The total number of persons conveyed by these companies is the lowest in the statistical one, which is 314,404 geographical miles, and runs from Berlin to Strasburg, to Hamburg, to Hannover. The next in length is the German Rhine-Main Broadcasting Railway (296), extending from Vienna to Bruns, Olmitz, Leipiz, and Stockerau. The Berlin and Hamburg line is 76 miles, the Upper Silesian, 50; the Borzum, 50; the Weser, 50; the Bever, 50; the Johns, 50, and the Butter, 50. The total length of the whole railway system is 4,500 miles, and the total number of persons conveyed is 3,000,000,000, of which 400,000,000 are transported by the railways of the German government, and 300,000,000 by the railways of the German government.

German Railways.—On the 6th ult., an experimental train went from Munich to Nuremberg, and the line was opened to public traffic. The section from Munich to Nuremberg will be completed in the near future, and will be opened to public traffic. The line will be opened in the public in the 1st of May next. The section from Nuremberg to Minden, which will complete the German and Caledonian Railway, is also expected to be opened in the near future. There is a considerable amount of traffic on the railways, and the railways will continue to be opened in the public in the near future.

Whitesone and Merriott Railway is open for goods, and to be opened for passenger traffic on the 1st of March.

German Railways.—On the 6th ult., an experimental train went from Munich to Nuremberg, and the line was opened to public traffic. The section from Munich to Nuremberg will be completed in the near future, and will be opened to public traffic. The line will be opened in the public in the 1st of May next. The section from Nuremberg to Minden, which will complete the German and Caledonian Railway, is also expected to be opened in the near future. There is a considerable amount of traffic on the railways, and the railways will continue to be opened in the public in the near future.

LIST OF PATENTS.


SIX MONTHS ALLOWED FOR ENROLMENT, UNLESS OTHERWISE EXPRESSED.


Francis Preston, of Acrwick, near Manchester, spindle-maker, for "certain improvements in the machinery for preparation to be used on machines for preparing cotton and other flaxaceous substances for spinning."—January 20.

Francis Zievenstock, of Oswestry, Shropshire, a manufacturer of Bleachers, for "certain improvements in the apparatus for preparing bleachers for bleaching and coloring, and in the apparatus for bleaching and coloring flax, hemp, and other flaxaceous substances."—January 25.

Richard Walker, of Rochdale, Lancashire, cotton-spinner, for "certain improvements in the machinery and apparatus for preparing cotton and preparing other substances applicable to the manufacture of other products of distillation."—January 25.


Thomas Webster Rammell, of 12, Dorset-place, Devon, gentleman, for "improvements in apparatus for boring into the earth." (A communication.)—January 25.

Elizabeth Grounds Lidde, of Aldred-street, London, for producing a certain textile substance by the assistance of an apparatus."—January 25.

James Taylor, of Portervale, gentleman, for "an improved apparatus for boring into the earth." (A communication.)—January 25.

Peter Armand Leconte de Fontainemoreau, of 15, New broad-street, London, for "certain improvements in the apparatus for producing certain products, and apparatus necessary for the useful application of all those products."—January 20.

John Law, of York place, Fortnum-square, Middlesex, gentleman, for "improvements in machines for producing cotton and other flaxaceous substances."—January 20.

Richard Albert Tolman, of Scott's Yard, Hackney, for the manufacture of certain acids, alkaline, and alkaline salts."—Feb. 1.

Christopher Vaux, of Frederick-street, London, gentleman, for "improvements in steering and applying beer, ale, and porter."—February 2.

John Henry, of the county of Stafford, middlesex, manufacturer for, "improvements in apparatus to be used for raising and lowering weights from mines and other places."—Feb. 1.

John Henry, of the county of Stafford, manufacturer for, "improvements in apparatus to be used for raising and lowering weights from mines and other places."—Feb. 1.

James Whitaker, of Leeds, in the county of Yorkshire, for "improvements in machinery for working coal-mines."—February 5.

Thomas De Bouley, Esq., of Sandgate, Kent, and John De Bouley, Esq., in the county of Devon, for "improvements in blast furnaces, and blast-furnaces, and blast-furnaces, and blast-furnaces."—February 5.

Christopher Vaux, of Frederick-street, London, gentleman, for "improvements in steering and applying beer, ale, and porter."—February 2.

John Lenoch, of Brighton, engineer, gentleman, for "certain improvements in the machinery or apparatus for watered grain."—February 5.

John Lenoch, of Brighton, engineer, gentleman, for "certain improved apparatuses for carrying and taking cotton and other flaxaceous substances."—February 5.

Stephen George, of No. 10, Hamilton-place, New-road, Middlesex, for "improvements in obtaining and applying motive power."—February 5.

John Styles, of No. 5, Bishopsgate-street, London, gentleman, for "improvements in the machinery for watered grain."—February 5.

James Chapman, of Eveleigh, Wigan, gentleman, for "improvements in machinery for watered grain."—February 5.

John Smith, of Eveleigh, Wigan, gentleman, for "improvements in machinery for watered grain."—February 5.

William Eaton, of Camberwell, Surrey, gentleman, for "improvements in machinery for watered grain."—February 5.

Joseph Marsh, of Greenwich, gentleman, for "improvements in the preparation of culls and other materials."—February 5.

Thomas Hare, of Greenwich, gentleman, for "improvements in machinery for carrying and taking cotton and other flaxaceous substances."—February 5.

William Edward Newton, of No. 68, Chancery-lane, Middlesex, for "improvements in steam locomotives." (A communication.)—February 18.

George Lennox, of Eveleigh, Wigan, gentleman, for "improvements in machinery for carrying and taking cotton and other flaxaceous substances."—February 5.

Francis Henry Walker, of Harrington-square, Middlesex, gentleman, for "improvements in machinery for carrying and taking cotton and other flaxaceous substances."—February 5.

Nathaniel Card, of Manchester, town manufacturer, for "certain improvements in machinery or apparatus for twining, twisting, or manufacturing cord, bands, and other flaxaceous materials from cotton, flax, hemp, silk, and other flaxaceous materials."—February 5.

Francis Stansfield Meadon De Sannes, of Millbank, Middlesex, for "improvements in the manufacture of certain acids, alkaline, and alkaline salts."—February 19.

Alexander Bevan, of Upper Welbeck-street, Middlesex, electrical engineer, for "improvements in clocks and time-kippers, and in apparatus connected therewith."—February 19.

Alexander Bevan, of Upper Welbeck-street, Middlesex, electrical engineer, for "improvements in clocks and time-kippers, and in apparatus connected therewith."—February 19.

Stephen Burrell, of Newcastle-upon-Tyne, manufacturing chemist, for "improvements in machinery for preparing and applying essential oils to certain compundes, which improvements in machinery and apparatus may also be employed for other purposes."—February 19.

Richard Walker, of Rochdale, cotton-spinner, for "certain improvements in the machinery and apparatus for preparing cotton and preparing other substances applicable to the manufacture of other products of distillation."—January 25.

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STRAIN ON THE PLATFORM OF A SUSPENSION BRIDGE.

In the following paper it is proposed to examine the nature and amount of the strain to which the platform of a suspension bridge is subjected, by its connection with the chains and piers, and a load equally or unequally distributed throughout its length. We shall assume that the platform is rigid, the curve of the chain a catenary, the links indefinitely short compared with the length of the platform, and the rods indefinitely close to each other and inextensible.

Let $O$, the centre of the platform, be taken for origin; the axis of the platform, which we suppose horizontal, for axis of $x$; and a vertical through $O$, for the axis of $y$. Let $dt$ be taken to represent the tension of the rod applied at point $(x, y)$ of the chain; $T$ the tension of the chain at that point; $t$ the weight of a unit's length of chain; then we shall have

$$
d (T \frac{dy}{ds}) = dt + id \cdot \frac{dx}{ds} = 0.
$$

$$
T \frac{dy}{ds} = t + is \cdot \frac{dx}{ds} = c; \quad \therefore \frac{dy}{dx} = \frac{t + is}{c}.
$$

In the common catenary,

$$
\frac{dy}{dx} = c's, \quad c' \text{ being an arbitrary constant;}
$$

But for small $t$, it must be $\mu$, where $\mu$ is some constant. Consequently, the result of all the tensions of the rods, attached to any portion of the chain, passes through the centre of gravity of that portion. If, now, the platform be supposed uniformly loaded throughout, and perfectly rigid, it would be impossible to determine whether its weight was wholly supported by the chains, or wholly by the platform, or how it might be divided between them; but as the nature of the materials we are considering is only so far rigid, that neither the flexibility of the platform, nor the extensibility of the rods and chains, are supposed to be sufficiently great to affect the curve which the chains assume, a very little consideration will be sufficient to show that the weight of the platform will be so distributed, that the tendency to bend it will be a minimum. When the platform is unequally loaded, if we suppose the load not sufficiently great sensibly to deflect it, it will be hereafter shown that a pressure will be generated on that pier nearest to the centre of gravity of the platform. In practice, however, if the load be much increased and unequally distributed, the platform would bend, and the curve assumed by the chains be modified; the point where the resultant of all the vertical tensions of the rods meets the platform, approaching nearer to the centre of gravity of the platform and load, and, in case disruption ensued, actually and suddenly coinciding with it.

To find the strain on any point of a platform equally loaded throughout:—

Let $P$ be a point in the platform, and $PQ$ vertical thereto; $AP = x; AO = OB = a; CQ = S'QD = S''$

$W$ = weight of platform and load; $T'$ = tension of rods from $P$ to $A; \ K$ = distance of the centre of gravity of $CQ$ from $P$.

Let $V = VS$, where $V$ is determined from the equation $VS' + VS'' = W$.

Then the moment tending to turn $AP$ about $P$, which measures the strain at $P$, is given by the equation—

$$
\frac{d \alpha}{d \alpha} = 0.
$$

Moment of strain $= VS'K - W \cdot \frac{C}{4a}$.

If the load be unequally distributed,—

Let $G$ be the centre of gravity of load and platform; $S$ the whole length of the chain.

Then a pressure will be exerted where the platform rests on the pier nearest to $G$. Let $X = \frac{Y}{X} = \frac{Z}{X} = \frac{S}{X} = \frac{S}{X}$.

Taking moments about $O$, if $OG = a; OW = aX'; W = X + VS$;

$\therefore V = W \left( a - \frac{l}{a} \right)$.

And for the strain at $P$, if $w' = \text{weight of platform, } AP$, and its load,—

$p = \text{the distance of its centre of gravity from } P$;

Moment tending to turn $AP$ round $P$ =

$W \frac{a}{a} + VS'' - WP = W \frac{a}{a} + \frac{a}{a} - \frac{a}{a} - WP$.

Deductions from the above formulae:—

1st. When the platform is equally loaded throughout, the strain will be least when the chain has but a slight depression; for then, $VS''$ will most nearly, ceteris paribus, equal $\frac{C}{4a}$.

2nd. The strain of a load, unequally and unsymmetrical distributed, will always be greater than the strain produced by the same load equally distributed.

J. H. B.

[In the remarks appended to Sir Howard Douglas's paper in our last number, it was observed that several topics were passed over for the sake of brevity. Let it be inferred that there were still wide differences of opinion (which is not the case), it may be remarked that the topics referred to were not of a controversial nature, and that this question of the strain on the platform of a suspension bridge was one of the most important of them.]

ON THE MOTION OF FLUIDS.

The discrepancy between theory and experiment in all problems concerning the flow of water has been generally acknowledged. This extraordinary fact has hitherto been accounted for on the supposition of the imperfect character of the fluidity of that liquid; whereas, as we shall presently show, it is not the water but the analysis—not nature but the philosophers who are at fault. In the present paper we shall point out some of the fundamental errors of analytical hydrodynamics, and endeavour to show how theory and practice can be reconciled. Some time since, one of the most eminent of living mathematicians pointed out to us the incorrectness of certain analysis connected with the motion of a wave along a canal, in which, as he clearly proved, the hypotheses adopted were inconsistent with themselves; that is, parallel motion and perfect continuity were assumed to co-exist. Our attention has since been more recently directed to the subject, and having taken Professor Miller's work as a text-book, we were astonished to find the same two assumptions vitiating the whole of the chapter on fluid motion.

In section V. of Miller, the first sentence runs thus—

"When an incompressible fluid flows through a tube, the velocities of the fluid at any two points, are inversely proportional to the areas of the perpendicular sections of the tube at those points; supposing the tube to continue always full, and the velocities at all points in the same section to be equal to one another, and perpendicular to the section."

The two hypotheses with which this paragraph concludes are inconsistent. Let the tube be of variable bore and its axis straight, let this axis be the axis of $x$, and let $u, v, w$ be the velocities of any fluid particle parallel to the axes of $x, y, z$, respectively; then, by the equation of continuity for incompressible homogeneous fluids, we have

$$
\frac{du}{dx} + \frac{dv}{dy} + \frac{dw}{ds} = 0.
$$

Now $v$ and $w$ both = 0, by the hypothesis; $\therefore \frac{du}{dx} = 0$. $u = c$. —which is absurd.
In determining the motion of water issuing from a very small orifice in the bottom of a cylindrical vessel, it is clear that the tube may be considered of unequal but continuous bore, how then can we find the quantity discharged from the orifice? This we shall endeavor to do approximately. We shall first however seek for the maximum velocity of the issuing stream near the orifice.

Suppose B'B the orifice, A A' a horizontal section of the fluid above B'B, taken at such a height above B'B, that all the fluid beyond A A' may be considered at rest. L M is the axis of the stream. P any point in L M. Then the motion at P may be supposed wholly vertical. Since L M is the axis of the stream, if then L P = x, v be the velocity at P, the density of water = $\rho$, and $\gamma$ the measure of the accelerating force of gravity, and $p$ the pressure at P, we shall have

$$\frac{dv}{dt} = g - \frac{dp}{dx} \cdot \frac{v^2}{2} = g x - p + C.$$

Let now h be the depth of B'B below the surface of the water in the vessel, the distance between B B' and A A' = 3h, then we have

$$x = g (h - 3h) + C - v,$$

because if $w =$ atmospheric pressure, $p (h - 3h) = pressure at L$.

So far as $p$ is concerned, the velocity will be greatest when $p$ is least. Let $h$ be the value of $x$ when $p$ has its least value, which is clearly v.

$$\frac{v^2}{2} = g (h - 3h + h),$$

$h$ and $d^2$ both being extremely small. This expression becomes $\frac{v^2}{2} = g h$. This, as far as it goes, apparently agrees with the method of finding $v$, given in the books. We may remark, however, that in all demonstrations we have seen, the great error is committed of estimating the motion from the surface of the fluid, and assuming all particles in the same horizontal section to have the same vertical velocities. Now in fact $p$ becomes discontinuous near the orifice, and when the orifice is indefinitely small passes suddenly from $p = g h + \varepsilon$ to $p = \varepsilon$, and consequently the equal number for $\varepsilon$, which assume the continuity of $p$ cannot be applied without further adaptation.

To determine the velocity and quantity emitted at the orifice, requires an altogether different kind of investigation.

We shall here suppose that the tube is full, and that the fluid is vertically at rest within the vessel, even close to the opening; this, although not strictly correct, will be found near enough to give tolerably accurate results.

Let A = area of orifice. At time t from the commencement of the motion, suppose that if the jet had moved with a velocity in all its parallel sections equal to its mean velocity of projection at B B', it would have extended to a small distance, x, from B B'. At time $t + dt$, let y become $x + \delta x$, then an additional quantity, $A \delta x v$, has been shot out from the orifice in the time $dt$. Let R be the internal force that affected this; p the pressure on the jet, then, since the only external force is $Ag h$ (neglecting $Ag x$ as extremely small),—

we have $p + R = Ag h$;

and $R = \tau v$;

also, $A \delta x v = \rho \delta t = (Ag h - R) \delta t = Ag h - A \delta x v$.

$$\frac{dv}{dt} = Ag h - A v^2.$$ When the motion is steady—

$$\frac{dv}{dt} = 0,$$

and $v = \frac{dv}{dt}$.

$$\therefore \frac{dv}{dt} = Ag h.$$

This is very near to the results of experiment—If Q be the quantity discharged in time t—

$$Q = At \sqrt{\frac{g h}{p}}.$$

To determine the motion in a pipe of uniform bore:—

Suppose the tube inserted into a shallow reservoir of water kept constantly full; let the tube be straight, its diameter = d, and length = l; let $h =$ height of surface in reservoir above the point of efflux. When the motion is steady, let the mean vertical velocity of the particles in the reservoir, just above the point where the tube enters, be $\varepsilon$ times the velocity in the tube. Now, it is found that the resistance of the tube varies as the square of the velocity, and that this resistance arises from the inequalities of the interior of the tube. If, therefore, $l =$ length of tube, and $d$ the diameter, the absolute resistance will vary as $ld^2$; but the mass of fluid varies as $ld^4$.

Let now $x$ be the distance of any point of fluid in the pipe from the point where the pipe enters the reservoir; then, by the time that $x$ becomes $x + \delta x$, a mass of fluid, $\pi \delta x d^3$, has had its velocity changed from $\mu v \varepsilon$ to v.

Therefore, if R measure the force which accomplishes this—dt the time of $\delta x$ becoming $x + \delta x$—we shall have

$$R \delta t = (- \mu) \pi \delta x d^3 \delta v;$$

and, $\pi \delta x d^3 \delta v = \pi \delta x d^3 (- \mu) \frac{dv}{dt} \delta t = \pi \delta x d^3 \mu v \varepsilon \delta t.$

Therefore, when the motion is steady, and $\frac{dv}{dt} = 0$,

$$v = \frac{g h}{1 - \mu + \mu \varepsilon \frac{l}{d}} = \frac{g h}{1 + \mu \varepsilon \frac{l}{d}}$$

If $1 - \frac{\mu}{\frac{3}{5}}$ or $\frac{\mu}{\frac{3}{5}}$ = $\frac{1}{57}$ nearly, this becomes Eytelwein's formula.

If the water had first passed through a tube, length l and diameter $d$, and then through a tube l', diameter $d'$, we should have had

$$v' = \frac{g h}{1 - \mu + \mu \varepsilon \frac{l}{d} + \mu \varepsilon \frac{l'}{d'}}.$$

Eytelwein's formula in inches is $v' = 23\frac{1}{3} \sqrt{\frac{h}{l + l' + 57 \frac{d}{d'}}}$

Example.—Water flows through a 9-inch main of 5000 feet, and then through a pipe of 4000 feet long and 5 inches diameter, the height of head being 100 feet, what is the velocity of the discharge? —

$$v = 23\frac{1}{3} \sqrt{\frac{h}{1 + \frac{l}{57 d} + \frac{l'}{57 d'}}}$$

$$l = 13 \times 5000 = 65000$$

$$l' = 12 \times 4000 = 48000$$

$$h = 13 \times 100 = 1200$$

$$d = 9$$

$$d' = 5$$

$$57 d = 518$$

$$57 d' = 285$$

$$v = 23\frac{1}{3} \sqrt{\frac{1200}{1 + \frac{65000}{518} + \frac{48000}{285}}}$$

$$= 23\frac{1}{3} \times \sqrt{452},$$

nearly; or 47 inches per second nearly.

We may remark that the value we have obtained for the mean velocity of the discharge at a small orifice, $\sqrt{\frac{g h}{\rho}}$, is rather greater than the velocity derived from experiment; this does not arise from any
fault in our hypothesis of the mean velocity of the particles in the vessel being $= 0$, but from the resistance of the sides of the orifice. It is probable that the mean velocity just over the orifice, is some small fraction of the velocity beyond it—this, if considered by itself, would give $v$ something greater than $\sqrt{2/\pi}$. But the resistance is more than sufficient to counterbalance the effect of the interior velocity: $v$ would properly be represented by the expression

$$\sqrt{\frac{g}{1 - \frac{1}{\pi}} + x}$$

where $x$ is rather greater than $\mu$.

J. H. R.

A NEW THEORY OF THE EARTH, THAT FULLY ACCOUNTS FOR MANY ASTRONOMICAL, GEOGRAPHICAL AND GEOLOGICAL PHENOMENA, HITHERTO UNACCOUNTED FOR.

By Oliver Byrne.

Although the sciences of mathematics are coeval with man, and have been cultivated with the greatest avidity by the greatest minds of every age, in every civilised nation; although their extent and application has been so great—considered by some to be capable of little further advance—yet it may safely be asserted that they are only in their infancy; as long as we continue to improve, so long will the bounds of mathematics continue to extend, till all other human inquiries become subject to its simple and unerring principles. The theory which is here promulgated, and which we shall endeavour to exemplify and explain in the simplest terms possible, is capable of being submitted to the most exact and rigorous mathematical scrutiny. Yet in this place we prefer establishing it by a general concurrence of facts which are known to almost every observer, rather than by an abstruse and elaborated mathematical proof. The earth, in its position on the former plane, the subject will be understood by the many, while the latter, which is given in the proposer's new work "On the theory of the heavens and earth," about to be published, would only be understood by the few, who at present know enough of the uncertainty and dissatisfaction which have attended former attempts to establish the point in view by such a procedure.

By observing the apparent motions of the fixed stars and of the sun and planets, the true motions of the bodies in our solar system were discovered,—not before the attention of man was for a considerable time engaged by their appearances and changes, and many theories respecting it were advanced and contested; but this, and other subjects, were capable of being submitted to mathematical investigation, was ultimately set right. The motions of the earth on its axis and round the sun were discovered in the same manner, by observing the apparent motions of the fixed stars. Seeing that all the stars rise and set in the course of a day, the stars must move round the earth, or the earth must revolve on an axis in that time; the truth of the latter motion was finally established. It was also observed that the stars which appeared to set with, or immediately after the sun, gained an advance on him till they were lost in his rays, then appeared to pass him and return to their former position with respect to the sun, in the course of a year. This fact shows either that the stars moved round the sun, which stood still, while the earth with revolving on its axis would possess a wobbling motion, or what might be called at the present day a great nutation, to effect the change of the seasons; or that the earth stood in the same position revolving on its axis, while the sun made a circuit of the heavens for the year, or lastly, what was ultimately found to be true, that the sun nearly remained in the same relative position, as well as the fixed stars, and that the earth moved round him in the course of a year, and that also in such a manner, the changes of the seasons were produced.

At present here it would be useless, as well as a laborious task, to give even an outline of the several theories and conflicting opinions which have prevailed, before the true theory of the solar system was established. We regret that our present limits will not permit us to give such an outline; as it might at the same time give a caution to many not to condemn, censure, or approve, before they have investigated and understood. This theory of the stars is very great—considered by some to be capable of little further advance; but this, and other subjects, have been capable of being submitted to mathematical investigation, was ultimately set right.

Let $P$ be the pole of the equinoctial $a$, and $P$ the pole of the ecliptic $\beta'$; $\beta$ the first point of Aries where they intersect; and $s$, a star. Then $\beta$ is called the right ascension, and $a$ the declination, of that star; $\beta \beta'$, $\beta s$, the longitude of the same, respectively. If these planes were to intersect at $\beta'$, the effect would be, that the longitudes of the stars, which are always estimated from the intersection of the planes of the equinoctial and ecliptic, or from the first point of Aries, must continually increase; and by comparing the longitudes...
of some of the stars at different times, the mean motion of the equinoctial points, or the precession of the equinoxes, may be discovered. M. Lalande, in his astronomy, has computed the precession by comparing the longitude of Spica Virginis, as assigned by Hipparchus, with the longitude of the same star computed in 1750.

1750 B.C. Longitude of Spica Virginis 5° 8' 0" 1750 A.D. Ditto ... 6° 20' 31"

Increase in 1876 years 0° 26° 21' From this it appears that the annual mean precession is equal to 26° 21'. By a number of like comparisons, the same author 1878 fixed the secular precession—that is, the amount of accumulated precession for 100 years—to be 1° 23' 29"; the mean annual precession corresponding to this is 0° 55' 43" and the sum of such annual precessions amounts to 1° in 714 years. If we suppose the precession to be 50'° 1', then, in 25,689 years (360 x 60 x 60 x 10), the first point of Aries will have retrograded through an entire circle. The quantity 50'° 1', which is the mean value of the precession, is obtained from the differences of the longitudes of a great many stars (three or four hundred, for instance), computed at different epochs. This mean quantity may not agree with the mean quantity derived from the observations of a single star, however many, or accurately made, these observations may be. It will be found the case with Pollux, the second star in the following table. The differences, however, between the mean quantities of the precession as they result from three hundred stars, or from a single one, is in all cases very small.

Longitudes.

<table>
<thead>
<tr>
<th>Stars</th>
<th>1815</th>
<th>1756</th>
<th>Difference of Longitude in 59 years.</th>
<th>Mean Annual Increase.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ζ Arietis</td>
<td>-1 6 7</td>
<td>1 4 15 3</td>
<td>49 38</td>
<td>50 47</td>
</tr>
<tr>
<td>Pollux</td>
<td>3 20 39 48</td>
<td>3 19 50 55</td>
<td>48 53</td>
<td>49 70</td>
</tr>
<tr>
<td>Spica Virgins</td>
<td>6 21 15 31</td>
<td>6 20 26 29</td>
<td>49 63</td>
<td>50 30</td>
</tr>
<tr>
<td>ζ Aquilae</td>
<td>9 29 9 53:8</td>
<td>9 28 20 6</td>
<td>49 67:8</td>
<td>50 60</td>
</tr>
<tr>
<td>ζ Pegaei</td>
<td>11 20 24 31</td>
<td>11 20 23 19</td>
<td>49 12</td>
<td>50 96</td>
</tr>
</tbody>
</table>

Yet the difference which is found to exist, points out some peculiarity in every star. For instance, Pollux cannot be like most of the other stars, apparently entirely fixed, but must have what is called, or what we are obliged to call, from default of a knowledge of its cause, a proper motion. However, the comparison of the longitudes of the stars, computed to the epochs of 1756 and 1815, establishes, as we have before observed, the important fact of the precession of the equinoxes. Because the mean longitude of a star is not altered solely by the precession of the equinoxes, astronomers employ the term annual correction, comprehending under it the effects both of precession and of annual proper motion.

We shall now compare the latitudes of the stars mentioned in the above table, in the same epochs.

Latitudes.

<table>
<thead>
<tr>
<th>Stars</th>
<th>1815</th>
<th>1756</th>
<th>Difference of Latitude in 59 years.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ζ Arietis</td>
<td>-9 57 37:4 N.</td>
<td>9 57 3 2</td>
<td>+ 3' 4</td>
</tr>
<tr>
<td>Pollux</td>
<td>-6 40 18:4 N.</td>
<td>6 40 3 3</td>
<td>+ 15:4</td>
</tr>
<tr>
<td>Spica Virgins</td>
<td>-2 2 24:8 N.</td>
<td>2 2 6</td>
<td>+ 16:8</td>
</tr>
<tr>
<td>ζ Aquilae</td>
<td>-29 16 35:5 N.</td>
<td>29 16 44 44</td>
<td>- 8:5</td>
</tr>
<tr>
<td>ζ Pegaei</td>
<td>-19 24 44:4 N.</td>
<td>19 25 44</td>
<td>- 4:0</td>
</tr>
</tbody>
</table>

It appears from this table that the changes of the latitudes are very small; in no case amounting to 0° 4" annually. "The astronomical fact is," says Woodhouse, "a minute annual change of latitude, and a considerable change of longitude. With regard to the former change, we may conjecture that it arises either partly from the precession of the equinoxes, and partly from other causes, or that it is altogether independent of the precession." The succeeding tables show the variation both in rapid ascension and declination of the stars whose latitudes and longitudes we have just compared. These variations more clearly point out the general apparent change produced in the heavens by the rapid motion of the earth's axis, than those of the latitudes and longitudes, as the declinations and right ascensions of the stars are reckoned in a manner similar to the latitudes and longitudes of places on the earth. Yet they are not in complete accordance with the right motion, as the latitudes of places have been supposed to remain fixed and from the dissatisfactory theory of corrections, of which we shall speak hereafter.

Right Ascensions.

<table>
<thead>
<tr>
<th>Stars</th>
<th>1843</th>
<th>1817</th>
<th>Difference</th>
<th>Mean annual variation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ζ Arietis</td>
<td>1 58 20:6</td>
<td>1 56 52:6</td>
<td>5:37</td>
<td>+ 5:36</td>
</tr>
<tr>
<td>Pollux</td>
<td>7 35 42:9</td>
<td>7 34 6:0</td>
<td>3:36</td>
<td>+ 3:36</td>
</tr>
<tr>
<td>Spica Virgins</td>
<td>13 15 59:60</td>
<td>13 15 53:7</td>
<td>6:2</td>
<td>+ 6:2</td>
</tr>
<tr>
<td>ζ Aquilae</td>
<td>19 43 7:34</td>
<td>19 41 51:9</td>
<td>2:3</td>
<td>+ 2:3</td>
</tr>
<tr>
<td>ζ Pegaei</td>
<td>22 56 56:64</td>
<td>22 56 38:95</td>
<td>7:69</td>
<td>+ 7:69</td>
</tr>
</tbody>
</table>

Declinations.

<table>
<thead>
<tr>
<th>Stars</th>
<th>1843</th>
<th>1817</th>
<th>Difference</th>
<th>Mean annual variation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ζ Arietis</td>
<td>N 22 43 4:14</td>
<td>N 22 35 33:1</td>
<td>7:04</td>
<td>+ 7:04</td>
</tr>
<tr>
<td>Spica Virgins</td>
<td>S 10 20 25:55</td>
<td>S 10 12 0:3</td>
<td>8:12</td>
<td>+ 8:12</td>
</tr>
<tr>
<td>ζ Aquilae</td>
<td>S 8 27 20:37</td>
<td>S 8 22 37:6</td>
<td>5:07</td>
<td>+ 5:07</td>
</tr>
<tr>
<td>ζ Pegaei</td>
<td>N 14 21 41:77</td>
<td>N 14 13 20:0</td>
<td>8:17</td>
<td>+ 8:17</td>
</tr>
</tbody>
</table>

Of the Collapsing of the Plane of the Equator and Ecliptic.

The angle contained between the plane of the equator and ecliptic is what is denominated the obliquity of the ecliptic; which is shown, from repeated observations, to be variable. In this place it will be sufficient to show the results of a long succession of such observations by different astronomers, taken from the "Encyclopedia Metropolitana"—

Eratosthenes, 230 B.C., made the obliquity to be 25° 51' 20"
Hipparchus, 140 B.C., 23 51 20
Ptolemy, 140 A.D. 23 51 10
Pappus, 320 23 30
Albintius, 680 23 35 40
Araschel, 1070 23 34 0
Prophatius, 1500 23 34 0
Regiomontanus 1460 23 30 0
Waltherus, 1490 23 29 47
Copernicus, 1560 23 23 28
Tycho, 1567 23 25 30
Cassini or, 1666 23 25 9
Cassini jun., 1672 23 28 54
Flamsteed, 1690 23 28 48
De la Caille, 1750 23 28 19
Bradley, 1735 23 28 18
De la Lande, 1768 23 28 0
Pond, 1816 23 27 50
"Oliver Byrne," 1843 23 27 34

The observations of Albitius and Araschel are here corrected for refraction: those of Waltherus, De la Caille, De la Lande, computed. The obliquity of Tycho is put down as correctly computed from his observations; also the obliquity as determined by Flamsteed, is corrected for the nutation of the earth's axis; three corrections Lalande applied. It is manifest, from the above observations, that the obliquity of the ecliptic continually decreases; and the "irregularity which here appears," says the writer, "in the diminution, we may ascribe to the inaccuracy of the ancient observations, as we know they are subject to greater errors than the irregularity of this variation. If we compare the first and last observations, they give a diminution of 70" in 100 years. If we compare the observations of Lalande with that of Tycho, it gives 45". The same compared with Flamsteed gives 50". If we compare that of Dr. Maskelyne with Dr. Bradley's and Meyer's, it gives 50°. The comparison of Dr. Maskelyne's with that of Lalande, which he took as the mean of several results given 50°, as determined from the most accurate observations. The observations of Pond, compared with those of Bradley, give 44° for the variation of the obliquity in 100 years, or 0° 44" annually."
Of Solar and Lunar Nutation.

(See "Woodhouse's Astronomy," page 333, chap. xv.)

The two inequalities that give title to the present subject are immediately, or rather intimately, connected with that of the preceding (on the precession of the equinoxes). For the purpose of pointing out the connexion, we must look at the physical causes of these inequalities; and, in the inexact action of the cause of precession, we shall be able to trace the cause of solar and lunar nutations.

The actions of the sun and moon on the excess of the earth—which Woodhouse assumes to be "an oblate spheroid, above the greatest inscribed sphere," the retrogradation of the equinoctial points, or, as it is technically called, the precession of the equinoxes. The natural circumstances in the production of these phenomena are—the excess of the matter just spoken of. The other circumstances, scarcely less material, and indeed essential to the phenomena, are the retrogradation of the equinoctial points, or, as already said, an inclination of the moon's orbit to that of the sun's, and, consequently, to the earth's equator. If the sun and moon were constantly in the plane of the equator, there would, notwithstanding the earth's oblate form, be no precession. When either luminary is on the equator, its action in producing precession is nothing. Twice a year, therefore—namely, at the two equinoxes—the sun's force in causing precession is nothing; and twice a year—namely, at the solstices—it is the greatest. It must, therefore, be of some mean value in the intermediate times. The retrogradation, therefore, of the equinoctial points, as they arise from the sun, cannot be equal, since the equinoxes produce precession together, consequently is not equal to the retrogradation of the pole, and the retrogradation of the pole is not uniform. There will be a like oscillation, and a like inequality of precession, from the lunar retrogradation, but for a longer period. From both causes, then, the northern latitude, and the right ascension of the stars will be changed. In order to make the former the true precession, we must correct them both by the solar and lunar nutations. The former are nutations, which are by far the most considerable, was not found out from a previous persuasion or belief of the existence of its cause. Bradley, soon after the discovery of aberration of light, noticed it as a phenomenon, and then assigned its cause, and the laws of its variation. But the solar nutation has never appeared to astronomers as a phenomenon. It could scarcely be expected to be noticed as such, since its maximum is less than half a second. Its existence and quantity are derived from physical astronomy; and on such authority, it is introduced as a correction of astronomical observations.

Woodhouse concludes this account by saying—"It has been proved, in confirmation of Bradley's conjecture, that the phenomena of nutation are explicable on the hypothesis of the pole of the earth describing round its mean place (that place which it would hold in the small circle described round the pole of the ecliptic, were there no inequality of precession,) an ellipse, in a period equal to the revolution of the moon's nodes. The major axis of the ellipse is situated in the solstitial colure and equal to 19°296: it bears that proportion to the minor (such are the results of theory) which the cosine of obliquity bears to the cosine of twice the obliquity; consequently, the minor axis will be 14°364. These are M. Zach's numbers; Bradley's are 18°16; Maskelyne's, 19°10; Laplace's, 19°16. (See "Mequangue Celeste," lib. v, p. 381.)" Now, the right motion, or change of the earth's axis, is effected by the combined actions of the sun and moon on the excess of the earth over its greatest inscribed sphere, which excess will be shown hereafter to be in a continual state of change. Former theorists ascribe to this influence of the sun and moon, upon the excess above mentioned, the effects which we have just summed up from Woodhouse's Astronomy and the "Encyclopedia Metropolitana,"—namely, "The precession of the equinoxes," "Solar and lunar nutation," and "The culminating of the planes of the equator and ecliptic." Here there is but one effect ascribed to this combined action of the sun and moon.

(To be concluded in our next.)

[As far as we can understand the purport of the above paper, it is to show that the variation of the angle of the obliquity is not oscillatory, as has hitherto been supposed, and partially demonstrated by some of the most eminent of modern mathematicians. We trust Mr. Byrne will in the next number favour us with his analysis, and justify the view he has taken of the subject.]—Enron.
ON THE COMBINATION OF THE TELESCOPE WITH THE DAGUERRÉOTYPE.

(From the Transactions of the Royal Society of Bohemia, 1846.)

Professor Doppler, of Prague, says, that for the ascertaining of the diameters of fixed stars, the telescope has been hitherto mainly depended upon, and that the investigator might have supposed it possibly ever can and will. The susceptibility of the human eye for the minutest objects has been hitherto considered paramount; but M. Doppler asserts, that the susceptibility of the human retina is surpassed many thousand times by that of a prepared (iodized) Daguerreotype plate. Physiological experiments have shown, that objects, which appear to us under an angle of vision less than 50 or 40 inches, are no more seen in externo, but as amorphous simple points. On the other hand, physiological researches of such men as Muller, Weber, &c., have shown, that the diameter of one of the nerve-papillae of the retina is no more than 3 or 5/80 of an inch. But, comparing the susceptibility of the retina papilla with the microscopic experiments made with Daguerre's plates, it will follow that the single globules of mercury are of such extreme minuteness, that they become only visible by a 500-fold magnifying power; and, therefore, that on the space of a Daguerre plate, equal to one retina papilla, more than 40,000 single globules of precipitated mercury are to be met with. Each of these is capable of producing the image of well defined objects—which would merge on the human retina in single, indiscernible luminous points. Thence, Prof. Doppler argues, that Daguerre's plates are 40,000 times more susceptible for impressions than the human eye.

Considering, moreover, that a great improvement in microscopes is very probable, M. Daguerre thinks that instead of telescopes, microscopes will come into use. At the exact point, therefore, where the image of a celestial body is formed before the object-lens of a telescope of considerable length, an apparatus is to be placed, whereby a silver plate (iodized, brome-iodized, or otherwise prepared) can be securely inserted. As the place of the images is the same for all celestial objects, a plate of a well defined, constant thickness, can be inserted with great accuracy. In this way, Daguerreotype images of all, even of the smallest, fixed stars, can be obtained, if (as is to be supposed) the light will be sufficient to affect the plate. It is also to be taken into account, that the images of the fixed stars, obtained by an object-lens of from 10 to 12 inches, will possess a light, 10,000 times stronger than they present to the naked eye. Plates thus affected, are to be treated with mercurial vapours and laved (lapisl.), and then viewed by a good microscope. As these images will have been magnified (through the action of an object-lens—say of 110 inches focus length) to the extent of 14 times their natural appearance; and being again magnified 1,200-fold,—the angle of vision under which they are now to be viewed, will have been increased 16,000-fold.

J. L.

REVIEWS.


Mr. Cresp's long expected Encyclopedia of Engineering has at length made its appearance, much to the credit of its indefatigable and talented author, who, after ten years of laborious compilation, has produced a work of the size of a large folio, and nearly as bulky: it is a vast octavo volume, consisting of rather more than 1600 closely printed pages, and upwards of 3000 well executed wood engravings by Branston.

The work is divided into two parts—the one entitled "The History," the other "The Theory and Practice, of Engineering." The first part contains a vast quantity of information; and is devoted to the description of merely the external forms of edifices.

To the History of Engineering we shall for the present confine our remarks, reserving for another opportunity the consideration of the second and more practical division. From this our analysis we appropriately turn to the history of the road, the canal, and the steam-ship, and the thoughts that shake mankind." Mr. Cresp transports us to a period coeval with the first rude attempts of Ethopian architecture, and starting from that point exhibits, step by step, the gradual progress of structural science. The principle of the arch, which, according to the authorities quoted in the Encyclopaedia, must have been known to the early Egyptians, is lost sight of in a marvellous manner by the Greeks; its employment even by the Egyptians, seems to have been very limited. The tract, which appears to a considerable extent, than the grecian style, being lightened by the grace and simplicity, and openness of effect of early Grecian architecture are due, mainly, to the exclusion of all curved lines and tracery, and seem to us impossible to be developed in any construction that admits the arch as a prominent feature. For our part, we believe that the contrast between the vast simplicity of ancient masonry, and the clear deep unclouded blue of an eastern sky, must have produced an effect infinitely more sublime than the most gorgeous of English stately cathedrals, viewed as they are against the clouded sky, and through the smoky medium of our dull climate. The vault of Myconos, to which reference has been made in a former number, is a curious instance of the form, without the properties, of the arch.

From Grecian, Mr. Cresp conducts us to Grecian architecture, a division of the work containing some highly interesting information, of which we shall proceed to give an analysis. It commences with an account of the Grecian, towers, and other military defences of the important city of Rome; we have engravings of the wall of Servius Tullius, which surrounded the entire city: the bold severity of the outline, the battering of the lower portion of the wall, and the capping formed by an embattlement, show at once its object—that of a defensive boundary; next we have the Aurelian Wall, and Gate of St. Paul, then the Gate of Spelia, of Antioch, approaching in design to our Norman style of architecture. The Gate of Perugia is another example of an early gate, marked by the boldness of its outline. The Gate of Augustus, at Pano, is of a more ornamental character:

The Gate of Augustus at Pano.

"The lower portions of which are of great antiquity. Fausto Fortunae was the name the city formerly bore, which, from its sumptuous buildings, was greatly admired. There are three entrances, flanked by circular towers, and having the characteristic of the early Roman triumphal gates, with semicircular-headed openings, and crowned with a bold projecting cornice, over which is the battlement. Immediately over the three entrances was a gallery, formed by seven arches, between Corinthian pilasters, and surmounted by a regular entablature. The repairs these walls underwent during the reign of Constantine somewhat changed their character, and since that period the upper story was destroyed by a cannonading which took place when this town opposed Julius II. Various inscriptions remain a silent witness of restoration."

and lastly, we have the Gate of Autum, one of a triumphal character.

The work then proceeds describing the materials used in the edifices of Rome. Burnt bricks came into general use for public buildings about the time of Augustus, when they were made less than an inch in thickness, of a triangular shape; sometimes the brickwork was formed of a mixture of red and yellow brick; at a later period a mixed construction was formed of brick and tufa, as in Carthage's circus. With all the detail, the work is not unimportant, and is for young architects and students of all ages. It is a rare and valuable work, and will be found an indispensable companion to the student of architecture.
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the materials. Various descriptions of stones were used—the tuff of a reddish hue, and of a volcanic production, much used for the interior of walls, and in reticulated and rubble walls—pepperino, another stone much used, also of volcanic production, but harder, and resisting the action of fire and the weather better than the tuff—and the travertine, a stone much used in public edifices, calcareous, hard, and of a yellow tint. The most ancient edifices of Rome were constructed of Albano stone, put together in squared blocks and capped by metates or cramps; it was also used in conjunction with the travertine stone, which from its greater hardness was used in those parts of an edifice most liable to injury, as arches, architraves, cornices, &c. Marble of various countries was also largely introduced in the public edifices of Rome.

The Romans devoted much attention to pavements, which—

"When used for floors, were highly decorated, much attention being required to prepare the soil to receive them, and to select the material of which they were formed. When on the ground, it was carefully examined, and rendered solid throughout, after which it was spread over with some dry material. When laid upon a timber floor, walls were not built under it, but a space left between it and the floor, that the drying and settling should be equal throughout. Holm timber was preferred to oak, being less liable to split and warp, and thus cause cracks. After the joists were laid, thin boards were fastened down to them by two nails, driven through the edges of each, which prevented their rising. The strew was then spread over the whole, to prevent the lime coming in contact with the timber, which would have immediately caused it to decay. Over this was a layer of rubbish, the stones of which were as large as would lie in a man's hand; on this layer the pavement was afterwards laid. New rubbish required that every three portions should be mixed with one of lime; and old, five parts to two of lime. Wooden beaters were employed, which by repeated blows reduced it to the thickness of nine inches. An upper layer, composed of three parts of potash and one of lime, was spread over this to a depth of six inches, on which was laid the slabs of marble, stone, or tesselum, being taken so that the whole should lie in a proper inclination: it was then rubbed off, and the joints or edges of the ovals, triangles, squares, hexagons, or other figures, made perfectly smooth. After rubbing and polishing, marble dust was strewn over; then lime and sand run into the joints.

Pavements in the open air had over the first flooring another layer of boards crossing them, properly secured by nails, so that the joints were doubly covered. The pavement first laid was composed of two parts of fresh rubbish, one of potash, and two of lime. After the first layer, a composition was spread over it, pounded into a mass, not less than twelve inches thick. The upper layer being spread, the pavement, consisting of tesserae, each about two inches thick, was laid on, with an inclination of two inches to ten feet, to prevent the frost from injuring it at the joints: before the winter it was saturated with dregs of oil. When great care was required, the pavement was covered with tiles two feet square, properly jointed, having small channels an inch in depth cut in the edge on each side. These, filled with lime, tempered with oil, had the edges rubbed in and pressed together. The lime in the grooves or channels growing hard, neither water nor anything else would pass through. After this precaution, the upper layer was spread and beaten with sticks; over which, either large tesserae or angular tiles were laid with the proper inclination."

Mr. Crevy has given us some architectural descriptions of the public buildings of Rome. Although they do not strictly belong to engineering, the examples afford data, for construction taken from engravings of the Basilica at Fano, the Amphitheatres of Castrense and the Coliseum.

For the purpose of covering the arena of these amphitheatres, and to protect the spectators from the rain or sun, a velarium or covering was used—

"Lampridius (in Com. a Militibus, Clasariis) informs us that the management of the vela was left entirely to sailors, as they were more expert in going aloft amidst ropes, and understood the tackle which regulated the spreading of it better than others. There can be no doubt that it required considerable dexterity on the part of the engineer to keep steady an awning containing 113,345 superficial feet, which would be required for the amphitheatre at Nimes, and for the magnificent Coliseum nearly 250,000 superficial feet, or more than diwole; the weight of which, at only one pound per foot, comprising the ropes and tackle, would amount to 112 tons or thereabouts. So vast a weight disposed and upheld by tension alone creates our wonder and admiration.

At the level of the attic story are 120 projecting consoles, each having a circular hole about 10 inches in diameter, corresponding with a circular mortise of the same size, and 6 inches in depth, made in the projection of the cornice of the second order. The upper openings of the hole in each console has externally a groove 2 inches in height, destined for an iron collar, to which was attached a tie, which secured it to the wall of the attic at the level of the top of the console: the holes which contained these have some portions of the iron with lead remaining.

The whole of each console received a round mast, which, passing through it rested in a hole sunk in the cornice below, the iron collar preventing it from acting against the sides of the console and fracturing it. The masts alone would not be sufficient to support the weight of the vela, extending over an elliptical area, the axis of which, in one direction, was 436 feet, and in the other, 331. To aid in the support, other posts were introduced through mortises about 10 inches in length, placed opposite each console, at the projecting part of the moulding which crowns the interior of the attic; on each side, 4 or 5 inches from the edge of the attic, are holes still containing the lead which secured the iron ties that held these latter posts in their places. Under the mortise holes are others, 8 inches square, and 2 feet in depth, made in the upper step of the attic to receive the second post. The two posts were afterwards securely braced.

Over the centre of the arena was an oval covering, permanently fixed, which in the Coliseum was ornamented with an immense golden eagle. Round the edge of this oval covering was attached a large cable, 120 pair of cords, of equal length, stretched from the mast on the exterior to this cable, were worked by pulleys; thus forming as many compartments. Each pair of cords was furnished with rings, to which the covering was attached, so that it could be drawn backwards and forwards at pleasure. The whole of these were called the velum velarium, and each single compartment velarium. The distance between the ropes on which the velarium ran was greater towards the attic than at the centre; consequently, to make the velarium run freely on its rings, it was necessary that it should be of an equal width throughout: when spread, towards the attic it was stretched, whilst towards the centre it sagged, and formed as it were a fold. To prevent the sun passing through the opening thus made by the sagging, an internal hanging was attached around the fixed permanent oval."

The Romans devoted great attention to the construction of baths which were generally used by all classes of citizens. At one time, there were more than 800 baths in Rome; the most complete contained six principal apartments, i.e., the Apodyterium, for undressing; 2nd. The Frigidarium, or cold bath; 3rd. The Tepidarium, used to prevent, by the temperate air which it contained, the dangerous effects of too sudden a transition from the extreme of cold to that of heat; 4th. The Laconium, an apartment warmed by a stove, to send forth a dry heat; 5th. The Balneum, or warm bath; 6th. The Electro- sium, or Ointurarium, where the oils and perfumes used by the bathers were kept.

We now come to that portion of the work which may be strictly considered as connected with engineering—harbours and buildings in water. It will be seen by the construction of these works that the Romans devoted vast talent to their formation and construction. In our Journal for January last, we gave a highly interesting paper on the Harbour of Ostia near Rome, by Sir John Rennie, together with a plan of the harbour. We are now, through the labours of Mr. Crevy, enabled to give engravings showing a section through Claudius' Port, and the elaborate Pharos.

SECTION THROUGH CLAUDIUS' FORT, OSTIA.
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The Bridges of the Romans.

These bridges are generally constructed with semicircular arches of stone of the highest quality; they were remarkably solid and well proportioned, and formed fine specimens of Roman architecture as applied to bridge building—the Ponte Sisto and Bridge of St. Angelo are two fine examples. The bridge and aqueduct of Spoletto consisted of 10 Gothic arches, 70 ft. 8 in. span; the centre arches stood 326 feet high above the river Moragia.—Trajan’s Bridge, over the Danube, is the most magnificent in Europe, built A.D. 105. It consisted of 90 semicircular arches, 180 ft. 5 in. span; the springings were 46 feet above the river, and the piers 44 feet thick by 83 ft. 3 in. wide; the stones used were enormous, but it was destroyed a short time after its construction.—The Bridge near Terni, on the Nera, consisted of 17 arches, 191 ft. 10 in. span, and 111 ft. 5 in. high up to the springing; the piers were 27 ft. 6 in. thick, and the total length of the bridge 2592 feet, by 38 feet wide. The dimensions of the few examples we have selected show that the Romans were quite equal to the modern engineers in the stupendous character of their works.

We shall close this article with a description of the Bridge of the Trinity, a bridge of more recent date. (See Engineer March.

"The Bridge of the Trinity, at Florence, was constructed in 1750 by Ammannati, a celebrated architect. This bold work consists of three arches, nearly elliptical, the curve being portions of two parabolic arches, whose angle at the top is masked by an octagon. The span of the arches is from 87 feet 7 inches to 95 feet 10 inches; the springings are 7 feet 10 inches above low water, and the rise is one-sixth of the arch, the arches are 3 feet 2 inches thick. The breadth of the piers is 26 feet 3 inches, and that of the bridge 33 feet 9 inches. The facings of the piers are worked stone, with well executed mouldings. The other parts of the structure are of rusticated facing, and the foundations rest on a general framework extended and crossed by several rows of piles. A defect which occurred under one of the piers of the bridge was repaired in 1811 by the elder Gourry."

The architectural character of the Bridge of the Trinity at Florence is particularly worthy of attention, because it is a rare instance of pure arcuate construction, executed subsequently to the decay of pointed architecture. The "Revival" (or as it ought to be called the "Ruin") of architecture had no more hideous or conspicuously characteristic than that of sticking upon arches ornaments of a totally inappropriate character. The taste which promoted this fashion was precisely that of the Indian squaw or African savage, who sticks bits of fancy in his ears and nostrils. The Florence bridge, however, is singularly free from these faults, though erected at a period when the subservience of decoration to construction was utterly disregarded—it has not the slightest vestige of trabeate construction.

Except in the pointed period, this merit is extremely rare. Previously to that period the Romans, like the Revivalists, treated the arch as a thing to be ashamed of. They endeavoured to disguise its real character as much as possible, absurdly overloading it with the forms of Greek temple-architecture, and producing a nonsensical combination which would appear irresistibly ludicrous, had not a multitude of examples familiarised our eyes to the incongruity. Let the reader compare Blackfriars or Waterloo Bridges, with their foolish unmeaning columns, with this Bridge at Florence or London Bridge; and then, if he can so far overcome the prejudices of education, ask himself which is the purer and more sensible architectural design.

We now come to a very interesting portion of Roman engineering—that is, the supply of water. The Romans devoted great zeal and attention to the obtaining of a good supply of pure and wholesome water—not like the Londoners, who are content with obtaining their supply from the polluted river, because the whole district of the metropolis is under a monopolising combination.

The supply of Rome with water required seven aqueducts, until the time of Caligula, when two others were commenced. The most memorable were, the Aqua Julia and the Topaia, the length of the two being 17,126 paces, 7,000 of which were above ground, and 6,172 on arches.—The Anio Vetus, length 43,000 paces, 221 of which were subterranean to convey the Anio, after they had been at a subsequent period, the water was brought from the river at a greater distance, 20 miles beyond Tivoli, for the purpose of obtaining the water of the Anio in a purer state; the length of this last aqueduct was 61,710 paces, 7,468 being above ground, and the remainder subterranean. The Aqua Appia commenced at the Gragnano, in Rome, was 11,190 paces in length; the whole, excepting 60 paces, was carried underground and arched over.—The Aqua Virgo, 14,105 paces in length,—12,865 underground, the remainder above, on 700 arches.

The port constructed by Claudius, in advance of that of Trajan, was amongst the boldest executed by Roman engineers:—an oval sheet of water, enclosed from the ocean by broad and spacious mole, affording a safe haven for vessels which navigated the western shores of Italy; an artificial island lay between the horns of these two mole, with towers at each extremity, containing machinery and tackle of various kinds, by which the boatsmen could at all times enter safely. These constructions must have been a work of prodigious labour; their solidity is attested by the writers of the time, particularly by Pliny. In the middle of this island stood a pharos, before which was the colossal statue of the emperor Claudius. Fire was placed, at the approach of night, in the upper story of this lofty structure, which could be seen from a considerable distance. Orders of the purest architecture decorated three of the stories, and ingeniously-castored rooms and staircases served for the use of the officers and men to whom this part of the port was entrusted. Covered galleries and porticoes standing high above the sea, and stretching far into the ocean, invited mariners to enter, and produced an imposing effect to all who navigated these seas.

The port of Claudius united to that of Trajan gives us an idea of the arrangements in use during the reign of these emperors: magazines for stores of all kinds, docks, slips, and other buildings usually found in a modern port, were here executed in a manner equal to those of the imperial city. Temples, triumphal arches, rostral columns, and trophies, occupied the spaces not used by the mariners, and noble roads conducted the merchandise and warlike stores from thence to every part of the empire.

Descriptions and engravings are given of the harbours at Naples, Cuma, Pozzuoli, Spezia, Genoa, Ancona, Antium, Tarentum, and Brundius.—all of them possessing considerable interest; there follows some account of the Roman roads and the celebrated Appian way, which is succeeded by...
The arches which decorate some portion of this aqueduct are not only well proportioned, but receive further embellishment from a regular order of Corinthian columns; where the passage is preserved through the line, the elevation is increased by an additional height. The section at the side shows the channel for the stream, which flowed in the attic, built above the order, covered in by a vault carefully worked and well tied together; here every precaution seems to have been taken to guard against leakage, which, if it ever happened, would be immediately discovered, by the pouring out of the water at the defective place; and along the whole line of aqueduct, materials were deposited, that there might be no delay in the work; there would be also less to perform than to take up a whole length of mains laid under a second arch. Such an inconvenience in crowded streets, the Romans wisely avoided, and continued to prefer the system of raised aqueducts to those buried in vaults underground.

AQUA VIRGINIAN.

The engravings of this viaduct, and also of the Gate of Augustus, at Fano, show a combination of the Trajane and Arcuate architecture, so much adopted by the Romans; although it is highly ornate, the combination of the two do not appear to form one construction; the Trajane looks like an accessory to the Arcaute, and put up after the latter had been erected. This barbarism of attaching idle ornamenting columns and entablatures to useful, effective arches, is compared by Hope, in his Architectural Essay, to the barbarous treatment of his subjects by the tyrant Mezentius, who tied living men to dead corpses. Many a modern architect would do well to think over this comparison.

Drainage was also well understood by the Romans, as may be shown by the great drainage of the Pontine Marebres, 28 miles in length, and the Cloaca Maxima, a sewer 14 feet in width and 32 feet high, for the drainage of the Imperial City. The drainage of the lakes Albano and Fucino may vie with any of our modern works. We must, however, abruptly terminate our extracts from Rome, or we shall transgress for the length of our review; and proceed once to France. It is necessary, however, to make the preliminary remark, that Holland and Germany are briefly dismissed in two pages, without a single illustration: this conciseness is to be regretted, as those countries afford some noble examples of engineering; particularly Holland, in its canals, sea walls, and works of drainage.

Engineering in France is very fully noticed, with ample illustrations. Mr. Cresp has availed himself of the numerous treatises on engineering which form so valuable a portion of French scientific literature; he has given detailed accounts of all the principal ports and harbours of France. The description of the celebrated breakwater at Cherbourg, formed of immense earth-works, 260 feet in diameter at bottom, 60 feet at top, and 70 feet high, is highly interesting. The lighthouses and canals are next given, and are followed by engravings of numerous bridges erected in France, one of which we have selected as a good specimen of French bridge-building—

"The Bridge of Seves, over the Seine, on the road from Paris to Versailles, was designed by M. Bequey de Beaupae, and executed by M. Viguereau; it was finished in 1820, and consists of nine principal semicircular arches, 59 feet in span, and two lesser 16 feet 4 inches in span for the towing path. The thickness of the piers is 11 feet 5 inches; the width of the bridge 42 feet 7 inches. It occupies the situation of an old wooden bridge, and the axis is in the direction of the dome of the Invalides. The piers were founded by means of caissons. The arches were constructed on trusted centres, which did not change their form during the placing of the voussoirs.

All the arches were keyed in July, 1819, except the first on the right bank, where there still remained fourteen courses of voussoirs to place, when orders were given to break down the bridge, and the centre of this arch was first set on fire, and the fourth blown up by two discharges, which caused the collapse of some of the inner voussoirs of the arches, and it was afterwards discovered that settlement had taken place in the third, fourth, fifth, and sixth piers, the greatest of which was 22 inches. In 1818, the sixth pier was loaded with 112 tons, without any movement resulting; it was thought fit, however, to discharge the weight by means of arches in the pier. The foundation plinth, about 1 foot 11 inches thick, weighed a ton and a half; the voidings, however, diminished this weight by about 15 tons. A general foundation was also constructed by throwing in rubble. The settlements are attributed to the effect of the explosions; but they were, of course, removed, and the piers been loaded, the distance between the beams filled in with hydraulic masonry to a height of 6 or 8 feet between the ground and the tops of the piles, instead of with masonry laid in common mortar, which does not harden under water.

In this beautiful example, the roadway is kept perfectly level throughout, and the arches are all of the same span; this was rendered necessary, as the banks on each side of the river were low, and it was not deemed advisable to raise the crown of the roadway, which might have been done on the Paris side, but towards the town of Seves it would have been difficult to accomplish, as the houses on each side of the street, and the entrance to the royal park, would have been equally inconvenient. The piers, all of the same dimensions, are of great strength, their width being nearly equal to a fifth of the span of the arch.

The faces of the voussoirs, which are rusticated and rounded, increase in depth towards the spandrel; the effect is improved by this arrangement, and we have an additional strength given where it is most required. For the piers connected, and arch stone of the best quality available was made use of, and apparently the atmosphere has produced little change upon it: as the stones laid in the quarry, so are they bedded, and their dimensions and proportions are well defined for their respective situations. In the spandrels and wing-walls, there does not appear to have been sufficient attention paid to the backing, and inferior material is said to have been used.

This bridge, which has a decidedly Roman character, of which fig. 1, Plate VIII., is a general view, is one of the best where semicircular arches have been preferred to the elliptical; the same centre would serve for all the arches, and there is some economy in such an arrangement; but the piers occupy together upwards of 90 feet, while the breadth between the abutments or water-way does not exceed 622 feet: by the adoption of a flatter arch, the roadway would have been rendered, and on the other hand, the water-way would have been obtained; but the whole is deservedly much admired, and its design seems in harmony with the scenery around, and with the character of the river: over a stream where the tide rose considerably, or the navigation was more important, a bolder design might have been introduced.

The elevation and section through the piers (figs. 2 and 3, Plate VIII.) show its solid construction, and the form also of its stairings: over the arch are well contrived drains, which let off the waters that fall upon the roadway, and conduct them behind the spandrels into the stream below: the blocking course, which forms the parapet, is supported upon a bold block cornice; and the absence of all balustrade and railing greatly adds to the effective structure. The road, too, the sides beyond the water-channel is a footway laid with a gentle inclination.

The works of the United States occupy a few pages, but no illustrations are given of the numerous engineering works with which America abounds.

Engineering in Great Britain next occupies a considerable portion of the work, which we must pass over until next month, giving now only the description of London Bridges, which we may boast as being one of the finest specimens of bridge-building in the world, and one of the noblest edifices of the City of London.

"When the committee of the House of Commons had determined upon the erection of a new bridge, Mr. George Rennie, at the desire of his father the late Mr. Rennie, made the design as it is now executed; and as the contractor in the services of Mr. Rennie, his son by his death in possession of this important undertaking devolved upon his sons, and Mr. George Rennie holding at that time a situation under the government, his brother, Sir John, who was his junior, was named the acting engineer. Messrs. Joliffe and Bevan were the contractors for the cost, including the approaches, amounted to £1,468,311. The first pile for the cofferdam was driven on the 15th of March, 1824, and the dam was finally closed on the 1st of April the following year, and after the water had been pumped out 29 feet below low-water mark, it was found remarkably tight.

On the 14th of April in this year, the excavation in a stiff blue clay, after which the silts and planking were laid ready for the foundations, purposes on the 13th of June: the first stone laid was a piece of Aberdeen granite, 3 feet 8 inches long, 3 feet 6 inches broad, and 2 feet 10 inches deep, containing 300 tons. The first pile for the cofferdam was completed soon after, and pumped out by the 24th of August; in 1826 the foundations on the Southwark side, comprising the abutments and wing-walls, were carried up, and the second pier was commenced.

The cofferdams of the first and second piers being no longer required, a
portion of the piles were cut off on both sides, to prepare them for the support of the centres; and after the horizontal wedges were fixed on the heads of the cofferdam piles, on the 30th September the first rib was set up by the pile drivers, and the double diaphragm of piers and poles by means of screws, assisted by the tide. The cofferdam of the third pier had by this time advanced, and soon afterwards that of the fourth pier, when it became necessary to provide more water-way by removing the pier between them, this task of the old builders, of making the tide forming the frame of whole timbers for the traffic to pass. This was performed at the cost of £3000, by demolishing one half of the arch at a time, after which the pier below was taken away 4 feet below low-water mark. By the 4th of August the new pier was finished and the first arch was completed, and then the second arch was keyed in, the foundation of the third pier completed, and that of the fourth laid. In 1821, the water being pumped out of the north abutment dam, and the excavations made, the first pile was driven on the 1st of February, and the coffer foundations completed on the 1st of March following; the masonry was then carried up to the springing of the arches.

The first arch turned having now stood the entire winter, the wedges were struck 2 inches back on each side, and the crown lowered 3 of an inch; the wedges were driven back 4 inches on the following day, when the crown of the arch sank another half inch. On the third day the latter drove back 6 inches, when the crown of the whole arch was clear, and shortly after the wedges were entirely driven back, when the soffite of the arch was accurately examined, and found to have preserved its form entire, although it had been above 100 feet by this time the arches of all the places, and the masonry considerably advanced; in 1829 and 1830 the centres of the middle, fourth, and fifth arches were shifted back, and when released of their load, the middle arch sank 2½ inches, the fourth 2½ inches, and the fifth 1½ inches.

The centre arch is 152 ft. span, and rises 29 ft. 6 in. above Trinity House water mark; the arches on either side 140 feet, and rise 27 ft. 6 in. above the same line, and the abutments span 130 feet each, and rise above the same line 24 ft. 6 in. The entire way was being 692 feet, and the quantity of stone used in constructing the bridge and its abutments was 120,000 tons; the number of piles of 20 feet in length under the pier and their abutments was 2092, and the total number for the rest of the bridge 7700; there were four sets of timber centres, each weighing on an average 800 tons. The amount of Messrs. Joliffe and Bank's estimate for the bridge alone, including an extra set of centres, was only £425,081, 9s. 2d. The bridge was opened to the public on the 1st of August, 1831, with great pomp; after having been in progress seven years and six months.

The masonry is completed by the contract specific, from which we make the following extracts (See Plate VIII.):—

The masonry of the abutments were of a circular form, and those of the piles of an elliptical form, as shown in figs. 5, Plate VIII., composed of two elliptical arches, the two arches being square, and connected by a semi-elliptical arch, the spaces between the piling was filled with tough, well beaten clay, thoroughly puddled; the piling, it will be seen by the engraving, was well secured by diagonal struts, besides wrought iron tie-bolts.

The platforms of the abutments were laid 34 ft. 6 in. below Trinity House water mark in the front, and 34 ft. 6 in. at the back; the two piers 40 feet, and the middle piers 45 feet; over the whole surface, piles of elm, fir, or beech, 12 inches diameter and 20 feet long, were driven into the clay 18 feet below the platform, in rows, 4 feet asunder, and the spaces cut off on the top, and a space of 3 feet below the pile-head excavated and filled in with Kentish ragstone, well beaten down, and raked in five parts of sharp gravel as one part of lime; after which, sill, 12 inches square, were spiked on the pile-heads transversely; the intervening spaces were filled in with brickwork, excepting at the extremities, which were of stone. Above these sills there was laid longitudinally another row of sills, spiked down to the first row of sills with 18-inch jagged spikes, and the spaces between filled-in level with Bubbling stone. On these sills and fascias was laid a planking of 6-inch beech, elm, or fr plank, bedded in mortar, and spiked down with 12 inch jagged spikes, and upon this timber platform the masonry was built. Round the abutment, sheet piles 6 inches thick and 18 feet long, and round the piles below the timber and 20 feet long, were driven in; the whole planed, plumbed, and tongued at the edges.

The masonry of the piles and abutments is formed on the exterior faces with granite ashlar, 2 ft. 3 in. to 3 feet thick, with headers 4½ feet long, and the interior filled in with Basketley, Painswley or cobstone.

The five arches have semi-ellipses, the centre arch 152 feet span and 29 ft. 6 in. rise; the arch stones are of granite, 4 ft. 9½ in. deep at the crown, and increasing to 10 feet at the springing. The two arches next the centre are 160 feet span and 27 ft. 6 in. rise; the arch stone 4 ft. 7½ in. deep at the crown, and increasing to 9 feet at the springing. The four side arches are 130 feet span and 24 ft. 6½ in. rise; the arch stones at the crown are 4 ft. 6½ in. deep, increasing to 8 ft. 6½ in. at the springing. All the stones are 18 inches thick at the intrados, and increase in thickness to the extrados, and each arch rests on 5 large and 9 smaller keystones, raised entirely by means of screws, assisted by the tide. The cofferdam of the third pier had by this time advanced, and soon afterwards that of the fourth pier, when it became necessary to provide more water-way by removing the pier between them, this task of the old builders, of making the tide forming the frame of whole timbers for the traffic to pass. This was performed at the cost of £3000, by demolishing one half of the arch at a time, after which the pier below was taken away 4 feet below low-water mark. By the 4th of August the new pier was finished and the first arch was completed, and then the second arch was keyed in, the foundation of the third pier completed, and that of the fourth laid. In 1821, the water being pumped out of the north abutment dam, and the excavations made, the first pile was driven on the 1st of February, and the coffer foundations completed on the 1st of March following; the masonry was then carried up to the springing of the arches.

The first arch turned having now stood the entire winter, the wedges were struck 2 inches back on each side, and the crown lowered 3 of an inch; the wedges were driven back 4 inches on the following day, when the crown of the arch sank another half inch. On the third day the latter drove back 6 inches, when the crown of the whole arch was clear, and shortly after the wedges were entirely driven back, when the soffite of the arch was accurately examined, and found to have preserved its form entire, although it had been above 100 feet by this time the arches of all the places, and the masonry considerably advanced; in 1829 and 1830 the centres of the middle, fourth, and fifth arches were shifted back, and when released of their load, the middle arch sank 2½ inches, the fourth 2½ inches, and the fifth 1½ inches.

The centre arch is 152 ft. span, and rises 29 ft. 6 in. above Trinity House water mark; the arches on either side 140 feet, and rise 27 ft. 6 in. above the same line, and the abutments span 130 feet each, and rise above the same line 24 ft. 6 in. The entire way was being 692 feet, and the quantity of stone used in constructing the bridge and its abutments was 120,000 tons; the number of piles of 20 feet in length under the pier and their abutments was 2092, and the total number for the rest of the bridge 7700; there were four sets of timber centres, each weighing on an average 800 tons. The amount of Messrs. Joliffe and Bank's estimate for the bridge alone, including an extra set of centres, was only £425,081, 9s. 2d. The bridge was opened to the public on the 1st of August, 1831, with great pomp; after having been in progress seven years and six months.

The masonry is completed by the contract specific, from which we make the following extracts (See Plate VIII.):—

The masonry of the piles and abutments were of a circular form, and those of the piles of an elliptical form, as shown in fig. 5, Plate VIII., composed of two elliptical arches, the two arches being square, and connected by a semi-elliptical arch, the spaces between the piling was filled with tough, well beaten clay, thoroughly puddled; the piling, it will be seen by the engraving, was well secured by diagonal struts, besides wrought iron tie-bolts.

The platforms of the abutments were laid 34 ft. 6 in. below Trinity House water mark in the front, and 34 ft. 6 in. at the back; the two piers 40 feet, and the middle piers 45 feet; over the whole surface, piles of elm, fir, or beech, 12 inches diameter and 20 feet long, were driven into the clay 18 feet below the platform, in rows, 4 feet asunder, and the spaces cut off on the top, and a space of 3 feet below the pile-head excavated and filled in with Kentish ragstone, well beaten down, and raked in five parts of sharp gravel as one part of lime; after which, sill, 12 inches square, were spiked on the pile-heads transversely; the intervening spaces were filled in with brickwork, excepting at the extremities, which were of stone. Above these sills there was laid longitudinally another row of sills, spiked down to the first row of sills with 18-inch jagged spikes, and the spaces between filled-in level with Bubbling stone. On these sills and fascias was laid a planking of 6-inch beech, elm, or fr plank, bedded in mortar, and spiked down with 12 inch jagged spikes, and upon this timber platform the masonry was built. Round the abutment, sheet piles 6 inches thick and 18 feet long, and round the piles below the timber and 20 feet long, were driven in; the whole planed, plumbed, and tongued at the edges.

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The five arches have semi-ellipses, the centre arch 152 feet span and 29 ft.
tion of a Patent for Invention. Mr. Spence has divided his volume into two parts, which together occupy about 190 pages. The first division treats of the general subject of inventions by which a patent is invalidated; the second of the conditions necessary to maintain the specific invention secure against all attacks. The first division is prefaced by an introduction, in which Mr. Spence gives the following definition of a patentable invention:

"It must be remembered that every invention has its birth at a given period in the progress of manufactures; that it takes up certain defects and proposes a plan for their removal. It is such a plan as is put on a level with perfection in the branch of manufactures to which it belongs. Hence the necessity for clearly determining in the specification the exact position which the invention occupies in the march of improvement."

This definition appears to us too limited, insomuch as it excludes all inventions founded on an entire principle; a patentable invention must be either something tangible, or some specified method of manufacture, the object of which is to produce something useful to society.

"Public user," is generally the claim advanced against patent right; on this subject Mr. Spence is particularly clear and copious. In a country like Great Britain, where the minds of men are constantly on the stretch to perfect the various departments of manufacturing, inventions the same nearly in substance will often occur simultaneously or in succession to various persons. The question how far an invention for which a patent is sought has been previously employed is consequently often extremely difficult to be settled; experiments instituted for the purpose of obtaining a result which another, and perhaps, more lucky individual has at once arrived at, are frequently so like "public user," that the jury is deceived by their resemblance. Mr. Spence has extracted from the Reports one or two instances of the kind, and his comments upon them are worthy the attention of all patentees. An additional and another disqualifying fact—and the second treated of in Mr. Spence's work. Lastly, previous specification, on which subject we extract the following observations:

"But in applying this principle to practical cases, it is easy to see that the question mainly turns upon the legal sufficiency of the said specification; so that although the specification of public knowledge and public use is not required (as we have seen) in principle, yet in practice it is found essential from its bearing upon the question of sufficiency; for if the description of an invention contained in an unrolled specification be unintelligible or impracticable, there is no disclosure of a perfected invention. Now public ignorance and non-user are some evidence of this; insomuch as they give rise to the supposition that the specified plan did not answer its purpose, and for that reason did not come into use, nor become publicly known. For suppose there had been anticipated by a former specification, the patentee rests his case upon his evidence of public ignorance and non-user, unless he is quite satisfied that there is nothing under the two inventions, the latter consideration in such case affording ample ground for the opposition of the former, the public in any practical sense, and are probably by no means easy of reference, owing to the vagueness and unsuitableness of their patents' titles; and yet these specifications when discovered are to be assumed as publishing to the world whatever they contain. Accordingly the legislature, sensible of the discrepancy between the principle of law that the unrolled specification renders public whatever it contains, and the actual fact, sensible also of the occasional hardship to which such discrepancy exposes the patentee, has provided for the patentee the relief of a separate and distinct specification, for the patentee's separate and distinct substitute of the specification, in the act 6 & 7 Will. IV, c. 53."

In the next division, we find good faith insisted on, as the first and most necessary qualities of the specification. As by the nature of a patent, the public are restricted from benefitting themselves by an invention, without duly recompensing the inventor, it is just that the exact extent of the invention should be clearly known, lest the inventor be restricted for more than he has a right to. There is another reason, too, why the specification should be distinct and accurate; that is, that the public may not be deceived as to the value of the thing protected, and thus be debased into combining with the patentee to carry out an useless project. The next point to be observed is the order of the specification; on this subject, as a remarkable instance of the perusal of our author, we shall quote, from p. 72, the following passage:

"But we come now to that part of the specification which is a sense may be said to be the most important of all: the part referred to is the claim. It is here that the essence, principle or spirit of the invention is stated in such a manner as to be capable of being understood and explained up and resolved into its one idea. All the previous description of circumstances now comes to be seen only as affording a clue to the right interpretation of this final definition of the essential character of the invention. This principle is easily understood, and the fundamental condition is, that it may be rightly understood reference must be had to the antecedent matter; and it may indeed be said that the intelligibility of the whole specification greatly depends upon the particular interpretation of the claim which is inserted by such reference; it would be comparatively easy to discover what construction to put upon the claim provided all the former portions of the specification plainly referred to the main idea contemplated by the invention, but such construction becomes a difficult matter when it is attempted to insert a claim which is not consistent with itself and with others. So far as difficulties of this kind can be overcome, they are sometimes obviated by stating the claim first in a negative form. It is well to avoid every objection being made to the specification on the ground of ingenuity can devise; and accordingly it may be foreseen that the true, distinct nature of the invention is left open to misconception by a mere statement of what it is, since it may appear to be not only that, but something more also, (probably of prejudicial character) unless guarded from such construction by a suitable negation. This course is particularly advisable when the patent is for a new combination of materials or processes, which in their separate form are old or not open to be claimed. Crane's patent is a case in point: as consisting in the application of anthracite or stone-coal, combined with a hot-air blast in the smelting or manufacture of iron from ironstone, mine or ore. Now the patentee in this case, feeling that the ground to be occupied by his invention is narrow, was careful to specify very fully to lay such claim as would lead to a right apprehension of his real subject-matter. He shows, that is, the importance in a commercial point of view of using the stone-coal in the manufacture of iron; and thence infers that the abandonment of the article which he calls as a claim for the process, which he states was only a combination in the means employed to adapt it to the purpose. He accordingly gives instructions as to a practical mode of applying it to this use, the essential feature in which is the adaptation thereto, and combination therewith, of the hot-air blast, which he states he has accomplished his purpose, he says:— I would have it understood that I do not claim the using of a hot air blast separately in the smelting and manufacture of iron, as of my invention, when uncombined with the application of anthracite, or stone-coal, or coal, or application of anthracite or stone-coal in the manufacture or smelting of iron, when uncombined with the using of hot-air blast. But what I do claim as my invention is the application of anthracite or stone-coal and culm, combined with the using of hot-air blast in the smelting and manufacture of iron from ironstone, mine or ore, as above described."

"The claim being in this form anticipates any objection that might be raised on the ground of interference with the hot-air blast patent of Neilson, except that Crane must take a license from him to use that part of the combination. It also avoids the objection of including what was known to be old in the manufacture of iron, so far as a series of (it would appear necessarily) industrious efforts to improve it; and it would so render it so. But it likewise sets at rest all uncertainty as to the real subject-matter of the patent by the positive form in which the claim is stated. So that the whole effect of the claim may be stated as follows:-I do not claim the hot-air blast patent of Neilson (or) the application of anthracite or stone-coal without the use of hot-air blast (that has been tried and has failed), yet it is for the application of anthracite or stone-coal combined with the use of hot-air blast for the manufacture of iron. And the only question that arises on the claim is, whether the subject-matter of a patent can stand upon such narrow ground. To this question the Court of Common Pleas answered in the affirmative—such opinion, in this case, resting upon the fact that the best and most accurate evidence at the trial showed with the hot-air blast to have resulted from the combination, viz., an improved quality of iron at a diminished cost of production. It would seem that before the date of this patent the application of anthracite or stone-coal to the manufacture of iron was felt to a certain extent, but one which did not appear to reach the consumer, succeeded in producing better iron at a cheaper rate by the use of this article. To what cause then is his success attributable? The essential difference between his mode of operation and that practised by his predecessors, whereas they used the hot-air blast, he used it in combination therewith, and this being the only essential distinction between the two modes, to such is ascribed the difference of result."

The next two chapters, on the language and description of the specification, have reference to subjects of scarcely less importance than that on the order of the specification. We shall conclude our notices of the work by quoting from the final and recapitulatory chapter, the following admirable piece of advice, which all patentees would do well to consider:

"The arrangement of the section of good faith is as follows: the general form and constitution of society, with its laws and orders, have come down to us through past ages with the authority of divine sanction; it is therefore the duty (as well as interest) of all who enjoy the protection of the law to uphold its integrity by honest compliance with its enactments in the

To detect and expose error—no less than to supply correct information on all subjects connected with mechanical science—is the constant endeavour of the conductors of this Journal; and in no instance are we more forcibly reminded of the responsibility of our position, than when called upon to analyse the merits of educational works professionally adapted to further the ends we have in view. Mr. Heather's treatise is peculiarly of this character; his claims on public attention rest mainly on a profession of elementary precession of style, as will be seen by the following quotation from his preface—which will likewise serve to indicate the general nature and plan of the publication:

"In putting forth a work in parts, it is not usual to make any preface, as might otherwise be the whole be completed; but as I shall introduce into the treatment of the subject, in its earliest stage, some new enunciations of important principles, and shall endeavor to show that considerable improvements can be made upon the manner in which this subject has been handled, by even the greatest masters, I have thought it more courteous to my readers, thus early to call their attention to the influence which these principles will exercise throughout the subject.

My endeavour has been, in the first place, to attempt, with what success may be, to give clear and distinct definitions of the terms thereafter to be employed; and, in the next, to confine their use, on all occasions, strictly to the sense in which they have been originally defined."

In reply to all this, we are sorry to be compelled to state that the success of Mr. Heather has been in an inverse proportion to his pretensions, that his definitions are not clear and distinct, and that he has lamentably failed to prove—so far, at least, as he himself is concerned—considerable improvements can be made upon the manner in which this subject has been handled by even its greatest masters. We do not deny that Mr. Heather may be capable of clearly apprehending physical principles; but we do most justly assert, that he is utterly incapable of putting forth his conceptions either correctly or in a manner intelligible to those among his readers who may have taken up the subject of mechanics for the first time. His phraseology is incorrect in the extreme; terms constantly occur to which no definite meaning has previously been assigned; his definitions are either old and well-known forms clothed in a new and unoriginal garb.

Lest, however, we be accused of undue severity, we proceed to give extracts from the number before us, pointing out the various inaccuracies and fallacies as they occur.

The first four paragraphs of the introduction being purely metaphysical, are, perhaps, not strictly within the province of a physical critique. We must, however, object to the assumption of the immutability of the law of nature, as derived from the immutability of their Divine Author. The same face that was smiling and beautiful at fifteen is wrinkled at fifty; the same leaf that was green in June is brown in November; the universe is in a continual state of change. Why, then, should the laws that govern this varying world be themselves unvarying? Why might not the purposes of Creation determine that also should be subject to time, and that by an immutable decree of the Creator?

"While a certain determinate point with respect to a body, always preserves the same distances from the objects which surround it, the body is said to be at rest; and, when these distances undergo successive variations, it is said to be in motion."

This definition is neither new nor complete; it is incomplete because it is purely geometrical, and excludes all idea of the mechanical consequences of motion. Suppose the earth the only body in space—neither sun nor planets existing, to which to refer its motion—then, according to the above definition, any point on its surface may be said to be at rest. But the variation of gravity at that point (supposing the Magnus effect of the poles), arising from the centrifugal force, demonstrates that there must be a motion of rotation of the earth about an axis, and, consequently, that the point in question is absolutely moving, though, relatively to the other parts of the earth, at rest.

"Bodies, however different in volume, upon which the same force produces the same effects, are said to contain the same quantity of matter. The quantity of matter in a body is called its mass, and the greater the mass the greater the number of particles it is said to contain."

This definition is sheer nonsense. What are we to understand by the word effects? Are statical or dynamical effects here alluded to? If statitical, behold the consequences of this certainly new definition. Suppose one pound of coal supported by a scuttle, and another by the surface of the earth;—then the weight of the earth—"the same effect"—therefore more powerful than the scuttle and the earth,—ergo, the mass of the scuttle is equal to the mass of the earth. What Mr. Heather probably means is this:—any two bodies are said to have equal masses, when equal velocities are generated in them in the same time, by equal, single, and invariable impressed forces, where by equal impressed forces is meant such forces that would cause the bodies when at rest to exert equal pressures against fixed plane surfaces perpendicular to the direction of the forces.

From this definition of the word mass—combined with the fact, that the dynamical measure of gravity is the same for all bodies—we infer that the masses of bodies vary as their weights. As this definition cannot be understood by the tyro until he be conversant with the various measures of force, and the third law of motion, it ought to be deferred until those are explained. In the next number of the Journal, we hope to lay before our readers a short account of the measures of force,—the laws of motion,—and the meaning of the word mass, or quantity of matter. Let us punctuate ourselves with stating where we believe Mr. Heather to be incorrect, without any attempt at emendation—from which, indeed, the limits of a cursory review preclude us.

"12. Any two forces which are in equilibrium, when applied to the same material particle of any body, in the same right line, in opposite directions, are called equal forces.

13. A force which produces the same effect as two equal forces, applied at the same point in the same direction, is said to be twice one of these forces: a force which produces the same effect as three, is said to be three times one of them; and so on.

14. We are thus enabled to measure all kinds of forces, by units selected from the effects produced by forces of any one kind; and it is found most convenient to select those units from the effects produced by the attraction of the earth upon bodies near its surface. We find, in fact, that all bodies near the surface of the earth have a tendency to fall towards its centre; and, if we do not resist them when they do fall, we shall have, by a sufficiently accurate cause which counteracts, and thus holds in suspense, the effect of this tendency; but the moment we remove the counteracting cause, the body begins to fall, and continues to do so, until it meet with some new obstruction.

15. When this effect is entirely uncounteracted, the same velocity is always generated in the same time in all bodies, whatever be their figures, volumes, and masses. This force, then, is called gravity, and is measured by the velocity generated in a second of time; and this measure is taken for the unit of measure of all other forces which are not in equilibrium, and when our object, consequently, is to find the relations between the forces and the motions produced.

16. When, however, we apply a force to a body in the opposite direction to gravity, so as to be exactly in equilibrium with it, the body can keep the body at rest, in which case we find that the force so applied must be in exact proportion to the mass of the body. The effect, then, of gravity in counteracting the effects of the other forces applied to a body, when it is kept at rest, is called the weight of that body; and, in the investigation of the relations subsisting between the magnitudes and circumstances of action of forces in equilibrium, the forces are measured by the weights of the bodies which they will support."

This is a jumble of inextricable confusion—the explanation of measures of force—a subject of the first importance—is disposed of in about forty lines. One kind of force is described as producing effects of three kinds; another two kinds of forces that would cause the effects, and their susceptibility of measurement, are left entirely to conjecture. There are many causes followed by effects, which are not capable of being measured. Alcoholic liquids produce effects which are not capable of being measured. We cannot say that A is three times as drunk as B.

"Gravity, in fact, must be considered as acting upon every particle of which a body is composed, and generating in each of those particles, in the same time, precisely the same velocity; and thus these particles neither accelerate nor retard the motion of one another."

Another instance of the inaccuracy of our author. This assertion, applied to rotating bodies, is absolutely untrue.

We have now arrived at the end of the introductory chapter; the remainder of the number contains nothing very original or very incorrect.}

[Other text continues...]

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on the second part of Dachau's proof of the parallelogram of forces—which consists in omitting it. On the whole, we think we have fully justified our opinion of Mr. Heather's merits as an author. We think it possible, as we have observed before, that it is to Mr. Heather's interest to abstain from being a publicist; and the amiable confidence we have reposed on him is not likely to be prolonged unreasonably. The editor has repeatedly stated his willingness to be re-engaged, and we shall conclude by solemnly declaring, in old-lady-phrasology, that—A Treatise on Mechanics, by J. P. Heather, B.A., is a very improper work to put into the hands of young persons.

The Brit. Atlas, Atlantic Steam-ship. Twenty-five folio of Engravings: London, by W. F. W. Mr. Weale has at length produced this long-looked for work, but not in the state he was at first intended; for reasons for not doing so he gives in his preliminary advertisement. "The author," he says, "had undertaken to provide accurate drawings, with a descriptive text, which he has totally disregarded, although repeatedly urged, during a period of two years." For our own part, we are at a loss to know who has the right to be called the author, etc. Whether the engine of this vessel, the model of the iron work of the vessel, showing the joining of the iron ribs and plates.

CHAPEL OF JESUS COLLEGE, CAMBRIDGE.

The following account of the recent restorations in this beautiful edifice is given by a correspondent of the Athenaeum, with the subscription "D.S."
The fellows of the College have done wisely in entrusting the restorations—to a more meritorious—the very competent architect (Mr. Salvin), and it is to be hoped that no alteration will be made in the arrangements—"It is now more than a twelvemonth since I transmitted to you an account of the discoveries which have been made, during the last year, or two, in the Chapel of Jesus College, Cambridge; and in the progress of which some of the beautiful architecture of the ancient Church of the Nuns of St. Chadegund, which had been concealed for the last 350 years, has been more exposed to the admiring eye of the lovers of ancient Art. Since that time, further research has brought more of the original features of the church to light; so that, at the present time, sufficient data have been obtained from which to determine the plan, and in great measure the architectural character of the entire building as it stood before Bishop Alcock (hereby setting an example followed, by W instow at St. Frideswide, Oxford) pored off the inaccuracies to adapt it to the more moderate requirements of a College chapel. This interesting work has been done, with his usual ability, by Professor Willis. It is said of Cavier that, "he gives a single bone, and he would reconstruct the skeleton;" and those who have heard or read the Professor's Lectures on the Cathedrals of Canterbury and Winchester will at once discern the same talent in him. Give him a piece of original walling here—a broken shaft there—the fragment of a base or a bit of a string-course in some out of the way corner, where no eye less keen-sighted than his would have discovered it—and in due time he will show you what the whole building must have been. The results of his investigations in the present instance have been laid before the Cambridge Antiquarian Society, and will appear as one of the numbers of their Transactions. Meanwhile, I may state that this, which till within the last two years seemed to be a plain cross church without aisles or chapels, now proves to have been originally a spacious and magnificent edifice—an example of the purest style, which is now short and perfectly plain, is shown to have had aisles, the pillars and arches of which were built up into the present walls, and are now partially uncovered; and so have extended much further westward, into the Master's lodge—one of the piers being actually discovered in sit in Dr. French's oven. The transepts had aisles or chapels opening eastward and westward on the wall of the northern transept was lighted by a large round-headed triplet, which has been blocked by the College buildings shutting against it. On either side of the choir, were two arches opening into aisles or chapels; and the east wall was pierced by a triplet of lancet windows with black panelling between. The shatterd remains of the original architecture are of such exquisite beauty, that even had Bishop Alcock's alterations been in the purest taste of his day we could not have given him the act of mutilation; but when we see at the misericors, low-browed windows, and other decorative features perpetuated by him, it must be admitted that the good prelate was as much a dervish of taste as any whitewashing churchwarden of the last 50 years. Of course, it is vain to hope to restore all the fallen glories of the church of St. Chadegund. We cannot expect that the Master should give up his house and his oven to reconstrucl the nave—unless it was for the purposes of the chapel of a by no means large college; nor, however gladly we should watch the restoration of so interesting an architectural monument, can we desire it. Still, it is cheering to see that what is practicable is being done, and that more is in contemplation. The eastern aisle of the northern transept and the northern aisle of the choir have been rebuilt under Mr. Salvin's directions; and the arches opening into them—where so many were lost in the ruin—are being discovered, and in the course of the ensuing summer—and the fine fitness of painted deal shall have given way to the rich oak stalls which are already being carved after the original model (one having been, fortunately, preserved in the Lodge when the chapel was ' repaired and beautified' in the dreary last century)—I know not where we shall be able to find a more exquisite example of the pure and graceful architecture of the thirteenth century, or a college chapel (with the exception of King's as being more beautiful and interesting). By the munificence of the Master, Dr. French, the four lancets to the north will be fitted with stained glass by W allet, and the eastern lancets will be similarly decorated. The glass in the present east window will be removed to the large window in the eastern transept, which, is well calculated to show by its parts that we may be able to state that the spirit of improvement has extended from the fabrics to the services of the chapel: an individual member of the College having offered to present an organ, and to train and endow a choir, which will be accommodated in the nave recent reconstruction. The same benefactor has presented the College with a statue of Bishop Alcock—which now fills a niche in the tower over the great gateway. The improvement, both in effect and in meaning, is immense. I trust that the college will take good care of this work of restoration by punishing the Walsh windows, and replacing the mullions, at least in the lower windows, if not in the whole front. It is too much to hope for the restoration of the original proportions of the façade by the removal of the upper story—which, as may be seen from Loggan's View, is a later addition, and is seen with the dignity of the other gateway. Much more we can hope to be seen in the praiseworthy manner; and it is to be hoped that those to whom their college is an object of affectionate pride will come forward to aid in the completion of a work so interesting as the restoration to its original dignity and beauty of the chapel in which Cranmer and Pearson once worshipped.

CANTERBURY CATHEDRAL.

At the Archaeological Institute, March 5, Prof. Willis delivered a lecture on the Conventual Buildings attached to the Cathedral of Canterbury, and on the Monastery of St. Anselm and the Monestary of St. Thomas a Becket. It was a kind of bird's-eye view; and that the monestary by whom it was made was no great master of the rules of perspective—for some of the buildings are drawn upon their heads, and others upon their sides; but still, it was easy to understand what was in the mind of the artist. Here, in the monastery of St. Thomas a Becket, there are here the external walls and principal entrance; here the chapter-house; cloisters, refectory, dormitory, necessarium, kitchen, brew-house, bake-house, granary and infirmary; here the prior's house, the apartments of the dean, the hall or refectory for the choristers, and the chapter house; here the north and south walks of the great north and south walks of the aqua;—by far the most curious part of the whole drawing, because it immensifies us of the ingenious and admirable contrivances of the monks for the thorough supply of the whole monastary with water. The Norman gate-
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THE CENTRAL SUN.

Although it has been known that the sun is merely the central body of our planetary system,—yet, it seems that it is Mädler's discovery, which will bring us somewhat nearer to the elucidation of the form, extent, and the stratification altogether of our whole solar system,—such, at least, as is accessible to human ken, present or future. The discovery of Mädler has already done so much, as to afford us some fixed point from which the form, extent, and stratification of this huge system of star-molecules can be ascertained, measured, and laid down,—although it is true that the indications of the huge system do not extend to the hitherto calculation or construction of our common or our central sun, as he excludes from his system the Magellanic clouds and other numerous nebulæ. But, therefore, all these vast accumulations of milky ways will have been properly observed and studied, the true central sun of the cosmos is still unattainable. Now, the calculation and construction of a world's-orrery is becoming a grand desideratum. The scale, certainly, as we have to deal with $1,000,000 of parallaxes of the sun,—will be a difficult task; still, it is not so much the scale of the paddle wheels and framing to apply buoyant vessels of such immense proportions, as the cardinal and the cheerful manner in which they endured all sorts of privations. Commander Caffin, of the Sturgeon steam sloop, was first sent to assist in getting off the Sphynx. He at once saw the necessity of mechanical help, and immediately applied to the Portmouth dockyard, where Rear-Admiral Parker ordered Mr. Watts to go to her, taking 50 mechanics of different departments; and no time was lost in consulting on the best means to be adopted. It occurred to Commander Caffin that they should avail themselves of the paddle-wheel steam sloop, so as to have a number of small vessels of some kind underneath, and Mr. Watts thought a raft of casks or of tanks might answer the purpose. The difficulty, however, of lashing or uniting them together sufficiently securely to withstand the immense force of the rollers and breakers, so common off that part of the island, was seen, and Commander Caffin then suggested the London barge, decked over and applied as canals underneath the paddle-boxes. On this the framing was immediately planned, and Mr. Watts's designs were received at Portsmouth; after which they were improved or varied. The mine of Buckeye was discovered, containing 25 lb. per cwt. of copper.

The prospects of Canada are equally cheerful, and the strata of these Lakes Huron and Superior are very profitable, and companies have been formed both in Montreal and Quebec, whose surveyors were very active last season. The Quebec society have begun operations at Maimasaas, and the first samples of ore yielded a gross average of 30 lb. per cwt. of copper. The society of Montreal have begun the construction of furnaces and pounding engines on a large scale. Their surveyors have found large lumps of copper, one of which weighed two tons, and seams of that metal 60 feet wide by 70 feet deep. The ore is conveyed through the lakes and canals to the railing furnaces, and it is intended to cut a canal at the Soo St. Marie, where the communication between the Hurons and Superior takes place. As the mining district is a very barren one, profitable employment will thus accrue to the surrounding growing-lands. J. L. J. L. y. 

THE RECOVERY OF THE SPHYNX STEAM SLOOP.

The recovery of the Sphynx steam sloop from the fate which was generally predicted for her, has redoubled much credit to Captain Austin, C.B., Commodore Caffin, Mr. Bellamy, assistant master attendant of Portsmouth Dockyard; Mr. Biddlecomb, master; and Mr. Ballard, second master of the St. Vincent, and the officers and men of the royal navy; and Mr. Watts, assistant master shipwright, of Portmouth Dockyard, to whom was entrusted the task of recovering this fine steamer from off the coast at the back of the Isle of Wight, where she stranded in February last, during a fog. It is impossible to commend too highly the exertions of all engaged in the arduous task, and the cheerful manner in which they endured all sorts of privations. Commander Caffin, of the Sturgeon steam sloop, was first sent to assist in getting off the Sphynx. He at once saw the necessity of mechanical help, and immediately applied to the Portmouth dockyard, where Rear-Admiral Parker ordered Mr. Watts to go to her, taking 50 mechanics of different departments; and no time was lost in consulting on the best means to be adopted. It occurred to Commander Caffin that they should avail themselves of the paddle-wheel steam sloop, so as to have a number of small vessels of some kind underneath, and Mr. Watts thought a raft of casks or of tanks might answer the purpose. The difficulty, however, of lashing or uniting them together sufficiently securely to withstand the immense force of the rollers and breakers, so common off that part of the island, was seen, and Commander Caffin then suggested the London barge, decked over and applied as canals underneath the paddle-boxes. On this the framing was immediately planned, and Mr. Watts's designs were received at Portsmouth; after which they were improved or varied. The mine of Buckeye was discovered, containing 25 lb. per cwt. of copper.

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REVOLUTION IN THE MANUFACTURE AND TRADE OF COPPER.

The copper mines of Cornwall and Wales have, hitherto, yielded 16,000 tons of copper annually; for which, however, 170,000 tons of ore were required, as they do not yield more than an average of 9 lb. per cwt. These mines will no longer be able to compete with those of other countries, discovered or ever worked at the present moment. We allude chiefly to the South Australian mines; the mines of Cottam, north of Cleveland, are still supplying the demands of the copper-works, but it is nothing more than the cassinum aquae of the dawn; and, on a minute examination he discovered, on clearing the rubble out, the hollow pillar in the centre (represented in the drawing) by which the cassinum aquae was supplied with water.

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of the proposal for a medal, the time of adjudging the medal, and the time of presenting the medal, be suspended pro Adito; That the Council be authorized to award medals to the number which they shall think fit to do; That the award of the Council be communicated to the Society, and that the medal or medals be presented at the ordinary meeting of April 9 was carried.

BUDDHIST ARCHITECTURE.

At the Royal Asiatic Society, Colonel Sykes read an extract from a letter received from Captain Kittoe, who has been making some recent observations and researches in the country of Buddhism, described by Dr. Duchmann Hamilton, in the second volume of the Society's Transactions. Capt. Kittoe states that he has found and copied a number of inscriptions, some of which he promises to send to Col. Sykes; and that he has heard of others, some miles inland, never yet seen by any European, which he intends examining. He was unsuccessful in his search after remains of Buddhist architecture, having met with but four or five fragments; but he found a great number of small sculptured stones, which he thought were miniature chaityas or shrines, a sketch of one of which he forwards in his letter; the base being a cube, the upper surface surrounded by a hemisphere, from the apex of which rose an obelisk. In each of the four vertical faces was a compartment, containing a figure of Buddha, the figures in different attitudes and in various postures in the different compartments; generally sitting with the hands folded, but sometimes erect; and a few seated on a bench. One of them, which he has in his possession, is inscribed with the usual Buddhist formula, yathartha-kama-pratiksha, which is decisive of its appropriation. Col. Sykes observed that these chaityas in all probability are representations, or the identical shrines seen by the Chinese traveller, Fa-hian, at the beginning of the 5th century of our era; and afford a valuable attestation to his theory respecting the then existing belief in the four Buddhas, the predecessors of Sakyamuni.

Captain Kittoe believes the present temple at Gyah to be less than 800 years old, and to have been built for Goma-rin. He thinks he shall be able to trace the amalgamation of the sects by their sculpture; and he is preparing to make drawings of the most interesting of these relics. Captain Kittoe states that he has discovered another of Aoka's pillars at Bakrwoy, the site of an ancient city of the Buddhists, on the banks of the Lijian. It was broken, many years ago, into three pieces, one of which was brought to Gyah by Mr. Bodham, and set up in the bazaar, where it goes by the name of Bodham's Folly, an apt illustration of the light in which the natives of India, and too many of our own countrymen, regard the preservation of such remains of past ages, from which alone the recovery of any portion of the ancient history of our country can be expected. The Rajah there suggested to Captain Kittoe that he should make copies for one of the sites of the city, but the piece of the pillar, the base, is almost entirely buried beneath the surface. Captain Kittoe is about to dig it out, with a view to its preservation. Colonel Sykes remarked that this discovery affords another proof of Fa-hian's truthfulness, as it has brought to light another of the pillars mentioned by him, but which had hitherto escaped notice.

LITHOGRAPHIC STONE IN ARABIA.

At the Royal Asiatic Society, the secretary read a paper which had been furnished by the Hon. East India Company, containing an account of the discovery of a quarry of good lithographic stone on the southern coast of Arabia, which will be available for our presses in Bombay, and other parts of India, which at present import a considerable quantity of that kind of limestone from the quarries of Germany. The discovery is due to assistant-surgeon H. J. Carter, who is employed in the service of that company in the coast of Arabia. Mr. Carter found that much of the land was of calcareous formation, of various series; the limestone was of a very fine grain, which induced him to gather some specimens, and forward them to Dr. Buist, of Bombay, for the purpose of trying their quality in lithography. The stratum composing this fine-grained stone lies three or four miles inland, and close to the summit of a ascent, down which the blocks might be rolled, with very little trouble, close to the water's edge, where they might be immediately shipped. The inhabitants of the country, though somewhat fierce, are easily managed by proper treatment, and would readily protect persons employed to work the quarry; and Mr. Carter suggests that means should be taken to ascertain the best method of producing the quarry, or some other arrangement upon his duties on the sea did not allow him leisure to pursue.

The report of Dr. Buist was very favourable to the quality of the stone. It was repeatedly tried, with some disappointments, upon the native presses, and found to take the paper well, and to print with a purely not surpassing by the very best stones imported from Munich. Dr.
COOPEP MINES IN ARABIA.

A paper from Mr. Carter was read at the Asiatic Society. "On the Copper Mines in the Island of Mesopotamia on the Coast of Arabia," which he had been induced to search for in consequence of receiving information that the Persians had formerly wrought copper mines in the island. He had made several attempts to find the mines, but without success; the natives denied the existence of them. The writer of the paper had the purpose of making an experiment on a larger scale, by the first vessel in their service which may chance to be in the neighborhood of the rock.

TYRE AND SIDON.

A paper by Capt. Newbold was read at the Royal Asiatic Society. "On the mountains that lie between the coast of Tyre and Sidon and the river Jordan," a part of Palestine hitherto almost a complete blank in our maps. Captain Newbold proceeded in 1845 from Tyre to Banias, and returned from Hasalet and the castle of Shushaf to Sidon. He thus traversed the country in two directions, and was able to form a general view of the geographical names in the original orthography, most of which are wanting in Mr. Smith's valuable catalogue. The country is divided into the districts of Ezah-Shushaf and Beersheba; it comprehends an area of 408 square miles, being about 40 miles from north to south by 18 from east to west. The shore district is the celebrated Phoenician Plain; it rarely exceeds two miles in width; and in many parts the mountains come down close to the sea in bold precipices. The maritime tracts are unfruitful, and vary in height from 100 to 300 feet; the inland plains reach 200 to 300 feet on the west, and 200 to 400 on the east. The principal rivers are the Litani, the ancient Leontes, and the Lohmani, pass through it to the sea; and a number of small rivulets, running to the Jordan, drain it towards the west. The principal rock is the limestone of Lebanon, penetrated by extensive dykes of basalt, accompanying lines of fracture, which appear to be connected with the fearful earthquakes of which the country has so frequently been the theatre. The crater of an extinct volcano, with its steep and rugged sides of lava, and evident traces of former action, were seen by Messrs. Robinson and Smith, and described in their work. Much of the country is cultivated; wheat-fields are numerous, and the vine flourishes in the volcanic soil; cotton also grows, but the staple productions are wheat, millet, beans, tobacco, and lentils. The population amounts to 15,000, about thirty to the square mile; and is composed of Greeks, Druses, and Arabs. Captain Newbold examined the cisterns in the coast which have been taken for the dye-roots of the Tyrians, and found them to be nothing more than natural rock basins, excavated by the action of the tide. He says they occur all along the coast of Syria, from Gaza to the Orontes. The old city of Tyre and Sidon, and the sands and forms an inexhaustible quarry whence materials are drawn to build and enlarge the cities in the vicinity. Captain Newbold saw a beautiful marble temple of Minerva, as large as life, recently found among the ruins, and now in the possession of the Turks. He communicated the circumstances to our consul at Beirut, with the hope of preserving it from further injury. Some interesting accounts of remarkable spots in the interior, which were visited by Captain Newbold, concluded the paper.

RAISING AND SHAPING METAL BY STAMPING AND PRESSURE.

Abstract of lecture delivered at the Royal Institution, March 19th, by Mr. CARMASSELL. The lecturer's purpose was to show how objects of extreme perfection of form and structure are daily produced by simple manipulation. Having adverted to the old process of stamping sheet metal, and remarked that this process generally required that the article stamped should have a flange or rim, and that the process was inapplicable to any ornamental work which required undercutting in the sculptured part, Mr. Carmassell proceeded to describe the improvements lately introduced by the process of spinning (i.e., burning into form), which is performed by fixing the object in a lathe and pressing its surface with a blunt tool; and explained how, by means of a divided mandrel, undercut forms could be obtained. He then showed that this process of forming would be altered and improved by the blow of a heavy weight falling on its lower surface. Mr. Carmassell presented an example in a tea-pot, made of tinised iron plate by the joint process of stamping and burning to form. This article, which is of the best quality of wrought iron, weighing for 1s. 8d. Mr. Carmassell also exhibited the machine by which tin is shaped into boxes and bottles for holding perfumes, &c., by squeezing a small ingot of this ductile metal by a powerful pressure.

OF THE SUCCESSIVE PHASES OF GEOLOGICAL SCIENCE.

Abstract of lecture delivered at the Royal Institution, March 5th, by Prof. ANSTED. The lecturer stated that he proposed to give something of a psychological view of geological science, and to point out how far these ideas involved truth, and how far errors of exaggeration, although they were useful as suggesting new views and observations. After reviewing the philosophy of the ancients and the com- mon opinion of the Middle Ages with respect to the true aspect of philosophic investigation—the lecturer referred to the discoveries of Werner as being the first which distinctly created geological science. He stated that these discoveries induced three important assumptions: first, that the whole crust of the earth was originally covered with water; secondly, that the newer deposits were generally horizontal; thirdly, that there was an irrevocable order of superposition of similar mineral types. The idea thus involved was that of "the universality of formations," and a perception of order in the arrangement of the materials of which the earth's crust is made up; and the idea was described as useful and suggestive, although the conclusions were in many important respects unsound. While Werner was thus laying the foundation of geology by observations and a perception of order in the arrangement of materials, Whiston, the father of English geology, had obtained an insight into an important fact concerning the distribution of fossils; and at the same time Mr. Hutton, in his "Theory of the Earth," had recognised a succession of worlds and a history of the causes of the succession of the crust of the earth. The idea of the succession of the crust was, that "fossils are characteristic of formations," while Hutton first appreciated the importance of existing causes. The next step in geological discovery was to describe the relations of the formations, in palaeontology, and the establishment of the law of the adaptation of animals to their environment. This was in all animals. This law, however, is combined with another, also of great importance—that there is in all nature a permanent of peculiarities. Modified and brought to bear on fossils in this way, the "law of universal adaptation" was described as the suggestive idea in this stage of geological progress; while the law afterwards made out concerning the presence of species in time as well as space was mentioned as affording important accessory aid in applying palaeontology to the determination of geological problems. After referring to the process of geological classification, and describing as the result of the working out of these various laws, the lecturer briefly stated the actual results of observation in descriptive geology, and the nature of the most remarkable speculations in physical geology: but the latter were indicated in allusion to the development in that department than dealt upon or described directly. Among these desiderata, he particularly referred to the condition of knowledge with regard to metas- morphic rocks—and their relations with rocks of distinctly igneous origin, and the fossiliferous strata rocks on the other. He stated that much yet remains to be done in connecting the present with the immediately antecedent condition; but expressed grounds for belief that investigations actually in progress may lead to some satisfactory and fixed conclusions. In conclusion, the lecturer expressed the hope that the subject would soon occupy a very important place as an inductive science, leading to great practical results.
HISTORY OF ENGINEERING.

By Sir J. Rennie, President of the Institution of Civil Engineers.

(Continued from page 81.)

RAILWAYS.

Whilst the turnpike road and coach system was rapidly advancing towards perfection, numerous active and inventive spirits, aspiring after better things, were busily employed in racking their brains to invent a mode of travelling which should supersede it; and the great difficulties however presented themselves—and amongst the agents which were thought of, none appeared so well adapted for the object as steam, the success of which, in the hands of Watt and others, had proved so triumphant, that had been近百 years before, the men who thought of it, being in want of speed for vehicles, a different kind of road was required to that to which hitherto been used: and at length the railway system was introduced.

Railways, formed with wooden rails, or parallel pieces of wood, with carriages having wooden wheels to run upon them, had been in use at Newcastle as far back as 1761, for the purpose of conveying coal down from the mines to shipping-places on the banks of the Tyne; Labelye, in 1748, described improved carriages, used by Allen in stone quarries at Bath, having wheels with flanges of cast iron, adapted to run on wooden edge-rails; being an improvement upon those at Newcastle; afterwads, the wooden rails were plated with iron, which made the carriages run more easily with greater load; cast-iron wheels, were brought into use for the first time by Reynolds of Colebrook Dale in 1767; and more completely by Curr at Sheffield, with wagon having cast iron wheels without flanges, the rails being in the form of tram-plates; and in 1799 Edgeworth introduced three or four iron rails drawn in a train, by one horse. These iron tramways, laid upon stone blocks, with the carriages above described, having smooth-tyred wheels without flanges, came into general use, for drawing coals, stone, and other minerals, from the mines and quarries underground, and at short distances from canals; but no lines of any great length were made for general traffic. The first line of any seat, it is believed, was that at Loughborough, by Jessop, in 1789; also between Cardif and Merthyr Tydfil, the act for which was obtained in 1794; this was followed by the Cromford and Surrey railway between Wordsworth and Merstham, in 1834; for the purposes, all these were considered works of the kind. About this time railways were used by the contractors during the execution of great works, at the London, the East, the West India Docks, in Lloods, where the huge engines to work the cranes were required for moving materials was required; when the works were completed, the rails or plates, which were made with side flanges to keep the wheels in the places, were generally sold, and were occasionally used for constructing short lines to canals and shipping-places. The only power applied to draw the wagons was that of horses. These railways were considered inferior to canals, and were seldom used, except when the traffic was chiefly descending, so that the empty wagons could return with facility.

Locomotives, which are applicable to the propulsion of carriages might, it would seem, have naturally commenced with carriages on the common roads; but so many difficulties intervened, that the attempt was not made until after it had been effected on railways. Dr. Robison proposed, in 1767, to send his steam carriage on the London and Westminster road; afterwards the application of Newcomen's or Watt's engines, for propelling carriages, could not be attempted with any probability of success, as they required copious and constant supplies of cold water for condensing the steam, which would have rendered the machine so cumbersome and unwieldy as to be unmanageable. Watt's practice was to condense the steam at a comparatively low temperature: for although he tried it in almost every state, from high to low pressure, he ultimately, under all circumstances, preferred employing steam at 3 lb. above the pressure of the atmosphere. Amongst his earliest investigations he made a model of a high-pressure engine, which acted very well; and he described a high-pressure locomotive engine in his specification of 1784; but he considered steam at such a high pressure too expensive to be made use of. The same thing was the case at the time with Mr. Savery, who at the end of his experiments, made use of it. His assistant, Mordoch, afterwards made a working model of a locomotive engine which acted very well, but he did not pursue it further. Leopold had proposed a high-pressure engine in 1784; and one was made by Cognot at Paris in 1770 for propelling a carriage, but it failed entirely, and was never used.

Trevithick and Vivian obtained a patent in 1803, for high-pressure engines, in one of which locomotion was to be produced by the adhesion of the wheels to the rails; and in another by the wheels running upon a flat belt, driven by a water-wheel. Mr. Vivian proposed ribbed wheels with nails or bosses, for the purpose of enabling the engine to ascend steep places. In 1804 they made a locomotive engine, which travelled upon the Merthyr Tydrii railway; it consisted of one high-pressure cylinder, with a fly-wheel, and another wheel, two of which were turned by the action of the piston, and produced a velocity of five miles an hour, drawing after it several wagons, containing a load of about 18 tons. This locomotive worked by adhesion alone. The experiment was not considered successful, as the weight of the carriage, with the boiler, was considered too great for the rails, and might have occasioned considerable damage to them, and if the weight of the engine had been reduced sufficiently, it would have been too light, and the wheels would have slipped upon the rails. Thus we see, that the great principle of adhesion, for producing locomotion, was clearly understood at the outset, and was only abandoned in consequence of the cast iron plate rails at that time in use, being unfit for carrying it into effect. In addition to the objection on that score, the weight of Trevithick's locomotive, more than once, rose against them in consequence of one of them having exploded in 1803. This objection was made to all Trevithick's locomotive engines, although ultimately they came into use. He had made an attempt to propel carriages on common roads by his engines, in 1800, and constructed this engine worked by steam, which was exhibited publicly, in the neighborhood of Bethlehem Hospital. To that ingenious and able man the origin of the locomotive system may be said to be due. In 1811 Blenkinsop took out a patent for his rails, having teeth like those of a saw, having corresponding teeth, were worked by the engine, thus securing the engine against the chance of slipping. This was brought into use for conveyance of goods from the near Leeds. A patent may be said to have been the first practical employment of locomotive engines for carrying the expense, friction, noise, and slowness of the motion, which scarcely exceed four to five miles an hour prevented it from being generally adopted. In 1813 a motion took out a patent for producing locomotion by levers, worked by the engine, resembling a good deal the motion of a horse. This however failed, and a serious accident occurred by the explosion of the engine attached to it. Chapman followed, and patented an invention for producing locomotion by means of chains laid along the line of road, passing round the wheels of the locomotive, and thus travelled forward. In 1813 Blackett resumed Trevithick's original plan, and constructed an engine which worked by adhesion alone, upon the rails at the Wylam Colliery, in Northumberland.

George Stephenson in 1814 improved upon all the former locomotives, and took out patents in conjunction with George Dodd in 1815, and with Loash in 1816. The locomotive, in his hands, soon became sufficiently perfect to be brought into general use on railways, for drawing coal wagons at a great rate that could be performed by horses. The engine was sustained on the axles of the carriages, by means of small pistons working in cylinders, supplied with water from the boiler, which acted like theitle of the pistons. To these engines it was thought all the four wheels were impelled by them; the engine was followed by a tender carrying water and fuel. Here was a grand epoch in the history of railways, which were destined at no very distant period to effect such a complete revolution in the whole system of international communication, as to pass round the wheels of the locomotive, and thus travelled forward. In 1813 Blackett resumed Trevithick's original plan, and constructed an engine which worked by adhesion alone, upon the rails at the Wylam Colliery, in Northumberland.

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The Liverpool and Manchester Railway Company obtained their first act in 1826, under the Mesures. Rennie, but the kind of tractive power to be employed was left open for future determination. The railway works, however, proceeded, and considerable progress was made before it was decided what power should be employed. The company employed Messrs. Walker and Bastrick to investigate the different means employed in the North as tractive power on railways, and to report which, in their opinion, the most expeditious and best adapted for the road railways, and reported in favour of using stationary engines to draw the waggons and carriages. Stephenson and Rennie were in favour of locomotive power. The directors took up the matter with considerable spirit, and offered a reward of five hundred guineas for the best locomotive engine. The competitors for this premium were, Stephenson, Brunswite and Ericson, and Hackworth and Bradworth. The weight of the engines was restricted to 6 tons, including the water in the boiler, and the load was limited to three times the weight of the engine at no less than 15 miles an hour, and the speed was to be constant rate at least. The trial of the engines of the three competitors was made on a part of the Manchester and Liverpool railway, in 1830, and the extraordinary speed of both engines was marvellous, and so well was the trial was realised by Stephenson's engine 'Rocket.' So long as the motive power was steam, and pinion, the greatest velocity attained scarcely exceeded 4 or 5 miles an hour; this was only adapted for the transport of heavy goods, and was useless, except when using extensively brought into use; but the principle of adhesion being adopted, and 7 and 8 miles an hour obtained, the success of this great invention became evident, and it was predicted that its adoption would be general. Still, however, doubt and prejudice prevailed with many, and amongst them
were some men of no ordinary ability and experience, and it was not until the triumphal success of the great experiment in 1829, that the most sceptical considered the improvement adequate, much less the universal. The scientific world beheld with amazement this extraordinary result, the consequences of which could hardly be foreseen. Sprunging at once from a velocity of travelling of 10 miles, the greatest speed of coaches, to 31 miles in an hour; and the dreamers of the elevated expectations of its promoters, that they saw no bounds to its extension.

Stephenson's engine for the competition was upon an improved plan; the boiler contained numerous small tubes, through which the flame, or rather heat, from the fire-box or furnace, was made to pass, thus exposing a greater surface of water, for the reason that, and increasing the rate of evaporation. Booth, the indefatigable secretary to the company, has the credit of this great improvement, which is now universally adopted, not only by the English companies, but also in many of the Continental railways, a distance of 20 miles; also one of 13 miles in length for a similar purpose from Haytor to Newton; and a more perfect example was completed by Walker between the West India Docks and London, on the Commercial road, a distance of two miles, in 1836. The total is composed of blocks of granite, 4 to 6 feet long, 16 inches wide, and 12 inches deep, nicely squared, bedded, and jointed, and laid in a bed of concrete; it has been found of considerable service in reducing the friction, and enabling heavy engines to pass. The advantages of such concrete are many, and obvious.

In addition to the adoption of wooden sleepers, it has in some cases, where great speed is employed, been considered advisable to introduce a layer of india-rubber, or elastic felt, between the rail and chair or chair and rail. The result sometimes will be found to make the movement more easy: for now that the extraordinary speeds of 40 to 50 miles per hour have been effected, and are daily employed on the Great Western and other railways, too much care cannot be taken in constructing the wooden form of the rails, and particularly laying the permanent way; and until this is done it is scarcely prudent to exceed the present high velocities.

Gauge of Railways.—Before leaving this subject, it may perhaps be necessary to make a few remarks upon the width of gauge. This important question comprehends so many elements, that the determination of it is involved in considerable difficulty, and experience alone can afford it satisfaction.

Stephenson, who has taken such a prominent part in the introduction and extension of the railway system, adopted the gauge of 4 feet 8 1/2 inches. Messrs. Albert Smith and Company, of Liverpool and Manchester railway before it was commenced; this, contrary to their advice, was afterwards made 4 feet 8 inches. Brunel proposed, and carried into effect, 7 feet on the Great Western. The Eastern Counties was originally laid at 4 feet 8 inches, and the Great Eastern at 5 feet 8 inches; and the Ulster lines are laid at 6 feet 6 inches. Cubitt now proposes a uniform width of 6 feet throughout the kingdom; the object of all being to ensure the greatest perfection in the engine and fixed machinery, economy of working, and safety in transferring passengers and goods. Taken in the abstract, a broad gauge would appear to afford the means of making more powerful engines, which can do double or triple the work of a 4 feet 8 1/2 inch engine; but it involves a greater first cost, and a commercial question arises, is this necessary, when already, upon the narrow gauge, a speed of 60 miles an hour has been obtained with a tolerable degree of safety. It has been held that the mode of making the road has been improved; and in the mining and manufacturing districts, the narrow gauge is stated to be more convenient and less expensive. Uniformity of gauge, however, is generally admitted to be desirable; and in order to avoid any inconvenience arising from a change of carriage for both passengers and goods, and it is to be regretted that a broader gauge had not been adopted on the Manchester and Liverpool railway, which might have served as an example to all subsequent lines, and have prevented the difference of opinion which has since prevailed. The gauge of the Great Western is probably greater than is necessary; but as it has already been adopted to a considerable extent, and has certainly realized very extraordinary results, and as it is impossible that further improvements will result from a break of gauge, it would seem not to be desirable to stop the progress of improvement by altering it now, when it may be the means of creating further improvements in itself, as well as in the light gauge system, which is so much at present out of date.

Progress of Railways.—The traffic on the Manchester and Liverpool railway far exceeded the most sanguine expectations, and the passenger traffic, which was scarcely reckoned upon as a source of revenue (goods alone being relied upon), increased to such an extent, that it soon superseded every other conveyance between Liverpool and Manchester, and produced a large additional revenue. Notwithstanding, however, its brilliant success, the great cost of the railway, and the remonstrances of old prejudice against innovation, and the almost insurmountable opposition from the pro-Pugilists, the Manchester and Liverpool railways were extended beyond the borders of the metropolis. The views of the railway directors were supported by the great increase in the number of passengers, which was due to the improved chairs for supporting the rails, with side keys of hard compressed wood to keep them in their places and resist the concussion, have been greatly adopted; in this latter department Hanson and May have introduced great changes; the sleepers have been steeped in preparations from the past tests of Burnet, Ryan, and Bethell, for the purpose of securing greater durability. A variety of plans for making the rails and laying the permanent way were introduced, as much as, or even more so, as the bridge or hollow rail screwed down to longitudinal sleepers, which again are screwed to transverse sleepers below them, as adopted on the Great Western railway; the solid rail secured by screws to longitudinal sleepers alone, or with a cast iron plate, and (Cumberland) rail fixed to transverse sleepers, as adopted on the Dublin and Drogheda line, and others, all of which require the test of experience before any correct opinion can be formed as to their respective merits. Rails of prepared iron, patented by Prosser, have been used, with the adhesion of the wheels on steep inclines, but have not been much adopted.

Stone railways or trams, which have been in use in the streets of Milan for a long period with considerable advantage, were employed at the Darlas, in 1829, and in various parts of the United States. A light rail, 2, a distance of 20 miles; also one of 13 miles in length for a similar purpose from Haytor to Newton; and a more perfect example was completed by Walker between the West India Docks and London, on the Commercial road, a distance of two miles, in 1836. The total is composed of blocks of granite, 4 to 6 feet long, 16 inches wide, and 12 inches deep, nicely squared, bedded, and jointed, and laid in a bed of concrete; it has been found of considerable service in reducing the friction, and enabling heavy engines to pass. The advantages of such concrete are many, and obvious.

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irg interest of canals, roads, land-owners, &c., which was only overcome at enormous cost. Amongst the first of these may be mentioned the London and Birmingham, the Grand Junction, the Great Western, Bristol and Exeter, Southampton, Brighton, Dover, Leeds, York, and others. The great success of the London and Birmingham railways, the lines being a series of successive places, extending over 8 or 10 miles, without interruption, having fixed engines with ropes actuated by them, so that the traffic was transferred from one place to another, taking the form of trains, was a great check to the new lines of the same name, and was in fact associated with the invention and propagation of the railway system.—Barne, Birkenhead, Biddr, Bodo, Blackett, Booth, Brandon, Braid, Brunel, Buick, Bush, Cartwright, Ericsson, Giles, Good, Hackwood, Biddr, Bees, Leather, Loch, Lombr, McNeill, Rattrick, G. and J. Rennie, Reynolds, G. and R. Stephenson, Trevithick, Vignoles, Virian, Watt, Walker, Wood, and many others.

Steam Coaches.—Great efforts have been made to perfect steam-coaches, so as to enable them to travel upon turnpike roads, but hitherto without much success. The idea was suggested by Robison to Watt, in 1769, and Watt patented it in 1784. Symington proposed it in 1786. Trevithick's patent of 1802 was the first high pressure engine that was actually made and tried, and that had been successful. It had been designed by Brumm, constructed a steam-coach in 1823 for Griffiths, which was not successful. Gordon tried one in 1834, and Gunney, who was more successful, constructed some with boilers, having very small tubes; he attained a speed of between 2 and 3 miles an hour. The Boadicea was the steepest hill near London; he went from London to Bath and back, in 1831, and his steam carriage ran for four months between Cheltenham and Gloucester; but it was extremely difficult, and too expensive, to keep them in order, and the boilers, containing a capital of metal chambers; they ran for some time, with apparent success; but there were so many difficulties that they did not get into use. Dance, Field, Hill, Maccoll, Russell, Cayley, and others, also attempted it, with varied success; but the system is still more powerful, that they can ascend places at considerable velocities and with tolerable loads, where formerly it was considered impracticable. Examples of these may be mentioned;—the inclined planes of Edge-hill and Rainhill on the Manchester and Liverpool railway, the Incline plane on the Glasgow, Clydesdale and Edinburgh, the incline plane on the Birmingham railway, and other places. The most remarkable and successful application of the steam system is the Blackwall railway, by Stephenson and Bidder, in 1843. The line commences at Fenchurch-street, and terminates at East India Docks, Blackwall, being about 34 miles long; it is carried upon brick arches above the streets, and at each end, or terminus, there are powerful fixed steam-engines, turning large drums or cylinders, round which the ropes for drawing the trains are wound, and the driving force of engines at the London terminus, built by Maudslay, is 254 horse power, whilst each pair at the Blackwall end, built by Burnes, is only 140 horse power, the line descending all the way to Blackwall. The plan of the engines is much the intermediate and increased; in a way to be affected by attaching the carriages to the rope, by a clutch worked by a lever; this is readily detached by a man on the carriage, whilst the rope is passing over the sheaves, and returned to place. The public have great confidence in the lines between these two streets and the Minories are worked by the momentum of the carriages one way, and by gravity the other. This system has its advantages and disadvantages, and is more particularly advantageous when the load is regular, and where the line is so that the full advantage can be taken. The wear and tear of the ropes is very extensive, but has latterly been much diminished, by the substitution of wire ropes for those of hemp.

ATMOSPHERIC RAILWAYS.

The atmospheric system has been the subject of much discussion here and elsewhere. It was first proposed by Clegg, in 1834, by working a model was constructed of sufficient dimensions for the carriages to be introduced at one end of a tunnel, and the air being exhausted by a steam-engine at the other, they were propelled forward, by the pressure of the atmosphere. It was even proposed to adapt the system for the speedy transmission of letters; but this arrangement, being so imperfect, other than the ingenuity of the idea, was of no practical utility. It was afterwards improved by Medhurst, in 1827, and further improved by Clegg and Seadon, who tried an experiment upon a single carriage, which was made to travel 1 mile in 2 minutes, by making the carriages travel outside the tube; and in 1839, it was further improved and patented by Clegg; since that period it has been brought into operation by Clegg and Saouda, who tried an experiment upon a single tube, in 1828, to drive 100 yards in 30 seconds. This experiment showed that a load of 6 tons could be propelled at a velocity of 30 miles an hour, with an atmospheric tube only 9 inches diameter and 12 mile, where the country was difficult, and not well adapted for locomotives. That extension was opened in the latter end of 1843, and continued working ever since. The line is single; the rails, although rather lighter, are laid upon the ordinary plan, and in the centre between there is a tube about 15 inches in diameter, having a slit or opening at the top, which is closed by an elastic valve; a piston, fitted to the foremost carriage of the train, is inserted into the tube, which is connected at the upper end with an air-pump, worked by a steam engine, which exhausts the air from the tube, and the piston attached to the foremost carriage is then urged along the tube by the pressure of the atmosphere, and the motion is transmitted to the carriage in the tube. The vacuum in the tube: as fast as the piston advances, the valve in the slit of the tube is opened, and is closed again after the piston has passed, and is rendered tight and impervious to air by a composition of fatty matter placed in the grooves into which the edge of the valve falls. The planes of this line are extremely steep, being in places 1 in 50, and the curves are very sharp. The highest vacuum obtained has been 26 inches, with a speed of 15 miles an hour. The train returns from Dalkey by gravity alone. For the construction of the atmospheric railway, the principle has been tried upon a larger scale upon the Croydon and the South Devon railways; a portion of the former has been opened, and a speed of 60 miles an hour has been obtained, with a vacuum in the tube of 37 inches; and a train, composed of six carriages, was drawn over a distance of 31 miles in 14 minutes, or at the rate of 35 miles an hour, the barometer indicating a vacuum of 25 to 28 inches. The engines are 3 miles apart, and a power of horse power is employed for the whole distance. The tube is 15 inches in diameter, and the air-pump 6 feet 8 inches diameter; the greatest slope is 1 in 50. The South Devon line has not yet been tried.

Considering the recent introduction of this system, and the new con-
Steam Navigation.

The extraordinary improvement in the mode of communication, which has been effected by steam power and railways on land, had been preceded by equally surprising and important effects produced by the application of steam to sea and river navigation. The vast increase of personal intercourse, the successful transit of different nations, together with the wealth and power that has resulted from this great discovery, and which is still augmenting, has operated more than any other invention on record (not even excepting printing, which has been greatly extended by steam) towards realizing what was once considered Utopian—the bringing of the various nations of the world together, and uniting mankind into one great family, working harmoniously together for their common good.

The steam engine, in its various and numerous applications, may justly be styled the grand improvement of the last ages. It has been worked in almost every occupation and sheet metal, for it is capable of performing with a degree of celerity, economy, and skill, every operation which formerly could be executed by hand. By the number of different and infinitely variable machines which without it could never have been attempted. It may also be employed as a means of conveying merchandise and travellers from one place to another, whether for business or pleasure, with a degree of celerity, economy, and safety, that could not be equalled by any other means. Thus the increase of commerce, national industry, and wealth, as well as general intercourse between nations, serves to dissipate prejudices, and to create moral good feelings towards each other, and thus to promote peace; but if, unhappily, war should ever recur, then by the increased facility afforded for attack and defence, steam would equally serve to shorten its duration by rendering the results more decisive, and making mankind less wicked.

The origin of the application of steam for propelling vessels is claimed by several individuals of different nations; but it is generally admitted that to Great Britain is due the merit of having introduced and established the successful practice of the present age. The application of wheels to propel boats dates as far back as the Homers; in 1696, Prince Rupert's barge was propelled in a similar manner, and tug vessels, with wheels worked by horses, for towing vessels against wind and tide, were proposed. Papin proposed, in 1696, to propel boats by rams and pinions with cogs in a similar manner. Prince de Guise, in 1742, is said to have made an experiment on propelling a vessel in the presence of the Emperor Charles V., at Barcelona, in 1643. The experiment is reported to have succeeded, and received the approbation of the emperor, who, on hearing of it, immediately requested its publication, as it was considered by him as an invention of considerable value, and nothing further was heard of it, until after the introduction of steam navigation, when the statement was made in order to claim for Spain the merit of this great invention. Had this claim been brought forward earlier, and published to the world, it might perhaps have been allowed; but appearing at this time, it could have no influence, and must clearly be regarded as in no way interfering with the title of Great Britain to the discovery. Jonathan Hulls, in 1787, published a pamphlet, wherein he gives a plate representing a boat with a wheel attached to the stern, driven by a steam engine to propel the boat, and tugging behind her a vessel of war. This is clearly the first representation on record of a steam boat, the object of which was for the purpose of defense; but experience showed that this opposition from prejudice, that he does not appear to have prosecuted it afterwards. Hulls proposed to apply Newcomen's engine for propelling the wheel, but as it was very difficult to produce rotatory motion with that kind of engine, the ideas have been abandoned. Sir George Savery proposed, in 1696, to apply manual power to the capstan of a ship, by the intervention of a wheel and pinion for turning paddle-wheels attached to the sides of the vessel; and, at a later period, Captain Burton proposed to apply the power of the engine for the purpose of bringing the bear appears to have been laid aside until 1766, when the mechanical and scientific world had again turned their attention towards the improvement of the steam engine, and Dr. Robison, of Edinburgh, proposed to Watt to apply for a patent. Watt accepted the proposal, and in 1776 at the time that had not made sufficient progress with his invention, to enable him to take up and work out the idea with sufficient prospect of success, as it is evident that he could not have considered Newcomen's engine at all calculated for such a purpose, to work on, in his opinion, his engine, foreseeing, no doubt, that when once that end was accomplished, other important results would follow.

The subject of steam boats still lay dormant for a time. In 1789, the Marquis de Jouffrot is said to have made a steam boat, 140 feet long and 15 feet wide, which was tried on the Seine at Lyons, but it was not successful. About the year 1787, Watt had so far perfected his steam-engine, and rendered it capable of producing rotatory motion, as to enable it to be applied to the purpose of propelling vessels, and prepared the way for the introduction of the modern system of steam navigation; but although numerous attempts were made with imperfect engines for propelling vessels, even after Watt had obtained patents for his improved engines, yet it was not until 1819 that any successful attempt for the rotary engine, in 1800, that it was applied to steam vessels.

About the year 1788, Fitch andRamsey, of America, and Serratelli, of Italy, appear to have tried some experiments, and thus they may claim to the honour of being the first upon the Continent to build a steam vessel. In the same year, Miller, of Dalawinston, constructed a double boat, 60 feet long, with two paddle-wheels in the centre, to be moved by manual labour, in order to race with another boat propelled by oars in the usual manner; it was entered for the second annual race held by Mr. Miller, and the effect of this experiment convinced him, that power only was wanting to bring the invention to perfection. Taylor proposed to apply the steam engine for this purpose to Symington, a practical engineer of the day (who had previously proposed some improvements in Newcomen's engine, and had made a model showing how it might be applied for the purpose of propelling carriages), in order to assist him in applying the steam engine for working paddle-wheels. A steam engine with two cylinders, 4 inches in diameter, each of about one-third the power, was accordingly made by Symington and Taylor, and was applied to drive the paddle-wheels in the centre of the double boat, employed for pleasure on Loch Lomond, in 1789, and it attained a velocity of about 8 miles an hour. The success of this experiment was complete as far as it went, and established beyond doubt the merits of the discovery; it therefore induced the ingenious and persevering workmen to try it further by other vessels. One was constructed for the Forth and Clyde canal, and was the former one, to be worked by an engine on a larger scale. The engine was made at Carron, and was of a peculiar construction, in order to avoid infringement on Watt's patent; it had two atmospheric cylinders of 12 inches diameter, the pistons working in pipes, with a lever acting alternately and by means of chains; pole-yawls and ratchets turned two paddle-wheels, one being placed before the other, in the space between the two parts of the double boat. This machinery, it will be observed, was not fitted to Hail's plan of revolution, but for the propulsion of the boats and engines were completed, and the experiment was tried on the Forth and Clyde canal, on the 26th December, 1799, and was still more successful than the first, having attained a velocity of 4 or 5 miles an hour. An account of this experiment was published in the Edinburgh newspapers of the day. The signal success of this second steam boat rendered further experiments unnecessary, and it now only remained to bring it into practical operation. Messrs. Miller, Symington, and Taylor had proved to the world the merits of the discovery, and not wishing to incur further expense or trouble in combating the prejudices and opposition of mankind, which invariably obstruct the introduction and prosecution of every great invention, did not prosecute the subject further, but left it to others to work out and develop the great invention of Hail's invention, which was destined, at no distant period, to produce such a wonderful revolution in the social world. The engines and machinery were accordingly taken out and returned to Carron Works, and the boat, which was only a pleasure-boat, and fit for nothing else, was transferred back to the lake of Dalawinston, and again applied to its original purpose. Mr. Miller returned to his agricultural pursuits; Taylor to the instruction of a tutor; and Symington to his profession of a practical engineer.

In 1793, Ramsey made some experiments for propelling a vessel by forcing water out of the stern by a steam engine: this does not appear to have answered.

In 1795, Earl Stanhope, well known for his mechanical genius, tried an experiment for propelling a vessel, by means of a propeller in the form of a duck's foot; and about the same time Smith fitted a boat with an atmospherically employed on the banks of the river, and was evidently several others which were tried, appear to have been very successful; the great difficulty seems to have been in producing the rotatory motion by the steam engine employed for the purpose, and it is singular that none of them tried to apply his engine, which, deprived of one of its chief contrivances, Boullon and Watt themselves were too busy in making their engines for the numerous mills and waterworks then becoming daily more general, to turn their attention to fresh speculations, the issue of which was at that time doubtful and which did not prove successful.

In 1801, Lord Dundas, who took great interest in mechanical pursuits, employed Symington to construct a steam boat; this was propelled by an engine on Watt's plan, having one cylinder placed horizontally, and the plate and crank, in the stroke of 4 feet, was 13 inches diameter, and attached to a connecting rod, with a crank at one end, turning a paddle-wheel, placed in a well-hole at the stern of the vessel, which had two rudders, one on each side of the cavity in which the paddle-wheel was placed. This was the first practice of the great invention in Watt's system, and was called the 'Charlotte Dundas'; it was employed for towing vessels on the Forth and Clyde canal, and answered its purpose completely, but the proprietors of the canal objected to its being continued, in consequence of the agitation of the water produced by the paddle-wheels, which they alleged would injure the banks of the canal.
In 1802, Fulton, who had been some time in England, hearing of Symington's attempts, went to Scotland, visited him on board his boat, and requested to see it tried. Symington accordingly got up the steam, made several trips up and down the canal, and fully explained to Fulton every part of it. On the following Monday, May 23rd, the boat navigated the canal from威尼斯人 to Glasgow, and back again, going and coming with the current, for seven miles, and taking in everything, observing at the same time, that the objection of injuring the banks of the canals and small rivers might apply in England, but that in America, where they were upon a much larger scale, this inconvenience could not be so great; with both boats in steam, the whole country would be of immense public and private advantage, and stated his intention of introducing them there. After this visit to Symington, Fulton proceeded to France, where he constructed his first steam boat, and tried it on the Seine in 1804. In 1817, it was exhibited in France, and afterwards.

It is rather singular that Napoleon, who was then First Consul, and who usually was alive to all great improvements, and carried them through with a degree of energy and talent which overcame all opposition, should not have been known to have had schemes of the same sort, namely, that he should have allowed such a fine opportunity of benefiting France to have slipped through his hands; but perhaps the same may be said of England, as being still more extraordinary, for the advantages of the steam engine and machinery had then become universally acknowledged. Fulton, however, impressed with the importance of the invention, and being thoroughly convinced of its ultimate success, pursued it with unremitting perseverance and energy, and in 1805 he applied to Messe. Boulton and Watt to make a steam engine for a boat which he was about to construct in America. This boat was accordingly built in 1807. Watt's steam engine reached America in 1806. The vessel was named 'The Clermont,' from his friend Livingston's residence; the wheels and machinery were on Symington's plan, but improved by Boulton and Watt; the boat was 240 feet long, and only attained a speed of 5 miles per hour. This was the first steam boat used in America, and Fulton and Livingston then took out patents for introducing steam boats in various places in America, and built several others upon his plan, which were purchased by Messe. Boulton and Watt to make the steam engines, which were sent from England, each succeeding engine being larger than its predecessor. Although it was generally known that the steam boats had succeeded perfectly in America, and that their employment was increasing rapidly, a little or no attention was paid to the subject in England. The idea of employing steam boats on the ocean had never been conceived, and the objections raised to the agitation of the water by the paddle-wheels on the Forth and Clyde were entirely entertained as to the success of the system anywhere but in large rivers, such as those of America. In 1812, however, Henry Bell, of Glasgow, organized the 'Hastings' Company, and had successfully launched a vessel that had been done by Symington, determined to try once more whether the invention could not be applied on the Clyde; he accordingly caused a small boat of 26 tons burthen to be built at Forth Glasgow, by John Wood, who has since become so well known as a ship-builder; it was 40 feet long, with 10 feet beam, and in it was placed a steam engine of 4 h.p., on what was termed the bell-crank principle, introduced by Watt; the boiler was placed on one side of the vessel and the engine on the other, with four wheels. The fire-deck, or the upper portion of the vessel, consisted of detached arms, with paddles or floats at the end, which, however did not answer, and the complete wheel, according to Symington's plan, was subsequently adopted. This steam boat, which was called the 'Duke of York,' was composed of a vessel of 150 tons burthen, and was sent from Glasgow and Helensburgh (Bell's native place), in January, 1813, and attained the speed of 5 miles an hour. The 'Duke of York' succeeded so well, that Bell determined to build another vessel of larger dimensions and power. Numerous other parties, seeing the success which had attended Bell's exertions, determined to follow his example, and several other boats were built during the succeeding years of 1813 and 1814; they were however, still very imperfect, until Cook, of Glasgow, in 1814, constructed the fourth vessel, the 'Glasgow,' which he placed on the Forth and Clyde, and which proved so successful that more vessels of the same kind were ordered, and nine were constructed in Glasgow and Helensburgh, and others sent from Messe. Boulton and Watt: this was the first steam vessel in the navy, and it is still in use. By degrees several others were built.

In 1820 a steam tug was built by Maundy, for Messe. Smith, for the purpose of towing their barges upon the Humber; and in the same year, Maudslay and Field applied the expansive action of steam in the cylinder, which was a great improvement; also escape valves for the water, which might boil over into the cylinders. In that year also, steam packets were built by Mr. Jackson of Butterley Iron Works: these two vessels were intended to establish a regular connexion between London and Calais.

The General Steam Navigation Company was established by William Jolliffe, who built two of the largest steam-boats that had yet been tried, called the 'George the Fourth' and the 'Duke of York,' they were between 500 and 600 tons burthen, and had engines of 130 h.p., furnished by Joseph F. Herd, of Stockport. The Butterley Iron Works: these two vessels were intended to establish a regular connexion between London and Calais and London and St. Petersburg; they accordingly started in September 1827, and answered extremely well, notwithstanding the heavy storms which they encountered in the Bay of Biscay and in the Baltic. The General Steam Navigation Company was also extended, part with the two vessels (which were afterwards purchased by the Government), and limited their views to the British Channel and the South Atlantic Oceans. 'Enterprise,' of 600 tons burthen, was built by Gordon and had a pair of 120 h.p. constructed by Maudslay and Field, made the voyage from London to Calcutta, by the Cape of Good Hope. The advantage and supremacy which belong to the British in the art of marine navigation, having been now thoroughly established, their employment becomes universal; and the size, power, and number of the vessels increased daily in every part of the empire.

In 1813, a small vessel, with a side-lever engine of 14 h.p., by Cook of Glasgow, made a voyage from Glasgow to Dublin, and round the Land's End to London; it then ran between London and Margate with passengers with considerable success, and this led to others being established in various places; the Scotch boat serving as a model.

In 1817, Boulton and Watt purchased a small steam boat called the 'Caledonia,' which had been built in the Clyde, with very defective engines, and employed engines on the side-lever principle, of 14 h.p. each, made a great number of experiments with the 'Caledonia,' and went with it to the Scheldt and other places; the arrangement of the engines, as improved by Watt, was then exhibited for the first time. For the first time, there should have allowed such a fine opportunity of benefiting France to have slipped through his hands; but perhaps the same may be said of England, as being still more extraordinary, for the advantages of the steam engine and machinery had then become universally acknowledged. Fulton, however, impressed with the importance of the invention, and being thoroughly convinced of its ultimate success, pursued it with unremitting perseverance and energy, and in 1805 he applied to Messe. Boulton and Watt to make a steam engine for a boat which he was about to construct in America. This boat was accordingly built in 1807. Watt's steam engine reached America in 1806. The vessel was named 'The Clermont,' from his friend Livingston's residence; the wheels and machinery were on Symington's plan, but improved by Boulton and Watt; the boat was 240 feet long, and only attained a speed of 5 miles per hour. This was the first steam boat used in America, and Fulton and Livingston then took out patents for introducing steam boats in various places in America, and built several others upon his plan, which were purchased by Messe. Boulton and Watt to make the steam engines, which were sent from England, each succeeding engine being larger than its predecessor. Although it was generally known that the steam boats had succeeded perfectly in America, and that their employment was increasing rapidly, a little or no attention was paid to the subject in England. The idea of employing steam boats on the ocean had never been conceived, and the objections raised to the agitation of the water by the paddle-wheels on the Forth and Clyde were entirely entertained as to the success of the system anywhere but in large rivers, such as those of America. In 1812, however, Henry Bell, of Glasgow, organized the 'Hastings' Company, and had successfully launched a vessel that had been done by Symington, determined to try once more whether the invention could not be applied on the Clyde; he accordingly caused a small boat of 26 tons burthen to be built at Forth Glasgow, by John Wood, who has since become so well known as a ship-builder; it was 40 feet long, with 10 feet beam, and in it was placed a steam engine of 4 h.p., on what was termed the bell-crank principle, introduced by Watt; the boiler was placed on one side of the vessel and the engine on the other, with four wheels. The fire-deck, or the upper portion of the vessel, consisted of detached arms, with paddles or floats at the end, which, however did not answer, and the complete wheel, according to Symington's plan, was subsequently adopted. This steam boat, which was called the 'Duke of York,' was composed of a vessel of 150 tons burthen, and was sent from Glasgow and Helensburgh (Bell's native place), in January, 1813, and attained the speed of 5 miles an hour. The 'Duke of York' succeeded so well, that Bell determined to build another vessel of larger dimensions and power. Numerous other parties, seeing the success which had attended Bell's exertions, determined to follow his example, and several other boats were built during the succeeding years of 1813 and 1814; they were however, still very imperfect, until Cook, of Glasgow, in 1814, constructed the fourth vessel, the 'Glasgow,' which he placed on the Forth and Clyde, and which proved so successful that more vessels of the same kind were ordered, and nine were constructed in Glasgow and Helensburgh, and others sent from Messe. Boulton and Watt: this was the first steam vessel in the navy, and it is still in use. By degrees several others were built.

In 1820 a steam tug was built by Maundy, for Messe. Smith, for the purpose of towing their barges upon the Humber; and in the same year, Maudslay and Field applied the expansive action of steam in the cylinder, which was a great improvement; also escape valves for the water, which might boil over into the cylinders. In that year also, steam packets were built by Mr. Jackson of Butterley Iron Works: these two vessels were intended to establish a regular connexion between London and Calais and London and St. Petersburg; they accordingly started in September 1827, and answered extremely well, notwithstanding the heavy storms which they encountered in the Bay of Biscay and in the Baltic. The General Steam Navigation Company was also extended, part with the two vessels (which were afterwards purchased by the Government), and limited their views to the British Channel and the South Atlantic Oceans. 'Enterprise,' of 600 tons burthen, was built by Gordon and had a pair of 120 h.p. constructed by Maudslay and Field, made the voyage from London to Calcutta, by the Cape of Good Hope. The advantage and supremacy which belong to the British in the art of marine navigation, having been now thoroughly established, their employment becomes universal; and the size, power, and number of the vessels increased daily in every part of the empire. From this period nothing remarkable appears to have occurred, until the construction of the 'United Kingdom,' which was by far the largest in
The next great step in advance was the crossing of the Atlantic. This had long been in agitation, and was freely discussed by numerous enterprising minds, but the most popular idea was to employ the screw as a driving and important object; but the great practical difficulties involved in the execution were not so easily overcome.

To construct a vessel of sufficient size, with engines of adequate power to propel her through the storms of the Atlantic, and carrying with the sufficient fuel to keep the engines in motion, was considered by many (among them were very competent authorities) to be extremely difficult, but by the world in general the task was considered to be wholly impracticable.

The idea of such a great undertaking, and a company of enterprising individuals, with Brunel as their consulting engineer, was formed for that object; it was, however, with difficulty that they found engineers to carry it into effect, some of the first constructors of the day being unwilling to risk their reputation on the unknown. And, however, who had already taken a prominent part in the prosecution of steam navigation, saw their way, and boldly engaged to construct engines of the requisite power, well adapted for the purpose. Accordingly a vessel, called the 'Great Western,' was designed by Paterson, and built by him at Bristol; and the engines were completed and fitted on board in March, 1838. The vessel was 310 feet long, and 38 feet beam, drawing 15 feet when laden, being 1240 tons barthen, and capable of carrying 500 tons of coal, which was calculated to last for 12 to 15 days. The engines were upon the so-called lever principle, each of 210 h.p., with cylinders 73 inches diameter and 7 feet stroke, making 15 strokes per minute; they were fitted in cast iron frames, with the latest improvements. The boilers were constructed of the American Patent, with the tubes being cast in the boilers, and have been since much used; they had brine pumps, and were worked under a pressure of 5 lb. per square inch; the total weight of the engines and boilers, including the water and the paddle-wheels, was about 490 tons. The vessel was driven by two engines, and the trial was on the Thames in March 1838, realizing 13 miles per hour. On Sunday, 8th April, she started on her first voyage from Bristol, under the command of Captain Hosken, with seven passengers, and a cargo of 60 tons of goods, besides 600 tons of coal, and reached New York on Monday, 23rd April, a distance of 3000 miles, in thirteen days and ten hours. Her arrival created the greatest interest; the crowded were crowded with spectators, anxiously waiting to give a hearty welcome to the enterprising and successful adventurers, who had so triumphantly solved the grand problem, and had brought the New World within a few days' sail of the Old. On her return she left New York on the 7th May and reached Bristol toot, 23 passengers; performing the voyage in 15 days. The success of this voyage opened the possibility of having the most sanguine expectations of its promoters, and indeed of the whole world, there seemed no bounds to the extent of steam navigation; other companies of engineers were engaged, and more powerful engines were designed, in equal confidence of success; then followed the 'British Queen,' by Napier, of 500 h.p., the 'Liverpool,' of 500 h.p., and the 'President,' of 600 h.p., whose melancholy fate served for a time to damp the ardour of speculation and community. It was no longer the Atlantic having thus been established, and its superiority over the old sailing being clearly proved, time only was necessary to render it perfect. The line from Liverpool to Boston was then designed, and carried into effect. The Cross Channel at first was the only trade carried on; then the Continentals, the 'Acadia,' 'Caledonia,' 'Hibernia,' and 'Cambia,' of about 1000 tons and 450 h.p. each. This was followed by the gigantic project of the Royal Mail Company, for carrying the mails between England and the West. The engines of these vessels, each of about 1300 to 1500 tons barthen, and 425 h.p. The engines of these vessels resembled very much those of the 'Great Western,' whose complete success induced their being taken models for future ones. The great weight and space occupied by these engines, being upon the average about 4 tons for every horse-power, rendered it difficult for them to carry any great amount of cargo beyond the passengers, and thus the profits as a mercantile speculation were materially lessened; it became extremely desirable, therefore, to ascertain whether engines of a lighter and more compact form could be held not be made of less weight, and to occupy considerably less space.

In order to effect this object, engines were invented, by which the power was applied directly from the piston to the paddle-wheel shaft, without the use of levers or other means of increasing the supply of water to the engines, and at first great objections were made to them in consequence, as was asserted, of the loss of power arising from the obliquity of the pistons on the paddle-wheel shaft. Messrs. Seward's were the first in this country to try the system in 1832, and not withstanding the objections above stated, it has been improved by them and by other engineers, and has materially gained ground. The objection of action of this system, compared with that of the side lever system, can only be made in the light of an extra fricition, which is fully, if not more than compensated for, by the reduction of weight and space. The modifications of the system by Miller, have been very successful, and consigned to the forms of vessels adopted by him, have enabled great speed to be attained both by sea-going vessels, and his boats on the Rhine and other rivers. Even the objection of extra friction, however, if teable, is obviated by the vibrating cylinders described in Trevithick and Vivian's patent in 1806, patented by Wills in 1808, by Macby in 1811, by whom the first engines of the kind were constructed; subsequently improved by Maudsley and Field, and Spiller; and now extensively manufactured by Penn, Miller, and others; Maudsley and Field's double cylinders have been enlarged in a large class of frames and condensers; the tubular instead of the common Sue boiler, first proposed by Bickley in 1784, and afterwards improved in the locomotive boiler, and introduced into steam vessels by Maudsley, Spiller, Bramah, and others about 1825, as well as the use of steam of higher temperature and increased expansive action, have combined materially to increase the effect of the engines, and reduce the consumption of fuel; so that the space and weight occupied by them is now reduced to nearly one-half what it was originally. Engines of other kinds can now occupy the same space and tonnage in the vessel; thus a material advantage has been gained in enabling vessels to carry a larger quantity of fuel, by which they can extend their voyage; and greater power is rendered disposable for propelling the vessel through the water. As economy of time becomes daily more important, every means which can effect it are brought into operation, and thus the power of the engines has been continually augmented, in order to produce greater speed and shorten the duration of the voyages. Referring to the Navy, we find, that in 1825, 60 h.p. was the largest; in 1827, 100 h.p.; in 1828, 200 h.p.; in 1830, 220 h.p.; in 1838, 440 h.p.; and in 1845 we have the 'Instruction' and 'Terrible,' with over 1000 h.p. in each, and it is improbable that ere long greater power will be employed. With this increase of power, which make such rapid progress, the mercantile steam navy has not only kept pace with it but has even led the way; for the enterprising, commercial spirit of this country is ever on the stretch; and improvement is aimed at with avidity, and the greatest inducements are held out to officers and artists, in fact nothing but constant progress can satisfy the restless spirit of improvement. In the infancy of the art, we were satisfied with 5 or 6 miles per hour, now, when we have reached 15 miles per hour, we are confidently looking to a still greater result. Whilst the improvements, above described, have been making in the engines and in the mode of applying them, various attempts have been made to obviate the inconvenience and loss of power occasioned by the concussion of the floats of the ordinary paddle-wheel entering the water, as well as the heavy drag or back action of the water when the floats leave it; numerous experiments and inventions have been tried for constructing a wheel, or such a portion of the float, as would be driven in a more advantageous manner, and having effected the object, shall leave it again with the least resistance. To describe the numerous inventions of this kind would be foreign to my purpose, and would occupy too much of your time; it will suffice to mention the invention of the mechanism, by which the floats always enter and depart from the water perpendicularly; those of Cave, Oldham, Morgan, Perkins, Seward, and Barlow, which are modifications of it, differing chiefly in the angle at which the floats enter and leave the water, and the mechanism by which the floats are held in their respective positions; the principle of this invention is extremely good, but in practice it has unfortunately been found, that the wheels of this construction, after a little use, are liable to get out of order; it is therefore generally adopted to divide each float-board into several parts or narrower floats, and to arrange them so as to form a series of hydraulic cylinders, that they shall all enter the water at the same place in immediate succession; as the acting force of each board is radiating, it propels whilst

* The total amount of steam power employed in the Royal Navy is about 35,000 h.p.
passing under the water in the ordinary way, and when it emerges, the water escapes simultaneously from each narrow board; this principle was not followed in the earlier models, and was therefore desirable to contrive a simple means of detaching the paddle-wheels from the engines, so as to allow them to turn round with the motion of the vessel through the water, and thus to prevent them from impeding her way; various novelties of this kind have been invented but the simple and honest design, which is so much employed, was invented by Brainville and Miller; it consists of a friction clutch attached to the paddle-wheel, which, by means of keys and screws, can be tightened or slackened with facility, and thus the paddle-wheel is attached or released at pleasure. Numerous attempts have been made to introduce the rotative engine without pistons, but they have hitherto not been successful.

The great results rendered by steam navigation induced the mechanical world to turn their attention towards the extension and improvement of it; Buonell and Watt, Maudslay, Field, Robert and David Napier, Jesse, Glyn, Barnes, Miller, Ravenshill, Girdwood, Manby, Spiller, Scott, Sinclair, Caire, Sadler, Forster, Woodard, Penn, Fairbairn, Hall, Bennie, and numerous others have devoted their minds to it, and have produced some splendid examples of engines and mechanisms in that department. When we look back to Symington's original engine, in 1788, it appears to have been a very simple machine, not at all to be recognised as the same, and from a speed of 8 to 6 miles an hour in smooth water, we now find that a speed of 80 and 90 miles an hour against a heavy gale and head wind in the Atlantic, and above 17 miles in still water, has been obtained, whilst improvements are in progress which lead us to anticipate at any very distant period far greater results; much of this, no doubt, is due to the perfection of the workmanship, as well as to the more correct proportions and adaptation of the various parts of the machinery, compared with what was formerly done, and which it was impossible to accomplish with the slender and inefficient means then at command; for this we are greatly indebted to the improved self-acting tools of Whitworth, Fox, Lewis, Sharpe, Roberts, Namnith, and others. The improvements in the form and construction of the engines were also contributed much; and in the investigation of this difficult subject we are much indebted to John Wood, Oliver Lang, Fearnall, Finchem, Ditchburn, Symonds, Rule, Seppings, Scott, Stamell, Edye, Patterson, White, Pasco, and others.

(To be continued.)

REGISTER OF NEW PATENTS.

PAPIER MACHE ORNAMENTS.

CHARLES FREDERICK BISLEFIELD, of Wellington-street, Strand, to which he is the manufacturer, for "Improvements in the making moulds or dyes, used in the manufacture of papier mache and other materials, in moulding or forming articles from certain plastic materials."—

Granted July 14, 1846; Enrolled Jan. 14, 1847.

The invention relates, first, to improvements in making moulds or dyes used in the manufacture of papier mache and other materials, and to improvements in moulding or forming articles from certain plastic materials. Secondly, to moulding or forming mouldings from certain plastic materials on wood.

The first part of the invention consists in the application and combination of certain matters heretofore mentioned, for making moulds or dyes used in the manufacture of papier mache and other materials, by moulding or forming them therefrom. The materials are as follows:—tannagoletico, sulphur-balsam, gum-thus, and gutta-percha, with a suitable solvent of gutta-percha, preferring Venice turpentine, Gum-thus and gutta-perchas are matters imported into this country, and are well known. Tannagoletico is prepared by mixing a solution containing tannine with a solution of glue or animal jelly, of about 36 parts, which is then subjected to a bath of a solution of sulphur in fixed oils, mostly prepared with sulphur and linseed oil, and usually consists of two ounces of flour of sulphur and eight ounces of linseed oil, mixed, heated, and stirred, till the sulphur dissolves. In making the moulds or dyes above mentioned, mix, dry, and heat the gutta-percha, Venice turpentine; to this solution add cuttings of gutta-perchas, and kneel them by means of heat, preferring to use a pug-mill heated by an external steam bath for such purpose. These materials so combined may consist of various proportions of the ingredients, depending on the manner the combinations are to be used in making moulds: the following proportions are preferred,—nine parts by weight of tannagoletico dissolved in eighteen parts by weight of Venice turpentine, adding four to five parts of sulphur-percha; but thicker for more purposes, for dyes or moulds, for making articles in papier mache and other materials.

By adding a small quantity of glicerine, especially where little or no sulphur-balsam is employed, it will be retained longer from becoming hard. For very hard moulds or dyes, capable of sustaining considerable pressure, mix with such combinations fine flour from ovens as much as possible so long as the combinations will retain a plastic state, and allow of being readily used, by being pressed into moulds, or into figures or models. White and red lead, and oxides of some metals, such, for instance, as oxides of iron in the state of powder, may be used for giving hardness to the compounds, taking care that they are not added to such an extent as to destroy the plastic materials of the combinations. Gum-thus and sulphur-balsam may be combined with gutta-percha without using the tannagoletico, by means of heat, and the effects of combining these two ingredients is, to produce a very plastic compound, and suitable for forming moulds or dyes by being pressed on or into soluble dies, for various purposes, and the same will be hardened and modified by using other ingredients, as before explained. And sulphur-balsam may also be combined with gutta-percha by heat, and will produce a plastic compound more or less fluid when hot, according to the quantity of sulphur and other ingredients employed, and the impressions from models or surfaces (by pressing the same on or into soluble surfaces), and such impressions will be applicable as moulds for making articles from other plastic materials pressed therein. And such combination of sulphur-balsam and gutta-percha may be combined with the other materials in the same manner as before explained.

When mixing the above mentioned materials, dried by heat, it will be necessary to heat or grind them by machinery, to make them blend intimately together. The first part of the invention also consists in employing the above mentioned combinations of materials as plastic preparations, to be moulded or formed in order to produce articles therefrom in any suitable moulds or dyes for architectural and other ornaments and other uses; and owing to the peculiar properties of such plastic preparations they will be found highly useful, for they will take and retain very sharp impressions, which, when set and dry, will not be readily injured, and moisture will not have so prejudicial an effect on articles moulded from such compositious as on many other plastic preparations, and their degree of durability and strength are equal to such combinations, particularly where it is desired to give tenacity thereto, will be benefited by having paper-makers' rag dust, or other fibrous material, ground or mixed therewith, and where pliability is desired to be given to the combinations above mentioned, glue may be mixed with the above compound; the degree of pliability desired to be obtained for the particular purpose to which the combination is to be applied.

The second part of the invention consists in forming mouldings for architectural purposes, by spreading gilders' preparation (gloe or size and whiteness) by means of gauges, on to wood, and then subjecting the said mouldings to the pressure of objects to mould them. In making mouldings, it has been usual to prepare the wood mouldings to the contour desired, and to lay on a succession of coating of the gilders' preparation, and then by rubbing the surfaces thus prepared, the same are rendered smooth. In place of this process, the gilders' preparation is now used somewhat thinly thawed, which will be suitable for making a substantive coating at once, and is then laid on to the wood moulding by means of a gauge. In performing this process, a sheet-metal gauge is fixed on a bed in such manner that a prepared wood moulding may pass under it, leaving a space between the gauge and the wood moulding, according as it is intended to have the preparation spread more or less thickly; and on one side of such gauge there is a hopper containing the plastic preparation usually employed by gilders, or printer's composition (gloe and treacle) may be mixed therewith, to give elasticity or slight pliability to the surface. The wood mouldings pass under the hopper, which is operated by steam to keep the plastic material in a melting state, the wood moulding being caused to slide on a long bed, by which it will become covered with the preparation. The wood mouldings being thus coated, are, when dry, to be subjected to the pressure of dyes to impress the surfaces thereof, and for this purpose the use of the roller dyes is preferred.
LOCOMOTIVE ENGINES.

RUTLAND GALLOWAY, OF Buckingham-street, Strand, Middlesex, engineer, for "Improvments in locomotive engines."—Granted April 18; Enrolled October 15, 1846. With Engravings, Plate IX.

In constructing locomotive engines for railways, it has heretofore been usual to give motion to two or more of the wheels which carry the engine and have these wheels rolling on two rails, so that they may be turned in any direction. Now one of the objects of this invention is not to use the carrying wheels as driving wheels. Another object of this invention is to apply the power employed to produce two wheels placed on either side of a central rail, and to obtain the requisite holding or bite on the central rail by causing such two driving wheels to be pressed towards each other, and consequently against the central rail, by means of springs and apparatus suitably arranged for carrying the two driving wheels (on each side of the central rail) to press the rail more or less, according as more or less holding to the rail is required from time to time.

The driving wheels of the locomotive engine, shown in the engraving, Plate IX., are applied horizontally on each side of a centre or middle rail, and are pressed towards each other by means of springs, the pressure of which can be regulated by adjusting screws, or by any other convenient means, so that they may be pressed towards each other with any degree of force the springs will admit of. The means, therefore, of those wheels is exerted simultaneously on each side of the middle rail. By such an arrangement it will be evident that the bite or adhesion necessary to propel the train is independent of the weight of the engine, and as the adhesion can be increased or diminished according to the amount of force with which the driving wheels are pressed against the rail, this system obviates the slipping of the driving or propelling wheels upon the rail, heretofore consequent on making the driving wheels also carrying wheels in a locomotive engine.

The slide valves may be at either side of the cylinders, and worked by eccentrics placed on the axles. To secure the necessary bite on each side of the middle rail, the lower bearing of the axles are at liberty to move for a limited distance horizontally, in mortises or slots cut for that purpose in the horizontal axles, and are pressed towards each other by the springs, c. c. To effect the desired adjustment of the pressure of the springs, the rods are connected to the centre pieces, e, e, one of which has a right and the other a left-hand female screw through it, the threads of which are cut on the right and left-hand screws on the rod, f, f. On one end of f, f, there is a bevel wheel g, working into another bevel wheel h, the axis of which is carried up in front of the fire-box, as seen dotted in fig. 3, and has a handle accessible to the engineer, so that the pressure of the springs on the driving axles, and consequently the bite of the driving wheels on the middle rail, can be adjusted at pleasure when the engine is in motion.

The claim is for the mode of giving motion to locomotive engines, whereby two actuated wheels, a, a, are used; and the causing of two wheels to be pressed towards each other and to a central rail.

THREE-CYLINDER LOCOMOTIVE ENGINES.

GEORGE STEPHENSON, of Tapton House, Chesterfield, in the county of Derby, engineer, and WILLIAM HOWES, of Newcastle-upon-Tyne, in the county of Northumberland, mechanic, for "an improvement in locomotive steam-engines."—Granted February 11; Enrolled August 1, 1846. (Reported in the London Journal, Plate IX., with Engravings)

The ordinary kinds of locomotive engines are, as is well known, composed of two horizontal, or nearly horizontal, steam-cylinders, disposed parallel to each other, either between or outside the wheels of the engine; the present invention consists in substituting for one of the said steam-cylinders two smaller steam-cylinders, with suitable valves, &c.; the smaller cylinders being of such dimensions that the compounded capacity of the two will be equal to the contents or capacity of the larger cylinder for which they are substituted. The two small cylinders are placed one at each side of the central line or middle of the breadth of the engine, and at equal distances from that central line; and the remaining large cylinder is situated in the said centre, as usual.

The crank-pins belonging to the smaller cylinders are arranged parallel to each other, and pointing in the same direction; and the crank-pin of the central cylinder is so placed, that the direction assumed by its radial line will be at right angles to the direction assumed by the radial lines of the other cylinders.

The object and effect of this improvement is to counteract or neutralise any tendency that the oblique action of the several connecting-rods on their crank-pins may have to produce a lateral vibration or rocking motion of the engine upon its supporting springs, when travelling very rapidly, or in any other direction in which each connecting-rod acts, when the piston is near the middle of its stroke, of course, causes the exertion of a force either to lift up or press down the guides which retain the joint at the end of the connecting-rod and of the piston rod in its intended rectilinear motion; and in the common locomotive engines, with two steam-cylinders, this force operates alternately at opposite sides of the central line of the engine, and consequently tends to produce the lateral vibration or rocking motion above mentioned. But this tendency to produce lateral vibration will be wholly counteracted or neutralised in locomotive engines constructed according to this improvement; because the central steam-cylinder, with its connecting-rod, will act in the same direction from the breadth of the engine, and therefore the lifting or depressing force resulting from the oblique action of that connecting-rod will act equally on both sides of the engine; and further, as the pistons of the two small cylinders act simultaneously, and in the same direction, the lifting or depressing force which may result from the action of their connecting-rods are equally operative at the same time. The consequence of this will be that the tendency to tilt or rock, at opposite sides of the said central line, and at equal distances therefrom, and will therefore have no tendency to produce lateral rocking.

In the three cylinders, fig. 1, is an elevation of an improved locomotive engine; fig. 2, is an end view, partly in section, of the three steam cylinders, with their valves and accessories, on an enlarged scale; and fig. 3, is a corresponding horizontal section and plan of the same parts. The ordinary parts of the locomotive engine being well known, any description thereof is unnecessary. a, a, is the central steam-cylinder, situated beneath the boiler. b, b, is the side steam-cylinder, directing the motions of the joint by which the end of the central piston rod is attached to the forked end of its connecting-rod, the other end of this rod is secured to a crank at the centre of the axis c, of the driving-wheels. d, d, are the two small steam-cylinders. e, e, are the guides for the joints of the piston-rods: each joint is connected by a rod f, with a crank-pin g, on the axis or boss of each driving-wheel. The requisite distribution of steam to the cylinders a, d, d, may be performed by means of sliding-valves, and working gear, in the usual manner, but so that the valves of the two cylinders d, d, will always be opened simultaneously in the same direction, which may be done by the working gear, or set of levers manipulated by the engineer on the main shaft c, than is usual. In fig. 2, the valves are represented as sliding against vertical faces at the sides of their respective cylinders; in order that the valves may point directly to the central line of the main shaft c; which arrangement of valves (as well as the arrangement of all the wheel-axle, &c., beneath the cylindrical parts, of the boiler) forms part of certain improvements in locomotive engines, described in the specification of a patent obtained by Robert Stephenson, June 23, 1841; but although that arrangement of valves (and of the six wheels) is suitable for engines constructed according to the present improvement, the valves may be caused to slide against horizontal surfaces, and the wheels may be accorded as good engine in the usual manner. l, l, are the steam-chest or valve-box containing the slide-valve m, for the central cylinder a, and n, is the valve-rod, which passes through a stuffing-box in the end of the steam-chest, s, is the steam-chest containing the slide-valve p, for one of the small cylinders d, and g, is the valve-rod. The steam-chests l, and o, form one space for containing steam, which is conveyed from the boiler into it by the pipe r, and is alternately admitted into one or other of the cylinders a, and d, by their slide-valves. s, is the steam-chest of the cylinder d, which is supplied with steam from the boiler by the pipe t, and passing through the stuffing-box, t, t, it enters the smoke-box w, where it is turned upwards, in order to discharge the whole of the waste steam up the chimney, as usual. The two steam-pipes, s, and t, are branches of one common steam-pipe, to which they are united in the smoke-box; and the supply of steam...
through this pipe is regulated in the ordinary manner by a valve, the handle of which is seen at the end of the boiler within reach of the engine-man.

The working gear for moving the three slide-valves is of the ordinary kind, and is actuated by four eccentrics on the main axis; one pair of eccentrics being used for working the slide-valve of the central cylinder, and the other pair for working the slide-valves of the two small cylinders.

The locomotive engine shown at fig. 1, is designed to run upon narrow gauge railways, and for that purpose the two small cylinders are fixed outside the framing; but when this construction of engine is required for broad gauge railways, the small cylinder may be placed within the framing; and the eccentrics of the central cylinder of the two small cylinders, instead of being attached to crank pins on the driving wheels, are connected to cranks formed on the axis of the frame, in the framing. In place of one central steam cylinder, two small cylinders may be substituted; so that there will be four small cylinders, the piston-rods of which are connected by rods with four cranks on the main axis; the cranks of one pair of cylinders being fixed at right angles to the cranks of the other pair.

The present improvement is applicable to locomotive engines mounted on four wheels, and to locomotive engines having four or six of their wheels connected by rods in the ordinary mode of coupling.

The patentee, in conclusion, states, that their invention consists in the improvement, hereinbefore described, of applying the steam cylinders, with their pistons, piston-rods, connecting-rods, and crank-pins, in a locomotive engine, so that there shall be two steam cylinders, connecting-rods, and crank-pins, disposed at equal distances on each side of the axis of the engine (each side of which the engine is to travel); those two connecting-rods acting on the said crank-pins with like motion, in the same direction, one as the other, at the same time, to urge their crank-pins onward in their respective circular orbits. And also, that there shall be one large steam cylinder, with its piston, piston-rod, connecting-rod, and crank-pin, situated at the said middle of the breadth of the engine, or of the rails, in the manner of what has been heretofore termed a large central steam cylinder. Or otherwise, in place of such large central cylinder, two small steam cylinders, with their pistons, piston-rods, connecting-rods, and crank-pins, disposed at equal distances on each side of the said middle of the breadth of the engine, or of the rails, as conveniently can be.

In order, by such application of the three or four connecting-rods, and corresponding crank-pins, as aforesaid, to counteract or neutralise all tendency that the oblique action of the several connecting-rods, on their respective crank-pins, may have to produce a lateral vibration or rocking motion of the locomotive engine, from side to side, on its supporting springs, when travelling with rapidity.

STEAM BOILER FURNACES.

Ambrose Lord, of Allerton, Chester, toll collector, for "Improvements in furnaces and the flues of steam-boilers, for the purposes of consuming the smoke and economising the fuel."—Granted June 24; Enrolled December 24, 1846. (Reported in Newtow's London Journal.) (With Engravings, Plate IX.)

This invention consists in the application, to one boiler, of two furnaces or sets of fire-bars, which are to be fed or supplied with coal alternately; and also in arranging or constructing the flues and regulating the dampers in such a manner, that the smoke, gas, and other unconverted combustible matters, evolved from the fire, which has been last fed, shall pass under and through the other fire when at a clear red heat, and be thus consumed. When the fire which was last fed has attained a red heat, so as to give out no smoke, the dampers are to be reversed, which will reverse the draught. The other furnace or fire-place may then be fed or supplied with fuel, and the smoke and gas from it will pass under and through the clear red fire, and so on alternately.

In order more clearly to explain his invention, the patentee has shown two modifications, one with moveable grates, and the other with stationary grates. In plate IX., fig. 1, is a vertical longitudinal section, and fig. 2, is an end view of a cylindrical boiler, with the improvements applied thereto. a, a, a, is the brick-work, supporting a boiler b, b, b, has two oval flues c, c, and d, d, extending through it from end to end. The lower flue c, c, is provided with rails e, e, upon which the moveable grates f, f, and g, g, run, being provided with wheels h, h, for that purpose. It will be seen that the boiler b, b, is provided with a water-space i, i, about the centre, extending across the boiler half the breadth of the engine (or the flue of the course of the smoke (or a bridge formed of brick-work may be used); and the flue c, c, is provided with cross-bars k, k, from which have swing-doors l, l. When shut, these doors serve to direct the passage of the smoke and gases, and they may be opened for the purpose of removing the ashes from the grates, and to increase or decrease the draught leading to the chimney; and o, o, are the fire-doors, provided with air-valves, for the purpose of regulating the draught. When it is desired to heat the boiler, both of the moveable grates f, f, and g, g, are brought towards the fire-doors, and the fires are lighted. All the dampers are then opened by the lever p; the damper q, which work the dampers is in a perpendicular position; but as soon as one fire (say g) has attained a clear red heat, it is pushed along the rails e, e, as far backwards as the bridge i, i, and the lever g, is pulled outwards, whereby the damper r, will be opened, and the damper s, closed; and by brushing the bridge of the lever p, the damper q, will be opened and the damper r, closed. The apparatus will then be in the position shown in the drawing, and the smoke and other combustible gases proceeding from the grate f, being guided by the swing-doors l, l, and the bridge i, i, will pass under the furnace and through the clear red fire of the grate g, and thereby be consumed and converted into pure heat; thus effecting a great economy of the fuel. When the fire in the grate f, has burnt clear, and the furnace requires a fresh supply of fuel, the grate g, is drawn forward towards the fire-doors, and fed with fuel, and the grate f, is pushed backwards close to the bridge i, i; the dampers are then reversed, by means of either of the levers p, p, the fires are lighted, the damper q, is worked through the flues, and causing the smoke, &c., evolved from the coal upon the grate g, to pass under the furnace and through the clear fire in the grate f, and so on alternately. If it is desired to reduce the heat of the furnace, this may be readily done by drawing both of the grates towards the fire-doors, and opening or withdrawing all the dampers.

Fig. 3, is a horizontal section, and fig. 4, an end view of a cylindrical boiler, showing the application of the invention with two stationary grates. a, a, is the brick-work, and b, b, the boiler, which has two flues c, c, and d, d, extending through the same from end to end, on a level with each other. a, a, are the movable grates, and d, d, contain the two stationary fire-grates a, a, and one at each end of the boiler. It will be seen also that at each end of the boiler there is a flue g, g, connecting the rods of the two flues c, c, and d, d, and that the fire-doors k, k, (which must be furnished with air-valves) are fastened in the flues g, g, leading to the fire-bars in the chimney; and these vents i, i, are connected together by a flue (which is not seen in the drawing) passing under the boiler. Now, supposing the fire-grate a, to have just received a fresh supply of fuel, and the fuel upon the fire-grate f, to be burning at a clear red heat, then the damper k, in the flue g, must be opened by means of the lever r, which, at the same time, will close the damper m, communicating with vent i, i, and the damper n, in the vent i, i, leading to the chimney, must be closed. At the other end of the boiler, the damper m, must be opened, and the dampers k, k, and n, closed. The smoke from the newly-fed fire a, will pass through the flue c, c, along the fire b, b, and through the clear fire in the grate f, f, where it will be consumed and converted into pure heat, which the draught of the chimney will cause to pass through the flue d, d, down the vent i, i, under the boiler to the vent i, i, and thence to the chimney. When, fresh fuel is supplied to the fire b, the dampers must be reversed, and of course the draught; and, consequently, the passage of the smoke and heated air will be reversed also.

The patentee remarks, that although the flues, in which the fire-grates are placed, are described as being oval, and also shown in the drawing as such, yet he does not confine himself to that shape, although he would prefer its use, as allowing a greater width of fire-bars, and, at the same time, shall ensure a clear red heat in the chambers of the boiler, which chamber being either common or separate, or the two fire-grates to one boiler; but he claims the application to one boiler of two separate or distinct fire-grates or furnaces (whether moveable or stationary), which are to be fed or supplied with fuel alternately, and which are to be connected together by flues, regulated by dampers in such a manner that the smoke and other products of combustion evolved from the furnace or fire-place which was last fed or supplied with fuel, shall be caused to pass under the other furnace or fire-place, and upwards through the fire of the same, for the purposes of consuming the smoke and economising the fuel.

EXCAVATING MACHINE.

Thomas Symes Prideaux, of Southampton, gentleman, for "Improvements in machinery for excavating."—Granted July 15, 1846; Enrolled January 16, 1847. (With Engravings, Plate IX.)

The machine consists of a series of cutting instruments or buckets placed on the end of arms, made to rotate in such a way that after
they have excavated the earth, the baskets will, as they descend, displace the contents into a series of baskets on an endless band, and then discharge them on to a trough; and again the earth is transferred from the trough onto another series of endless buckets to a moveable skid or wagon. The machine appears to be complex; but, if the principle was found to answer, might, we think, be simplified.

The following description, by reference to the engraving, will explain the figure. 0 is a wooden frame supported by flange wheels R, that run on iron rails C; and the front part of the frame is bolted to another frame of iron D, for carrying a shaft F, upon which the revolving arms F are fixed side by side of each other, and on the ends of these arms are fixed the cutting instruments G. For working this machine, steam or other power is conveyed to the crank A, keyed on to a driving shaft I, upon which is a bevelled wheel for giving motion to a corresponding bevelled wheel K, and connecting rod L, thence by another corresponding bevelled wheel to a bevelled wheel keyed on the shaft M, which carries a chain wheel N, for transmitting the motion by an endless pin chain S, to another chain wheel P, keyed on to the shaft before explained; Q is an endless chain of buckets revolving round the rollers O, O, to receive the earth from the cutting instruments when in the position G, and carries it on to the trough T, from which the earth is again removed by another series of endless buckets Q, that pass round the rollers R, and discharge it into the hopper P.

The endless chains are set into motion in an eccentric on the driving shaft I, from which motion is transferred by the connecting rod E, to a crank or crank-pin on the wheel I, fixed on the shaft that turns with the roller over which the endless buckets S revolve, and whence motion is given to the lower roller O, that sets in motion the first endless bucket Q. There is one other motion on the driving shaft I, which is connected with the revolving arm G, and that is the endless screw T, that takes into a piston Y, fixed on the axle of the flanged wheels for propelling the carriage as the work advances, and which may be regulated to any desired speed. The hopper or wagon T is either tilted over by turning the handle Z, or removed on to a platform for conveying it away.

**FURNACES FOR COPPERS, &c.**

JOSEPH MORDAN, of Old-street, Middlesex, copper and still manufacturer, for "Improvements in setting and fixing copper, stills, and boiler, and in the construction of furnaces."—Granted June 29; Enrolled Dec. 29, 1846. (With Engraving. Plate I[X].)

The improvements relate to the arranging the side and bottom air passages of the furnaces, and the application of hollow fire lamps, a, a, shows a copper, still, or boiler, b, fire-place under same, c, furnace, d, bearing bars supporting same, e, ashpit, f, f, stove-hole, g, furnace door and frame, h, spout, or mouth plate, i, bridge of furnace, j, opening parallel with end of furnace bars at bridge, through which the heated air passes, and meets the vapour or gases arising from the burning fuel, and whereby a supply of unheated air is thrown into the combustion, k, valve or slide with handle to the same, and communicating with the front at door-frame for regulating the necessary amount of air or air to be admitted in the bridge of the furnace, which must be opened immediately after the fuel is thrown on the furnace, and to be closed when the combustion of the coal has taken place: holes or pim to be provided in the handle of the same, to prevent its being opened any wider than is absolutely necessary for the combustion of the fuel. l, flame bed or butt formed of fire-tiles or other incombustible materials, to cover the air-flues or oven, through which, by flame passing from the furnace, heat is communicated. m, doors through which the smoke and tinders must pass, which will necessarily fall through the air opening, n, cast iron plates at bottom of ashpit, covering the air-flues, upon which the heat from the furnace and fire-place is reflected, and communicated through the same to air passing through flues underneath, and which plates are to be kept free from accumulating ashes. o, o, air-flues for the atmospheric air first passing under and along the centre of ashpit, and dividing itself right and left under same, then passing on each side of, and in, the ashpit wall, and continuing on through the hollow fire lamps which line the furnace; after which, continuing on right and left under flame bed or butt, where it then meets and descends to the valve or slide at k, and passing through which, it then enters the furnace in a heated and rarified state at the opening at bridge of same, i. p, p, hollow fire lamps for the lining of furnace, through which the air is conveyed from the flues of ashpit. q, entrance for the admission of the atmospheric air to flues, which is to be assisted and increased by the use of a fan or blower attached to same.

The chart or arrows show the direction which the atmospheric air takes in its progress to the opening at bridge of furnace at i. Also, the faint lines on ground plan show the construction of air-flues under the line of stove-hole and ashpit. Also, the letters f to b, and b to f, shown in the cross section, mean respectively front to back, and back to front. And also, the dark dotted circle shown on the ground plan, is the bottom of copper, still, or boiler.

**IRON AND BRASS MOULDS.**

DAVID YOULLO, STEWART, of Montrose, Scotland, iron-founder, for "Improvements in moulding iron and brass."—Granted July 16, 1846; Enrolled Jan. 14, 1846. (With Engraving. Plate IX.)

Fig. 1 is an elevation of the machinery and apparatus, and fig. 2 a vertical section of some of the moulds. A cylindrical mould box, preferred to be made in two parts and connected together, as shown by bolts passing through the spoons, and keyed up by wedges. At the lower end is a step to receive the lower part of the pattern it, which is preferred to be of metal. d a presser, to press the sand into the mould-box a, around the pattern e. The presser consists of a tube of thin sheet metal, with a projecting flange f, or portion of a screw; the worm or flange not passing completely round, but leaves an interval between the two ends. f is a projection, there being a similar one on the other side. These projections loosen the sand above e. The tube d revolves round the pattern e, and keeps it upright; and as the presser d revolutes, it rises by the inclined surface of, that surface continually feeding the sand, and pressing it down upon immediately below it, thus causing the sand to be compactly pressed into a mould. On the upper end of the tube d is fixed a cog-wheel c; and the upper end of the tube d revolves in an opening formed in the cross-head g, such cross-head being guided in its upward movement by the guide-bar h, and the revolving square-bar or axis i, which turns in bearings at j j. On the upper end of the axis i, is fixed a bevelled toothed wheel k, which receives motion from the axis i, by means of a bevelled toothed wheel fixed thereon; and such axis 4, receives motion from a steam engine or other power, by a strap attached thereto, as is well understood, or by other convenient means. n is a pinion which slides on the revolving-bar or axis i, but turns therewith.

**PROCEEDINGS OF SCIENTIFIC SOCIETIES.**

**SOCIETY OF ARTS, LONDON.**

On the evenings of the 3rd and 10th ult., this Society, for the first time, attempted to establish an Exhibition of British Manufactures: although it was not very extensive, it contained several interesting objects of art. The specimens of Carving by Machinery attracted attention. Those by Irving's patent were distinguished for clearness and precision of form, especially in mouldings, for which, indeed, this process seems best adapted. There were also some productions by means of heated moulds, which, though good, were eclipsed by those from Jordan's patent, which were very fine. A Bush of Hops and Brace of Partridges were worthy to hang by the side of Grinnell Goodwin's work. A portion of the Ghiberti Florentine Gates was also on view, and the machine employed accomplished precisely the task assigned to the sculptor's assistant. It clears away all the superfluous and prepares the object for the final touches of the artist,—no matter how high the relief, or how low and intricate the undercutting. Another feature connected with it, is that simultaneously several copies can be executed. The impetus which this machinery is calculated to give to internal decoration cannot be too highly estimated. It multiplies artistic power without limit; only stopping short of that perfection which makes the artist's last touch and approval necessary. This machinery is applicable alike to sculpture, it contains several interesting objects of art.

The Exhibition of Glass was not extensive. The specimens by Messrs. Richardson, of Stourbridge, proved that we are already chemists enough to paint what colours we please on glass, as on china. This is quite a novelty. Some of the forms of the vases are very elegant—chiefly based on ancient examples. The specimens of Metals were few and not very satisfactory. The Coalbrookdale Ironworks, though they have executed some pretty good castings, and made a very fair article, this Exhibition was much the best. An exhibit of sheet silver was interesting: it superseded casting, and economies two-thirds of the precious metal. There was only one specimen of electro-gilding.

The show of Pottery and Porcelain illustrated that branch of English manufactures, and enabled any one so disposed to become acquainted with its rise and progress. The specimens were classed chronologically,—begin-
ing with the better-pots and many-handled "tygs," or drinking cups, of the time of Queen Elizabeth, and ending with the pottery of the present period, showing how the manufacture of English pottery has advanced step by step, until it has reached that perfection by which it commands a preference throughout the world. The manufacture at Delph is almost put down by it, and the very best specimens of old and modern English manufacture, notwithstanding duties almost prohibitory. So far as successful imitation is concerned, English pottery has accomplished all that can be desired. It has superseded, owing to its superior make and cheapness, the original, which it imitated. The old native Delph plate is not to be compared with the modern English plate. Wedgwood in many points surpassed the Burslem wares; while the best specimens of Sevres vases and Dresden figures are equalled by us in general execution, and in many features of workmanship,—though inferior in some kinds of colour and in the "glazing." No doubt, the respect of price, English manufacture has in all cases enormous advantages.

There were some noble specimens of Statuary Porcelain exhibited by Messrs. Copeland and Garrett, and in "Pariis" by Messrs. Minton. From these specimens it appears that the works of the sculptor may be placed within the reach of unassisted numbers. The material or "body," in both cases, is very beautiful, and has only to be connected with good Art to produce a perfectly successful union. The workman, it is true, must have an adequate knowledge of the human form in order to be able to unite, with proper feeling, the separate parts in which the figure is necessarily cast. There were also some beautiful Porcelain Mosais of Messrs. Minton.

Some examples of Black Printing for paper-hanging, exhibited by Mr. Hare, of Greenwich, and perfect copies, on a large scale, of Murillo's "Boys," in the Dulwich Gallery. We hope next year to see a large number of articles in cast iron, brass, and bronze, adapted for ornamenting the interior of edifices; likewise some specimens of carpet and paper-hangings. Some patterns which we have lately seen, manufactured in this country, are quite equal to the French.

ROYAL SCOTTISH SOCIETY OF ARTS.

Feb. 23.—George Wilson, M.D., F.R.S.E., V.P., is the Chair.

The following communications were made:—

Dr. Wilson experimented on the "Noise of the Electric Spark in different Gases, as a means of illustrating the power of electric Fluids to conduct Sound."—The experiment was conducted by Dr. Wilson on the action of atmospheric and hydrogen gas. When the electric spark was passed from one conductor to another in the interior of a glass globe, filled with hydrogen gas, the noise of the spark was exceedingly feeble, being nearly drowned by the noise of the spark taken outside from the prime conductor. On the contrary, when the globe was emptied of hydrogen and filled with common air, the noise of the spark in the interior of the vessel was louder than the exterior spark, having a metallic ringing sound. He, therefore, suggested this as a simple means of transferring the power of elastic fluids to conduct sound. Thanks voted and given from the chair.

By permission, Mr. Powall exhibited Nett's "Patent Electro-Magnetic Telegraph." The telegraph was shown in action, and was described by William Alexander, Esq., F.R.S.E., F.R.S.A. The Electro-Magnetic Telegraph has been invented by Mr. Nett, and exclusively made in his works. The apparatus comprises a series of two solenoids placed one above the other, the solenoids being connected to the hands of common clocks which tell the hour; this hand is longer on one side of the pivot or axle on which it moves than on the other side. The longer end points to a circle of electro-magnets which surrounds the dial plate and the shorter end to a series of figures which is at a short distance from the centre of the dial plate. The hand (or hands) move with what is termed a dead-beat escapement, the motive power being the electric fluid acting upon a toothed wheel which regulates the hands, by which the almost regular movement of escape is obtained. When the hand is to be put in motion, a key, something similar to a key of a piano-forte, is pressed, and the pressure removes the hand points to the letter necessary to spell a word, or to a figure necessary to spell a number. The words are spelled with unerring accuracy, and signals pointed to without the possibility of mistake. No magnetic needles move on the dial-plate and by their deflections indicate the letters, or words, or signs, necessary, in the message to be written. In the United States, the system is used for telegrams used, but a bell is used, the number of strokes struck on which indicates certain things to be communicated from one station to another. There is but one wire employed, and the cost of the apparatus, batteries, &c., is not great. The method is simple, and the number of points which may be arranged is very great.

The great advantages of this invention are stated to be its simplicity, its accuracy, the ease with which it is worked and understood, and the almost impossibility of its sustaining injury, unless from great violence; there is no insulation to take up space. It is stated that it had been adopted between Northampton and Bliworth, where it answers admirably; and that it had been favourably reported upon by Mr. Faraday and Major Brandreth to the Admiralty; by Mr. Brandreth the plan was introduced into a course of lectures, at the Polytechnic Institution. It was stated to be a most important improvement on the rapidity and accuracy of telegraphic correspondence, and a novelty in the application of the principle of electric communication.

March 8.—David MacLagan, M.D., F.R.S.E., President, in the chair.

Experiments were exhibited, showing the perfect safety of the patient from the electric fluid during the administration of the Venus of Solombro,

"Ekhe; and a description given of the forms of the inhaler. By Mr. Archibald Young.

Mr. Young concluded his series of experiments on the inhalation of ethereal vapour by showing that the ethereal contents of the lungs would not escape from which he did not believe any effect of the breath or of the patient from the inhalation or burning, yet that, as a volume of vapour of ether, when mixed with 33 volumes of common air, formed an explosive mixture, persons using ether should not do so rashly, as, in certain circumstances, instances of which were given, explosive mixture in the apartment, but did not know how it occurred during the administration of ether by inhalation. Mr. Young showed various simple forms of the inhaler, some with valves and some without them, and very portable, made of japanned tinplate, as suggested by Bonfants, the supervisor.

Description of an Improved Kinnaird-Grate, combining more perfect Radiation of Heat, with a provision for the admission of Air and returning it warmed into the apartment. By James Gray.

This grate, whose heating power was stated to be much superior to the common forms of the Kinnaird-Grate, is in appearance the very reverse of the latter, in place of supporting sheets, being entirely covered with a single sheet of metal, with a provision for the admission of air, made from the grate, which issues through a grating on the back, and a grating on the front. The grate has been described by W. Browne, Esq., respecting one of the "Archives of Uphall Church, in Buckinghamshire," was read; and a sketch by that gentleman exhibited, showing the principal features, viz., a carved wooden architrave, the surroundings of which are the dog-tooth alternated with small roundels, the outer moulding adorned with a series of diagonally-set triglyphs of a more antique character than Gothic ornaments commonly are.

A description of the Remains of the Ancient Norman Refectory in the Bishop's Palace at Hereford," by J. Clayton. There are few existing examples of Norman architecture which present the timber-work in such excellent preservation as that at Hereford. This great Hall is one of the earliest examples of the class of buildings to which belong the Halls of York, Lincoln, Durham and Winchester. In the middle of the hall are two side compartments, by two ranges of columns of four each, from which spring the arches supporting the roof; and the peculiarity of this example consists in these pillars and arches being entirely constructed of oak. The stone of the Hall has been destroyed and one half of the roof now serves to shelter the principal apartments of the present episcopal residence, erected upwards of a century ago. Above these apartments, which are of one story only, are seen the upper portions of the pillars, the arches, and the roof; the lower parts of the columns being concealed in the division walls of the modern rooms. The principal arches, viz., those over the central compartment, were of 22 feet span; and each formed of two pieces only, cut in the arched form from the solid timber—which must necessarily have been great dimensions. This oak, although whitened by age, is perfectly sound. Drawing of the details were exhibited; also one conveying the writer's idea of restoration of the interior of the Hall—showing that the original building must have had much greater appearance, not only by the addition of the richness of design, but from a massive gr内幕arum, the peculiar characteristic of this early style of architecture. A few particulars were given of the city of Hereford prior to the erection of the refectory in question, which was probably soon after the Conquest. —The Hall at Oakham was then described by Mr. Clayton as a most beautiful specimen of the Norman buildings of this class. It does not possess the peculiarity of being composed entirely of timber, nor has it the magnitude of the examples at Hereford; but it remains in an almost perfect state, being part of the ancient castle, and is now used as the county courts for the shire of Rutland.

* Observations of the Ancient Roman Ruins in the Parish of Ade, in the West Riding of Yorkshire, by H. D. Chalmers, Esq. Among the objects particularly stated to was the corbel table, which had evidently been added out of the solid timber, having projecting pieces which fitted into the between the ceiling joists, or rather beams. Mr. Chantrell was of opinion

* This evening's proceedings were accidentally omitted in last month's Journal.
that this roof was originally open, like the cradle roofs of the 15th century, many of which occur in the churches of Yorkshire. The south door was mentioned as exhibiting one of the finest specimens of Normans sculpture in the country. The capitals of the principal pillars of the chancel arch were preserved, on which sat sculptured figures representing the Baptist, and the other the Crucifixion. It was mentioned that the same character and grouping occur above the door of the Baptistery of the Church of St. Basil at Bruges, known as "La Chapelle du Christ Tourné," which edifice is a little dot-shaped building found in the time of William the First, and other peculiarities of style which occur in the sculptured figures of one of the southern capitals, are additional reasons for assigning the date of the 11th century to this building.

March 8.—S. Angell, V.P. in the Chair.

Mr. J. Scott Russell read the concluding portion of a paper on "On the Peristyle and Pediments in connexion with the Paving of the Athenian Acropolis," in which he recapitalized his first and second principles, he went on to examine the third cause of bad qualities in the construction of a room. He showed that in a large square room, of the usual form, the reflection of the same sound was carried to the speaker's ear by different paths, and in different periods of time; the result of which was the confusion of successive sounds and syllables with each other—and so a prolific cause of indistinct bearing. It required another principle to afford the remedy of these evils, and that was the fourth principle—which he believed was quite new. He might venture to call it the principle of the non-reflexion and lateral accumulation of the sound wave. It had originally been suggested to him by the observation of a similar phenomenon in the wave of the first order in water. This wave, he said, had no longer completely reflected from the surface on which it impinged; and that the same result would be obtained if the surface were divided into those of the same phenomena in the latter wave. He had observed that at angles below 45° the sound wave was no longer completely reflected from the surface on which it impinged; and that at angles above 55° the sound wave was, &c.—where it was possible to place flat or curved surfaces at such angles that the direction of the sound should be very oblique to the surface, it might be harmlessly disposed of, and prevented from injuriously reflexion. This was exactly what the slats of a shop, the ceiling of a cathedral, and the partitions of boxes in a grand opera house, did so successfully for buildings of a large class. The same principle enabled him to explain the Whispering Gallery of St. Paul's (which is circular) and another equally celebrated, mentioned by Saunders, which is perfectly straight. The same principle also explained the convection of sound along the smooth surface of a lake and over the flat surface of a sandy desert—as well as the extraordinary reverberation or accumulation of sound in some portions of a building. The fifth principle was that of the polarization of the human voice. Mr. Russell showed the rapid diminution of intensity of sound on both sides of the axis of the mouth—and that instead of extending in a circular wave round the head of the speaker, as had been supposed, the line of hearing-distance was an elongated oval, spreading from without.

March 29.—Mr. C. Fowler in the Chair.

Mr. James Bell read his essay "On the Adaptation and Modification of the Orders of the Greeks by the Romans and Moderns," for which a Medal of Merit had been awarded:

The order, in Grecian architecture, constituted the chief feature, and constituted the character and proportions to the entire edifice; the columns, on the introduction of the arch by the Romans, lost its importance, and, together with that, its extreme delicacy of finish and proportion; in place of which, luxuriance and richness were substituted, so as to harmonise more thoroughly with the sentiments of the Roman people. This change gradually led to a complication of the style; the arch, in the Constantine era, gaining in importance more and more until the Pointed style arose from the ruins of the Classic. On the revival, the Italians by the sense of imitation, endeavoured to restore it to its primitive purity, and many of them were severely mortified in the attempt. The Gothic object, although the painter-architects introduced many flagrant abuses both in composition and detail. In the north of Europe, where the Pointed style was successfully applied, the change was produced by the grafting of Classic details on a Gothic outline, constituting the Elizabethan and Renaissance; and, at the same time, an increased intercourse with Italy led to the adoption of the new style in all its purity, for much of which credit is due to Sir Christopher Wren, who was neither either misunderstood or altogether overlooked, although the feeling of the age, so far as regards detail, tends rather to imitation than to modification. To the Germans, however, was due the merit of the most complete application of the works of the Greeks—a result which had been anticipated from analogy between the habits of thought and feeling, and even language, which may be traced between the two nations.

Institution of Civil Engineers.

Feb. 28.—Sir J. Rennie, President, in the Chair.

A supplement to the papers on "The Holder or Great North Holland Canal," by Mr. G. B. W. Jackson, was read. It contained a description of the harbour and works at Nieuwendiep, which might be considered as legitimately connected with the Holder canal, inasmuch as they were constructed with a view of providing facilities for merchantmen navigating the North Sea. The banks or shoals situated at the mouth of the Marsdiep channel act in a peculiar manner; they narrow the entrance, resist the undue influx of the tides, thus preventing injury to the channels of the持zeren, and prevent the entrance of hostile fleets, as the navigable channels run within range of the protecting forts; and they assist in maintaining the velocity of the currents which keep the channels at their usual depth. On the coast of Holland the ebb-tide contains particles of sand at a farther point than the ebb-tide has commenced flowing up along the Schulpener-gat; this can only be accounted for by supposing that the tide runs up from the south-west, and that the ebb occurs from the north-west, whilst the ebb still continues, in consequence of the ebb from the north-west reaching the coast. The Schulpener-gat and Landsdiep may therefore be termed the flood-channels; whilst the Noorder-gat may be considered the ebb-channel. Upon these spots, whose preservation was of such consequence to the country, the Dutch have lavished their best care, and exercised their ingenuity.

The shore-works consisted chiefly of groynes, composed of timber piles and fascines, with stone covering. The average length was two hundred yards, with piles in one or two lines of sixteen feet apart. The whole length of 2000 feet was preserved from decay. A breakwater also, 1500 feet in length, 75 feet wide, at 3 feet below high water, with slopes of one to one. This was also formed of fascine beds, weighted with 3000 lb. of stone, and 4000 lb. of tiles upon every superficial area of 144 square feet. The upper surface was covered with matting, and made convex, the centre being one foot and the sides three feet below the level of high water. Hurdling was then used, and the whole was covered with blocks of stone weighing from 300 to 500 lb. each. The total length of 2000 feet was subsequently built, the breakwater being completed, and by means of these works the ebb-stream was increased to such an extent as to once to deepen the channel eighteen inches, although the bed was of clay. In 1758, a new breakwater was started to tenant the channel to a depth of nineteen feet was arrived at. The whole length of the proposed harbour was then dredged to a depth of seventeen feet under high water level. Another wapping bank of 8675 feet in length was then constructed, with numerous groynes to arrest the sand and preserve the coast. A quay and jetty were then added; the piles composing the latter were covered with sheet lead between high water level and one foot below the ground, in order to preserve them from the ravages of the Terrofe Nemulis, which, in a state of population, had a length of 2000 feet and was useful in securing the sand of the coast from being blown or washed away.

Among several cases of the failure of protecting-walls, one was particularly described of a nearly vertical sea-wall, whose foundations were sunk down five feet below the angle of the coast; the wall was built with great care, and with first-rate materials—it was, however, exposed to the action of a heavy sea in North Wales. During a severe storm, the waves were thrown up in a mass forty feet above the wall, and falling from a height of forty feet; it was destroyed in five months, and the sea-wall thereby destroyed the whole wall. It was exposed to a violent wave, which enabled the waves to extend their strength, and broke them up into forms, which did not suffer at all. Numerous deductions were drawn from these and the occurrence of similar phenomena, which has resulted in the use of the sea-walls, which it has recently become fashionable to recommend as a theoretically more correct form, in opposition to the well tried plan of embossed civil engineers, who have almost universally adopted slopes for resisting the action of the sea.
March 3.—This evening the discussion upon Mr. Jackson's paper was resumed, and was extended to such a length as to preclude the reading of any paper.

The comparative advantages and disadvantages of vertical and sloping sea-walls were discussed; and instances were given of the effect of sea upon the foundations of coastal towns, with especial reference to the sea, the building of which was accomplished by an overhanging coping of such extent as to deflect the curling wave outwards, and throw it back upon itself rather than allow it to fall bodily inwards, as in the case of the Peaseman's wall mentioned at the last meeting.

For this object the effect of having a large thickness of clay, acquiring force as they travelled along, was contrasted with this. On the other hand, the action of the various kinds of waves was shown upon sections of the beach at Margra, where the surf was so notoriously bad, and where it appears that all along the coast of the wall was washed away into natural steps, of a level and then a small slope of 45°.

A breakwater had been formed off that beach by throwing in loose masses of rock forming their own slope; this, when carried up within ten feet of the water's edge, was completed.

In Knootty Sound the same effect of the drawback of the waves was noticed. Sections of the Mole of Venice were shown. That mole, which is nearly 16 miles in extent, had a section of a sloped foreshore with a nearly vertical wall, then a slope at another angle, and above high-water mark another nearly vertical wall. When the sea rolled in upon the mole they partially covered over against the first wall, and were projected with augmented force against the upper one. The consequence was, that the mole was partially destroyed, and the repairs, which had been executed for some time, had been increased to an angle of about 15°. The destruction of the nearly vertical walls of Portpatrick was also noticed. Those walls, although constructed of the finest Anglesea limestone, were dressed, doweled, and tied down vertically and horizontally by large chain-ends, so that the thickness of the wall was increased to 80 feet of solid material, it could not be made to stand. The situation was extremely exposed, and the sea frequently rose to the top of the light-house, which was itself 90 feet above the level of high water spring tides.

The causes of the peculiar action of the draw-back of the waves, as exemplified by the removed shingle from the beach where the wind was on shore, and the accumulation on the shore of the winds where the wind was on shore, and the accumulation on the shore of the winds where the wind was off shore, were referred to. The effect of the wind on the water during high or driving wind, and the height of the wall was increased to 80 feet of solid material, it could not be made to stand. The situation was extremely exposed, and the sea frequently rose to the top of the light-house, which was itself 90 feet above the level of high water spring tides. The causes of the peculiar action of the draw-back of the waves, as exemplified by the removed shingle from the beach where the wind was on shore, and the accumulation on the shore of the winds where the wind was on shore, and the accumulation on the shore of the winds where the wind was off shore, were referred to. The effect of the wind on the water during high or driving wind, and the height of the wall was increased to 80 feet of solid material, it could not be made to stand. The situation was extremely exposed, and the sea frequently rose to the top of the light-house, which was itself 90 feet above the level of high water spring tides. The causes of the peculiar action of the draw-back of the waves, as exemplified by the removed shingle from the beach where the wind was on shore, and the accumulation on the shore of the winds where the wind was on shore, and the accumulation on the shore of the winds where the wind was off shore, were referred to. The effect of the wind on the water during high or driving wind, and the height of the wall was increased to 80 feet of solid material, it could not be made to stand. The situation was extremely exposed, and the sea frequently rose to the top of the light-house, which was itself 90 feet above the level of high water spring tides.
NOTES ON FOREIGN WORKS.

The Russian Porkpuri.—The emperor of Russia has ordered that the effigies, which have been made for several years past, near the town of Zarechnin, south of St. Petersburg, be continued. This town had been the capital of Tartar Cheems during the 300 years of its Russian dominion. Some ruins of houses have already been discovered, in which divers utensils and 4000 Tartar coins have been found.

Great Adoring of the Banks of the Rhine.—Several of the old castles, castles earlier in their history and before the Dutch, will have to be reconstructed, which will spread an uncommon lustre over these fertile and magnificent banks. The Prince Frederick of the Netherlands has purchased Castle Fürstenberg, between Niederneukirchen and Rheinfelden, near St. Goar; all of which are to be rebuilt in an antique and most splendid style. [We wish something similar were done with some of our English and Scotch castles.]

Moving mountains in Italy.—From the embouchure of the Trebuto up to Fervos (near Grottaferrata), extends a range of hills, of tertiary formation, up to the shores of the Adriatic, and is mostly covered by olive and orange groves. Some time ago, three of these hills moved to the extent of 155 paces, and passed into the sea to the extent of 28 paces. There were no other phenomena observable, save the uprooting of some trees; but a clayey substance flowed from the banks of the sea, and even, at times, from the crevices of the soil; and it appeared that an inward upheaving force had been exerted upward. A German naturalist, Albert von Conow, who observed it most accurately, thinks that it has been caused, like the earthquake on the Rhine, by some more or less distant earthquake.

Cutting of the Isthmus of Suez.—As Austria is determined on the prosecution of the Trieste overland route, the above project has been added as a secondary, to give a new lease of life to the Suez canal. The work on the isthmus has been suspended, and reported thereon. The canal is to be navigable for three masters. 150,000 francs have been already subscribed for the study and survey thereof, and English and French engineers have consulted. No shares are accessible to the gambling of stock-jobbers.

Reorganization of the Sculpture Galleries of the Louvre.—The King of France has ordered that the late demesne of Marais, Clarac and Dubois should be made instrumental in re-organizing the direction of the above Galleries. The collection is to be uniform, and the departments of classic and oriental antiquities, for each of which a separate curator has been appointed; —for the former, Count Laborde, the well-known traveller in Asia; and M. Longpré, archivist of the Royal Library, for the department of oriental antiquities. This new concept bids fair for further improvement, and it is to be hoped that these treasures, hitherto stored in the vaults and cellars of the Louvre, like the great Egyptian antiquities, the Maganese marbles, &c., will once more see the light.

Roach of the Human Voice.—On account of the speeches of Xenexes, and others, addressed to whole armies, the question has been mooted of late, amongst antiquarians, how far the human voice can reach. It has been properly corrected ascertained, that a man may make himself heard by 30,000 persons—a very tidy number, in many respects. And thus, taking into account the excellence of the accoustics of domes, vaults, &c.—St. Paul’s, and even St. Peter’s, might be filled out by a human voice—of course, a strong one, in every respect.

St. Petersburg.—March.—Since Peter the Great’s time, the character of everything structural or material the Russian Government has attempted—has been one of greatness and splendour. Thus, the huge St. Peterburg and Moscow railway will be open for traffic in about 18 months; and at the great festival which the city of Moscow is about to celebrate in September next—viz., the seventh centenary of its foundation,—parts of the life will be available to the public.—Amongst the huge buildings, public and private, lately erected at St. Peterburg, we may mention the new addition to the palace of the general staff (horse guards), a structure of gigantic proportions;—the palace for the officers of the ministers of justice and the Imperial domain;—the complete rebuilding of the marble palace, and the Dresdener adjoining the Imperial palace.* The new bow bridge, the bridge of the new connection of the gigantic church of St. Isaac (entirely of granite) is now being internally adorned, in a splendid style, which will employ the artists of St. Peterburg of every kind for a considerable time.

The following account states that this structure has been remarkably during the last year. Both the north and south porch have considerably advanced; the nave begins to be covered with galleries,—and the works of the stonemasons are praised as some of the richest and most sumptuous in the world. As to the statues and other decorative ornaments of this national building has existed so much interest, that an especial journal—the Domshift (the cathedral granite)—is discussing its progress. In this we find several strictures on some late proceedings of the commission, which has caused great anxiety on account of the appearance of the old:—"Illesco poparit in muris." The Domshift says that 16,000 dollars are to be diverted from more legitimate purposes for paving the Cathedral nave now,—although, surely, this will be injured by the progress of the works, &c. Above 30,000 dollars are to be employed for adorning the whole extent of the Cathedral is a temporary manner. This, certainly, is a large sum for the prurient desire of seeing at once the whole expanse of this astounding building. The painting and gilding of the doors (the space where divine worship is hitherto performed), is objected to.

At a Meeting of the Archaeologists of the Grand Duchy of Baden, an interesting essay was read by M. Zell, ministerial councillor, on two Roman inscriptions lately found. The first will be a fragment of the inscription of the public guild-hall of the trade of carpenters (ligurini) in the Roman colony, which existed under Caracalla, 1700 years ago.

What is Style?—by Goethe:

Style—is art, and otherwise—

In the west, of course,

Of other pen, or brush, or tool—

Too much,—or too little nature,

Will thus know how difficult this is. . . .

Try!

* Speaks then of the dwellings of British Kings!

NOTES OF THE MONTH.

French Institution of Civil Engineers.—We are happy to hear that a similar institution to the London Institution of Civil Engineers is about to be formed in Paris, under the auspices of the French Government. M. Durand, Minister of Public Works, has devoted his attention to its formation. We most heartily wish it success.

Shakespeare Cliff.—A large slip of this interesting locality took place on Monday, March 1; when a surface of chalk 364 feet in height, and 253 feet in length (about 48,000 tons), was precipitated to the bottom. Another fall of 10,000 tons has occurred in 1847. The public have visited the spot, and reported the accident.

St. Peter's, at Rome.—The two states of medieval design, meant for Peter and Paul, standing on each side of the ascending steps before the portico, but which are two blocks of shapeless travertine, are to be removed. They might have harmonised with the Byzantine taste of the old basilicas to which they belonged, but were a palpable eyesore in juxtaposition with the sculpture prevalent throughout the works of Leo X. and his successors. Their limbs are stiff, their attitude awkward and clumsy, their antiquity unreasonably venerable. Like many other of our time-honoured resealiables, they have received notice to quit, and will be immediately replaced by two marble statues of somewhat different taste, from the chisels of Fabrici and Tadolini, the one director of the Belle Arti, the other a scholar ancient. These modern productions are on a colossal scale; each figure is nearly twenty feet in vertical height, though a single block from Carrara. Each cost 12,000 dollars, and both are now ready to be transported from the workshop.

New Oxford Street.—By order of the Commissioners of Metropolitan Improvement, the thoroughfare from the east end of Oxford-street and Tottenham-court-road into Holborn has been thrown open to the public. The buildings, with some few exceptions, are completed, and many of them opened for business. The road is 40 feet in width, with a footpath on each side 13 feet in breadth.

Ephraim College, India.—Mr. Orlebar, professor of astronomy, and Mr. Pole, professor of engineering, have both resigned. Indiscipline is, in each case, assigned as the reason of retirement. The charge of the Observatory has devolved on the draftsman of the Indian navy.

Rise in the Soil of Egypt.—During the course of the industrial operations lately ordered by Mehemet Ali, it was shown that the soil of Egypt is rising each year very perceptibly, in consequence of the contained deposit left by the Nile. This elevation is calculated at 30 feet during the last century for provinces adjoining the river.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

Lord Dunmore's War Plan.—We understand, says the Hampshire Telegraph, that the secret official trial to ascertain the effect of a continuous evolution of intense gas in projecting shells or shot from a tube, resulted, on an average, in throwing twenty-five six-pounder shot to the distance of 7,000 yards. As a great number of these large charges would far exceed the range of common artillery. Another important advantage is said to accrue—namely, that the continuous rush during their emission would prove much less injurious to vessels projecting such missiles than the shock or rush of single discharges. We learn that Lord Dunmore's innovation is to be employed against our merchantmen, which is likely to be evaded by having the end of a heavy pole or cable formed of hard twisted gun-cotton.

Some remarks on the Air and Water of Tournai, by Dr. R. A. Smith. Read at the Chemical Society, January 14th. Having given some attention to the inquiry into the health of towns, the author was anxious to find what the real evil in the polluted atmosphere of towns consisted of; and in furtherance of this object commenced a series of examinations on the water used in the towns. The water was drawn from the river Oise and the Arques, and cisterns, was first examined; and on heating the solid matter obtained by evaporation, it burnt, giving the odour of fat, and a strong smell of alkali-unorganised matter. Main cleaned in a clean porcelain dish, and treated in the same way gave indications of a similar kind, but in a smaller degree. The moisture condensed from the breath contained organic matter in large quantities; and when collected from the windows of crowded rooms, it smelt strongly of human sweat during the evacuation; and when the same water was boiled, the smell abated, but the smoke in chimneys, was, on examining, found to consist of much more organic matter than is generally supposed. Water from a great number of wells situated in Manchester was submitted to examination, and in all similar results were obtained. Dr. Smith finds also that the water of rivers and canals becomes contaminated in this way as much as that which issued from the spout. The air of all towns, in many cases remarkable, arising from the rapid oxidation of these asemenised ingredients. The author concludes by stating that it is pursuing this investigation at various seasons, so as to make a more complete examination of the subject; and that the whole of the analytical results will then be given.

THE GREAT BRITAIN STEAM-SHIP.

The following reports were read at a meeting of proprietors of the Great Britain, held lately at Bristol.

"In Duke-street, Westminster, Feb. 27, 1845.

"Gentlemen,—I beg to enclose Captain Claxton's account of the proceedings at Dunkirk last day, dated the 20th instant, and also his statement of the transaction to the ship, in the manner recommended by me. Notwithstanding the great difficulty he has had to contend with from almost incessant bad weather, with the wind blowing dead on shore nearly the whole of the month of January, and consequently preventing the tides from setting strongly out to allow of the work being properly proceed of with; and notwithstanding the occurrences of more than one storm at the most critical period of the work, he has, as fully reaped upon his doing, succeeded in so far protecting the ship that she has been comparatively unharmed by violent seas. She has no doubt whatever, whatever may have seriously damaged her. We may now calculate on seeing her at this very month, with a very solid, very strong, and a very serviceable ship, in every respect. In every part of execution, and almost from day to day to devise modes of proceeding with only the expenditure of the greatest care and attention. This is, therefore, the result upon which I kept me daily informed; and simple as my views might have appeared to the ways of our ships, they have a very happy bearing in the saving of many alterations and improvements as it progressed. I had readily confidence on this. But when I informed my friend Captain Claxton undertook the work, and the result has fully confirmed my opinion. Captain Claxton will be able to make a very substantial addition to the ship. I hope in about a fortnight from the present time to be able to give you some opinion upon this point, but one requiring much consideration, and I had the opportunity of conversing with Captain Claxton on the subject, and also had before me all the measurements and data which has been collected, it was useless to attempt it.

"I am, gentlemen, your obedient servant,

"I. E. BRUNEL."
touched to a stand-pipe from the main; and from one up to four of these branches were provided for upwards of an hour,—the addition of one, two, or three, to the first appearing to make little or no difference in the respective power of any of them. The quantity of water which was conveyed was very great. It is said that at the east end of the church, and not only were the overflows beyond the corbel, and on the roof of the church, over the tile, but also to the top of the wall, and on the roof of the house, which we should think, little, if at all, short of 90 feet. The plan, which combines hydraulic power with the advantage of steam, offers many important advantages. If, however, it is not adopted entirely, as the latter, if adopted, will afford great and rapid protection to property in cases of fire—and that, too, with a large saving of expense."

York, March 10.—Sixteen 24-pounder gun carriages, with traversing platforms and equipments complete, have been shipped from the Royal Arsenal on board one of the Ordinance sloops for Pembroke, to be erected on the batteries for the defence of that port. Lord Beresford's company of Royal Artillery, 6th battalion, will leave Woolwich next week for the same place, to take charge of the guns, and to mount them for use. In future, the company will be permanently stationed at Pembroke, so as to place the batteries in a state of complete defence.

The New Military Prison, erected in the Royal Artillery Barracks, near the north-east corner, is now nearly complete; a large body of workmen have been employed in its construction. The prison will be covered in. The prison, however, will not be appropriated for the reception of prisoners till about May next, as time must be allowed for cleansing the cells. In consequence of the state of the country, and the rapid progress made by the coast defences, 110 gunners were entered lately in the Royal Arsenal as labourers.

The Coast Defences.—Northern District.—The following is the return of the number of guns mounted on the northern coast of England, from Hull to the coast of Scotland, excluding the guns ordered for the defence of the Humber. Hull citadel, seven 18-pounder guns on common carriages; Yarmouth Castle and Clifford's Fort, five 15-pounder guns, and six 8-pounder guns on common carriages, and one 8-inch mortar; total 12 guns.—Forth Rock Battery, sixteen 22-pounder guns on traversing platforms, and two 18-pounder guns on common carriages; total 18 guns.—Scarborough Castle, six 18-pounder guns, and four 12-pounder carronades, on common carriages; total 10 guns.—The names of the officers attached to the batteries, and the officers in command of the common carriages, total 3. Grand total for the district, 56 guns.

Lowestoft Harbour and Railway.—The timber works of the north pier, lying near the pier head, about 200 yards from the pier head, are being completed. The progress of this work is progressing rapidly. By the end of June, the harbour, it is confidently expected, will be completed, the first lock will be completed in 17 feet of water, and it will be open at an average tide. The work commenced last May, and there is now 2,500 feet of pier-work finished. The railway works are nearly completed, and the line will be open for goods traffic on the 1st of April. The railway is 21 feet above sea-level, and is completed of 21 feet above sea-level, and is completed of water at the lowest period of the tide, a depth which extends 100 yards within the entrance.

LIST OF NEW PATENTS.
GRANTED IN ENGLAND FROM FEBRUARY 20, TO MARCH 23, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

James Clark, of Fleet-street, in the City of London, civil engineer, for "certain Improvements in distillation and brewing, and certain applications of the materials thereby obtained.
(June 30th, 1846.
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(June 17th, 1846.

Alphonse de la Normandy, of Bethnal-green, Middlesex, analytical chemist, for "Improvements in the manufacture of fish."—February 24.

Thomas West, of Westminster, in the City of Middlesex, for "certain Improvements in the manufacture of fish paper."—February 24.

Frederick Walton, of Wolvaston, Staffordshire, and tine plate worker, for "certain Improvements in the manufacture of fish paper."—February 24.

George Russell Darnell, Staff-suron of the first class in her Majesty's army, now stationed at Chatham, in the county of Kent, for "an improved fish for insulating harness."—February 24.

James Simpson, of Bath, for "Improvements in the manufacture of fish paper."—February 24.

Juan Nepomuceno Ardon, of Mexico, in the Republic of Mexico, gentleman, for "Improvements in the manufacture of fish paper."—February 24.

John Hall, of Manchester, Lancashire, for "certain Improvements applicable to articles of food, and for the improvement of certain articles of food."—February 24.

William Temple, of Holcombe Brook, near Bury, in the county of Lancaster, for "certain Improvements in the method of singling and dressing yarns, and in the machinery or apparatus for the same."—February 24.

Frederick Ransome, of Ipswich, engineer, for "Improvements in working coke and other kilns, or ovens."—February 24.

Benjamin Mann, of 7, City Road, Middlesex, tea dealer, for "Improvements in treating or dressing coffee, to render it more wholesome for use."—February 25.

William Eccles and Henry Berrig, of Walton-on-the-Dale, in the county of Lancaster, for "Improvements in spinning machinery."—March 2.

John Wood, machine maker of Leeds, in the county of York, for "certain Improvements in machinery for spinning fibrous substances."—March 2.

John Smith, of Romford, in the county of Essex, for "Improvements in the art of distilling certain substances."—March 2.

Samuel Townshend, Bishop, of Hackney-terrace, in the county of Middlesex, for "Improvements in the construction of the upper part of chimney stems."—March 2.
ON THE MEASURES OF FORCE AND LAWS OF MOTION.

If a body be disturbed from a state of rest, or if the rate of a moving body be accelerated or retarded, the cause of the motion is in the first instance, and of the acceleration or retardation in the second instance, is called Force. When a material particle, acted on by only two forces in opposite directions, is kept at rest, the two forces are said to be in equilibrium and statically equal. The material particle, last considered, is said to be kept at rest by the pressures of the two forces. The notion of pressure seems to arise from the peculiar sensation experienced in the muscles of the human frame, when the limbs are supporting a heavy weight or thrusting against an opposed obstacle.

By pressure, as manifested in the sense of touch, we are acquainted with the forms of all objects within our reach and grasp. If we had no other means of communicating with the outer world than by contact, our knowledge of it would be extremely limited; we could have no conception of colour, and but very little of distance; the extent of a hundred miles would be as difficult to imagine as a million with the aid of vision. These deficiencies in the sense of touch are compensated by the sense of sight—that is, by the consciousness of the presence and relations in space to each other of external objects, as evidenced by vibrations in ether, which are communicated through the optic nerve to the brain. Hearing is excited by vibrations transmitted through the air or any other elastic matter, and which, in many instances, are so intense, as to be sensibly felt. Windows are frequently broken by the report of artillery—and thunder, when close, shakes the walls of the stoutest buildings. We observe, then, that all our experience of the phenomena of the universe is derived from force.

Force acquaints us with the existence of matter;—say, more, we might, with perfect propriety, consider matter as composed of geometrical points, the loci of radiating forces. In by far the greater number, however, of investigations which require the aid of mechanical science, it is sufficient to consider the properties of matter, without any reference to its ultimate constitution. Thus, having previously by experiment determined how far elasticity, rigidity, flexibility, &c., influence the circumstances of statical or dynamical phenomena, we are enabled to solve problems involving these considerations, without any further inquiry into the nature of internal or molecular forces.

Before, however, we can apply mathematical reasoning to determine or predict what happens when any number of forces act upon a body, it is necessary that some of the effects of force should be susceptible of numerical comparison. In order to render our meaning clearer, let us, by way of analogy, consider the method usually adopted to measure heat. Heat is evidenced by many effects; among others, by the sensation of warmth,—by the impiety which it gives, when developed within certain limits, to the growth of plants,—and by its interference with the laws of chemical affinity. Yet none of these effects are sufficiently definite for the purposes of measurement. We cannot be certain that the same source of heat will always, under the same circumstances, excite the same sensations;—may, we cannot be certain at any two times that the sensations of hot or cold we experience are the same. Still less can we avail ourselves of the effects of heat on vegetable life. While, as to the changes occasioned by a high temperature in the chemical constitution of bodies, they are involved with so many accompanying phenomena—so complex and discontinuous—that they could scarcely be compiled to furnish a scale of measurement.

There is another effect, however, of heat, which we have not yet noticed, and that is—its power of expanding the volume of bodies. This effect is rendered the more valuable by the fact, that whatever phenomena of heat are due, at any one time, to a particular temperature—that is, to a particular amount of expansion of the liquid of the thermometer—are likewise due to the same temperature at any other time. Here we have a class of effects which are always the same for the same causes, and are susceptible of arithmetical comparison—the two qualities necessary for a measure. Consequently, temperature is universally adopted as the measure of heat; and in thermotics, all the symbols and numerals have reference, not to heat, but temperature.

To return now to the effects of ordinary forces: among these, weight—or the statical effect of the force of gravity—suggests itself as an appropriate measure, not only of the gravity of different bodies, but of the pressures occasioned by any kind of forces whatsoever. By comparing the weight of bodies with the force of a spring-balance, it is found that the weight of the same body, at the same place on the earth's surface, is always the same—and independent of the position of the body in space.

Again, if we take a prismatic body, homogeneous throughout,—say a cylinder of lead—and divide it into two equal parts, we shall find the weights of the two halves equal. Also, if we divide the cylinder into any number of equal parts, we shall find the weights of all these equal parts equal to each, and the sum of their weights equal to the weight of the undivided cylinder. Let the weight of the cylinder be represented by \( \frac{p}{n} \); then the weight of an \( n \)th part would be represented by \( \frac{p}{n} \), and the weight of \( p \) (equal parts) by \( \frac{p}{n} \times n \); but, as we have shown the weight of a body is not altered by dividing it into parts—consequently, the weight of a portion of lead, of which the volume is equal to the volume of the \( p \) parts, would be represented by \( \frac{p}{n} \); and its volume would be \( \frac{p}{n} \times \text{volume of the undivided cylinder} \). Hence we infer, that the weights of homogeneous substances vary as their volumes. If now we take the weight of a specified volume of a given homogeneous substance as the unit of measurement,—a force which would make equilibrium with a weight \( r \) times the specified weight is denoted by the number \( r \); and all formulæ in statics concerning the relations of forces in equilibrio, represent each force by the number of times the unit of force must be multiplied in order to make equilibrium with it.

When we have to consider the motion of bodies, it is more convenient to employ another measure of force, the nature of which we now proceed to explain. We must first, however, define velocity. The velocity of a moving body, at any time, is the space which the body would pass through in an unit of time, supposing the rate of the body uniform and the same as at the time. As for example,—if 1 foot be taken as the unit of space, and 1 second for the unit of time, a body moving uniformly at the rate of 3 feet a second is said to have a velocity expressed by the number 3.

Now, it is found by experiment—First, "that if a body be at rest, it will continue at rest until acted on by some force; and if it be in motion, and acted on by no extraneous forces, it will continue in motion with an uniform velocity, and in a straight line." Secondly, if when a body is in motion, it be acted upon by an invariable force, in the direction of its motion, the quantity by which the velocity of the body will be increased or diminished (according as the force is accelerating or retarding) will always be the same in the same time; and is quite independent of the initial velocity which the body possessed before it was subject to the influence of the force.

This latter fact at once furnishes us with a convenient dynamical measure of force, known by the name of the measure of accelerating force. Professor Whewell still observes that the measure of the accelerating force would be a much better term for it. This measure of accelerating force, which, for the sake of brevity, is frequently simply designated "accelerating force," is the velocity generated in a moving body, during an unit of time, by an invariable impressed force. If the force vary with the time, the measure adopted for any time \( t \), is the velocity which would be generated in an unit of time by the force if invariable, and the same as at the given time \( t \); thus

* The paragraph between inverted commas summarizes the first law of motion.

gravity accelerates the velocity of a body falling in vacuo by 32 feet a second; taking feet and seconds as units of space and time, the accelerating force of gravity is represented by 32\footnote{4}.

Our next object must be to endeavour to discover some law connecting the statical and dynamical measures of motion. We are conscious, from every day experience, that the velocity we could communicate to a large and heavy obstacle by thrusting against it with all our strength, is much less than the velocity we could communicate in the same time to a smaller and less ponderous obstacle. We know that the same pressure will not always communicate the same velocity to different bodies in the same time. Let us now define all bodies to have the same masses in which the same pressure would create the same velocities in the same time. This definition of the word mass will save much unnecessary explanation in the following experiment.

Suppose \( n \) equal balls made of the same material, quite smooth, and capable, by some mechanical contrivance, of being fastened to each other at pleasure, and thus forming one or any number of solid bodies.

Let \( n = 1 \) of the balls be fastened together and placed on a smooth horizontal table, the remaining ball be tied to one end of a thin inextensible string, and the other end of the string attached to the \( n = 1 \) ball. If now the single ball is allowed to hang down beyond the table and descend, dragging the other balls after it on the table, and the velocity at a time \( t \) from the commence ment of the motion be measured, and if the experiment be again tried with \( 2, 3, \ldots, n \) balls hanging down, and \( n = 2, n = 3, \ldots, n \) balls, &c. on the table, the velocities at the end of the same time \( t \) will be found to be proportional to the numbers \( 1, 2, 3, \ldots, n \); but the pressures communicating motion were the weights of the one, two, three, equal balls, &c., and the mass moved is invariable—namely, the mass of all the balls; consequently, we learn that when the mass is constant, the velocity acquired at the end of any time is proportional to the pressure causing it—the pressure not varying with the time. Moreover, we infer that the velocity generated in a given time, and therefore in the unit of time, is proportional to the pressure when the mass is constant.

Next suppose that the \( n \) balls are all united, and as one mass, compelled to move by the gravity of \( n \), other equal balls; in this case, we shall find that the velocity generated in an unit of time is the same, whatever be the value of \( n \); consequently, when the velocity generated in an unit of time is constant, the pressure varies with the mass; and we have already shown that when the mass is constant the velocity generated in an unit of time varies as the pressure;—therefore, when both the mass and velocity vary, the pressure varies as the product of the mass and velocity generated in an unit of time. It is not necessary in these experiments that the balls should be made of the same materials, provided they be of such a magnitude that any one of them, when attached in succession to each of the rest by the inextensible string above alluded to, should generate in them all the same velocities at the same time. Since the dynamical measure of the force of gravity is the same for all bodies, it follows that the weight of bodies varies as their masses. It is sometimes assumed that the masses of bodies varies as their weights, which of course leads to the same results.

If \( m \) denote the mass of a body, \( g \) the accelerating force of gravity, the unit of mass is so chosen that \( mg = \text{mass, where} \), \( m \) is the weight of the body. The property of matter by which it apparently resists a force tending to move it, in proportion to its mass, has sometimes been called the vis inertiae,—an useless term, since it expresses nothing more than is expressed by the word mass. If \( e \) be the velocity generated in a body in an unit of time, \( e \) is the measure of the accelerating force acting upon the body: \( m \times e \) is called the measure of the moving force, or more frequently the moving force, where the word force is transferred from the cause to the measure of the effect.

Consequently, when pressure, which does not vary with the time, acts directly on a body, the moving force is proportional to the pressure. In obtaining the above relation between the statical and dynamical measures of force, which is known by the name of the third law of motion, we assumed that the same pressure would generate the same velocity in any material system, provided its mass were constant, and its parts so connected that they must all have the same velocity. We assumed, in fact, that the pressure of the hanging balls produced the same velocity in the whole number of balls as it would have done on a single ball of the same material and equal in bulk to all of them.

This, perhaps, ought previously to have been demonstrated by experiment; although, in proving the third law of motion by means of Attwood's machine, most writers take the same principle for granted—as we think, most unwarrantably. Newton stated the third law of motion thus—action and reaction are equal and opposite; on this Professor Whewell observes, "since, in virtue of the equality of the action and reaction between two bodies, the momentum gained and lost are always equal, the momentum gained and lost are sometimes called action and reaction, and the third law of motion is then expressed by saying that in the communication of motion reaction is equal and opposite to action."

By momentum is signified the product of mass by velocity. If we are to understand by action and reaction only the momentum lost by one body in transferring motion, and gained by the body to which motion is transferred, we do not think that there is any connection between the proposition of Newton and the third law of motion, as it is stated by modern philosophers. But in fact by the equality of action and reaction, is meant that force, whether measured by the pressure exerted or momentum lost in the body communicating motion, is productive of momentum in the body to which the motion is communicated, equal to the momentum lost, and proportional to the pressure exerted.

The principle of the equality of action and reaction is of the greatest importance: taking the statement in its most extended meaning, it enunciates not merely that in the communication of motion, the momentum gained and lost are equal, but that the internal forces connecting the different parts of a material system—provided the connection and relation of those parts continue the same—are likewise equal and opposite. We have now briefly described the various measures of force and the first and third laws of motion; the second law of motion is generally given in the following words: when a force acts upon a body in motion, the change of motion in magnitude and direction is the same as if the force acted on the body at rest. As an example of this,—if a body in vacuo were projected horizontally, it would arrive at the surface of the earth in the same time as though it had been simply allowed to fall from a state of rest. All the laws of motion are suggested by ordinary experiments; which indeed only prove them approximately, owing to the utter impossibility of excluding all forces but those the effects of which we are examining: nevertheless, in proportion as we remove disturbing causes, so do we find the results of our inquiries tend to coincide with the limiting statement of these fundamental laws. A far more accurate test, however, is furnished by astronomical observations:—the orbits of the heavenly bodies, calculated on the supposition of the truth of the laws of motion, are found to coincide with their observed orbits so nearly, that any difference may fairly be ascribed to errors of observation.

The only planet that could not be made to keep to its table was Uranus; the differences of its observed and predicted places were always, however, extremely small—yet, from such data as these, Mr. Adams, previously, in England, and afterwards M. Leverrier, in France, computed the orbit of the new planet, long before its existence was announced by the telescope of the observer. In conclusion, we beg to state that we have not endeavoured to give any new definitions, or to vary the statements and terms usually employed to express the relations of force, motion, and matter; our aim has been to explain, to persons not accustomed to the terse style of mathematical works, the fundamental principles of mechanical science.
THE CIVIL ENGINEER AND ARCHITECT'S JOURNAL.

A NEW THEORY OF THE EARTH, THAT FULLY ACCOUNTS FOR MANY ASTRONOMICAL, GEOGRAPHICAL AND GEOLOGICAL PHENOMENA, HITHERTO UNACCOUNTED FOR.

By Oliver Byrne.

(Continued from page 101.)

The following illustration will show, in a very simple manner, how different effects may appear to be produced by investigating causes separately, that act jointly.

Let a material point P, be acted upon by two uniform forces at the same time, in the directions P A, P B, and let the lines P A, P B, represent the magnitudes of these forces. It is well known, by what is technically called the parallelogram of forces, that it will not obey either of these forces, but the combined effect of both, and describe the diagonal P C. Now the point P, would arrive at C, in precisely the same time, if the causes of action be investigated separately, even if at every alternate instant the forces alternately act; yet the path described by P, would be very different from the true one, which the joint actions of the two forces cause it to describe. The zigzag path P, 1, 2, 3, &c., will be at best but an approximate to the true one P C. This illustration of combined action, viewed jointly and separately, simple as it is, compared with the joint actions of the sun, moon, and the other bodies in the solar system, on the excess before mentioned, shows how astronomers, by continually correcting a false hypothesis, have distorted the true motion, which we shall continue to explain.

In stating that the earth's axis changes its position, we do not consider the mass moveable with it, no the change of the axis, which is to be understood by what is termed its right motion, changes the position of the equator, and, therefore, the latitudes of all places. It may be necessary to remark here, that the right motion of the earth's axis is very slow; so much so, that scarcely any perceptible difference in the latitudes can be observed in 100 years,—chiefly on account of this motion not being recognised in a proper manner, which has tended to baffle the theory of corrections, now so satisfactory. For the purpose of exemplification, we shall show how this motion of the earth's axis would cause the phenomena of a precession of the equinoxes. This may be shown by simply allowing the poles to change their position in two opposite circles. It may be necessary also to remark that this supposition is made merely for the purpose of illustration, for the right motion of the earth's axis is not in a circle, but in a looped spiral curve of double curvature, the nature and properties of which are given in the proposer's new work on the Theory of the Heavens and Earth, before alluded to. However, when this supposed plain motion is understood, the right motion of the earth's ecliptic) can readily be conceived. If a right line P p, be supposed to revolve about its middle point O, in such a manner as to describe a circle A P P', the other point p, will describe an equal circle, whose plane will be parallel to that of the former circle. The lines P p, P' p, O, O', with the same velocity, will produce a plane parallel to the planes of these circles. Now, if a plane be supposed to pass through O, perpendicular to P p, and intersect the plane E E, in E a, when the point P, moves to P', the plane perpendicular to P' p, passing through O, will intersect the plane E E', in E a' ; so that if P p, P' p, O, O', be considered consecutive positions of the earth's axis, the plane of the ecliptic to be E E a, and the variable plane passing through O, perpendicular to P p, P' p, O, O', the plane of the equator, then the consecutive points E E, &c., show the precession of the points where the planes of the equator and ecliptic intersect, and how their positions are changed with the motion of the poles. The motion simile causes, but with the exception of the difference in the nature, causes what is technically termed the precession of the equinoxes. Now, the spiral motion, or rather change of the earth's axis, above alluded to, which is chiefly caused by the influence of the sun and moon on the excess of the earth above its greatest inscribed sphere, is what we have designated the right motion, or change of the earth's axis. The nature of this motion can be readily conceived from the apparent phenomena of precession, nutation, &c. Hence, this exposition shows that the earth has but three motions; namely, one round the sun, one on its axis, and a change of that axis; the nature of this last motion or change is something similar to that which is observed in a globular body splintered into two large fragments; that is, the change of the axis in this globular body is only calculated to give an idea of the uniform change of the axis of the earth, caused, as we have before observed, by the constant and commanding influence of the sun and moon. As the poles shift their positions on the surface, so does the equator and the protuberances there; and, in fact, every particle of which this globe, if we may so term it, is composed, endeavour to accommodate itself to this motion, so that the earth's true form is that which may not be improperly termed an exfoliated spheroid, continually, but slowly, changing its relative position. To guard against any misconception, it may be necessary to state, that the change of the protuberances at the equator, or rather the change of the excess of the earth above its greatest inscribed sphere, is not a sliding of that excess over the inscribed sphere, but the establishment of another and another excess in different positions, in consequence of the change of the position of the earth's axis, which is continually being changed by the influence of the sun and moon on the excess existing at any time. Every particle, internal and external, natural and artificial, is influenced by this motion. The sturdy edifices of man soon moulder down, or their foundations are depressed or elevated; the true cause is never assigned. When no local cause can be trumped up, it rests upon what is commonly termed the ravages of old time, which lets nothing alone.

The changeable protuberance or excess is said to be about 34 miles more in diameter at the equator than the diameter through the poles;—this slow and constant change of the excess of the earth above its greatest inscribed sphere, has done more in baffling the observations of astronomers and all bodies projected into space, than the study of the figure of the earth, than any other circumstance which might be named. If the earth were composed of one uniform substance, ready to accommodate itself to the behaviour of this change of protuberance, the true motion of the earth's axis would have been discovered long ago. The heterogeneous substances of which the planet is composed, are more and more changed with respect to colour, pliability, and form, with their varied positions by the influence of heat and cold in the great laboratory of nature, must in a greater or less degree, in every instance, point out the existence of this unerring law. The change of this protuberance, or rather the change of all the particles with respect to the imaginary line about which the planet revolves, its daily revolutions, although very slow and gradual, effects a change in the whole heterogeneous mass, every instant, more or less, according to the pliability of the several parts; those parts which do not instantly change, from the rigidity of their nature, ultimately feel its sway, so that the earth would become, from what we have termed the right motion of its axis, a figure whose nature and proportions could be readily determined, were it composed of one yielding and uniform substance; but on account of its heterogeneousness, and the rigidity of some of its component parts compared with others, this figure, which we shall here designate an exfoliated spheroid, becomes in part more or less slightly indented or elevated, according as these parts and those surrounding them are more or less sensitive of the constant disturbing cause. Not only a change in the inanimate kingdoms is effected by the right motion of the earth's axis, but also a constant change in the animate: it is not asserting too much to say, that
The latitudes of ordinary places may differ from time to time, in a greater or lesser degree, from the inaccuracy of instruments; observations, or measurements; but it ought to excite a suspicion to find the latitudes of observatories changing, where overnights have no possible chance of catching an error, unless the stars may be shifted, or the earth moved, the only things that have resisted the general movement. The rivers and the rocks, the seas and the continents, have been changed in all their parts, but the laws which direct those changes, and the rules to which they are subject, have remained invariably the same. The following facts and statements may tend to illustrate this theory. The gradual changing of the fixed stars, on which is fixed the north pole star, (Ursa Minor) with respect to the apparent north and south, shows that the axis of the earth is continually changing its position; this fact is not disputed, but the parallel of latitude on the surface of the earth are supposed to remain fixed, which is by this theory contested. In the sky, the stars containing the constellations of the Pegasus, and supposed to have been written by Zoroaster, it is said that Ormusd formed the light between the heavens and the earth; that he made the sun, moon, and stars, and divided the latter (probably those near the equinox) into twelve constellations. Each star in the zodiac is said to be seconded by 6,480,000 smaller stars, and all these are represented as soldiers, ready to make war on the enemies of nature. Ormusd, it is added, has also placed in the four quarters of heaven, four sentinels to watch over the stars; of these Tschertcher guards the east; Sateris, the west; Venason, the south; and Gersart, the north. There is said to be, also, a great star Mesologh, in the sky of Gersart, the purpose of giving protection to the south when the enemy comes in great numbers. Now it is impossible to form an opinion what can be meant by this enemy so mysteriously announced; but the designation of the stars seems to correspond with the Host of Heavens, which is used in the scriptures, and with the attendants or guardians of the Supreme Dality, which is the denomination applied by the Egyptians to some of the constellations and planets; and it has been attempted by modern astronomers to prove that four of the principal fixed stars were really situated in, or near, the four cardinal points of the horizon about the year 2000 B.C., which is the period assigned to the first Chaldean observations. D'Alembert remarks that the longitude of Aldebaran, at that epoch, was 11° 20', and its latitude 5° 30' south; and as Antares differs from Aldebaran in longitude by six signs, and has 4° 30' south latitude, it follows that these stars were then very nearly in the points of the vernal and autumnal equinoxes; consequently, one of them would be seen to rise near the east about the time that the other was setting a little to the north of the west. Now, it has been alleged that Tschertcher signifies the genius presiding over rain, and we know that the heliacal rising of Aldebaran was considered by the ancients as an indication of approaching storms; hence it is, with some propriety, supposed that the stars serving to give protection to the south were two of those alluded to in the Persian story. The other two stars are less certain, the right motion of the earth's axis not being recognised; D'Alembert supposes they might be Fornax and Regulus, which were then near in the plane of the solstitial circle, and the former would be visible in the south rising near the east; but of Antares and Aldebaran, he respectively rising and setting; but Regulus must have been 34° below the northern point of the horizon, supposed the axis not to change; consequently, according to this theory, Regulus would be visible at the same hour in that latitude. If, therefore, continues D'Alembert, it was meant that the four stars were at once seen in the situations just mentioned and look for some other star having the same longitude as Regulus, but having at least 34° of north latitude; the * in Ursa Major is so situated, and it is possible that this might be the star in question. M. Bailly observes, that the notice of the four stars quartering the heavens was extended by the Brahmans for in the Astronomical Institutions of the Celestial Empire, it is said that there are four spirals which preside over the four seasons, meaning probably the quadrants of the Zodiac, and it is likely enough that this kind of observations would be made by any people among whom astronomy was in its infancy.

This general apparent change of all the fixed stars, in pointing out the motion or change alluded to, is much baffled from the dissatisfactory theory of corrections, from the rise and fall of all places in accordance with the change of the excess before alluded to, and from the very slow motion that the stars could lead to, is the fixed opinion that the latitudes of places are never altered. It would appear that all astronomers and philosophers of every description had made up their minds to change everything before they would allow the latitudes to change, although such a change is shown to exist, whether the subject under consideration be astronomical, geodetical, or geographical.

We conceive it unnecessary to offer any argument to disprove the latter opinion, that these monuments were oriented by means of a mariner's compass, it being highly improbable that such an instrument would be used for that purpose, when the heavens present so many phenomena by which the end might be gained with much more ease and accuracy. Among a similar effect which can be submitted to actual measurement, may be mentioned the supposed true meridian standing, especially horizontal ones, as they partake of this motion in a twofold manner—that is, with respect to the elevation of the gnomon and the gradual change of the horizontal plane. Many instances of this kind are on record;—sun-dials excavated from the ruins of Pompeii and Herculaneum do not now tell the hour in the latitudes in...
which they have been found; if any person would take the trouble to compare the time which such disks now show, with that time which they ought to show, they will find that the earth's axis must change in the manner which we have described. It may be supposed, because the bearings of natural objects, such as the tops of mountains, do not change with the motion of the earth, that like the foundations of churches and other structures of man, that such a law has no equal influence over them: the fact is, that the rigidities of the materials of which they are composed not only prevents them immediately yielding to this motion, but also leaves them elevated or depressed, either gradually or suddenly, above or below the rest of the surrounding matter. This theory is borne out by many phenomena, but it is our intention first to test it by those which are capable of being submitted to actual measurement.

It is borne out by actual measurements which were instituted in different places, in order to determine the figure and magnitude of the earth. For this purpose, the lengths of small arcs were measured in different places on the surface of the earth, with the greatest care; but, for want of a true theory of the earth, their measurements, for the purposes for which they were instituted, were almost useless, and led to very unsatisfactory conclusions. Although these measurements disappointed the measurers, in pointing out the form which they supposed the earth to be before they commenced their labours, still their results are of the greatest use in supporting what is here promulgated. We cannot avoid remarking here, that the plans upon which all our great measures of the earth proceeded were very in-justiciable—that is, first supposing the figure to be one form while they were measuring it in another; and such a fault is not another: besides, they give way as much as possible to all their measurements and calculations to their preconceived opinions, despite of all the natural phenomena which pointed to the contrary. The values of the degrees of latitude found at different places on the earth's surface differ from each other more than might be expected, considering the great attention that has been paid to ascertain and make allowance for every known cause of error. In France, the lengths of the degrees were found to go on diminishing from north to south, but not in a regular progression. In England, on the contrary, they were found to diminish from south to north: so that if the figure of the earth were to be deduced from the degrees in the former of these countries alone, it would appear to be oblate; but if from the degrees in the latter, it would appear prolate. As might be expected, the lengths of degrees measured in the northern hemisphere of the earth deviate, with certain small limits, from the values they should have on the surface of any conjectured figure, except the one which we have described. The degrees measured in corresponding latitudes in the opposite hemispheres also disagree—this fact, as a matter of course, must necessarily follow. The proportions between the equatorial and polar diameters of the earth are, necessarily, stated to be wasted. Let us consider this in the case of France and Peru (in which last, it should be remarked, the observations of Bouger were made use of) gives, for that proportion, 324 to 333; D'Allembert, taking a mean of the observations of Bouger and La Cassardine, afterwards found it to be 309:363. The length of a degree in India, compared with that in England, showed the ratio to be as 329:325.

| The ratios | 318:317 | 314:313 | 289:288, and many others, have been given at different times from the same sort of measurements. The difference in these ratios instead of showing that they are all wrong, shows the exact character of every new current; this increase in the number of observed facts that support the phinco-dynamical demonstration. * 

That the earth is slightly indented or exended in different places, appears at once from the different magnitudes which actual measurements point out: if it were otherwise, no matter whether it was supposed to be spheroidal, ellipsoidal, or any other solid, formed under a uniform law of rotation, it would have been indented or extended spheroidal, * the difference could not have been so great; so that, although the right motion of the earth's axis, or rather the slow but constant change of the position of the excess of this planet above its greatest inscribed sphere, exerts its influence on all the particles of which it is composed, yet some of them for a time remain unaltered, from their rigidity—but, ultimately, all must give way, or be covered by the ocean, which is always ready to obey this general law of nature.

The late trigonometrical surveys show, either that the latitude of places have changed, or that the former surveys have been erroneous; now, it is more likely that the places have changed their positions with respect to the true north and south points, than that errors of such magnitude could be committed; one of the principal objects of trigonometrical surveying being to determine the geographical positions of principal or noted places, whether on coasts or inland, in islands or on continents, in order to gel accuracy in maps and for the purpose of accommodating navigators with the true latitudes and longitudes of principal promontories, lighthouses, havens, and ports. It is well known that these have, till lately, been requirements even in this country: the positions of some important points, which were not being surveyed, are not so certain; and the last survey found the best country maps in many cases to exhibit differences of more than three miles in distances of not more than twenty or thirty miles. The late surveyors may attribute all this to blunders made by their predecessors; but this is not as at likely, as the rudest instruments of the most careless observations could not so far mislead; in one hundred years from the present time, the same apparent blunders will be again detected. There is nothing which might be named that baffles the observer more, in determining the longitude either on land or at sea, than the erroneous opinion that the latitudes of places remain always unchanged. The whole face of nature seems to show that this uniformity is very far from being recognised; in that it exhibits such a variety of phenomena of the formation and structure of the earth, by this theory are set at rest for ever.

The chemical influence of heat and cold, combined with the gradual change in the matter, forms one of the most remarkable phenomena attributed to so many causes. By the right motion of the earth's axis, or rather the change of the excess so often alluded to, we have, among others, the following natural consequences:—Rivers appear to bury themselves in the earth, or rather, the places rise through which they flow. Mountains, which do not immediately give way to the change of surface, from the rigidity of the substance of which they are composed, ultimately, often without the slightest warning, decrease in altitude many feet. As this protuberance shifts its position, it only disturbs the particles, but in a very slight degree changes their respective distances; for instance, it is not to be imagined that the particles of one valley co-mingle with those of another. In the ocean, islands appear and disappear from the same cause. Continents, as well as islands, are increased in some parts and diminished in others, and that in such a regular manner that the influence of this general law is at once recognised. The structures of man, as those of nature, are subject to the same law. In Peru, for instance, the earth has recently risen so much that some new valleys have become barren; and, on the contrary, those which were barren, become fruitful. This motion not only changes the beds of rivers, but those of oceans and seas, so as not to show the same levels in places only a few miles distant—that is, with respect to what is erroneously called level of the sea. M. Chomel has fallen into error in his account of the theory of the tides, from his not having observed this general law of nature. In fact, the true cause of the motion of the waters on the surface of the earth, is mainly to be attributed to this motion. The sea-worn pebble obtrudes through the caverns of the earth and appears on the surface of the earth, so many miles from the sea, mixed with marine substances and remains of shell-fish. Fossil remains are found many feet from the surface, and in different climates from those to which they belonged,—often imbedded in substances which are evidently depositions, assuming different appearances from pressure, and being subjoined, and being great laboratory of nature to the different changes of temperature, and other local causes; it is not difficult to conceive how transformation can take place, for in the laboratory of the chemist the most durable substance is easily made to pass from one to another form, and the contrary;—water on the surface of the earth affords us daily a familiar instance of this, the water being actuated by a separate state of the earth, and by varying the motion of the earth on its axis, which is continually changing the excess so often mentioned, has this effect on the particles that compose the ocean; they are daily and hourly obliged to accommodate themselves to the behaviour of this motion, and also to the consequences of the less direct agents by which they are compelled to move: therefore, to imagine that the ocean can have a mean or uniform level, as Mr. Whitwell and many others do, is absurd. But this is satisfactorily shown by a comparison of the observations made on the tides in different ports and places. Soo far as the right motion of the earth's axis appears to the shortness of

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* In consequence of an Editorial note, annexed to the first part of this article, it is necessary for me to state that the mathematical demonstration of this problem is given in my work on 'the mechanics of solids' which will shortly be published, together with a concluding article on 'the Strength of Materials,' a subject fully discussed in my forthcoming work, just mentioned. O. S.
on the Measurement of Water Delivered Through Large (or Wide) Orifices; By M. Morin. (Communicated to the Academy des Sciences, Paris.)

In experiments on hydraulic motive powers, the most delicate portion, and that most subject to error, is the measurement of the quantity of water expended. Local circumstances, forms, or shapes, the arrangement of flood-gates, exert an influence of that great influence, which, as yet, has been too little studied, and the inexact appreciation of which has frequently led the most conscientious observers into serious errors, to which may be attributed, very frequently, the manifest exaggeration of certain results announced with the most perfect sincerity.

In order to avoid such errors, and to establish with some certainty, or at least with a sufficient approximation to it, the ratio of useful effect produced by the motive powers submitted to experiment, to the absolute amount of water expended, I endeavoured to determine upon a mode of measurement beyond the reach of controversy, which was somewhat difficult.

For this purpose, I first reflected whether I could measure, with sufficient exactness, the quantity of water supplied by an overshot-wheel sluice fixed at the head of a channel or race, in which the motive powers to be subjected to experiment were to be placed.

This sluice is equal in width to the head-race, constructed of masonry; it is inclined from above downwards at an angle of above 65 degrees to the horizon; its upper edge has an acute angle up-stream, and is rounded down-stream; it is 3 inches thick. Two racks, each of 2 inches wide, reduce the clear width to 6 ft. 7 in.

In order to estimate the volume or quantity of water that passed over this sluice, the tail-race, which was constructed of masonry, with a rectangular section, was closed below by a vertical dam of plain, in which the sluices of three openings; to these were fitted sluices of about 0.300 m. (1 foot) square, of this sheet iron, about 0.005 m. (.7 in.) in thickness, sliding in front of the orifices, which were formed with sharp edges. These iron sluices were, by means of screws, worked by hand; rods with marks showing the level, were placed in front of the orifice sluices, and the water sluiced, in order to show and to verify the invariableness of the levels.

From this short description, it may be readily conceived that by making simultaneous observations at the overshot-wheel sluice, and at the regulating orifice, the supply, or quantity delivered by the two kinds of orifices, might be calculated, by means of the very precise results of the experiments of Messrs. Ponelet and Lesbos, which were evidently applicable, with all desirable exactness, to the case in question.

But these experiments, undertaken on canals of great dimensions, which had vast basins, subject to the effects of the winds, and whose level was difficult to regulate perfectly by means of an ordinary mill sluice, could not possess a degree of exactness comparable to that of experiments made under more favourable circumstances. In order to examine into the whole together, and to disengage the results from accidental influences, we have reproduced them by a graphic construction, taking the values of the charge (or head of water) H, on top of the sluice, as abscissas, and those of the co-efficient of the supply or delivery as ordinates.

In examining the table of the results, and, above all, the curve which represents them, it is seen that the values of the co-efficient of the supply or delivery increase rapidly with those of the charge H, on the ground- sill of the orifice, from H = 0.03 m. (12 inches), and 0.04 m. (16 inches), up to H = 0.10 m. (4 inches), a term beyond which they still continue to increase, but more slowly.

If, to compare these results obtained with a sluice of 6 ft. 7 in. in width, equal to that of the head-race, and placed in the before-mentioned circumstances, with those which relate to a sluice of 0.20 m. (nearly 8 inches) wide, to complete contraction, we determine, by means of the figure, the values corresponding with the charges observed; in this last case, the following table may be formed, which is limited to the charges with which we have operated:

<table>
<thead>
<tr>
<th>Width of Orifizes</th>
<th>Charge H</th>
<th>Value of m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.04 m.</td>
<td>0.06 m.</td>
<td>0.08 m.</td>
</tr>
<tr>
<td>0.200 m.</td>
<td>0.407</td>
<td>0.401</td>
</tr>
<tr>
<td>0.217</td>
<td>0.284</td>
<td>0.355</td>
</tr>
<tr>
<td>0.300 m.</td>
<td>0.246</td>
<td>0.271</td>
</tr>
<tr>
<td>0.324</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These values, which, for small charges, made a very near approach to those which we have obtained, show that the diminution of the supply or delivery depends, in both cases, on the same cause—on the resistance of the side or wall of the sluice, or of the sluice. We notice, in fact, that in small charges, the fluid vein wets and follows the surface of the sluice; but in proportion to the increase of the charge, this influence of the sides or wall diminishes, and soon, indeed, the fluid vein detaches itself completely from the upper edge, which is sharp up-stream, and the resistance of the surface of the sluice ceases to be felt, whilst at the same time the suppression of the lateral contraction continues to exert an increasing influence on the augmentation of the supply or quantity delivered; whence it results that the co-efficient of the supply or delivery increases.

Such is the natural and simple explanation that may be given of the smallness of the values of the co-efficient of the supply or delivery for the small charges, and of their magnitude for the large charges observed in our experiments.

Notwithstanding the care taken in the execution of these experiments, the local causes and circumstances mentioned did not permit us to approximate nearer than ±4° or ±5°; but the sketch shows, notwithstanding, by taking them as a whole, the gradual and continual progress of the increase of the co-efficient of the supply or delivery, and, until now and more precise researches are made, I think we may, in applications to analogous cases, adopt with sufficient accuracy for practice, the values deduced from the sketch, for the co-efficient of the supply or delivery, viz.:

| Charges on the Sill of the Orifice, — in metres. | Values of the Co-efficient m., — in metres. |
| 0.04, 0.06, 0.08, 0.09, 0.10, 0.11, 0.12, 0.15, 0.20. | 0.24, 0.231, 0.233, 0.235, 0.245, 0.248, 0.249, 0.251, 0.252, 0.262. |

These values, which, for charges exceeding 0.20 m. (4 inches), are much greater than those which have been, up to this time, adopted for similar cases, show that sluices, arranged like that made use of by us, which is the case with many horizontal wheels, deliver more water than is generally admitted to be the case; and that, in experiments on hydraulic motive powers, we are liable, for want of a good method of measurement, to estimate the supply or delivery of water at one-sixth or one-seventh below the real amount, and, on the other hand, very much to over-value the useful effect.

Experiments on an Orifice with the Charge on the Summit.

Although the ensemble of the results obtained with the overshot water-wheel sluice, enables us to determine with sufficient exactness, at least for practice, the amount of water actually supplied or delivered in the experiments proposed, on hydraulic motive powers, I have thought it best to make use, for this purpose, of an orifice with the charge on the summit, so that the height, and, consequently, the
areas of the orifice remaining the same, the charge on the centre, being alone exposed to slight errors of measurement, enters into the calculation of the supply or delivery, but as under a radical, the second degree, and the influence of these errors diminishes when the charge increases.

For this purpose, I caused to be made on the same race or canal, an orifice of 1-196 m. (4 ft. 11 in.) in width, the vertical sides of which were 0-16 m. (5-8 inches), and 0-185 m. (6-6 inches) from the sides of the canal, and as the movements of ridges of the sluice were very slight, when compared with these distances, the contraction might be considered as nearly complete on these sides, as well as on the upper and lower sides.

The determination of the actual supply or delivery by this orifice, was made, as has been before explained, by means of a small iron sluice, whose greatest opening was 0-800 m. (18 inches).

The examination of the results obtained, and above all, their graphical representation, show that the greatest deviations did not amount to more, and were almost always less, than \( \frac{1}{4} \)th of the ordinates of the curve which represents them. And as, for experiments on hydraulic motive powers, such an approximation is quite sufficient, we have been able, in the ultrurious calculations of the supply or delivery of water, to adopt the values of the co-efficient of the supply or delivery deduced from this very curve.

We wish it to be observed that, in our experiments, the charges on the summit of the orifices having been comprised between 0-050 m. (2 inches) and 0-180 m. (7 inches) at farthest, and that this dimension, agreeably to the experiments of Messrs. Poncelet and Lesbros, producing an influence, at most, of only \( \frac{1}{2} \), the variation of the co-efficients has scarcely depended on any thing except the height of the oriflsses.

We have therefore been enabled, in accordance with this remark, to seek to compare the values of the co-efficient of the supply or delivery which we have found, with those which have been determined for equal heights of orifices of 0-20 m. (8 inches) in width, by Messrs. Poncelet and Lesbros, and we have thus formed the following table—

<table>
<thead>
<tr>
<th>Nature of the Orifice.</th>
<th>Values of the co-efficient of the theoretical supply or delivery for height of orifice of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orifice of 0-200 m. wide,</td>
<td>0-192 m.</td>
</tr>
<tr>
<td>Increase owing to the augmenting of width,</td>
<td>0-068 m.</td>
</tr>
<tr>
<td>Or,</td>
<td>0-130</td>
</tr>
<tr>
<td></td>
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</table>

It is seen that the width of the orifice appears to have had a considerable influence on the supply or delivery, and that the increase resulting from it for this supply or delivery has varied, in the cases in question, from \( \frac{1}{2} \) to \( \frac{1}{4} \).

These results prove how necessary it was to verify beforehand the correctness of the formula to be made use of for the measurement of the supply or delivery of water, since differences of this kind might result from it.

We will moreover observe that these results, giving amounts of supply or delivery much greater than might have been calculated agreeably to the rules generally admitted, the useful effects obtained from the motive power attained in the experiments of which we have to give an account, will be diminished in the same proportion, and that, in this point of view, our results will be less favourable to them than if we had been content to follow the ordinary rules.

**Evaporation of Water.**—A paper was read at the Academy of Sciences, Paris, respecting the quantity of heat annually applied to the evaporation of the water on the surface of the globe, and of the dynamic force of the streams of continents. M. Daubrée asserts that the evaporation employs a quantity of heat about equal to one-third of what is received from the sun, or in other words, equal to the melting of a bed of ice of nearly 85 feet in thickness if spread over the globe. The motive force of the stream, as it is known, is equal to between 373,498,774 and 384,678,628 horses working incessantly during the whole period of the year.

**ON M. BRUCHHAUSEN'S NEW THEORY OF THE TELLURIC FLUCTUATIONS OF THE SEA.**

By Professor Madler, of Dorpat.

Our globe presents an abundance of evidence, that its present condition is one which did not exist in times anterior. It is the purpose of the present time to establish these facts and their corollaries, historically and empirically, and to frame the way for their scientific elucidation; while the purport of the future will be to penetrate into their genesis, and to elucidate, in an incontestable manner, the first causes, whereby the existing effects and results may be proved and demonstrated to perfect evidence. We do not intend, by saying so, to ascribe all present endeavours to arrive at these first causes of our globe—nature—every endowment to respect is meritorious.

This apology we have to premise to our review of M. de Bruchhause's (of Luxembourg) theory of sea-motion, first communicated to the congress of scien mode at Bremen, and subsequently developed in an especial work. Its general features are as follows:

1. If masses of ice become fixed on the bottom of the sea, they cause a preponderance of that hemisphere whose pole they form, and, in consequence of that preponderance, the centre of gravity of the globe must change its place.

2. Ice masses of this kind are fixed as well at the north as at the south pole, but are not immutable, but increase and decrease alternately.

3. The fact, especially, that in a cycle of 21,000 years, the poles, have their summer in the perihelium and aphelion (by which, also a difference in the duration of seasons is given)—causes a disparity in the proportion of evaporation and precipitation, and consequently, a change in the face of the pole, and consequently, the shorter summer; as well as a decrease of these masses on the opposite pole.

4. In consequence of the shifting of the centre of gravity, caused by the increase and decrease of these masses, the sea must move to that pole where the bottom-ice is increasing.—The same thing will happen then, the shorter summer; as well as a decrease of these masses on the opposite pole.

These condensed statements suffice for testing their plausibility. M. de Bruchhause himself, considers the third argument the weakest, as the observations of Herschel (whose correctness is not disputed by M. B.) have proved, that the sum of the temperature of summer, is not changed by the different position of the Apiside line. Still, the distribution of heat over single seasons is, certainly, somewhat—albeit, not much—different; and could, possibly, be the cause of an imperceptible increase of the polar ice. We say possibly, because such a complicated phenomenon demands the most accurate physical inquiry,—which M. Bruchhause has not made, but endeavours to prove his position by induction.

In this place already, the objection can be raised, that an alternate increase and decrease of ice-masses (at least, as their limits are named) takes place every hundred years, as naturally, the winter pole will have more ice than the summer pole. If this difference were of sufficient quantity to act in the way put down by the author,—then, during every summer, we should observe a flowing from the north hemisphere southward; in winter, one in an opposite direction. The elevation of the continents and islands of the temperate and frigid zones, would be different in summer and winter. As, however, such a periodical change of the level of the sea (every year) is, surely, not observed,—then, also, the still lesser difference of arctic and perihelial summers, is also incapable of producing such a phenomenon. We say this, of course, in a very qualified manner, and we ourselves estimate at 20,000 feet. This difficulty cannot be obviated, even if the effect of this action be extended to several thousand years.

The same result will be arrived at by a simple calculation. Let us assume the extent of the polar ice, at an equal distance from the pole, at merely 10°; and as Weddel has sailed up to 74°, and Ross even to 76°, south latitude, we might safely consider it even more. Let us further consider the curve as the surface (independent of the curve of the globe) as being parabolic: let us take the density of the polar ice at 0-66; the density of the globe, according to Bailey's latest experiments, at 0-69; and let us express the thickness of the bottom-ice in feet by \( y \), the lifting of the centre of gravity of the globe thereby produced will be:

\[ y = \frac{0-69}{0-66} \sin^2 12° \times \frac{1}{800} \]

Whence it results, that for shifting the centre of gravity of the globe only one foot, a mass of ice will be required, which has a thickness of...
THE CIVIL ENGINEER AND ARCHITECT'S JOURNAL.

SANITARY REGULATIONS OF THE METROPOLIS.

If anything more worthily distinguishes the present age—notwithstanding Coningsby's outcry about the age of tinsel and brass—notwithstanding the charge of Mammon worship and the imputations of selfishness—it is the spirit of practical improvement, exemplified not merely in undertakings which are reproductive to the community and profitable to the conductors, but in projects of long and continued exertions of the Government and the educated classes, for the amelioration of the condition of all members of society, and in particular of the condition of those who, from want of intelligence and want of means, are least qualified to help themselves.

It is well to assume the attitude of sanctimetos temporis acti; to speak of the good old times; to banish virtue to the annals of antiquity; and, in denying modern merit, to lament modern depravity. That is an old vice; it is aptly characterised by the Sage of Judah and the Poet of Rome;—and it is one so tritely known among ourselves; that it must argue some confidence in the extent of public credulity, to try it on any large scale in our times. Have we all forgotten the classic scene in the "Spectator," where the shrewd observer takes down a book from the shelves of his library, and reads to the grumbler an awful description of the depravity of the times? "How true," says the grumbler, "how accurate—how minute!" And yet the page of the moralist did not refer to the time of Queen Anne, but to that of Henry the Eighth. In the time of Queen Victoria, a large school, with the Coming Man at their head, and Pagin for their Michael, cry out on the worthlessness of the present day, and sigh for the middle ages, and for the days of which we know nothing. To copy the merits of our forefathers, to catch their noble spirit, is well worthy of our ambition—but to adopt their system bodily, and to eschew all the merits and improvements of the present day, would be as insane in practice as it is antie and fantastic in suggestion.

If, however, there be one party who would drag us back, body and soul, to the middle ages, there is another who, for self interest, would oppose every improvement in the present day: so that no suggestion can be made for any practical measure, without its being met by the most violent outcry and misrepresentation. Such is the fate which has befall Lord Morpeth's bill and the sanitary arrangements.

None can have a more superstitious horror than we have of Government interference—none have been more consistent in their opposition to any unjustifiable attempt at extension of power and control. On the Steam Vessels question, our humble exertions were sufficient to frustrate the objectionable designs of the Board of Trade. On the proposition of the Buildings Act, we co-operated in obtaining the removal of the obstructions clauses; and we cannot charge ourselves on any one occasion with neglecting the interests of the public or of those professional readers who favour us with their confidence. We cannot, however, go so far as to object to all Government interference, or to deny that it can be properly exercised; for we have ourselves, on many previous occasions, in reference to this present question of the sewage and sanitary arrangements of towns, exercised what influence we possess in the exposure and correction of very serious abuses which are still so greatly prevalent.

We might sympathise with those who objected to the Government obtaining the sole control over the sanitary arrangements of the metropolis; but knowing what we do of the sewage, drainage, paving, cemeteries, and supply of water in the metropolis, and having so often had occasion to write in terms of disapproval, we cannot consistently say that the present system requires no alteration,—for we must say that it requires a great deal, and that Lord Morpeth's bill in that respect errs only in not going far enough.

We defy any sensible man to look at the wretched and confused mode of administration, the number of conflicting local boards, the host of useless and inefficient functionaries, the opposition and antagonism shown in the details of arrangement, and the miserable and contemptible results,—we defy any man, we say, to consider these things, and not feel ashamed of the filthiest metropolises of the world, and among the most practical and business-like people, such a disgraceful state of affairs should exist,—whereby the public money is wasted, the public wastes are neglected, and the public health is endangered.

On this point all opinions ought to agree—that the local boards should be abolished, and the administration simplified: common sense requires this, if economy and public justice did not imperatively claim the reforma-
by their want of professional skill, but by the want of power to carry out the most essential improvements and the best conceived designs.

If we look at the state of the sewage of the metropolis, we are sure all must agree that its present condition is bad, and that even the worst Government board could not be worse. The metropolis is split up among several irresponsible boards, exercising independent jurisdictions, and acting on the most discordant principles. While the upland is under the Finchley and Harrow Board of Guardians, the western division of the City of London Commissioners take charge of the East of London, sending some of their streams into the Finchley division. The western parts of London are delivered over to the Westminster Commission of Sewers, who have the Crown Commissioners for Regent-street and the Regent's-park interfering with them throughout. The southern suburbs belong to the jurisdiction of the Survey and Kent Commission.

The result may be anticipated: as there is no central authority, there are repeated conflicts between the jarring functionaries,—for the divisions embracing districts of undulating surface, have not, in all cases, the command of their own outfall, or have not the command of the natural outfall. Hence, circuits lines of sewer are adopted, to the great inconvenience of the public, and to the great loss of the rate-payers. The Regent-street and Regent's-park division, which is under the Woods and Forests, runs right up in a narrow strip through the Westminster division, from Scotland Yard to the Regent's-park, and has its own main sewer and its own separate outfall. The consequence is, that the Westminster Commissioners, instead of sending some of their water drainage into the Regent-street main sewer, which is a sewer of two miles in length, to join the King's Scholars' Pond sewer, higher up the Thames.

Proceedings of this kind are fraught with mischief and injustice; for not only have the Westminster Commissioners to contend with a very slight inclination, and a very bad outfall, through the King's Scholars' Pond sewer, but a great deal of money is wasted in the original outfall for the circular sewer, there is always a difficulty in keeping it in order, and there is necessarily a much heavier charge for its repair. The Regent-street sewer is one of great capacity; it is carried to a considerable depth, and is sufficient to drain Westminster, Bloomsbury, and Marylebone; yet a new and needless sewer has, under the present system, been made.

There is also, from the nature of the boundaries, some difficulty in securing the proper cleansing of the sewers by flushing; for the Westminster and the City of London divisions of sewers have not within their districts access to a sufficient supply and head of water. Under a combined system, reservoirs of water would be formed at Hampstead, Highgate, Frogney, and on the northern range of hills, and would be applied to properly flushing and cleansing out the sewers and drains in the lower divisions of the City, Westminster, and the Tower district. In the Holborn and Finchley division, the flushing plan is well carried out; but there is no reason why, by proper arrangements, the same facilities should not be generally and economically applied.

It is also very well known, that until a very late period, from want of a proper control on the part of the public, and from want of exertion on the part of the functionaries, the greater part of the sewers in the metropolis were constructed on improper principles, and in a wasteful and inefficient manner. This was particularly the case in the Westminster Commission of Sewers, and we believe we may claim some part of the merit—as having been to a considerable extent effected by our exertions—as the new sewers are being carried out in a manner, much more economical, much more efficient, and much more satisfactory. The present surveyor has done a great deal to lessen the expense by laying down oval sewers, and by giving sewers of a small size to courts and alleys he has extended the accommodation without increasing the outlay. Indeed, almost as much has been done as perhaps can be done, by the formation of small oval drains and the introduction of pipes, to make the construction of sewers as cheap as it can be,—so that our objections are not made on that ground. It is with regard to the proper direction of the sewers, and their proper application, that the greatest deficiencies are felt; and these are so serious, and have lasted so long, that we can place no confidence in the present system for their efficient and final remedy.

We have already said so much on these points (particularly in our Journal for 1843, vol. VI., p. 45), that we are almost disinclined to say any more,—except that being obliged to go over the same matter four years afterwards, and to contend with the same opponents, we cannot escape the repetition. Those who will refer to Vol. VI., p. 48, will find that we have gone as minutely into the subject as we can, and particularly in reference to Mr. Donaldson's defence of the Westminster Commission of Sewers; which, however, furnished us with ample evidence as to the defects of the present system, or rather want of system, and the necessity for its entire reform.

We cannot recapitulate all that we then said, but we may usefully avail ourselves of some of the evidence which we then adduced. We showed, on the authority of Mr. Donaldson, that in consequence of the Westminster system, some of the works, very large sums had been expended in rebuilding the main sewers and deepening the outlets. Thus, the Essex-street sewer, between 1816 and 1826, was lowered throughout a length of 9600 feet, or upwards of a mile. The eastern branch of the Hartshorn-lane sewer, likewise in the Westminster Commission, between 1831 and 1859 was lowered throughout a length of 4300 feet; and another branch of the same sewer, between 1820 and 1837, throughout a length of 3400 feet. The whole of the King-street sewer was, before 1839, lowered on a length of 1200 feet, and the Wood-street sewer, the College-street sewer, and the Horseferry-road sewer, were also lowered. Thus, in one division,—the Westminster division—the great extent of 31,450 feet (or 6 miles) of new main sewer has been constructed. Of this we should not of itself complain, if the whole system were not faulty, and if, instead of merely rectifying old errors, the new works did not, as we have already shown, involve further errors.

The works on King's Scholars' Pond Sewer are so heavy and so extraordinary, that Mr. Donaldson and others look upon them with a great degree of pride, as involving the application of much skill and ingenuity to overcome the difficulties with which the surveyors had to contend. Thus, the driving of the new sewer, for 650 feet is length, and at a considerable depth, was carried on from within the sewer, and an inverted arch was constructed, and the old obstructions removed; the works being carried on under buildings, and having been considered impracticable by John Rennie, Jesseop, Chapman, and others. In some parts of its course, this sewer was driven under courts narrower than itself, and frequently below the foundations of contiguous buildings, without inflicting injury upon them.

It is scarcely credible, that works so expensive and so difficult should have been undertaken without any adequate necessity; and yet such is the case. For, as we have already shown, the Regent-street sewer is amply sufficient for the drainage of the district; and, by the use of it, the enlargement, or rather reconstruction, of the King's Scholars' Pond Sewer might have been avoided, and the drainage carried to a shorter and more effective outfall.

The works in the City of London Commission have been, to a great extent, of the same character as in the Westminster Commission, having been directed to the formation of new outfalls, not for their own drainage, but for that of the upland districts. Under a proper system, the expense of these outfalls would fall on the whole district, and the outfalls would be properly adapted to the extent of duty which they have to perform.

The Westminster Commission, among others, long persisted in the use of flat sides to their sewers, though frequent failures occurred in their application, and they were expensive and cumbrous in construction, while there was adequate experience that the oval form of sewer adopted in the Regent-street and Holborn divisions was of greater solidity, was less expensive, and better calculated to secure a quick drainage. Naturally, the great object in sewage is to get rid of noxious waters as quick as possible; not to keep them penned up, fostering among the dwellings of the people, but to discharge them with the utmost speed. Thus, the Westminster form of sewer was not calculated to effect; while the oval form was exactly competent, as the investigations in our Journal, and the subsequent adoption of our views, have fully proved.

A comparison of two classes of sewers, in the Westminster and Holborn divisions of sewers, under the old plan, will show how wasteful was the expenditure under the former system.

In these calculations, the cost of materials and labour being taken as the same in each case, at 1s. per foot reduced, or £13 12s. per rod of brickwork, and 1s. per cubic yard for digging, strutting, and filling-in or removing the surplus ground; the top of the sewer being taken as six feet below the surface of the ground.

<table>
<thead>
<tr>
<th>Sewer Type</th>
<th>Length</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westminster first-class sewer</td>
<td>17 feet brickwork, 17a.</td>
<td>20s. 4d.</td>
</tr>
<tr>
<td>2 yards digging, 8s. 4d.</td>
<td>—total—</td>
<td>20s. 4d.</td>
</tr>
<tr>
<td>Holborn and Finchley Sewer</td>
<td>19 feet brickwork, 19a.</td>
<td>15s. 0d.</td>
</tr>
<tr>
<td>3 yards digging, 8s.</td>
<td>—total—</td>
<td>15s. 0d.</td>
</tr>
</tbody>
</table>

This shows a difference of 8s. 4d., or more than 50 per cent.
Westminster second-class sewer: 15 feet brickwork, 15s.; 5 yards digging, 2s.—total 18s. 6d.
Holborn and Finsbury second-class sewer: 9 feet brickwork, 9s.; 2½ yards digging, 4s. 4d.—total 11s. 4d.
This shows a difference of 6s. 6d., or between 50 and 60 per cent.

A Holborn first-class sewer used to cost less than a Westminster first or second-class—being, in fact, 90 per cent. cheaper than the Westminster second-class sewer. It is, therefore, scarcely conceivable that the monstrous waste of money involved in carrying out the Westminster mode of construction should have been so long persevered in.

The worst feature, however, in the present administration of the sewage is, that it is virtually inaccessible to that class of houses which most require drainage; and it is no exaggeration to say, that the dwellings of the lower classes in London are left without drainage. Very expensive and very well constructed main sewers and secondary sewers are laid down, but so far from being applicants for the drainers, it is an unenforceable law that drain the surface of the streets and roads. This arises from the commissioners of sewers carrying their labours no further than the streets, leaving the householders to make the communications with the sewers.

We were going to say that the commissioners left the householders to make the communications at their own expense with the main sewers, but that would scarcely represent the true state of the case, for the fact is, that the householders can only make a communication by exposing themselves to heavy pains and penalties. The regulations of the commissioners in most districts require as much expense to be incurred in making communications with the sewers as the cost of laying a sewer in a small street, and the result is that sewer drainage is a luxury unattainable by many of the middle classes, and the majority of the mechanics and of the poorer classes.

A most expensive main sewer may run within a few yards of a house, but the outlay required for running a drain into it is so large, is so disproportionate to the necessity of the house, and so exorbitant in reference to the means of the landlord and the extent of the rental, that the idea of incurring such an expense is given up as hopeless. The consequence is that numbers of houses have cesspools, and in the closely crowded houses in the small courts and alleys, it may be taken as a general rule that there are no water closets, that foul waters are kept on the premises, that nuisances ensue, and that the drains are too small to prevent the outflow of the effluvia. All these appliances of filth are, however, necessary to the house, and also to the occupants.

For such a state of affairs, so fatal to the poorer classes and so dangerous to the wealthier, the commissioners of sewers must be held accountable; and no remedy can be considered effectual until such a system is adopted, as will make it incumbent on the officers of sewers to provide adequate drainage for every house, rich or poor, and give medical men and officers of health the efficient means of removing evils which may deplore, but cannot prevent.

We have already stated in the pages of the Journal that the charge of the Westminster Commission of Sewers acted as prohibitory on fourth-rate houses within their jurisdiction, the charge being 10s. per foot. This charge of 10s. per foot is made on the length of the frontage of the house for permission to be allowed to enter one of the commissioners' sewers, built at the expense of the public; and if it be a corner house, the commissioners will not allow it to be drained at all into the sewer, although there is a public one within 12 feet of the house, and will compel the party to build a new sewer along the front of the house, and be at the expense of an expensive connection with the old sewer. The whole expense of making a new sewer and digging on the fourth-rate house would cost at the least £1,000, being 10 per cent. on the cost of the house, which might be done for about £110, if the commissioners would allow the house to be drained into the existing sewer. This is not a supposed case, but one which has actually occurred within the Westminster district, so that parties considered it their duty to construct cesspools to avoid an excessive outlay. By requiring each house to have separate drains, at whatever distance the house may be from the sewer, the charge of a heavy drain is seriously aggravated, whereas in many cases one drain would be sufficient for two or even for three houses. In fact, what is the difference between allowing such a practice, and running an inferior sewer up a small court into which many short drains are allowed to be made?

We wish some member of the House of Commons would move for a return of the length of all the sewers which have been built, rebuilt, or repaired at the expense of the public by the commission, their cost, and the actual number of houses on each side of the sewer which drain into it, and the number which do not, distinguishing courts; if we are not very much mistaken, this return alone would upset the present commission, and would show that these commissions do their utmost to obstruct the drainage of the metropolis, and consequently to injure the health of the inhabitants. What we contend for is, that if the commissioners are obliged to construct a sewer for public purposes, that all the houses on each side should be allowed to enter it, for, generally speaking, where the commissioners do build a sewer it is through an old district which has been passing sewer rates for many years; for instance, a sewer has been built in High-street, St. Giles's, by the commissioners, and although the houses on each side have been paying rates these 60 or 60 years past, they are not allowed to drain into it, without paying a fine of ten shillings per foot frontage.

If the management of the sewage in the metropolis present such a state of affairs, what can be said of the paving boards? It is bad enough to have half-a-dozen commissions of sewers, each of which embraces a large borough or many parishes; but the paving boards in many cases have not even the jurisdiction of a parish or a borough, but some parishes are split up among a score paving boards, each separate estate having its own paving and lighting boards, its own set of commissioners, and its own set of officers to take charge of the paving, lighting and cleansing of a narrowconfined district. The nuisance prevails to such an extent, and the want of organization is so strongly felt, that it is most extraordinary that it should have been submitted to so long. If Lord Morpeth should let the commissions of sewers alone—though we do not see why he should—there ought at any rate to be a consolidation of the paving boards, either into a central board or borough boards. At present, the City of London is the only district having a consolidated board, which is also that of the commissioners of sewers, and nothing has occurred in the working of that board to show its inferiority to the labour of the score or more boards, who mismanage the affairs of districts not greater in superficials, nor of more importance in extent of traffic.

It is stated, that besides the City of London Commission and the Regent-street Commission, there are no less than 84 different boards having the management of the paving in the metropolis. In the parish of St. Pancras alone there are no less than 18 different boards. In Kensington there are seven boards in the same street, in Leicestershire in the same street, in Whitechapel as in Bermondsey five, in St. George's, Southwark, four, in St. Andrew's, Holborn, four, and in Shoreditch, four.

Some boards have only the management of the highways, some only of the lighting.

Altogether there is such a confusion that the commissioners themselves in some cases scarcely know what they are about.

Of course, each of these boards has its own commission, its own clerk, its own surveyor, and its own rates, and it is easy to determine what must be the consequences—that while the rater-people are overcharged for such an establishment, the officers are inadequately remunerated. Instead of liberal salaries being given to parties of competent abilities, miserable stipends are allotted to those who now discharge the offices, while the public are not thereby benefited.

That it is requisite to have eighty-six clerks to boards and their subordinates, we cannot conceive that any one will take the trouble to affirm; while their reduction would leave a well-paid staff, and effect a large saving.

The surveyors and assistants attached to eighty-six boards would, no doubt, be reduced in number, though perhaps not to such an extent as the clerks, whose re-appointments would secure a large and efficient body of officials, with a graduated scale of liberal salaries; giving a stimulus to merit, and holding out an adequate reward for long services.

We are sure that the surveyors of the City of London, of the Woods and Forests, and of St. Marylebone, are not worse paid than the surveyors of such petty districts as Ely Place, the Saffron Hill Liberty, Tott Hill Fields, the Brewer's Estate, the Lucas Estate, or the Harrison Estate.

Under the present state of affairs, it frequently happens that the commissioners of sewers or of paving are restricted in their powers of useful to themselves to be so, and as the cost of amending a local act for a small district is considerable, they are often virtually debarred from the official discharge of their duties. This is one of the many circumstances consequent on their small and limited jurisdictions. Some of the commissioners of sewers consider that they are not empowered to do anything else but to repair old sewers,—all concer that they have no effective powers to make drains to houses, or to take necessary measures for the preservation of the public health.

There is nothing in the management of these paving boards, which can
be considered at all favourable to their pretensions of forbidding their duties. They are virtually irresponsible in the discharge of individual duties, and individuals are powerless against them; while being appointed by popular, and often by party election, they will take no measures, which by increasing the rates, may secure a better state of affairs, but endanger their tenure of office.

It is scarcely possible to walk down a main street without seeing the various tastes of these gentlemen exhibited in the shape of specimens of granite, macadam, wood, or asphalt, in every variety of form, often so badly contrived as to endanger the lives and limbs of passengers and cattle, and always in such a dilapidated state that it be a serious and objectionable nuisance. By the dirty state of the streets and roads, the houses are bespattered with mud, and shopkeepers are deterred from adopting light and expensive paintings and decorations. The dust created is blown into the houses to the deterioration of books, linen, and furniture, and in the case of tradesmen, to the very considerable injury of their stock. As to passengers, in summer their eyes, mouths, and nostrils are filled with dried horse dung under the name of dust, and in winter their clothes are spoiled by the accumulations of mud; whereas, under a proper system, it has been practically shown, there is no reason why even the most overcrowded thoroughfares should not be kept clean in summer and winter.

Upon the waste of manure which takes place in the metropolis, we will not dilate. It suffices that it is disgraceful to a practical country like this, that such large resources should be lost to our agriculture.

We must say, that if an amalgamation of commissioners is to take place, we can see no reason why it should not include the metropolitan roads and the county bridges, which should certainly not be separated from the jurisdiction of a competent authority.

We are free to admit, as we have already said, that it may be a matter of question how far Government control should extend, but we do not think, on a fair and impartial investigation, that can be any doubt that the consolidation should take place under one body of the jurisdictions for draining, paving, lighting, and cleansing the metropolis.

Whether that should be under a Government board, or whether under an elective board, we are not prepared to determine, though each would have its advantages and disadvantages.

A Government board would be virtually irresponsible, and would involve the disposal of a considerable amount of patronage, over which at the present time no effectual control could be devised.

An elective board might want unity, might court popularity by avoiding the discharge of disagreeable duties, and might dispense with its patronage if not for political purposes, at any rate for jobbing purposes.

Some of the evils of an elective board might be readily cured by making the election, not annual, but for a period of four years, thereby securing a certain degree of permanence of character in the board, and at the same time leaving each member at a proper period to answer to his constituents for the discharge of his duties. At present, the commissioners of sewers are irresponsible, and no Government board could be so bad as that respect.

An amalgamated board might be formed from representatives of each great division of the metropolis, those from the City of London being named by the corporation, and those from the large divisions, as St. Pancras and St. Marylebone, being named by the vestries. There could be no more difficulty in electing members of such an administrative and representative body than in electing guardians for poor-law boards, and we know of no objection to the adoption of such a course.

Under such circumstances, the distribution of patronage would be less obnoxious, and would most probably be faithfully complied with.

If such an elective board were formed, there should be no controlling power on the part of the crown, for that would destroy the energy and responsibility of the board without transferring it elsewhere. We should, however, be disposed to allow to the Crown a complete power of inspection, which for all practical and useful purposes would be quite as effective as control, and would bring the proceedings of the board within the cognisance of Parliament.

At all events, whatever may be our views as to the parties with whom power should be intrusted, we have no doubt it is for the interest of the public, and for the interest of architects, engineers, and surveyors, that the general principles of Lord Morpeth's bill should be adopted and carried out.

THE ROYAL ITALIAN OPERA, COVENT GARDEN.

One of the most important architectural events of the season has been the reconstruction of Covent Garden Theatre, as the Royal Italian Opera. This has been executed under the direction of Mr. Benedict Albanò, hitherto better known as an engineer, in which profession he has already acquired much reputation among us. The transition from flax-mills, steam boats, and railways, to an Opera-house, is a sudden, perhaps a violent one, but Mr. Albanò has shown that in the fine arts and the useful arts he has equal powers of design and execution.

Covent Garden was previously known as one of our largest theatres, but it did not afford the extent of accommodation required by the new style of opera. Mr. Albanò therefore laid before them three plans, one by which it would have been transformed into the largest theatre in the world, surpassing San Carlo and La Scala, a second smaller than those theatres, and a third which, though it gave additional tiers of private boxes, left the theatre of its original size. It is the second plan which has been adopted, though we wish, for Mr. Albanò's sake and our own, he had been allowed to eclipse our foreign rivals, and redeem us as Byron's old reproach of inferiority to theatres which will each accommodate nearly 4000 persons.

The old Covent Garden Theatre, it will be remembered, was constructed by Sir Robert Smirke, after the fire in 1808. He, also, wished to have a larger theatre, but was overruled by John Keable, who was fearful that if the theatre were larger it would be seen by the street, and Sir Robert's plan was therefore to construct the smallest possible interior or auditory within a large available exterior as possible. His interior stood against fire and harm during the long theatrical generation of nearly forty years, but has succumbed at length, before the hand of Mr. Albanò, to an unhappy fate, that of the destruction of works, which is likely to attract Sir Robert Smirke, as it has Sir John Soane. Sir Robert modelled his building, according to his statement, on the Parthenon at Athens, and the exterior possessed considerable merit.

We must now proceed to give what sketch we can of the building, though we cannot go into any detail, in consequence of our engravings not being complete for the present number, which prevents us from making the necessary references to illustrate our description.

It must be observed that the great design has been to convey the idea of grandeur and imposing magnitude, and this has been most skilfully carried out, while all that constructive skill could do, and all that attention to comfort demanded, has been completely effected.

The plan having been settled, Mr. Albanò proceeded to pull down the whole interior of the audience part and parts adjoining, and to re-arrange it. He has thus been able to get an enormous auditory, and a grand range of saloons with suitable approaches.

In the grand front, beyond what we have already noticed, the chief alteration is the carrying of a carriage-way beneath the portico, whereby visitors are saved the annoyance of getting out of their carriages in the wet, and the street approaches are widened.

On entering by the grand front, a magnificent hall and staircase attract attention. These are decorated with columns painted in imitation of Sienna marble, and lighted from lofty bronze candelabra.

At the head of the staircase is a range of saloons level with the grand tier, and 130 feet in length. Preceding these is the Shakespeare room, with a statue of the poet; the next is the ante-room communicating with the saloon or crush-room, forming three compartments by means of Ionic columns, and with a quantity of large mirrors on the walls. As the walls are papered with green, the gilding produces an exceedingly good effect, while comfort and luxury are consulted in the ottomans and couches.

On entering the theatre, it is seen that its dimensions are on a very large scale, as to height and breadth. The breadth between the boxes, 60 feet diameter, is particularly striking, and also the extreme height of the house. The pit has been sunk, and the tiers of boxes now rise six in number, forming a colossal amphitheatre of unaccustomed proportions.

The dimensions of the house are 80 feet from the curtain to the front of the boxes, and 60 feet in breadth would be seen, and the width across the stage between the columns of the proscenium 45 feet.

The ceiling is one of the attractions. Its dimensions are 70 feet by 62 feet. From the centre depends the enormous chandelier, one of the largest in England, and which is almost the only source of light to the house. It consists of several rings of light, and twelve clusters of twenty to five-and-twenty jets, producing the most brilliant light, while the reflection and polarization of the drops and pendants increase the picturesque effect. The
cally itself represents the sky, and is of peculiar form, partly elliptic and partly hyperbolic, so as to be in conformity with acoustic principles. It is also covered all round. We may note, too, that the procenium forms a splayed arch, so as to throw the voice into the centre of the house. All that could be done to make the house a good hearing house has been effected.

The seating is in keeping with the decorations of the house, of which the leading colours are white and gold, here and there set off with a slight turquoise blue. The relieved ornaments are all in the cannabacism composition, which admits of the gliding being highly burnished. The whole effect of the decorations is chaste and picturesque, while, by the boldness of the proportions, grandeur is preserved.

We may note that the ventilation has been the subject of the special care of the architect, and in which he seems to have attained much success.

The approaches to the house have all been re-arranged, separate entrances being provided to the royal boxes, to the boxes and stalls, to the pit, and to the gallery, with fire-proof staircases. The details in every part are also so arranged as to give the greatest comfort, and to enable a large audience conveniently to sit through a long performance, as well as to hear perfectly. This is really as great an advantage to the actor as to the hearer, as, without it, due attention cannot be paid to any representation, however skilful.

While we cannot withhold our testimony to the solidity of the construction, having inspected it in detail, we are bound also to notice the rapidity with which the alterations were completed, the old interior having been pulled down, and the new one erected from the foundations, within four months. This is a great feat, performed by Mr. Alban; and we must state that great credit is due to Mr. Hollond, the builder, and Mr. Passmore, the decorator, for the rapid manner in which they have executed the work. The brilliancy of the gas-lights, as is to be observed, is due to the use of Mr. Low's patent for naphthaline tar.

STATE AND PROSPECTS OF FRENCH RAILWAYS.

One of the greatest advances that has yet taken place in the progress of European civilization is slowly but surely approaching in the comprehensive system of railways in course of construction in France. The object of the following review is rather to glance rapidly at the present position of French railways than to dwell at any length on the reflections that naturally present themselves on entering into the consideration of such a subject.

Paris to Rouen.—The first line that comes under our notice is that from Paris to Rouen, opened for traffic on 1st May, 1843, being the first of the French railways, in chronological order, which was completed to the north of Paris. It is eighty-four English miles in length, and was constructed from the plans of Mr. Locke, the engineer of the South Western Railway. The plans of the line, as will be seen on the map of the country, were 8,832ft. from passenger traffic, and 3,722ft. from goods traffic in January, 1844, were respectively 10,034ft., and 14,693ft. in the same month of the present year. The extension of this railway, 57 miles in length, from Rouen to Amiens, was built by Mr. Breton, and has been in long time in construction, from the numerous works of art necessitated by the uneven character of the country through which it runs; among others, six important viaducts, one of which—that at Bernin—fell down shortly after it was completed, about fourteen months ago, and has since been rebuilt. There is also a bridge over the Seine, at Rouen, about 1,200 feet long. This line will complete the railway communication between Paris and Havre, which is the port of the capital, as far as its maritime trade with countries out of Europe is concerned, and where it will communicate directly with extensive docks now being erected on the left or south bank of the Seine, at Rouen, in common with that of the short lines from Paris to St. Germain, and to Versailles, by the right bank of the Seine, opened in 1837 and 1839 respectively. In 1846 another railway was completed to Versailles by the left bank of the Seine, neither having been constructed at profit; but has been proposed for the two companies to amalgamate, and from a joint station at Versailles, to extend their lines to Chartres, Rennes, and Brittany.

Paris to Orleans.—Going westward, the next line we meet is that from Paris to Orleans, opened in the same time as that from Paris to Rouen, in 1843. The length of this line, including a branch to Corbeil, is 93 miles; the share capital 1,660,000l., and the net returns about 10 per cent. It not only unites Paris with the flourishing city of Orleans, but also is extended thence in several directions, and by the line from Orleans to Tours, a distance of 69 miles; 2nd, by the Tours and Nantes railway, a branch from this to the principal centre of commerce on the west coast of France, 120 miles in length, the works of which are in a very forward state for about 65 miles, from Tours to Angers; 3rd, by the central railway from Orleans to Vierzon, Bourges, and Châteauroux. From Orleans...
way, the exact directions to be taken by which were settled by the Chambers in that year; and since that period, the greater part of the new lines have been put up to auction, and conceded to the company offering the greatest reduction on a maximum term of concession fixed by the Chambers. For some, the government has been reimbursed by the companies for any outlay expended on the line conceded to them; for others, it continues to pay all the expenses of the earth work, leaving the company only to provide the rails and working stock—the length of lease of course varying, as one or other of these alternatives has been adopted. Among the lines in the latter position, are those from Orleans to Bordeaux, from Orleans to Vierzon, from Tours to Nantes, from Avignon to Marseilles, and from Paris to Strasbourg; and in the former, are the Northern Railway, those from Boulogne to Amiens, from Paris to Lyons, and several other important undertakings. The length of the leases has varied much, according to the time at which the concession took place. The Boulogne and Amiens Railway, conceded in October 1844, before the excitement of 1845, was taken for 99 years, although of great value, as commanding the traffic between London and Paris; the Northern Railway, taken during the height of that excitement, and the great advantages of which had been greatly exaggerated, has only a lease of 38 years; the Paris and Lyons, taken subsequently, has one of 41. The Lyons and Avignon is conceded for 45 years, the Bordeaux and Côte for 66. Among the lines, partly for the outlay which is borne by the government, that from Avignon to Marseilles has a lease of 33 years, during which it is calculated it will produce 10 per cent. per annum to the shareholders, while the less lucrative line from Orleans to Bordeaux has only one of 26 years. The Paris and Strasbourg Railway is conceded for 44 years, and that from Tours to Nantes for 34. By their acts, the various railway companies have a certain maximum tariff imposed upon them, under which they may make any alteration, but which they cannot exceed. These rates are 1s. 6d. per mile for a first-class passenger; 1s. 4d. for a second-class; and 9d. for a third-class passenger. For goods, the maximum rates allowed vary on each line, and are generally much higher than those actually charged on lines already at work. French railway legislation is confused, and, in many instances, faulty; while no one can now be blind to the evils of reckless competition, induced by the system of putting the railways up to auction. On the other hand, the absence of parliamentary expenses, and the recognition of the principle that the first thing when a railway is to be made in any particular district is to get a decision from the Chambers respecting the exact route to be taken by it, so that no surveys need be undertaken by the company until this is determined upon, contrast favourably with the course of procedure adopted in this country. On the whole, however, many of the strictures on the French system of railway legislation made by Mr. David Salomon in the lucid and interesting comparison between that system and the one pursued in this country, contained in his recent pamphlet, will be found to be correct.

We have now entered into all the details it was our intention to touch at in the course of this brief investigation, but the whole subject will be probably rendered clear by a tabular view of the share capital of the various French railway companies, which we subjoin:

<table>
<thead>
<tr>
<th>Name of line</th>
<th>Paid-up capital</th>
<th>Capital not called</th>
<th>Total share capital</th>
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<tbody>
<tr>
<td>Andrésieux and Roanne</td>
<td>...</td>
<td>...</td>
<td>£ 800,000</td>
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<tr>
<td>Avignon and Marseilles</td>
<td>£ 800,000</td>
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<td>£ 800,000</td>
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<tr>
<td>Bordeaux and Côte</td>
<td>1,120,000</td>
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<td>Tours and Toulouse</td>
<td>200,000</td>
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<td>200,000</td>
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<td>150,000</td>
<td>1,500,000</td>
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<td>Central line</td>
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<td>Dieppe and Pécamp</td>
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<td>Grand, Conne</td>
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<td>640,000</td>
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<tr>
<td>Lyons and Avignon</td>
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<td>4,800,000</td>
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<tr>
<td>Mulhouse and Lanna</td>
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<td>2,300,000</td>
<td>4,800,000</td>
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<td>- Tours</td>
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<td>- Senlis</td>
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<td>- Strasbourg</td>
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<td>1,680,000</td>
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<tr>
<td>- (Left Bank)</td>
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<td>440,000</td>
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Total £21,488,000 £27,638,000 £49,146,000

The following description will explain the method of its working:

A and B represent a front elevation of the wheel; the buckets on the side A, are placed in an inverse direction to those on the side B; C is an over-shot launder, or water-course, flowing out to B; D, a backshot launder, conducting the water on to A, which acts in a reverse manner to that of B; E, a reversing gate, hung on a centre, and having a hollow quoin, similar to a common navigation lock-gate. F, a lever, attached to the axle of the gate, E, which, with its connecting pulleys, H and J, is made to turn the water alternately off and on to the over-shot and backshot launders, C, and D; G, the stopgate; H, the over-shot pulley; J, the backshot pulley. K, the stopgate pulley; having a graduating plate, E, attached for the purpose of regulating the feed. L, head, or reservoir. M, the water-way of back-shot launder, D; when the wheel is set in motion, the lever F, is
pulled over, and the gate G, raised; the water then flows on to the overshot section B. On the signal being given to stop, the gate G is shut down; and the water in the launder G is just sufficient to drive the wheel half a revolution, when it stops for want of its propelling power. On the signal being given to start in a reverse direction, the lever F, is pulled over; and on the gate G, being raised, the water flows on to the backshott section A, and thus alternately. Thus, nearly the whole of the gravitating force of the water is applied in a direct manner, and must save, independent of the cost of construction, and liability of breakage in gear-work, a great amount of power, which, where water is scarce, is a considerable advantage.—Mining Journal.

REGISTER OF NEW PATENTS.

GAS IMPROVEMENTS.

George Lowe, of Finsbury Circus, civil engineer, for "Improvements in the manufacture of, and burning gas, and in the manufacture of fuel." Granted October 8, 1846; Enrolled April 8, 1847. (Reported in the Patent Journal.)

This invention relates firstly, to a preparation of gas, by mixing with it, pitch, oil, fat, or other hydro-carbonaceous matter, and making gas therefrom; secondly, to a mode of arranging apparatus for purifying gas; thirdly, to improvements in making gas from coal and other matters rich in carbon, by introducing steam highly heated into the retorts used for that purpose; fourthly, to improvements in Argand gas-burners, whereby the gallery or apparatus for supporting the chimney is made to rise on a screw, so as to adjust the admission of the air to the flame; and fifthly, to certain means of manufacturing fuel from peat by causing dry blocks of peat to be saturated with pitch, oil, or other hydro-carbonaceous matter. The peat, after being dried and piled in a square iron vessel, about eighteen inches deep, until two or three inches of the top; a quantity of resin, tar, or other hydro-carbonaceous matter, highly heated, is run into the vessel till the peat is entirely covered; heat is also applied to the bottom of this vessel, in which the peat is kept for about an hour, in order to induce the hydro-carbonaceous matter to enter the peat; it is then run off, and the cakes of peat thus saturated to be placed on shelves or racks, and allowed to drain the unabsorbed matter from the surface thereof. A method in which the patentee considers preferable to the foregoing is, instead of placing the dry peat in an open vessel, he introduces it into a close vessel, similar to that used in the well-known method of treating wood in which he forms a vacuum by steam or otherwise, and then allows the heated matter to run in, and afterwards forcing it in with considerable pressure; the peat is permitted to remain in this state for about half an hour, when it is suitable for the purpose of being used; the unabsorbed matter being drained from the surface as before. Where tar is used the patentee prefers mixing it with about from five to ten per cent. of quicklime in a state of powder.

The second part relates to an apparatus for purifying gas, and which consists of two chambers placed one above the other, filled with coke, thereby splitting off the pitch and the like matters, and to a pipe or pipes, as the scrubber: the chambers containing the coke are divided by a space containing an apparatus for distributing a weak ammoniacoal liquor on the coke contained in the lower chamber; this apparatus, which forms the novelty of the invention, consists of two or more arms, placed on an axis, on which it revolves horizontally, each arm being perforated with a number of holes on one side, at different distances from the centre or axis; the holes in one arm being on a different side to that of the other, any liquid being allowed to pass into it; causes it to rotate, and thereby distribute the liquor over the coke. The principle of this will at once be recognised to be the same as Barker's mill, and will be readily understood. The upper chamber is furnished with a similar apparatus, which supplies it with water, or water slightly acidulated with sulphuric or sulphurous acids, in a similar manner to the other; the weak ammoniacoal water, or acidulated water, are contained in reservoirs above the chambers, the fall propelling this apparatus as before described. The coke in the upper and lower chambers is sustained on gratings, allowing the gas to pass freely through, which enters from the condenser by a pipe at the bottom, and passing through the chambers of coke, escapes from the upper chamber, partially freed from ammoniacal acid, but it is not absorbed by it; the gas is thus purified, and the usual process of purifying gas, but he prefers that it should take place after that process.

The third improvement, for the method of introducing highly-heated steam to retorts during the production of gas or other matters, rich in carbon, is as follows:—Steam being generated in a suitable boiler, is allowed to flow freely into the retort, at a point farthest distant from that at which the gas escapes; the steam in its passage from the generator to the retort is passed through pipes, heated to a great degree, in a similar manner to that employed for obtaining the hot blast, used for smelting iron and other purposes; it is well known that this method of heating steam does not materially interfere with the pressure at which it may be generated, and which should not be greater than that at which the gas is produced, as it would cause too great a flow into the retort, neither should it be allowed to flow during the whole time of one charge, and, therefore, the pipes must be furnished with suitable stop-cocks, and each retort furnished with a gas-burner, so as to enable the workmen to judge when the jet of steam should be discontinued. The gas-burner will be adjusted in height, in order to bring the jets to less colour, the regulation being easily acquired by a little experience.

The fourth improvement consists in constructing the gallery which carries the chimney, so that it shall be adjustable, in order to regulate from time to time the heat of the fire, in the same manner that the chimney for combustion shall be made to impinge on the exterior of the furnace: the method shown in the drawings attached to the specification, is by cutting a screw on the inside ring of the gallery, and on the outside of the burners; it will, therefore, be apparent that by the screw being raised or lowered, it, and at the same time the contracted part of which for deflecting the air will either be brought nearer to or farther from the jet of the burner, according to that which may be considered the best position, and will be regulated in some measure by the extent of flame required; when the air is deflected by a cone inside the chimney, it is attached to the gallery and moves up and down with it; other means besides the screw may be employed for raising and lowering the gallery, and thereby regulating the admission of air as before explained.

Fifth and lastly, this invention relates to the treating of dry peat and hydro-carbonaceous matter for fuel, in the same way as that described under the first head of this specification. Having described the nature of his invention, and that which he considers the best means of carrying the same into effect, he wishes to inform the public that he does not confine himself to the precise details herein described, so long as the principle of either part of his invention be retained; but what he claims is,—first, the mode of treating blocks of dry peat for the manufacture of gas by placing thereto a suitable vessel and providing them, in highly-heated retorts, pitch, oil, fat, or other hydro-carbonaceous matter, and also the saturating blocks of dry peat, by placing them in closed vessels. Second, the application of saturating percolating or impregnating vapours or gas to apparatus, such as before described. Third, the application of highly-heated steam introduced into retorts when making gas from coal or other matters. Fourth, adjusting the admission of air to the outer flame of Argand burners to prevent blow backs and spray, and lastly, the saturating blocks of dry peat, for the purposes of fuel, with resins, pitch, oil, fat, or other hydro-carbonaceous matter, by means of an open vessel and heat, and also by means of a closed vessel, as hereinbefore described.

GUN COTTON.

John Taylor, of the Adelphi, gentleman, for "Improvements in the manufacture of explosive compounds."— Granted October 8, 1846; Enrolled April 8, 1847. (A communication.)

This improvement relates to manufacturing an explosive substance, by the combination and union of nitric acid, sulphuric acid, and nitroglycerin or nitro-glycerine, the latter of which is derived from vegetable matters. The specification describes the converting of cotton into an explosive substance, as the patentee considers cotton the most available substance.

In preparing cotton, take nitric acid of sp. gr. from 1,425 to 1,500, and sulphuric acid of sp. gr. 1,900, and mix the acids in the proportions of three parts sulphuric acid, and one part nitric acid; they are then allowed to cool down to between 50° and 60° F. and then rough cotton, previously freed from all extraneous matters, is to be immersed in the mixed acids, in a suitable vessel of glazed earthenware, in so open a state as possible, occasionally stirring it with a glass rod; the excess of acid is to be drawn or poured off, and the cotton pressed with an earthen presser, lightly, so as to separate the principal part of the acid. The cotton is then covered and allowed to remain for one hour; it is then pressed, thoroughly washed in running water, to divest it from all free acid until it does not in the least affect litmus-paper; afterwards it is to be partially dried by pressure, and to inure its freedom from free acid, it is to be washed in a dilute solution of carbonate of soda, made by dissolving equal parts of carbonate of soda in a gallon of water, and put under a press, and the excess of carbonate of soda solution pressed out, which at the same time renders the cotton nearly dry. It is then washed in a solution consisting of one ounce of pure nitrate of potash in a gallon of water, pressed, and dried in a stove or room heated by steam or hot water to the temperature of from 150° to 170° F. The nitrate of potash seems to increase the explosive force of the cotton. In using cotton prepared as above, it must be borne in mind that to produce the best effect, much less must be used than of gunpowder, that is, is about the proportion of three parts of the prepared cotton to eight parts of Tower proof gunpowder.

Explosive cotton may be prepared by using nitric acid only, but the proportion of it in using the above mixture is much less. In using cotton prepared as above for the purpose of propulsion, as it is of a fibrous nature, it may be rammed at once into the gun, or if made slightly moist and pressed into a mould, it will, when dry, retain its form, and then may be made into cartridges.
The patentee does not confine himself to the specific gravity of the acids above mentioned, neither to the exact process herein described, but what he claims is, the converting vegetable matters into explosive substance by means of nitric acid.

FILTERING APPARATUS FOR STEAM ENGINES.

Nicholas Harvey, of the Hayle Foundry, Cornwall, engineer, for "Improvements in filtering of water for steam engines and boilers."—Granted September 3, 1844; Enrolled March 8, 1847.

These improvements relate to the introduction of a filterer in connection with steam engines and boilers, for the purpose of preventing incrustation, by packing in a vessel a, compressed sponge b, or other filtering medium, between two perforated plates c, as shown in the annexed figures. The supply of water is forced through the sponge by the action of force pumps; and during the passage of the water, the mud or sediment is deposited in the vessel f, from which it is occasionally removed.

Fig. 1, is a vertical section of the apparatus, a is a cylindrical case, b the sponge or filtering medium compressed between two perforated plates c, the pressure on the top plate being regulated by the weights d; the sediment is deposited on the funnel-shaped diaphragm e, and then passes through the aperture in the bottom into the vessel f; at the top of the vessel is a funnel g, with a cock for the purpose of introducing water to the sponge or filtering medium; h is the feed pipe for supplying the filterer with water, and i the feed pipe to the boiler; j is a pipe for drawing off the sediment from the vessel f.

Fig. 2, shows the apparatus connected with the hot well, and is similar in principle to fig. 1.

FLATTENING GLASS KILNS.

Henry Deacon, engineer, of Eccleston, Lancashire, for "Improvements in the construction of flattening kilns."—Granted September 26, 1846; Enrolled March 26, 1847.

These improvements relate first to the introduction of a moveable bridge, or partition to close the aperture between the flattening kiln and the piling kiln, used in the manufacturing of glass, and in the application and arrangement of wheels and rails to the floors of the kilns, and to the flattening stone. The bridge is similar to those generally adopted by iron masters, engineers, and smiths, for furnace doors, by constructing a frame of wrought or cast iron, to cover the opening between the kilns; this is filled full of fire-bricks, and supported from the end of a rod passing through the roof of the kiln, and attached to the end of a chain, which after passing over pulleys, has a counter-balance weight attached to it, in a position for the workmen to open or close the communication between the kilns.

The patentee states that this moveable bridge is very useful in bending glass for tiles, or for roofs of conservatories, &c. The mode of manufacture is as follows: having placed the mould upon which the glass is to be bent on the flattening stone, the glass is inserted through the push hole, where, after it is properly heated, it becomes the shape of the mould; the communication between the kilns is opened by raising the bridge or partition, and the mould is pushed back into the piling kiln, where it is removed from the mould by suitable instruments used for that purpose, and may be piled there, either on its edge or on its side; the bridge is then closed, and the operation of preparing another article is commenced as before.

The second improvement relates to building in the floor of the spreading and piling kilns, and furnishing the spreading stone with suitable rails, to run thereon. The wheels employed for this purpose are of cast iron, about 17 inches diameter, by an inch broad in the rim; they are built in the floors of the kilns in two rows, each row about two thirds the breadth of the spreading stone from the other, and the wheels from centre to centre, at a distance in proportion to the length of the stone; the floor is built close up to the sides of the wheels, till nearly on a level with the periphery; any dust or broken glass falling down into a chamber below, from whence it may be drawn by suitable instruments. The rails on which the spreading stone is supported is straight along the lower edge, or that which comes in contact with the wheels; the upper edge has several raised clipping pieces which are reduced until the stone is fairly bedded thereon; and furnished with lugs at either end to embrace the stone and keep it in a proper position with the rails. One of the rails is furnished with a groove in the direction of its length rather wider than the periphery of the wheels, which guides the carriage as it traverses backwards and forwards on the circumference of the wheels, from the spreading or flattening kilns, to the annealing or piling kilns.

TUBULAR BRIDGES.

William Fairbairn, of Manchester, civil engineer, for "Improvements in the construction of iron beams for the erection of bridges and other structures."—Granted October 8, 1846; Enrolled April 8, 1847.

These improvements relate to the construction of iron beams or girders, for bridges and other structures, by the use of plates of metal united by rivets and angle iron. Fig. 1, is a side elevation of part of a hollow iron beam, or girder; and fig. 2, a transverse section,—a, side plates; b, bottom plates; c, d, interior vertical angle or T iron for connecting the plates; a, with the covering plates, or styles, d, and rivets. The side plates are to be put together with butt joints, and riveted in a similar manner to boiler making. The top of this hollow beam is formed of two or more rectangular cells, composed of plates f, and angle iron g, fastened by rivets, and attached to the side plates a, by the angle iron i. The bottom of the hollow beam or girder is formed of iron plates b, fastened by means of covering plates over the cross joints, and rivets attached to the side plates by angle iron. The top of the hollow beam, or girder, may be constructed of cast or malleable iron, either cellular rectangular, as shown in fig. 2, or of an elliptical or any other suitable form, to prevent the top giving way, or pocketing from compressions; or other methods may be employed, such as thick metallic casting, or lighter iron plates, arranged so as to form hollow cells. The bottom of the hollow beam or girder may be also constructed of a series of plates, b, either of single or double thickness, riveted together; the plates are united to each other by alternating or breaking joint, and by a peculiar mode of riveting, called by the inventor chain-riveting, as it forms an entire chain of plates throughout; and the structure so unites the covering plates over the joints as not to weaken or otherwise injure the plates by rows of transverse rivet holes, but to form a connecting link to each joint, by a series of longitudinal rivets or pins. The drawings attached to the specification show various forms of girders to render them applicable to factories, warehouses, dwelling-houses, &c.
IMPROVED WATER CLOSETS.

Joseph Bunnett, of Deptford, Kent, engineer, for "Improvements in water closets, part of which improvements is applicable to other useful purposes." Granted April 15; Enrolled Oct. 16, 1846.

Fig. 1

This invention relates to an improved form of water closet, for shipping, and which is also applicable for dwelling-houses, where the sewer or outlet may be below the water closet. Fig. 1 is a section, and fig. 2 a side view, of a water closet with the improvements. The basin is supported upon a flanged elbow piece \( f \), and bolted to a horizontal pump or piston barrel \( G \), terminating in a delivery piece \( g \). Within the elbow piece \( f \), there is a valve, opening towards the piston barrel, which valve is fitted and dropped into its place upon a seating, as shown in the drawing, previously to the basin being fixed. Within the piston barrel \( G \), there is a piston, furnished with a valve, opening towards the delivery end of the barrel; this piston is worked by two horizontal piston-rods, passing through stuffing-boxes, only one is seen in fig. 1, but the ends of both are shown in fig. 2. On the upper part of the delivery piece \( B \), upon which an union screw is cut, for the attachment of a soil pipe, which may be taken to the most convenient point (either above or below the water-line), for delivering the matters ejected by the piston. \( L \) is the handle, working through a slot in the seat of the closet, by which the action of the closet is effected, through levers and connecting rods, working the horizontal piston-rods, and also for giving motion to a rod which opens and closes the cock \( B \); this cock communicates with the water on the outside of the ship by a pipe on its underside, and with a reservoir or cistern pipe \( A \) above, and also with the basin of the closet. On raising the handle \( L \), motion is given to the cranked levers, which cause the piston with the valve to traverse in the barrel \( G \), as shown by the dotted lines (fig. 1), and expel whatever substances have passed through the valve. The motion of the levers will at the same time open a communication with the pipe \( A \), the contents of which will rush down into the basin. On pressing down the lever, the piston will retrograde in the barrel \( G \), and whatever substances have passed the valve \( f \), will be forced through the valve in the piston, into the piston barrel, and be ejected by the next motion of the piston. The connection with the external water will, by the same movement, have been opened, and the pipe \( A \) will become filled, ready for rinsing the basin on the next movement of the pump. In order that the pipe \( A \) may perform the office of an elevated reservoir or cistern, it should be from two to three feet higher than the top of the basin; it is fitted with a floating air-valve at its upper end, which is closed by the rising of the water when the pipe is filled, but opens and admits air when the pipe is discharging its contents into the basin. The pipe must be of such capacity as to hold the quantity of water required for the use of the basin. The patentee prefers a small pipe (say \( \frac{1}{2} \) inch diameter), and leads it in a convoluted or zigzag form, as shown in the engraving, so as to maintain a head of water as long as possible, to give the necessary force to the jet passing through the fan. If the water closet is to be fixed in a ship, so that its seat will at any time be less than two feet below the level of the external water, the water will not rise high enough in the pipe \( A \), to acquire sufficient force by its gravity to cleanse the basin. In such cases the supply of water is to be drawn by means of a small force-pump or pumps worked by the lever, as shown in fig. 3; these pumps drive the water through a pipe carried up one foot or more higher than the level of the external water line, so as to guard against any undue influx of water through the pump valves.
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LIFE BUOYS AND BOATS.

ARTHUR HOWE HOLDSWORTH, Esq., of Brookhill, Dartmouth, Devonshire, for "Improvements in buoys, and in giving buoyancy to boats."—Granted August 29, 1845; Enrolled February 29, 1847.

This invention relates to the employment of India-rubber for tubes, and vessels, prepared as described in the specifications of patents granted to C. Haddock and A. Parkes.

The life-buoys are tubular vessels of prepared India-rubber, filled with air, like those described for boats; each when thrown into the water will constitute a life-buoy, and cords may be attached to them, to admit of a person securing himself thereto. "Watching buoys" may be made of any form, but the patentee prefers a globular shape, or a cylinder with hemispherical ends; the buoys are enclosed in a net of strong cord, and the mouth secured to a ring, to which the mooring chain is to be fastened.

For the purpose of giving additional buoyancy to boats, tubular vessels of prepared India-rubber are filled with air, and attached by cords to the raisings under the thwart, from the head to the stern, or placed across the boat, beneath the thwart, and secured thereto by cords. Apertures five by three inches are made in the sides of the boat (the bottom being level with the thwart), and each furnished with a valve, opening outwards, so that water may be discharged but cannot enter through them. When applying this invention to the quarter boat of a large ship, four apertures in the sides are made with valves; to each side of the boat are attached six tubes, six feet long and six inches in diameter, four being secured to the raisings below, and two to the raisings above the thwart; each tube is capable of supporting from 74 to 80 lb. when immersed in the water. The reason for placing the tubes at the side, rather than across the boat, is, that they may be more readily restored to an even keel, if, in being lowered from the ship, or from any other cause, she should be thrown on her side and suddenly filled with water; when this happens, the buoyancy of the tubes causes the boat to rise and the water to flow from it through the apertures, until the gunwale becomes elevated to a height above the surface of the sea, corresponding to the difference in height between the apertures and the gunwale; the crew can then easily throw out the remainder of the water. Boats intended to be used solely as life-boats, have six or eight apertures in their sides, and in addition to the ordinary raisings under the thwart, one or two more are fixed below them, and to these additional tubes are secured.

Fig. 1, is a side elevation of the machine, partly in section, to show the interior construction; and Fig. 2, is a plan, also partly in section. In this arrangement two horizontal fixed cylinders are employed, furnished with dies at their outer ends, and doors on the upper part for the admission of clay, which is forced out through the dies by the action of pistons working within the cylinders, in the manner commonly practised. The peculiarity consists in the mode of working the pistons. A, a, are the horizontal cylinders, secured to a bed-plate; b, b, are one of the tubular vessels attached thereto; g, g, the additional raisings or rails under the thwart; f, f, the side and bottom planks; h, h, the ribs e, e, the internal bottom boards; e, e, the corresponding tubular vessels. i, i, is a tube connected to the under side of the thwart by cords, for which purpose the rails g, g, are applied; k, k, are the valves or doors for closing the apertures in the sides of the boat; they turn on a hinge at the upper part, and are furnished with weights to cause them to close readily, and be kept closed, when required, by means of cords.

BRICK MACHINE.

FREDERICK RANSOME, of Ipswich, engineer, and JOHN CRABB BLAIR WARREN, of Little Horksey, Essex, clerk, for "Improvements in the manufacture of bricks, tiles, pipes, and other articles composed of plastic materials, and in the preparation of plastic materials to be used for such purposes."—Granted July 6, 1846; Enrolled January 6, 1847.
radially from the central shaft, and at an inclination from the perpendicular. When these hoppers are used, it will be necessary to stop the supply of clay as the pistons advance to press it through the dies: this may be done by a sliding-plate, or a valve, opening inwards, being made to close the bottom of the hopper; or the pistons may be provided with a shield to shut out the further supply of clay as they advance. In either case it will be requisite to stop the rotation of the sweepers or arms of the pug-mill.

INCUBATION OF BOILERS.

MAXIMILIAN FRANCOIS JOSEPH DELFOSSE, of Regent-street, Middlesex, for “Improvements in preventing and removing incrustation in steam-boilers.”—Granted August 25, 1845; Enrolled February 25, 1847.

This invention consists in adding to the water used in steam-boilers a mixture which acts on the precipitable matters in the water to prevent them forming any incrustations on the interior of the boiler, and which will also remove any incrustations that may have been previously formed. This mixture the patentee has named the “antiputrefying mixture;” it is composed of dry tannic or gallic extract, hydrate of soda, or soda deprived of its carbonic acid, matte of soda, and subcarbonate of potash. The proportions will vary according to the impurity of the water, and to the boiler being stationary or locomotive. If the boiler be stationary, and fed with fresh water, the amount of antiputrefying mixture for 366 hours consumption per horse-power may be made up by 12 oz. of hydrate of soda, 24 oz. of hydrate of soda, 2 drachms of dry tannic or gallic extract, and 6 oz. of subcarbonate of potash. For locomotive boilers, travelling on an average about 140 miles each day, the quantity of the mixture per horse-power is increased one-fifth. If the water be brackish, or a mixture of salt water and fresh (such as the water of tidal rivers), the matte of soda is omitted, and instead 6 oz. are used for 24 oz. of hydrate of soda, and five drachms instead of two of the dry tannic or gallic extract; the mixture is also prepared in this manner when seawater is used in the boiler. The patentee prefers introducing the mixture into stationary boilers in quantities sufficient for two, three, or more days; but locomotive and marine boilers are to be supplied daily with a portion of the mixture, corresponding with the amount of duty to be performed.

IMPROVED RAILWAY CHAIR AND SLEEPER.

M. M. Bessas-Lamfgie and Henry, of France, propose to combine the ordinary railway chair and the sleeper, by forming them of cast-iron in one casting, as shown in the annexed figure; i is a cast-iron plate, and b & c the chairs, which are kept at the proper gauge by an inch round wrought-iron bar d passing through the chair, and secured thereto by vertical pins e; the underside of the plates are grooved or ribbed to prevent them slipping.

HISTORY OF ENGINEERING.

BY SIR J. HENRI, PRESIDENT OF THE INSTITUTION OF CIVIL ENGINEERS.

(Concluded from page 119.)

IRON VESSELS.

The very important improvement in the introduction of iron for the construction of vessels, enables us to combine lightness and elegance of form with strength and durability. For this valuable addition to marine architecture we are indebted to Aaron Manby. In 1820-21 he constructed at Horsey, near Birmingham, a wrought-iron boat, called the ‘Aaron Manby,’ 120 feet long and 18 feet beam, and when laden drawing 3 feet 6 inches water; it was propelled by Oltham’s feathering paddle-wheels, worked by a single engine of 80 h.p., and was built for the purpose of plying on the river Seine. The boat was completed in 1821-22, and was navigated across the Channel by the present Sir Charles Napier, who was deeply interested in the undertaking; it was not only the first iron vessel that ever made a sea voyage, but also the first that conveyed a cargo from London to Paris direct, without transhipment. She continued plying between Paris and Lille for several years, until superseded by other more powerful and improved boats; the hull is yet in existence, and is still used with new engines on board, as are three others, which were built about the same time. In 1832 Maudslay and Company built four iron vessels for the East India Company for the navigation of the Ganges, and fitted them with oscillating engines, of the united power of 60 horses; they were 120 feet long, 24 feet beam, and drew 2 feet 6 inches water; they were so successful that six more were ordered shortly afterwards. The use of iron, however, did not make much progress until recently, on account of the prejudices and obstacles which generally stand in the way of inventions that invariably impede the progress of all great inventions. At present, iron is much employed for vessels, and promises in many cases to supersede timber. Objections against its general adoption have been urged, on account of the bottoms of the vessels being liable to become foul; the gales, and for the purpose of war, the splinters of the iron when struck by shot are said from recent experiments to be more detrimental than from wood. The art of building iron vessels is, however, in its infancy, and it is very probable that further experience and investigation will, in a great measure, obviate the evils. The strength, lightness, and other qualities that have been mentioned, give it great advantages for the construction of fast-sailing passage-vessels, and the water-tight bulkheads constructed with it, give great additional security in case of accidents; these water-tight bulkheads are now almost universally adopted; but the precise date and origin of their introduction is not very clear. Captain Evans, of Holyhead, proposed them for timber vessels in the year 1826, and soon after that time they were used in an iron vessel constructed by him. Examples of the importance that have frequently occurred, demonstrating the necessity of their introduction into all vessels, whether for water or sea navigation.

SCREW PROPELLING.

Great has been the result of steam navigation under the paddle-wheel system, still as perfection is approaching, it cannot be denied, that it has several disadvantages when applied to sea navigation during stormy weather, which is most desirable to obviate. Paddle-wheels act to the greatest advantage in smooth water, but when loaded, the entire action of the paddle-wheels during the rolling of the vessel, in a heavy sea, prevents that uniformity in the action of the engines, which is necessary to insure their greatest effect, and although this may be lessened, to a certain degree, by the use of mechanical or feathering paddle-wheels, many have stated, the complexity of their construction is objectionable. The resistance, offered by the paddle-boxes to the wind, in addition to their top weight, has a sensible influence in diminishing the speed and effect of the engines, and in ships of war, the general space occupied by the broaches of the vessels, materially interferes with the efficiency of the batteries; the wheel, as the principal propelling agent, being constantly exposed to shot, is under very considerable risk of having its efficiency impaired. The idea, therefore, of substituting for it some other propelling agent, had long been a favourite object of investigation amongst engineers. The origin of this, like every other great invention, is very difficult to be ascertained with accuracy, as the same idea not infrequently occurs at the same time to different individuals, totally unconnected with each other. The first idea of screw-propelling was, very probably suggested to fishes, whose chief propelling power exists in the tail, as also from the common and ancient practice of sculling a boat from the stern. A rude idea of stern-propelling was attributed to Duguet in 1777, but it was so totally different from the present invention with different propellers, and attributed the idea to the invention of a system of two boats, connected together by two cross-beams with a screw, inserted between the boats; this double boat was moored to a post in the river, and the current, acting upon the screw, turned it round, the motion this generated being communicated over pulleys, to which were attached the vessels to be drawn along; this plan may be likened to the effect of a water-wheel, or any other fixed fixed mover; still there is an idea of the screw, which, if pursued, might have been converted into screw-propelling. In 1798 Paimon proposed the sternphore to be applied to the bow and stern and sides of a vessel horizontally, but does not describe how it was to be moved. Lyttleton also proposed a screw-propeller in 1794. The first practical experiment, however, appears to have been made by Shorter in 1802, with a propeller of moveable spindle, applied to the stern of a vessel in the Thames. He afterwards tried several screw propellers, particularly in the ‘Superb’ line-of-battle ship in Gibraltar Bay, worked by a screw by the intervention of the capstans, by which the vessel was moved through the water at the rate of about 3 miles an hour. Shorter does not describe the kind of propeller used in this experiment, although Napier, who afterwards proposed a similar plan without knowing what had been done, when he accidentally found Shorter, had from him an account of his experiments, and saw a large collection of propellers applicable to the bow, stern, and sides of vessels. Napier acknowledged and admitted that Shorter had conceived almost every possible kind of arrangement, and that his models and plans comprised most of the systems since made public by different parties; Shorter also exhibited several experiments with different propellers, and attributed the best results to a propeller with a single blade projecting from the axis. In 1824 a work was published under the direction of the French government, describing the several models...
of propelling in use in America, on the principle of the screw; one plan was to have a barrel in the bow of the vessel nearly as long as the vessel itself, with a screw revolving in it to produce a forward motion. Another form of this system was to have a double screw between two boats. In 1825 a company was formed for applying Brown's gas vacuum engines to navigating boats on canals, and a premium was offered for the best invention for propelling boats with or without auxiliary sails. In some cases, the vacuum engine will act directly upon the propeller shafts, by cranks, without the intervention of wheels; the propeller shaft will make from 50 to 60 revolutions per minute, and the speed of the vessel will be from 5 to 7 miles an hour; this velocity will enable them to enable them to engage easily and to pass through the water with a high velocity, and the free uninterrupted use of their batteries, they will be fully equal to cope with any vessels of their class. The 'Amphion' frigate is also being fitted with a screw propeller, to move with a greater velocity than the 'Apollo.' The said company, by a patent dated July 25, 1825, limited to a pitch of 2 feet 5 inches. With this vessel he obtained a speed of from 7 to 8 miles an hour; he then tried her on the sea between Ramsgate and London, and she answered very well in driving against the wind in a heavy sea. Upon the conclusion of the experiment, the company, called the Ship-Propelling Company, was formed, Smith being their treasurer, and under his directions a vessel, called the 'Archimedes,' of 232 tons burthen, was built in London by Whithurst; she was 125 feet long and 21 feet 10 inches beam, having 9 feet of water between her 9 and 10 feet; she was propelled by a pair of engines of the united force of 400 horse-power. The machinery, which were made by Messrs. Rennie, instead of being placed in the vessel, was used as paddle-steam boats, were placed longitudinally, their engines were upon the direct-action principle, and their power was applied to work the shafts, which were placed, by means of two spur-wheels with teeth of hornbeam wood, and two pairs of iron teeth working into each other, the motion of the propeller shaft being 9 to 1 or, in other words, when the engine made 25 strokes, the propeller made 9 to 1. The vessel went through the water, as she was united to the shaft, by means of a water-tight stuffing-box passing through the stern of the vessel. The propeller at first consisted of a single-threaded screw; but this not answering so well, another screw was employed, with two threads of the same diameter, and two feet pitch. The 'Archimedes' obtained a velocity of 9 miles per hour through the water, and proved herself an admirable sea-boat, going head to wind in a heavy sea, and she established beyond all doubt the success of the invention, and its application to paddle-wheels in many cases; still, however, much remained to be done before perfection of the invention, from which useful results may be expected. She is 322 feet long, 50 feet 6 inches beam, draws 16 feet of water, and is 344 tons burthen. She is propelled by the screw, with a pair of engines of the united force of 1800 horse-power; one is 300 horse-power, and the other is 1500 horse-power, which, when the vessel was a screw-boat, appears peculiarly well adapted; for whilst on steaming the vessel, appears peculiarly well adapted; for the screw, being only applied, it seems, at the expense of much time and labor, and no advantage however, as to speed under all circumstances. In 1840, the 'Dwight' of 210 tons burthen, which was the first screw vessel ever commissioned in the British navy, was constructed. The engines, of 120 horse-power, upon the direct action principle, were attached to two spur-wheels with two pinions for working the screw upon the propeller shaft, on the same plan as the 'Archimedes.' The 'Dwight' proved herself an excellent sea-boat, and was steamed at the rate of 8 miles per hour through still water. The 'Rattler' was the second screw propeller vessel introduced into the navy. She was 176 feet long, and 32 feet 8 inches beam; drawing 11 feet 3 inches water, carrying 20 guns, and was about 888 tons burthen. The engines, of 300 horse-power, were constructed by Messrs. Maudslay and Field; and her screw, which was 10 feet diameter, and 11 feet pitch, made 103 revolutions per minute, being in the proportion of 4 to 1 of the speed of the engines; her velocity through still water was 9 miles per hour, and she proved a good sea-boat. All these have been surpassed in speed by the Royal yacht, the 'Fairy,' built for her Majesty, by Ditcheburn, with engines by Penn; she is 250 tons burthen, with two oscillating engines of the united force of 125 horse-power, driving one spur-wheel and one pinion; the screw consists of two blades, and makes 250 turns per minute, being the proportion of 5 to 1 of the moving power. The speed of the 'Fairy' is 15 miles per hour through the water. The merits of the screw system have now been so completely tested, that the Government have determined to introduce it more generally into the navy, particularly for guard ships; these vessels are to be of two classes, line-of-battle ships and frigates; the former having combined engines of 350 horse-power, the latter 350 horse-power; the cylinders of the engines are 4 feet in diameter, in some cases, they will be 5 feet, will act directly upon the propeller shafts, by cranks, without the intervention of wheels; the propeller shaft will make from 50 to 60 revolutions per minute, and the speed of the vessels will be from 5 to 7 miles an hour; this velocity will enable them to pass through the water with a high velocity, and the free uninterrupted use of their batteries, they will be equal to cope with any vessels of their class. The 'Amphion' frigate is also being fitted with a screw propeller, to move with a greater velocity than the 'Apollo.' 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be compressed into the smallest practicable space, still so as at the same
time to give the greatest power: in order to effect this, tubular boilers of
the most improved construction and power of evaporation; direct acting en-
GINes, in which wrought iron is substituted for cast iron whenever it is prac-
tical; the adoption of a grate which would give the least possible
storage for fuel to last for the average probable time that steam power
may be required, must be used. By the judicious combination of steam with
boiling, the time of long voyages may be materially reduced, and at the
same time considerable saving may be effected in the transport of mer-
chanics.

THE ELECTRICAL TELEGRAPH.

Connected with, and forming a most important adjunct to, the locomotive
system of communication, may be mentioned that extraordinary and useful
invention, the Electrical Telegraph.

The invention consists in directing a current of electricity through a wire or
wireless line, and conveying, by means of an electric current or galvanic cur-
rent, the intelligence to be conveyed. The galvanic or electric current may be
produced, either by a battery or by employing the natural electric currents of the earth.
The telegraph is worked by handles, which act by means of galvanism upon needles attached
to the wires at the other end of the telegraphic line, through which the gal-
vanic current is conveyed, and deflects them to points on a dial-plate, having
symbols (according to Cook and Wheatstone's system) or letters or numbers
representing the intelligence to be communicated. By this means, intelligence
is conveyed from one point to another along the line of wires, almost as
soon as it is received at each end, and thus, instead of the disadvantages of
conveying intelligence from one point to another unconnected with the rail-
way, it is of great importance in the working of the railway itself, by
preventing accidents; or in the event of an accident unfortunately occurring,
even though it be detached or disturbed, it will be known that the
section of the line is unsafe and clear the obstruction. Several persons claim the merit of this invaluable
invention; it is difficult to decide with accuracy upon the claims of priority,
larger. This has been the case with many other inventions, however, it has been
performed, which comes into play about 1810, Mr. Ronalds, of Hammersmith, is stated to have applied electricity for the purpose of
effecting telegraphic communication, and succeeded so far as to complete
a current through eight miles of wire. He also employed electricity as a
lighting medium. This was about 1810. Mr. Harington, of Hammersmith, however,
was too imperfect to be of much use, but it is evident, that the
idea once propounded and partially carried into effect, to a certain extent,
establishes Mr. Ronalds's claim to the merit of the discovery. In 1830, Mr.
Ainsworth, of Hammersmith, invented the motor of the electrically driven
vessels, which was perfected by his son, Capt. Ainsworth; in 1838, and of
voltaic electricity, for the purposes of telegraphic communication, and the
principles of this discovery have, it is said, been applied to many of the mo-
}
Improvements in this useful and indeed indispensable art, in England, are we
ded to Wallisford, Heygrass, Harrison, Graham, Hooke, Cumingon,
Mudge, filicott, Sunderland, Emsworth, Arnold, Vulliamy, Dent, Poydonsab,
Parkinson, French, Kater, and others.

MINERALOGY AND GEOLOGY.

Mineralogy, geology, and mining may be said to form an important
branch in the civil and mining arts. These subjects being so closely
interwoven, the engineer will, in many cases, find himself unable to carry on
his operations with that degree of certainty and economy, which is necessary
to ensure success, and independently of their value in this respect, there
are few departments of the law despised by the mining profession as
advancement, comfort, and civilization of mankind; whilst on the other hand,
no class has contributed more to the advancement of them than the civil
engineer, so that each department is essentially allied to and dependent
upon the other. The engineer having the advantage of being provided with
a knowledge of the various strata through which he has to carry his operations;
if for a cutting or embankment of a railway, it is essential to know the
proper and rock which will stand, the value and applicability of the
material, to be used for the purpose, and the capacity for water, etc., in
order to form a correct estimate for working through them, whether for his cuttings or his tunnels. If for a canal, the
same will apply, with the addition of the knowledge of the sources from
whence his supply of water can be obtained; this latter will also apply to
waterworks, in which the knowledge of the various qualities of water
applicable to the economy of mankind is so essential. In the construction
and maintenance of harbours, it is most important to have a thorough
knowledge of the mariner and the nature of the coasts where the
harbour is to be situated, in order to render it easily accessible to vessels,
whether for commerce or refuge, for its construction in the most economical
manner, or for its maintenance, in order that the slighter matter held in
masse may be avoided, the structure of which is the subject of the
embankments against the ocean, in order that nature herself may be rendered
subservient, as far as is practicable, in affording the requisite protection;
these in as in the operations of smelting the minerals of the precious or the
more useful metals, and mineral substances, are of essential service to the
engineer and deserve his peculiar attention.

MINING.

Mining appears to have been known and practised in Great Britain from
the earliest periods of our history, for the Carthaginians are said to have
carried on the Tyre, from Cornwall; but in those early days the opera-
tions must have been rude, and merely confined to the surface. This
irons in mining art made little progress until the knowledge of chemistry, and the
invention of machinery, enabled mankind to extract from the bowels of the
earth Nature's rich treasures, to investigate their different properties, and
to apply them to the uses of life. For this purpose, the miner has to use every possible means of
to extract the water and enlarge the field of his operations has to use every possible means of
of extricable water when the ore was raised from the mine, as also aiding in
in its reduction and the extraction of the metal in its most refined state.
Thas from the bowels makes the surface and within it have been worked to an extraordinary extent, as in the case of the
Comstock lode, which is to be wrought above a mile beneath the
sea. The total quantity of coal, which has been worked and consumed, is to
between 80,000,000 and 40,000,000 of tons. Without the steam engine
these operations would be entirely paralysed, and must cease. The total
annual value of the British mineral produce is said to amount to
20,000,000 l. In this valuable department we are much indebted to the
establishment of the Museum of Economical Geology, which will be the
means of extending the knowledge and use of minerals, as well as the best
mode of obtaining them. Neither must we forget the valuable services of
Sir J. De la Beche, Croll, Gwennap, Greenough, Bauch, How-
ner, Lyell, John Taylor, Gridley, Starke, Bullock, Sopwith, Phillips, Wood, Atkinson, Beld, and others, who have contributed so largely to the
advance-

VENTILATION.

Connected with mining may be mentioned the important subject of venti-
lation, the value of which is now so universally appreciated, not only for
mines, but for buildings in general. On this subject, it is essential to have the
velocities of fresh air through apartments, so that the air shall be always as
nearly as practicable in the proper state for respiration; but in effecting
this, it is desirable that the temperature shall not be reduced too low, other-
wise the latent heat produced in the air by respiration may be prejudicial,
and subsequently, of great importance, the artificial warming of apartments is
of equal consequence, and to combine both effectually is the great desider-
atum. Heat is the great medium for producing circulation, as in the
case of the sun; heat in buildings, is to be used in the same way, and generally, of the two, is
the required degree of temperature; warm water and steam conveyed through
pipes have been employed in many cases; those systems are however the
best whereby a large body of air is raised to about 100° by passing bet-
ween cases filled with hot water, and is enabled to flow freely into the
apartments or rooms, according to the time and purpose required, to meet the
requirements of the system of the warm-
ng; by such a plan, warm water may also be supplied to any part of the
building for domestic purposes. When stoves are used, they should be
located at the top of the room, and be supplied either with air, producing any disagreeable odour; for this reason porcelain is much em-
ployed, and it is essential to have a thorough circulation of pure air where stoves are employed. Upon this important subject, much information has
been collected by the late lamented Mr. Boulton, and others, in their
reports, and the labours of Sylvester, Tredgold, Arnot, Reid, Hood, Price, C. Manby, Perkins,
Haden, Stephenson, and others.

ENGINEERING ARCHITECTURE.

The pursuits of the engineer are intimately connected with architecture, not
merely as regards construction, but in taste also; and, although it is
not necessary that he should be so thoroughly conversant with all the
details of ornament, as to be able to practise as an architect, still he should be
so far acquainted with them as to be able to carry out the leading
principles with effect, whenever it becomes absolutely necessary in the
course of his practice. The works of the engineer, associated as they are
for the most part with the great operations of nature, should be designed
and constructed so as to harmonize with them. They must strike by their
general mass and proportion rather than by trifling details or minutiae of
ornament, which as a matter of taste, would be misplaced and unnes-
necessary. It is these materials, these unadorned materials, with their
first grand object of fitness for their purpose, they should be simple,
and in a few instances where ornament may be necessary, it should harmonize
with the structure and be sparingly used.

The application of heated air for the purpose of reducing iron from the
ore (commonly called the "hot blast" system, invented by Nielson, in
1820), has produced a considerable revolution in the industrial art of the
metal, as well as in the economy of manufacturing it, and the comparative
advantages of the new and old systems requires to be fully considered in its application to construction. Cast
iron, from the rigidity and brittleness of its texture, is not so well adapted
to resist tension or the sudden irregular strain, and to combine strength and lightness; whilst cast iron is only necessary in certain cases, and is
used in conjunction with its mass in a construction to prevent or alteration of form. By thus carefully studying the different properties of the different materials, we should acquire a knowledge of the best mode of adapting them to the several purposes to which they are applied, and to the several forms best suited to their respective qualities and the objects for
by which they are employed. One of the great advantages of woods consists in the
first economy and the facility of converting it to the several purposes to which it is applied, and the
most important of these is the adaptation to be preserved, as well as the stability of the wood, the
heat, and the modes of working it became better understood, wood alone was
used in conjunction with stone and brick, both for engineering and architectural
purposes; and, notwithstanding it has been altogether superseded for many
years, its uses are now increasing, and it is used in the construction of bridges, roofs, and other works where the first outlay of iron or
stone would be too great. Enough, I trust, has been said, to show the
intimate connection of the professions of the civil engineer and architect,
and the effects of the one are dependent upon the influence and the
be desired that a harmonious understanding should be cultivated between them, as it must tend to their mutual advantage, and nothing can contribute
to this desirable object more than the meetings of this Institution, to
which it is gratifying to find so many architects have attached

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Agriculture.

Neither must we forget the comparatively recent adaptation of engineering knowledge to the advancement of agriculture, and the various improvements in its cultivation, whether by using the steam-engine or the atmospheric life, whether by raising the pitch of the soil, or even by making it more productive of its products to domestic uses, is a much more economical and expedient manner than formerly, and to derive a greater profit from his exertions.

In the construction of agricultural implements, Measures, Ransomes, May, Cotton, and others, have already distinguished themselves.

In modern agriculture, under-draining forms an important and valuable principle; stagnant water generally has proved to be injurious to agriculture, and it is, I believe, now universally admitted that without thorough drainage it is impossible to cultivate the soil effectually; for this purpose the whole area formed by tiles laid from 1 foot to 4 feet below the surface, are generally adopted; the tiles are made by machinery invented by the Marquis of Tweeddale, Ainslie, and others, at a trifling cost; the surface water is thus conveyed from the land into the adjacent main drains and thence to the rivers. Water is the grand natural fertilizing agent, and any amount of care in its proper distribution is well bestowed; it is, therefore, worthy of consideration, whether in hilly countries and districts subject to alternations of dry and wet seasons, it would not be advisable to build up reservoirs which might be used during dry seasons for irrigation, in the manner adopted by the ancients; by this means, districts might be cultivated with advantage, which now are comparatively sterile.

Surveying.

Land and Maritime Surveying form an essential department in the profession of a civil engineer; without a correct knowledge of the former, it is impossible for him to lay out and determine in the best manner the proper lines of communication in a district, whether by canal, railway, or common road; and without a knowledge of the latter, it is equally difficult for him to decide upon the best situation for a port, and the most advisable means of improving and maintaining it. In these valuable departments much progress has been made. The great Trigonometrical Survey of the British Islands, which is now very nearly completed, is the greatest work of this kind ever undertaken in this country, and serves as a model for minor works of this nature. It was commenced by General Roy in the year 1769, under the direction of the Ordnance Department of the government, and has been subsequently carried on, with equal ability, by Lieutenants Shepherd and Codell Colen, and the Royal Colen, whose direction it now is. This great work, so far as it has proceeded, has already proved of essential service to the civil engineer, inasmuch as all the towns and villages, the chains of hills, valleys, and rivers, being laid down trigonometrically, its labour, as well as the expenses of his employers, are materially diminished, in tracing out the best lines for railways or other internal communications; instead of having to survey the whole district of his operations trigonometrically, he has only to take the leading points and to fill in the smaller fields, his work thus being of larger scale; and even before incurring this labour he can, with one of the Ordnance maps in his hand, determine in a great measure the general direction of all the lines of his work; thus understanding this, it is essential for him to have a thorough knowledge of the use of instruments, the various modes of levelling, for simple as it is, nothing requires greater accuracy,—in fact, upon this being properly done the success of the whole scheme or undertaking in hand may be said to depend; too much attention, therefore, cannot be paid to it; the instruments must be of the best kind, the construction, simple and substantial, easily adjusted, and kept in good order; the levels should be referred to one datum and proved in various ways; and a large and intelligible matter, so that they may at all times be easily referred to.

Maritime Surveying requires an intimate knowledge of the general laws which govern the tides, the set of the currents, the prevalence and direction of the winds, the soundings, anchorage ground, &c.; these should be regularly surveyed and registered, and the instrument and apparatus that is used by the engineer and the architect are much indebted to the labours of Ramsden, Troughton, Dollond, Carey, Simms, Watkins, Jones, Elliott, and others.

Draughts.

Drafting and modelling, although minor, form valuable, and in fact, indispensable departments in civil engineering; for unless the various projects proposed to be carried into effect, are in the first instance correctly delineated upon paper, it is impossible to convey a just idea of them, or to arrive at a correct estimate of the cost. Drawing may be classed under three heads,—mechanical or geometrical drawing, is that whereby the plans and sections are simply represented as they would appear on a plane surface; perspective drawing consists in representing the objects as they would appear from a distance; whereas the third, called the method of drawing, although very useful, and indeed indispensable, to the architect, in order to represent the true effects of light and shade of his different compositions, as they would appear when carried into effect, and upon a true perspective, the need of which is acknowledged, is not of such importance to the engineer, whose works are of a different kind, and much more extensive, that to represent them was simply would in many cases be impracticable; but inasmuch as so detached portions of his works, such as important bridges, viaducts, machinery, &c., perspective drawing may be employed with great advantage, it ought to be studied. Landscape and topographical drawing is also useful, in order to convey to unscientific persons an idea of a particular locality, in the manner that they are accustomed to receive it; and to be executed, and thus to remove fancied objections which otherwise might be overcome with difficulty; and this is still more useful with the application of colours when applied it at a later period. The different kinds of drawing are to be studied and practiced with accuracy, as they will be found essentially to forward the views of the engineer, and give satisfaction to his employers.

Although drawing, by far the most valuable, modelling in many cases is essential; for in the former case the objects are merely represented upon paper, assisted by light and shade and perspective, which, to persons in some measure acquainted with the subject, conveys a tolerably correct idea of what is proposed to be executed; but a model represents it (although upon a reduced scale) exactly as it is intended to be, with the different planes, dimensions, and surfaces; hence, nothing, except the work itself, gives such a perfect idea or representation as a model; it also enables the architect to make any change or alteration, which it would be impossible to escape his notice; whenever, therefore, models can be conveniently adopted or employed, it is advisable to do so; and it is gratifying to know that the art of modelling has made considerable progress, so that now they can be obtained at a moderate cost in wood, card-board, plaster, and clay, and will thus be more generally employed. In this department Salter, Deighton, Day, and others, have attained deserved celebrity. Working models of machines are extremely useful to give an idea of the action of a machine which it would be impossible to explain by words; the results, for it too frequently happens that a machine succeeds extremely well when tried in a model, but fails when put in practice; we should, therefore, merely consider the results of working models as guides to be worked out practically.

Meteorology.

The principles of this science, as far as they have yet been determined, claim our particular attention. Without a knowledge of the winds, and the quantity of rain falling in a particular district, we cannot determine with precision the proper form and dimensions of moles or piers to resist the action of the waves; we cannot calculate the load of the waves; but the most extensive districts of marsh land, or of the extent to which it may be necessary to improve the channels of rivers; or in carrying lines of railway through a country, to design the works in such a manner that they may withstand the weight of the elements; rather can we select the proper kind of stone or other materials for constructing buildings, unless we know the vici- nutes of climate to which they may be exposed, or the extent to which they may be acted upon by the winds.

In the investigation of the phenomena of this difficult science, we are much indebted to the late Professor Daniell, and to C. H. Smith, whose report upon the qualities of the different kinds of stone, as regards their tenacity, hardness, capacity of retaining moisture, and durability, for the purpose of selecting the best material for the New Houses of Parliament, forms an important and useful example, for which the engineer and the architect are much indebted, and the same course should be followed, as far as is possible, in the construction of other works, and, indeed, for the want of it, we now find many magnificent buildings partially decayed, which otherwise, would have been in excellent preservation.

Patents.

The improvements in manufactures, machinery, and other branches of art, result from a multiplicity of valuable inventions, which necessarily gave rise, on the part of the successful inventors, to a desire to secure themselves and their posterity, as far as is practicable, the benefits of their labours. The Government, perceiving and duly appreciating the situation, have proceeded to give effect to the principle which has been growing into law; that the nation in large, derived from them, wisely resolved to give every possible encour-
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agreement, by securing to them the exclusive right and title to their inventions for a certain number of years, and to enable them to recover, by legal process, the costs of all such proceedings. These objects have been so clearly set forth in the law as to have escaped general notice, without the previous consent of the inventors themselves. Hence arose the Law of Patents, or a privilege of the Crown to grant letters patent, conveying to the persons mentioned therein, the sole right to use or dispose of it. and the power to exclude others from using or disposing of it, generally about fourteen years. It is difficult to fix the date of the first assertion of this privilege of the Crown, but it was first defined by statute in the 4th year of the reign of Henry VII. The present law has undergone certain alterations and modifications, so that it now forms a branch of itself, which, with its various complicated relations, demands a peculiar study. Ever since the reign of Anne, parties have been compelled to specify in detail the nature and extent of their invention or discovery, previous to obtaining royal letters patent. The great number of inventions, which have multiplied considerably of late years, has given rise to an important class of professional gentlemen, styled patent agents, who devote themselves exclusively to the study of inventions and the peculiar laws relating to them, in order to secure to inventors their just rights and prevent them from being infringed upon by others. Amongst these gentlemen we may mention the names of Roberson, Newton, and others, to whom inventors are much indebted for the skill and attention with which their interests are guarded, as also to Godson, Holroyd, Hindmarsh, Rothe, Webster, Farey, Carman, and others, who have devoted themselves to the study of the Patent Laws, and have written ably upon them.

THEORY AND PRACTICE.

In the preceding pages, my remarks have been almost exclusively confined to the notice of the various works which have been carried into effect by civil engineers since the time of Suseaton; and although practice, upon the whole, is most important, nevertheless, we should not omit the study of the principles on which they are founded, for they are the basis of their practice, which can only be understood, and the principles of natural philosophy in general, and the mode of applying them to practice. They should cultivate a patient and equable temper of mind, in order to enable them to investigate, with rigid impartiality, the principles so variously illustrated in nature, and upon which the great operations which may hereafter be intrusted to their charge as civil engineers depend; and once having found out, and thoroughly understood, these principles in all their various applications, they should never depart from them; always bearing them in mind, and finally, the most important and useful lesson he can acquire, and which is the subject of practice. To what extent and guidance for the benefit of mankind, but never to opposition with impunity; her laws are immutable, and we may be assured that, either for good or evil, the same causes will produce the same effects; if, therefore, we wish to command success, we must adhere to her laws, and when we once thoroughly understand them, we shall be amply rewarded for all our toil; difficulties will vanish, and success will invariably attend our efforts. Previous to commencing practice, our junior members should not neglect the study of the laws relating to their profession, as it may be said to be the means of advancement to undergo an apprenticeship of some years in that department; for inasmuch as the success of so many of the works in which they may hereafter be engaged, particularly the mathematical, depend in a great measure upon the correctness of the selections which can be only thoroughly learned in the workshop, that is the place in which they must be studied; moreover, it will impart indubitably in their minds the principles which they acquire from books, and induce a degree of accuracy of thought and execution which cannot be acquired elsewhere; hence we find that some of our greatest engineers, both of the past and present age, have there acquired a considerable portion of their education, and owe a great degree of the utility and valuable assistance for engineers. Nothing, therefore, can be more erroneous than the supposition that the results are inconsistent with each other, for they are intimately connected with, and dependent upon each other. Without a thorough understanding of the principles of Mechanic and of Engineering is founded, it is impossible to carry them into practice without making errors in material and magnitude of means; and without the experience derived from the principles acquired from theory will be of little avail; both, therefore, must be closely studied, and we are not to produce a good work, form. Finally, composition, or the art of putting things into simple, clear, and intelligible words, should be studied, in order to convey to the world just notions of the measures proposed; also an intimate knowledge of the value of natural objects is important, in order that he may be enabled to make correct estimates, upon which the success of all commercial undertakings so materially depend.

CONTINENTAL ENGINEERS.

In making the foregoing remarks, I have endeavored to confine myself strictly to what has been done by civil engineers in England during the past and present centuries; but in doing so, I should be extremely sorry to be considered asidata, one of the greatest benefits of continental engineers, or the progress which has been made by them also during the same period, and we are proud to number many of them among the members of this Institution. To attempt to enter upon the equally interesting and instructive subject, would compel me to trespass much longer upon your patience, which I fear has been already tried too much; but I cannot omit remarking, that the greatest credit is due to engineers in France, who have, excepting in the harbor of Antwerp, and the harbor of London, which is somewhat detached, deserve to be mentioned; besides, the sciences of Levangers, Leghorn, and Naples; and the canals and the machinery of Lombardy; and the names of Leonardo da Vinci (said to be the inventor of the pound lock), Guglielmini, Friis, Manfredi, Martegotti, Vazio, Miliani, and numerous others. In Holland, the docks at Amsterdam, Rotterdam, Haerne, Anvers, Calais, and Dunkirk; the canals of Languedoc, Burgundy, and Picardy; the embankments of the Loire; the bridges of Boulogne, Calais, and Dieppe; the embankments of the river Meuse, and of the Danube, the Brenner, the Simplon, &c. In Holland, the magnificent embankments for defending the country from the sea; the great Texel, and numerous other canals. The system of drainage, although perhaps too complex and artificial, is also meritorious and worthy of remark. Through-out Germany, the system of managing the great rivers Danube, Elbe, the bridges across them, the canals connecting them together, as well as the roads and mining operations. In Sweden, the docks of Carlscrona, and the Tropphaben canal. In Russia, the docks at Cronstadt and Reval, the canals of the southern and northern navigation, in Spitzbergen, Algiers, Alicante, Tarragona, and Barcelona; the docks at Ferrol, Carthagena, and Cadiz, and the Arragon canal; and the railway system, which owes its origin to this country, is now making rapid progress everywhere on the continent. It is necessary to mention the tremendous power of our transatlantic brethren, the United States, to whom the world is much indebted for their many splendid public works and useful mechanical inventions and discoveries.

CONCLUSION.

I have thus endeavored to take a rapid survey of the different departments which constitute the profession of a civil engineer, since the commencement of the last century, or rather, from the time of Suseaton to the present day. Imperfect, however, as this survey has been, I fear it has trespassed too much upon your valuable time, although the interest and importance of the subject just entered into, and which would, if it had been treated by an able hand, at even a much greater length. Looking back to the humble goal from which we started, a little more than a century since, and then advertitng to the advances that have been made, we have seen the great and magnificent space we have traversed—what triumphant progress have we made! In how great a degree have both public and private prosperity, and the civilisation of mankind, been promoted by it. Within a few years our profession was comparatively unknown, and the great and beneficial results which have sprung from it were never anticipated; now it is universally in the ascendant, and it may be so with reason, for without presuming to undervalue the merits and importance of other professions, that of the engineer is of the highest rank. He is necessarily connected with the promotion of the comfort, the happiness, and the civilisation of the human race, and to be established upon principles of the very highest order.

Comparatively speaking, only a few years have elapsed since Great Britain, as regards engineering works, was in a very backward state: she had neither roads, canals, harbours, machinery, nor manufactures worthy of being compared with those of her neighbours on the continent. Let the comparison be made now, and we find that if we do not surpass every other nation we are inferior to none. And to what may this extraordinary change be attributed, but to the progress of civil engineering! Notwithstanding, however, we have advanced as far as we are still capable of doing so. Let the comparison be made now, and we find that if we do not surpass every other nation we are inferior to none. And to what may this extraordinary change be attributed, but to the progress of civil engineering! Notwithstanding, however, we have advanced as far as we are still capable of doing so.
fuel, and drawing the maximum load with the greatest velocity, combined with the greatest safety and economy; or, in determining the gauge of such which shall satisfy all the required conditions of safety, economy, and speed; in determining the most expeditious, safe, and economical means of transferring goods, passengers, and carriages, and such lines as are necessary to be put in process of construction and laying down the permanent way, in such a manner as to enable the trains to travel with safety, at the greatest speed the engines are capable of producing, with the least possible friction to the permanent way or to the engine and carriages;—in determining the resistance of railway trains; and devising means for obviating the leakage by the valve in the atmospheric system; in discovering a means for sealing the valve which shall preserve the desired consistency under all degrees of temperature; and in generally investigating that system of traction, in order to remedy any practical defects which may exist, and to ascertain when it may be applied with the greatest advantage,—in the improvement and adaptation of machinery to new objects in the arts and manufactures, and in the application of chemistry and geology to our operations.

These, and a variety of other improvements, are to be desired, and are worthy of our particular attention and study. The steam engine itself, improved as it is, and, we doubt not, will be the results produced by it, is capable of further improvements. Its bulk and weight may be further diminished, both in the form and construction of the boiler as well as in the engine itself, and, in effect, its power may be increased; or it may be made capable of producing the greatest possible benefit to our purpose some other power which shall surpass steam, or, perhaps, to substitute for it that all-powerful agent electricity, which has already attempted to apply to navigation. Observe and distinguish the objects of your industry; if you will be respected, you must be distinguished. The public are indigent, and not inattentive, and enlightened. Faraday, has pointed out the way, and is still proceeding in his distinguished career with remarkable success. We must not lose the opportunity of profiting by it; in fact, by the combined operations, it is impossible to foresee the results which may yet be arrived at.

This Institution, which has been for a few years ago, is scarcely known, has not its station amongst the first scientific societies of the kingdom; and as its objects are second to none in importance, whether as regard their ability or consistency under all degrees of gradation, or in general importance, it is necessary that those objects be only legibly and steadily prosecuted. In effect to effect in this we must not relax in our exertions, there must be no schism amongst ourselves; the Institution must be our rallying point; we must hold together, and the most contribution to its advancement, as well as that of our profession, by every means in our power—whether by papers, by verbal discussions, by contributions to the model-room or the library, or by the construction of works which shall serve as examples worthy of being followed. In fact, in every practicable manner, each according to our several opportunities.

Let the senior members, both by their precept and example, and their forbearance, courtesy, and assistance towards each other, with liberal and right-minded zeal, for the honour of their class and the advancement of the profession, contribute to its advancement, as well as that of our profession, by every means in our power—which objects we must be respected, we must be distinguished. The public are indigent, and not inattentive, and enlightened. Faraday, has pointed out the way, and is still proceeding in his distinguished career with remarkable success. We must not lose the opportunity of profiting by it; in fact, by the combined operations, it is impossible to foresee the results which may yet be arrived at.

A Great Bridge.—The new railroad bridge across the Stour between, at Harrisburg, is an immense structure. It is about 4,000 feet long, built upon the improved double-lattice plan. There are 28 spans, averaging 173 feet each; and two arched viaducts, one 81 feet, and the other 64 feet long. The entire cost of this immense structure is about $100,000 dollars—American Paper.
3. "Improvements in Railway Carriages." By Mr. James Wynt.

Mr. Wight exhibited a full-sized drawing of his proposed carriage wheels, having the fire at an angle of 45 degrees to the rails, entirely obviating the rubbing and abrasing friction of the present wheels, while the load is sustained by the second set of spokes converging at the upper journal of the axle, perpendicular to the rail. His proposed central apparatus requires for its support only a single small wheel, and the carriage is also adapted, adapting themselves to the curves over which they pass, and moving freely round without any slipping of the wheels, or twisting of the axles, resulting from their present form; and entirely dispenses with the necessity of water, as the motive power, designed to assist their sliding when compassing a curve—a property the reverse of which is of the utmost importance to the utility of the locomotive. He also suggested an improvement in the mode of tractions, by appending the drag hook at the head of a single buffer rod issuing from the centre of each carriage, in place of one from each side as at present, the end of each rod being made to compass two convex springs, which are placed under the centre of the carriage, so that either in the traction or propelling they are compressed simultaneously, and the concussion is sustained at the centre of the carriages without the slightest tendency to throw them off the rails.

April 19.—George Tatt, Esq., V.P., in the Chair.

The following communications were made:—

1. "New Method of Ventilating Public Buildings, Churches, Schools, Dwelling-houses, &c., by means of Hot-Water apparatus placed at the roof of the building, under the direction of Mr. Ritchie. Designed and applied by Mr. Bossey Rice.

Mr. Ritchie gave a short account of the methods which have been usually employed in ventilating buildings, and showed that, as the object was to induce a current from a difference in temperature, the plan he had in previous communications suggested (1844-4), of making use of the heat from hot water or steam, afforded a safe and efficient medium for extracting the exhaled air from apartments. He had since had several opportunities of seeing the effect in full operation in passenger cars and machinery depôts, where it has been most successful. He then described the method he had adopted at the Justiciary Court-house, Glasgow, and elsewhere. A powerful hot-water apparatus of patent tubes—raised to a high heat, and supplying themselves with water—is placed in a small chamber at the roof, and is heated by a furnace placed at the basement of the building. The apparatus acts as an artificial fire, and from the rarefaction of the air within the chamber the exhaled air from the apartment is drawn towards it, through a small hole in the roof, and rises or is expelled through an elevated chimney or shaft into the atmosphere—the heated current being protected from the action of the wind by means of screens or screens.

Mr. Ritchie showed the arrangement he had provided for the regulation or control of the velocity or movement of the air in the room. He pointed out, amongst other advantages of this mode of ventilation, that it was free from all risk of fire, as the furnace might be 10 or more feet from the heated chamber at the roof; that the air within this chamber admitted of a more rapid passage of the air, so that there was no risk of the reflux of the exhaled vapours, and, even when it was so, these could, by no means, be raised with the products of the combustion of fuel: that the apparatus was simply managed, and the expense not greater than other plans in use. He likewise showed the necessity of having every plan for extracting the exhaled air, an adequate supply of fresh air—that buildings, whether heated with or without open fires, should have the means afforded for obtaining a continuous supply of moderately warm air in winter, to replace that which is vitiated by respiration and one which goes off to the chimney. He showed the plan he had adopted for warming the Court-house, Glasgow, and the Commercial Bank, Edinburgh, with simple hot-water apparatus, which supplied the rooms with fresh air, duly regulated in temperature and humidity. He concluded with pointing out that the principles of the ventilation described was equally applicable to domestic as to public buildings; that a great many rooms might be ventilated with the same apparatus, and that he had petitioned the Board of Trade to extend the same. He showed a drawing of the apparatus, and said that the architect (W. Nixon, Esq.) for the New Police Buildings, Edinburgh, had adopted this plan for extracting the exhaled air from the cells and other rooms; that whole tenements (so important to sanitation) might be ventilated by the same apparatus.


The principle on which these chimney-cans are invented, is to prevent the inconvenience of smoke being sent back into apartments by high winds or by change of wind; and to have the construction of the chimney-cans such as will remove the draught, and to present no obstacle to the free passage of the smoke, and the cleansing of the chimney; while, in ordinary circumstances, no undue accumulation of soot can possibly arise. The cans being stationary, are less liable to go out of order than the movable ones, which have been so much used. Mr. Stewart has made a number of them quite successful, and that they had cured of smoke rooms which before had scarcely been habitable. These cans can be made of galvanized iron from 32s. to 30s., or in clay for 10s. 6d. The valve is fixed on the chimney-cans, and is operated, to prevent the smoke or down-draft, and is operated upon by a wire or chain from the fire-place.

3. "Self-Acting Cart-Driv or Break," which is worked by the Horse itself. By William Hetherington, land-steward to the right honourable Lord Douglas.

This break can be fitted up on any two-wheeled cart or coach, with shafts, at a very moderate expense, from the simplicity of its machinery. It consists of the following parts:—Two wooden rubbers, applied to the rims of the wheels, which are connected with each end of a cross-bar of malleable iron, 1½ inches deep and ⅜ of an inch thick, placed at right angles to the shafts, and horizontally, below the body of the cart in front of the wheels. This cross-bar is held in its place by keepers of iron attached to the outside of each shaft, leaving about ½ inches of space for the cross-bar to move backwards and forwards, so that the rubber may be easily withdrawn from or applied to the wheels. To the cross-bar are attached two iron rods, ⅜ of an inch in diameter, running each below a shaft, and fastened to each other by a hook that can be moved about its shaft, and allow it to move freely backwards and forwards. A hook is attached to each rod about two inches from their ends, so that when the horse is yoked by the shoulder and back-chains in the usual way, the back-chains can be hooked to the hooks that are urged by the load behind, on a steep incline, to press back the rubbers upon the wheels, and retard their progress to any extent desirable. When the horse is to be used, the keepers are not required to act, as such, when the horse is pulling forward on a level, or going up an incline, the wheels being pressed against the wheels by a spring fixed behind the cross-bar, which the rubbers are attached, and pressing that bar forward. Finally, two small keepers and hooks, at the ends of the rod, are used for the purpose of preventing their motion when backing the cart.

4. "A New Regulating Index for the Pendulum." By Mr. James McEwan, watchmaker.

The bob of the pendulum is made in two halves, being hollowed in the centre, so as to admit a conical wheel, carrying on its axis an index-hand which points on a dial-plate in front of the bob to the words fast or slow; the nut at the bottom of the pendulum being turned, it acts on the wheel by a pinion, and thus any person who has occasion to regulate the beat of the pendulum can see by the index-hand how far he raises or lowers the bob. Of course, Mr. McEwan intends this merely for common domestic clocks, and not for fine keepers, whose rate would be affected by the mere motion of the index-hand round the dial-plate of the bob.

5. "An Adhesive Hemstarch Compress," for suppressing undue bleeding, resulting from the Extraction of Teeth, constructed by Mr. Bossey Rice, dentist, was exhibited.

6. Specimens were exhibited of Mrs. H. Marshall's "Patent Intensive Cement," the inventor stating that although only half-an-inch thick upon the tiles, its capabilities of resisting fire were very great, and indeed, might be regarded as a trial for a considerable fire for a considerable time, while the tiles behind it, and in contact with it, would scarcely be affected.

A list of Prizes to be offered for Session 1847-8 was submitted by the Council and approved of, and ordered to be printed and advertised as usual. (See Advertisement.)

SOCIETY OF ARTS, LONDON.

March 31.—Wm. Polk, Esq., F.R.S., V.P., in the Chair.

M. Ricardo, Esq., gave an account of his "Indicator for ascertaining the Speed of Railway Trains." The machine consists of a pair of governors, to which motion is given by means of a hand on a horizontal wheel, attached to one of the carriages; as the speed of the train increases, the governors fly open and pull round a hand, which points out, on a graduated dial, the number of miles per hour at which the train is travelling. The governors are prevented from flying open with a jerk by two pieces of vulcanized India-rubber, which lengthen gradually as the speed of the train is increased.

The Secretary read a paper by Mr. T. R. Chapman, "On the working of his large-wheel narrow gauge Locomotive Engine, the 'Nanum,'" for the design for which he last session received the Society's Gold Medal.——The chairman having made some remarks on the statement put forth by him last year, the advantages possessed by the people over those on the old plan, proceeds to give the following account of the Nanum—

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April 21.—Dr. Roope, Secretary, V.P., in the Chair.

"On the Manufacture of Shell Canoes." By Mr. Gray. Six specimens of shells with the canoes cut upon them were exhibited.

The author commenced by stating that the ancient forms of canoes by engraving figures in low relief on different kinds of calcareous stones, and generally selected for that purpose those which had layers of different colour, were the earliest forms, or designs, of canoes, of divers colours. Such canoes are now made in Southern Europe and in France, where this art has lately been attempted to be revived; but the hardness of the materials requires so much labour to be employed in their fabrication, that they are too expensive for general use.

Numerous attempts have been made to substitute various materials, such as porcelain and glass, for the ancient canoes, but their great inferiority has caused them to be neglected. The best, and now most used, substitutes are shells, several kinds of which afford the necessary difference of colour, and are, after a long time, hard enough to resist wear. The shells now used are those of the flashlight Univalve, which are peculiar as being formed of three layers of calcareous matter, each layer being a perpendiculor lamina, placed side by side. The canoe cutter selects those shells which have the three layers composed of different colours, as they afford him the means of relieving his work; but the kinds now employed, and which experience has taught him are the best for his purpose, are, the Bell's Mouth, the Black Helmet, the Horned Helmet, and the Queen Conch.

Mr. Gray proceeded to detail the peculiarities of these shells, Mr. Gray proceeded to give an account of the progress of the art, which was confined to Rome for upwards of 40 years, and to Italy within the last 20 years, when an Italian commenced it in Paris, and now about 300 persons are employed in this branch of trade in that city. The number of small canoes was about 300, the whole of which were sent from England, the value of each shell in Rome being thirty shillings. To show the increase of this trade, the number of shells used in France last year was nearly as follows:

- Bell's Mouth, 8000, at an average price each, 1d: 6d. £6,400
- Black Helmet, 10,000, 50 1,000
- Horned Helmet, 5000, 2 60
- Queen Conch, 12,000, 1 70

100,500 shells . . . . . . . . . . . . . £8,950

The average value of the large canoes made in Paris is about six francs each, giving a stinging value of £32,000, and the value of the small canoes is about £8,000, giving a total value of the canoes produced in Paris, for the last year, of £40,000; while, in England, not more than six persons are employed in this trade.

The thanks of the meeting were presented to Mr. Gray for his communication, and to Mr. John Turner for two specimens, which were presented to the Society for its museum.

The second communication was "On a means of rendering Sculptured Sandstones impermeable to, or different of our changeable climate and humid atmosphere." By D. R. Hat. Esq.

The author, after stating the nature and structure of the various sandstones, the causes which operate upon them and separate the particles, and the plans usually resorted to for preserving masons' work from the injurious action of the air, said he had found that the ordinary process of saturating the sandstones with linseed oil, and then covering the same with occasionally used beeswax as an ingredient in paint, and knowing from experience that it is imperious to the blending or oxidising influences of the common atmosphere, he considered if applied to sandstone, it would render it very durable. "I believe (observes Mr. Hat,) that it has been used by the ancient in securing their fresco paintings, by rubbing it upon them, and facilitating its absorption by the application of hot iron, and a similar application has been recommended in modern times in respect to sculptured marble; but such a process must be very uncertain as to its efficacy, in as much as the absorption must be very partial and unequal. The plan I would recommend is applicable to statues, vases, and all sculptured architectural decorations—namely, a trough of suitable capacity must be built of brick, which must be placed under the sandstone, and a trough filled with sand; place the sand, at one end of the trough, a vessel made of tin or copper, and of the requisite capacity, into which puts spirits of turpentine or naphtha and beeswax, in the proportion of two or three pounds of the latter to a gallon of the former, according as the stone to be saturate is more or less porous. Keep the furnace burning until the sand has become sufficiently hot to dissolve the wax amongst the oleaginous or bituminous spirits in the tin or copper vessel. Place the stone to be saturated in the unoccupied part of the trough, so that it becomes a temperature equal to that which has dissolved the wax, and if the opening of the vessel containing the melted wax be immediately removed from the sand and dropped into the adjoining vessel, when, in a few seconds, it will absorb a sufficient quantity of the wax, held in solution by the spirits, to prevent the humidty of the atmosphere ever acting upon it."
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

April 19.—The following paper on the important public question of "Ventilation," and how far it may be rendered compulsory by legislative enactment, was read by Mr. J. T. Young.

The author commenced by stating, that the result of the extended investigations, so long conducted by the medical profession, in the nature and treatment of disease, demonstrated that the great duty of every man was to carry out preventive measures. English people seemed to be but little aware of the large amount of disease by which man at the present time is afflicted; and yet in details in Lord Morley's Report of last year, and out of 49,089 people who died in London in the year 1846, 22,274 were carried off before they reached the twentieth year; and only 2,241 died of old age, which Bowesville stated to be the only disease natural to man. In addition to this, it must be known that, as a general rule, when the body is examined after death, whether of a child or of a man, a third source of atmospheric impurity, the result of a state of disease, was a fact which induced a physician to state that he looked upon every adult he met in the streets of London as a walking museum of world anatomy. If the causes of the 49,089 deaths in 1846 be examined, it will be found that the enormous proportion of 14,368 was from diseases of the organs of respiration. Now it has been shown that the great source of these diseases was the respiration of impure air. To suggest measures for the removal of this great evil, and to prevent some of the most distressing diseases to the subject of ventilation, is the object of the request of the Society that he would deliver the present address.

Mr. Young then proceeded to consider the subject in its various bearings. In proof of the necessity for ventilation, he stated that it was of great importance, and be continually in motion, if stagnant, it became offensive and injurious. This was accounted for by the fact, that the air always contained a large quantity of animal and vegetable matter in the form of the ova of infusoria and the seeds of the lower vegetable plants, which is the cause of the deterioration of the organs of respiration. The air in the lungs was exposed to 170,000,000 of cells, having a surface equal to thirty times that of the body; so that during respiration the air was deprived of oxygen, and became loaded with deadly carbonic acid gas, and was rendered totally unfit for a second respiration. Being in reality a noxious air, the lungs are poisoned, and death ensues. A second cause of the deterioration of the air is the combustion of lamps, gaslight, candles, &c. A single candle is nearly as injurious to the air as a human being; twenty-four-hour argand burners consumed as much air as a man. A third source of atmospheric impurity is the vapour, loaded with animal matter, given off from the lungs and the skin: such parts pour out an ounce of fluid every hour; so that, in a chamber containing 500 people, twelve gallons of noxious fluid are given off in two hours. A fourth source of the medical profession is the large quantity of decomposing animal and vegetable matter left to give off its effluvia; and the difficulty there is in the renewal of the air in towns by means of the window, on account of the viscous mode of their construction and their large size. In reference to this particular subject, Dr. Webster stated that various classes of infusoria, which he was in the habit of keeping alive in his house at Clapham, all died in London; and it is well known that scarcely any plants will live in London. It was then stated that all diseases were distinctly traceable to the absence of ventilation—namely, fever, consumption, scrofula, deafness, and those most fertile origin of numerous diseases, the common "cold." It was shown that 120,000 people in England and Wales are always slowly dying from consumption; that there is but the amount of circulation among women than among men; that in 1839, out of 33 million who died in London, 28 died of consumption.

Mr. Young then declared that, up to the present time, the subject of ventilation had been neglected in the construction of houses, rooms, towns, and cities; that the greatest injury had been inflicted upon mankind by this neglect; and, as the population increased, and towns became larger, the evil must become greater, unless remedies were at once carried into effect. Under these circumstances, society should be sufficiently informed voluntarily to secure its well-being, it was the bounden duty of a government, the enlightened guide of its people, to suggest measures, and to see them carried out, to prevent the large amount of misery that the absence of ventilation entailed. The government of the people's present then, was how far could Government interfere with advantage in enforcing plans of ventilation by legislative enactments?

Mr. Young then submitted the following propositions, for the adoption of Government interference to advantage in enforcing plans of ventilation by legislative enactments:

1. That no living, sleeping, or work room shall contain less than 144 square feet, or shall be less than 8 feet high.
2. That such room shall have one window, at least, opening at the top.
3. Also an open fire or hearth.
4. That in every living, sleeping, or work room erected in future, some method shall be adopted of allowing the foul air to escape from the upper part of the room.

He then pointed out the practicality of carrying out this provision, either by the introduction of Arnott's valve into the chimney, thousands of which were at this time in operation, and which might also be adapted to carry off, without fear of smoke, by the addition of a simple contrivance which he described; or a distinct channel might be made for the purpose.

5. That every such room erected in future shall have some means of communicating with the window, or with the air admitted by the window.

6. That every public building in which gas is used, to insist upon the use of plans to carry off the products of combustion, and not to allow them to escape in a room. Various plans having this object are in operation in handsome mansions, &c.; and, in prospect of a Regent-street; by their use not only are the goods in the shop saved from injury, but the health of the people is improved. He was happy to hear that in Covent Garden Theatre not a particle of the products of combustion from the gas was allowed to enter the air.

7. That all churches, schools, theatres, workhouses, and other public buildings, shall adopt such methods of ventilation as are approved by the Medical Officer of Health.

Mr. Young pointed out that these desirable objects were to be effected, and showed that every house and room must be so arranged that it could be supplied with fresh air, to replace the vitiated air which has been removed. Prof. Horsley had carried out these plans in every part of his house; and until they were general, the diseases dependent upon the want of ventilation must be prevalent. He believed that it would be found that all the erecting, admirable plans of ventilation were adopted. Having given this subject deliberate consideration, he had arrived at the above conclusions; in which, among many others, he was supported by Dr. Sutheriland of Liverpool, and a large number of his fellow-labourers in the public-health cause, whose enlightened intelligence was only equalled by their benevolence.

In conclusion, he stated that the various Health of Towns Associations were founded to carry out sanitary measures, not only the personal comfort and happiness of the people, but the best means of promoting their physical welfare—a labour in which every enlightened man should join. And he felt that if government would lend all the aid in its power towards carrying out sanitary measures, not only would an enormous amount of misery be saved, but an amount of happiness would be gained of which we had at present only a faint idea.

INSTITUTION OF CIVIL ENGINEERS.

March 23.—Sir J. Rennie, President, in the Chair.

A paper was read "On the Ventilation of Mines." By Mr. J. Richardson. It dwells at some length on the present methods of ventilation and the objections to them, illustrating the positions by quotations from the best authorities on the subject; all of which went to show, that in spite of all the care and attention that had been given to the question, all the skill of the engineer, and the introduction of the safety-lamp in 1816, the loss of life had been greater since that period than it was in a correspondingly short period of time previous to its introduction. This must not be attributed to the lamp; for although it might have rendered men bolder, and induced them to tryst too much to it in ventilating those parts of the mine which formerly would have been abandoned, will it be borne in mind, that the loss of life was put at greatest danger, and the ventilation becomes more difficult; and, from the greater number of persons employed in one mine, if an accident did occur, the loss of life was greater in proportion. The author then entered into calculations, showing that the dimensions of the "upcast shaft," should in all cases be increased, in proportion to the augmented volume of the air from the expansion of the higher temperature at which it leaves the mine after traversing all the passages; and if this were attended to, not only would the general ventilation be better, but in the event of an accident occurring by an explosion, the derangement of some of the air-passages from falls of the roof, &c., an extra power could be applied, which would at any rate prevent a proportion of the mischief which otherwise occurs. The conclusion drawn, however, was, that in almost all cases it was the culpable neglect of, and not the want of means of prevention, that caused the destruction of health, life, and property in the mining operations of the kind.

This opinion appeared to be participated in by all the speakers, in the discussion which ensued, and in which the interference of government by legislative enactments, with respect to methods of ventilation, was severely criticized. Mr. Reynolds had brought to the discussion of this Institute, or in the present case, was how far could Government interfere with advantage in enforcing plans of ventilation by legislative enactments?

Mr. Young then submitted the following propositions, for the adoption of Government interference to advantage in enforcing plans of ventilation by legislative enactments:

1. That no living, sleeping, or work room shall contain less than 144 square feet, or shall be less than 8 feet high.
2. That such room shall have one window, at least, opening at the top.
3. Also an open fire or hearth.
4. That in every living, sleeping, or work room erected in future, some method shall be adopted of allowing the foul air to escape from the upper part of the room.
tunately, but competition to urge manufacturers and miners to bring their product to market of the best quality and at the cheapest possible rate.

March 30, and April 13.—The discussion on the above paper was con-
tinued through both these meetings, to the exclusion of any other subjects. The danger of ventilating the mining districts with dry disti-
buted, and their peculiarities discussed. The causes of accident by ex-
plosions, and the consequent choke-damp, were inquired into; and the fit-
ness of the attempted methods of prevention or cure was debated upon.
The bad air exhausting the air was considered, and the use of forcing
forward into levels by means of bellows and pipes. The system used in
the north of placing a furnace at the bottom of the up-shot shaft was in-
sisted upon as the best calculated to extinguish the extensive coal-dis-
thick; while the method introduced by Mr. Gibbons in Staffordshire of
exhausting the foul air, by air-heads cut in the top of the coal, connected
with a channel in the side of the shaft, terminating in a chimney on the
surface, was considered as a decided improvement. This system was in use
in that coal-basin, where the extraordinary thickness of 30 feet of the
vein of coal renders a peculiar plan indispensable. Various methods of
attempting to carry off the foul air from the 'goof,' whether by additional
shafts or by bore-holes, were proposed, and shown by mining experience
to be totally impracticable, and calculated to be rather prejudicial
than useful. The interference of Government was strongly insisted upon,
and as decidedly objected to by those miners whose long experience and good
judgment entitled their opinions to deference and consideration. It was
shown that the foreign mines which were under the constant superinten-
dence of Government engineers, far from being exempt from accident, were
not only more liable to the effects of deficient ventilation, but that the actual
loss of life through accident was greater than in those mines where no
attempts were made to keep the air clean, or to have any systematic
officers stationed in them. The influence of Government regulations
would have to be felt only in the case of first-class mines, where the
owners were actuated by any sense of responsibility. A mining board,
which they believed to be necessary, would have to be established at
London, for the purpose of promulgating the rules of Government, and
for their enforcement. The system of inspection would have to be
implemented by a system of education, or by the use of an apparatus
which would take the place of the human eye in the supervision of the
mines.

The subject of safety-lamps and their uses was also discussed: Dr. Reid
Clancy's first invention of the lamp in 1818, which necessarily failed from
its cumbersome form and general inapplicability for working purposes, and
the disadvantages it had suffered, combining with the other lamps in use,
as to show a bright light and yet be free from danger: the extraordinary
incoherence of invention thought by Sir Humphry Davy and Mr. George Stephenson, the one acting upon pure chemical theory, and the other
upon mechanical knowledge, yet both independently and simultaneously producing lamps which were almost identical, and which still remained
very generally in use under the names of the "Davy" and the "Goodey.

April 20.—"On the Design in the Principle and Construction of Fire-
proof Buildings." By Mr. Fairbairn, of Manchester. The paper com-
menced by insisting strongly on the danger of making use of cast iron
beams of large span, without intermediate supports, unless the dimensions
of the beam were very large, and pointing out the treacherous nature of a
crystalline metallic fabric as a support for iron, when applied to heavy weights
in the construction of buildings. After some further remarks on the
importance of a thorough knowledge of the laws which govern the
application of cast iron as a material in building, under the various strains
in which it is required to be subjected, the author proceeded to investigate
the circumstances connected with the fall of Messrs. Gray's cotton mill at Manchester. This building was said to be about 40 feet
long, and 31 ft. 8 in. wide, and to consist of two stories in height, contain-
ing the boilers below and the machinery above, over which, instead of a
roof, was a water cistern, covering the whole extent of the building. The first floor was composed of large iron beams, of 31 ft. 8 in. span, without
intermediate support; on these beams brick arches were turned, sustaining
the whole weight of the upper part of the building. The author then
pointed out that these large beams were totally inadequate to support the
weight of the superincumbent mass, especially as the whole pressure was
upon the beams, while the thrust of a form of ill-struck bellows was the
pressure; added to which, the wrought iron trussing was so badly ap-
plied, that the breaking strain was brought at the same time by the making truss were brought into a state of tension. The consequence of this was, that of the lower beams broke in the centre under a less weight than it had pre-
viously supported, both under preliminary trial, and when the cistern was
fuller than at the time of the accident. The paper closed with some
remarks on the delicate and inquisitive duty of reporting on such accidents
as these, and the necessity of the reputation of the writers of the former report to appear to have been involved; and the author expressed his reluctance in con-
demning the construction of the building in question.

In the discussion which ensued, it was argued that, if proper proportions of the different beams observed, the same result would have been
obtained, that the wrought iron trussing had been made so that they
allowed more than the breaking strain of the cast iron to be carried
at, before they came into operation. The instances of the trussed-beam
buildings, usually used by Mr. Stephenson and others, on railway
works, were quoted to show, that by a judicious employment of wrought
iron trusses upon cast iron beams, large spans might be carried with safety;
and even, in some cases, where, from unseen defects in the metal, a beam
had fractured, the brass rods had sufficed to support the structure, and
enabled the traffic to be continued across the bridge until the repairs
could be effected. In all cases a strength of not less than four to one should be preserved, and that for such uses as the iron beams of pumping engines, which were exposed to great vibration, and sudden shocks, from the sudden influx of steam below the piston, or the accidental breaking of a pump-rod, the proportions of seven or eight to one should be observed.

CHEMICAL SOCIETY.

March 15.—Lisset-Col. P. Yorke in the Chair.

"On the Decomposition of Water by Platinum and Black Oxide of
Iron." By Dr. G. Wilson.—The interesting researches of Mr. Grove, on
the decomposition of water by white-hot platinum, lately made public,
were applied for the first time by the author to the black oxide of iron,
produced by burning iron wire in oxygen gas, falling into water. In the
hope that this might afford some clue to the phenomenon in question, ar-
rangements were made for performing the experiment in such a manner that
the decomposition of water by the globules of oxide of iron was
well done by directing the fused globules of oxide, by means of a con-
ciled plane of tin-plate, from the jar in which the wire was burned, under
the edge of an inverted funnel testing a tube immersed in the water.
The quantity of gas discharged by the globules was very unequal; some gave none at all. Generally, globules from the thickest wire produced most gas. The gas on examination, however, was discovered to be pure hydrogen, merely suffused by a trace of atmospheric
air. It was, therefore, concluded, that the decomposition of water by
heat in Platinum and Iron, is at least no more than the decomposition of
it in Platinum alone, the gas being in the same manner. The black oxide of iron does not appear to have the power of further abstracting the oxygen from water. This experiment is, therefore, valueless in elucidating the fact of the decomposition of water by
thrusted platinum. It is probable, too, that the temperature of the melted
globules of oxide of iron is really much inferior to that of platinum in the
state in which it is employed in Grove's experiment, namely, just at the
point of fusion.

Dr. Wilson then argues, that the decomposition of water by a white best
may be preferable to the mechanical disruption of the particles in direct
contact with the heating body, and to not the decomposing power of heat
of atmospheric air, which can be done by the same processes that
cause its disintegrate would be tantamount to affirming that unlike effects may flow from the same cause, without any alteration in the qual-
ities or conditions of the water.

REVIEW.

Encyclopedia of Civil Engineering.—Historical, Theoretical, and
and Co. 1847.

[SECOND NOTICE.]

We paused last month in our notice of Mr. Creasy's book, at the
interesting subject of engineering in England, of which we only gave one
extract, that relating to New London Bridge.

Docks deserve a place no less prominent in Mr. Creasy's book, for they are works in which the English have peculiarly distinguished
themselves. Indeed, the tidal phenomena of the English coasts have
had as much to do with the extension of this class of work as any
commercial demand, for whereas in the coasts of Holland and the
United States, and in many parts of the world, the rise of tide is little
or nothing; in both Europe and America, it is of considerable, and
particularly favourable for all kinds of docking operations. In France
docks and basins are chiefly for naval purposes, and in the Mediter-
nanean there are no tides, so that England stands almost alone in a
class of works which demand great scientific resources, and which are
necessary to the prosperity of a maritime nation.

Mr. Creasy in taking this subject professes it by a description of the
natural features of each river and harbour, which is essentially to a
proper appreciation of the engineering works. In the Thames, Mr.
Creasy states that there are not only the commercial docks in the Lon-
encyclopaedia will be found a work of easy reference for plans of docks and harbours. 

St. Ives’ Harbour and Plymouth are the chief illustrations on the West coast, but the Breakwater and the Eddystone Light-house come next. Many of the most important lighthouses are shown, so as to exhibit the manner in which the work was tied in by dovetailed and jointed masonry.

Dover and Ramsgate are the plans given on the South-east coast, with a copious account of the works. The Bay of Dublin, with Kingstown and Howth, serve for examples of Irish works. Jersey Harbour and Guernsey’s close the list of harbours.

Among the lighthouses, of which numerous examples are given, we notice the omission of cast iron lighthouses and screw-pile lighthouses, which are recent additions to the resources of this department of engineering.

Mr. Cresy is the author of many valuable papers on the subject of civil engineering, and it is not surprising, therefore, that he should have given a particular attention to the building and construction of lighthouses and breakwaters. His excellency, therefore, is a valuable work, and one which is sure to be of great service to all who are engaged in the construction of such works.

Mr. Cresy gives a history of bridges in England, of which we shall avail ourselves of some extracts.

"Bridges.—We have no evidence of any bridges of consequence being erected previous to the Roman invasion, for we think he has given evidence to the contrary in the case of Old London Bridge. Anciently, bridges were erected of timber in preference to stone, because timber was the material at hand, the cheapest and the most available, as it was used for the same reasons at the present day in many parts of America and Europe. Mr. Cresy gives a history of bridges in England, of which we shall avail ourselves of some extracts.

The first stone bridge was begun in 1176, by the celebrated Peter of Corbou, who continued the work during the reign of Henry II., Richard I., until the second year of the reign of John, when he died, and was buried in the crypt of the chapel erected over the centre pier. It appears to have been the custom with the society called the Brothers of the Bridge, when any member died during the superintendence of any important work, to have his remains entombed within the structure; and as all great bridges were provided with a chapel and crypt, every member was afforded for the performance of the annual rites that were usually investiture of the great bridge at a consecration. The first stones of Ely Cathedral were laid in 1289, and of St. John’s, or Johannes Benedictus, the first brother and founder of the order, had such a chapel, where he was buried in 1290.

This stone bridge was 900 feet in length, 15 feet in width, and 60 feet in height, and the level of the stream is 52 feet. The bridge is a skew bridge and nineteen pointed arches, with massive piers, rising from 25 to 34 feet, raised upon strong planks, covered with thick planks, bolted together.

Bridges of very simple construction were long made use of over the wide rivers in England, but no skill was exhibited in the framing, nor any mechanical principle than that of strength; trees merely squared, were laid side by side, at right angles with the stream, supported on a single row of perpendicular piers, or several rows parallel to each other, capped and cross braced, and sometimes planked over to the sight that the water rose, the space between being filled in with stones. The roadway was cross-planked, covered with chalk and gravel, and frequently gravelly soil, in consequence of the air not being admitted to the upper side of the planking.

It would be an endless task to enumerate all the bridges erected in England by the freemasons of the middle ages; many were built, as has been observed, in the same manner as the cathedrals; after the piers were carried above the level of the stream, ribs of stone spanned the opening from one pier to the other, and supported a arch construction laid above them, an arrangement combining strength and convenience. The ribs of stone, or more rings of voussoirs spanning a river, upon which slabs of stone are laid, and the bridge completed; but it must be borne in mind that such ribs only serve the purpose of centres, and cannot have the strength of our modern bridges, where a wedge-like form is given to every portion of the stone.

After the reign of Henry VIII. bridge-building underwent a considerable change; timber constructions again became very common, and some of the choicest works of the latter part of the sixteenth century were built by the same hands. In 1553, for instance, James erected a bridge at Llanvast in Denbighshire, after the method practised in Italy, which was the model for some of the succeeding structures. It was formed of three segmented arches, the middle spanning 58 feet, with a versed sine of 17, and the breadth of the soffit of the arch 14 feet. The depth of the voussoirs, measured on the face, was 18 inches, the piers
were 10 feet in thickness. The pointed arch was no longer used, and the
defences of towers and gateways were unnecessary: the passage was
made more convenient, and the roadway approached a horizontal line, in
consequence of the substitution of vehicles for the pack-horse for the transit
of merchandise.

At the commencement of the eighteenth century we find evidences of an
attempt to improve the bridges throughout Europe, but there is no account
of any principles by which the engineer could be directed, nor are there
any maps up to this period. Such constructions were particularly en-
tirely; but what had been done in Italy does not seem to have found many
imitators here, and though Newton had discovered the principles upon
which mechanical science was based, it was long before the equilibria of
the modern signal was known. The historicists also held that the discoveries
that he had tried the experiment, and been made giddy by it. He
treated of the congelation of igneous vapours—and in language which
plainly indicated that he had incautiously exposed himself to their
termites was, but it was not then applied to the construction of bridges.

The specifications of the larger bridges of modern times will be
found very useful, as they include details of every important work.
It is said that the artistic and aesthetic qualities of the
weir works is fully shown. Copious extracts are also given from the
specifications, particularly valuable in illustration of the work-

The railway bridges give so many examples that a very good
instance is shown of the enlarged field of practice in the present
day. This affords Mr. Cresy the opportunity of describing skew
bridges.

Cast iron bridges form a section of themselves, and are followed by
suspension bridges, both of which are amply illustrated.

The Ancients World, or Picturesque Sketches of Creation. By D. T.
ANSTED, M.A., F.R.S., F.G.S., Professor of Geology in King's

Some years ago, the readers of French literature were entertained
by an abridged version in that language of a work bearing the truly
oriental title, "Takhia ulahia cha Ella Baris"—The perfec-
cation of gold in the description of Paris. The author was a young
student, the Sheik Refas, sent from France to the Pasha of Egypt to
complete his education. The original work was published at the
Arabic press of Boulaq, in Egypt.

The Sheik Refas, though a Musalman, resided in Paris, for the
purposes of the study of the Christian. Impressed with the wonders
of European civilization and the magnificence of the city in which his education was completed, he became
anxious to overcome the prejudices entertained by his country-
men against the arts, science, and institutions of the French.
His study, which was an interesting part of the modern
lemon system of astronomy with that of the Koran. He
marks that the former is altogether irreconcilable with the account given
in the books accounted sacred by the Christian as well as the
Koran; and that the orthodox of both creeds will have to exercise
great caution in reading the modern scientific treatises; for they are
written with such logical precision and review of his essay. These
nothing but the strongest faith is proof against their conclusions.

Here was the testimony of a sensible man, whose reason drew him
one way and his prejudices another. This state of ineradicable
not, however, peculiar to him. A great continental mathematician
thought it necessary to prefix his investigations with an apology
for the discrepancies which did violence to his faith; and made
an excuse which meant, as far as any meaning can be attached to it,
that he did not see any way of escaping the conclusions of modern
science; but if he must assent to them, it was against his will. The
theologians (who, until the present, have always preferred
dogmas to proofs) have frequently produced recantations, expressed
in a similar spirit.

A numerous and zealous sect existed in our own country not many
years since, who denounced the doctrines of Newton as blasphemous,
and attributed to the credence they had obtained the temporal cala-
dities of the country. Many half-helpful enthusiasts have attempted
refutations of the Principia,—and with perfect success, if it be
sufficient criterion of success that no one has replied to them. Even
within the last twelvemonth, the Quixotic attempt to enter the lists
with Newton, Laplace, and Laplace, has been renewed by a Mr.
Isaac Frost: whose chivalry we should have deemed somewhat too
late for the times, had we not read the reviews of his attempts
convincing us of that which otherwise we should have deemed
impossible—that Mr. Frost might yet find disciples. It is difficult to
decide whether he or his reviewers display the most ludicrous igno-
rance of the subject with which they imagine themselves acquainted.
Why should Mr. Foster, despair—perhaps Southcoote was eminently
successful in her day, and even now has followers.

Geology is in the same predicament as astronomy—it is unanswer-
able, but heterodox. It is true, that various dissentants have ap-
ppeared, and among them those whose education better results
might have been anticipated. For example, the Dean of York pub-
lished long letters in the Times, in which he demolished geology to
its own perfect satisfaction. Had he kept to the question of heter-
doxx, he would have done as much good as the most orthodox.
But when he descended from the mountain to the plain,—when
he attempted to discuss mechanical principles, he admitted the rights
of human reasoning and put himself upon a level with his opponents.
This was the fatal error of his tactics. He illustrated the motion of
waves with a bucket, which was a matter not of too evident
error that he had tried the experiment, and been made giddy by it. He
treated of the congelation of igneous vapours—and in language which
plainly indicated that he had incautiously exposed himself to their
fumes. The good doctor's zeal was worthy of a better cause.

An excellent theological library was turned into a bad laboratory, and
the Schoolmen and the Fathers were displaced by crucibles and the
three mechanical powers.

The philosophers of this school seem to forget that the simple
denial of the theories of modern geology is not sufficient; if they
reject these, they must substitute others. A vast number of natural
appearances have been treated with the same system of causation, and wertentg
of by-gone ages of animals,—the traces of violent disturbances of
the materials of the earth,—and those ancient records to which the
Pyramids are ephemeral gossips, are written in so large and legible
characters that it seems impossible to dispute their meaning. If,
then, the interpretation given by geologists be rejected, have they
not a right to demand the substitute?—or do they say—"cæteris paribus, they—our explanation of the facts; the facts themselves cannot be disputed;—how then do you explain them?

To this question no reply has been even attempted. But lest the
student of geology should feel himself in the same anomalous position
as the Sheik Refas with regard to astronomy, let him be assured that
the subject was not strictly debated, that the risk of appearing to discuss topics
not strictly within our province, we will endeavour to show how the dis-
crepancies in question may be reconciled without resorting to sceptic-
ism. The view which we take may be best explained by an illustra-

Suppose that an eminent writer on the laws of commerce and
industry had said in his writings that he made an accidental mistake respecting the construction of steamers or sailing vessels;—
would that mistake invalidate the whole of his treatise? A wise
reader would discriminate between the two kinds of knowledge, and
allow that his author might be thoroughly versed in political and
business matters, but not in the art of engineering and ship-
building. In the same manner, when David speaks of the "round
world" being made "so fast that it cannot be moved," are his aspira-
tions of thanksgiving the less worthy of reverence because he erred in
thinking the world a flat circle instead of a sphere, and was
ignorant that the spot where he indited was moving with a velocity
enough to give the swiftest arrow no chance of overtaking it?

What would be thought of the wisdom of a judge who opposed
trial by jury because the Jews had no such institution;—who adopted
the severe penal code of the forty years' sojourners in the wilder-
ness,—and passed sentence of death where subsequent experience
has proved a milder punishment to be more efficacious? Could an
English mariner adopt the rules of seamanship practised when Paul
navigated the Archipelago;—or a farmer adhere to the Levitical
rules for fallow lands;—or an architect imitate the construction of the
temple of Solomon? Must modern physicians adopt Herophilus's
painter of figs, or astronomers prefer his sun-dial to their own
orono-

Mum? Must we believe in the efficacy of the mercuries, and
suppose Gades the extremity of the world, because the geographical
knowledge of the inspired writers was imperfect? Must England
imitate "the freest nation on earth," (the United States) and sanction
slavery because it is recognized in the Pentateuch? Such, indeed, is
our absurd position, that we suppose that the commission extends to
purely secular objects; if, in other words (for the solution of the recent
confusion on the subject may be referred to this) the same respect be
demanded for their incidental remarks as for their primary do-

cries.

Can anything be more unreasonable than this? Men of every creed
admit that when the Queen appoints Royal Commissioners for a par-
icular investigation, their authority does not extend beyond the ob-
jects of their commission: and yet those who carry out the analogy
in matters of higher import, are reviled for impolicy, blasphemy, and
scepticism!

One more observation on the question as it affects geology, and we
dismiss the subject. The Mosaic account of the creation, like that
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of Hesiod, was in all probability nothing more than a record of the belief generally prevailing among the contemporaries of the writer. At all events, there is not one word in the accounts which assumes to them a higher character. But however this may be, one thing is certain—that the Mosaic account would be inconsistent with itself if interpreted literally. The sun was not till the third day therefore, during the previous twenty-four hours—the interval between sunrise and sunset—suns are, therefore, forced to a conclusion which no sophistry can elude—that here, as elsewhere in Hebrew, the day is an indefinite period or epoch. Lastly, be it remembered, that if the critical student reject the conclusions of geology, he must give further reason for which in many cases he is not prepared—extend his scruples to astronomy also: both sciences are equally at variance with the Mosaic cosmogony.

Of Professor Ansted's "Ancient World" the established reputation of the author renders a critical examination unnecessary. The principal object in the work was to present the reader with a series of pictures or descriptive representations of the appearance of the earth at different periods of its transition, from the chaotic condition, to that in which it became duly prepared for the habitation of man. With this object in view, Professor Ansted has generally confined himself to the statement of the facts of observation, and has frequently deemed it unnecessary to detail the steps leading to those results. In a work intended, not to prove the science of geology, but simply to lay before those who are about entering upon its study, a general description (an outline chart, as it were) of the routes they are to take, the minuteness of logical induction would be tedious and unnecessary.

The grand merit of the work is its fidelity and vividness of description. The wonderful story of creation is not told as an old story; but the reader is put in the position of an actual observer of the phenomena, and is transported to the very scene and time of their occurrence. This method of telling the results of science is beneficial to the student, by the strong impression it makes upon his memory; it is profitable, also, to the more advanced in knowledge. The advantage of clearly tracing out the results and actual applications of science can only be fully estimated by those who have experienced the benefit of this kind of study. The remark applies to the whole of the instructive and exact sciences. The philosopher who contains himself with understanding a particular "law," and the method of proving it, is content with knowing half a subject. He must develop the consequences of the law under all the variations of circumstances to which it can be applied—in other words, he must translate it into familiar, untechnical language—before he can be said to have apprehended the whole of its meaning.

Although the work before us displays geology in a new light—not as a description of the fossils of a museum, but as the natural history of animated beings,—although the dust of ages is wiped away from these records of the pre-adamite world, we are not to suppose that the author has given his subjects in a literal sense of the word. He exhibits the ancient inhabitants of the earth as living creatures, exhibits their form and size, their habits and manner of living, their relations to coeval animals, their means of securing their prey, and of resisting or eluding hostile attacks,—nothing is represented or described without authority. These Sketches of Creation are not fanciful sketches. On the contrary, they are drawn with scrupulous adherence to known facts, and in many cases, are even left somewhat obscure, because more precise representations of the subjects could not be given without the hazard, at least, of inaccuracy.

The opponents of geology are uniformly ignorant of its facts; but those whose prejudices are not too strong, nor intellects too weak, to allow them to learn truth, may acquire the rudiments of the science pleasantly enough from the present treatise. It is sufficiently precise and methodical for a lecture room, and yet far more entertaining than nine-tenths of the new novels. The author has practised an innocent artifice—a pious fraud—upon his readers. While they were invited to the second voyage of the Polygon, they were urged to be instructed. It would have perhaps added somewhat to the interest of Professor Ansted's work to the general reader, if the accounts of fossils had been less detailed, and the information respecting the changes which have taken place in the strata composing the earth's crust more ample. When, however, we consider the knowledge which has been wonderfully, but accurately, attained from the Polygon remains of ancient animals, we can scarcely feel surprise that one of the most nascent students of palaeontology should desire to confine attention to its results. A striking instance does this new and wonderful study present of the value of accumulated knowledge. By co-operation and unanimity of purpose, by the willingness of each labourer to pursue the task where his predecessor left off, the steep rugged road of knowledge has been made so smooth, and carried so far, that the labours of the present day are almost insignificant compared with the whole work accomplished.

It is no ordinary contemplation to see creatures that perished ages before history—our history—began, reanimated by this Prometheus flame of science which exhibits them moving freely on the face of the earth that has so long hidden their remains. "Can these dry bones live?" For us, he must give a new life, their sepulchre has been undisturbed. Earthquake, flood, tempest, and volcano's fire have passed over, yet not effaced them. The rough hands of the miner and the deliver reveal these sacred hieroglyphics, and the patient researchers of men of science expound them. The one exhibits the world as the repository of the skeletons of nations: the other penetrates the mysteries of the great charnel-house, and unfolds one page more of that blazing scroll which records the benediction and power manifested in the works of creation. The dry bones are dry no more: relit by flesh, renewed with life and strength, they add yet further testimony to the potency of that voice which is mighty in operation," and the vision of the Valley is fulfilled and interpreted anew.}


This work, which we recently noticed, has already attained a second edition, and which has been improved by adopting some of the suggestions we gave in our review—one of them, adding sketches to the field-book.


If we may judge of the example before us, this work promises to be one of great interest to the architect and the antiquarian. The present part is illustrated by four well executed engravings of Glassgow Cathedral, which we see are from the drawings of Mr. Billings, a gentleman well known to the Profession for his zeal in promoting works on Gothic architecture.

MR. WARNER'S INVENTION.—THE BALLOON "LONG RANGE."

Extracts from the Journal of the Proceedings of the Committee (Captain Chad, R.N., and Lt.-Col. Chalmers, R.A.) appointed to inquire into Capt. Warner's Inventions, by the Board of Ordnance.

13th August, 1846.—Capt. Chad and Lt-Col Chalmers repaired to the official residence of the first lord of the Treasury, where they met Lord J. Russell, the Marquis of Anglesey, Viscount Ingestre, and Capt. Warner, to settle preliminary instructions.

"Capt. Warner then produced five drawings, showing that his mode of operation is by means of an air-balloon.

The committee submitted to Capt. Warner the following experiment, requesting him to estimate the cost of carrying it out, viz., that he should construct a balloon capable of carrying 45 projectiles; that he should deposit 15 of these at 4 miles; 15 at 4½ miles; and the remaining 15 at 5 miles." [At a subsequent meeting, held 10th Sept., it was agreed "that the number of projectiles should be 30, instead of 45, and that each projectile should weigh at least 10 lbs., and that 10 should be substituted for 15 at the distances agreed upon; and it was further agreed upon that Capt. Warner should be in communication with Lt-Col. Chalmers, with the view of selecting the balloon for the experiment." It was also agreed that he would endeavour to be ready in all respects by the first week in October.]
15th August.—Capt. Warner delivered in his estimate for the expenses of the trial proposed to be made to test his "Long Range," amounting to £1,500. On the 12th Sept. this amount was advanced by the Treasury and paid to the Bank of England.

28th Sept. to 9th Nov., the Journal showed was occupied by Capt. Warner in seeking a suitable situation for the experiments.

9th Nov.—Lt.-col. Chalmer proceeded to Stafford, having previously received notice from Capt. Warner of a suitable situation for the experiment, which would be found on Carrick Chase.

10th Nov.—Lord Ingestre met Lt.-col. Chalmer at Silmnore, near Stafford, took him in his gig to Haywood-park, and was kind enough to lend him a horse for the purpose of surveying the Chase; they rode over this for some hours, and the Chalmer had previous to his going over it, and had selected a place at Haywood-park suitable in all respects for his operations; and as there was a clear uninterrupted space of many miles, Lt.-col. Chalmer consented to the situation for trying the experiment, and, on the 16th, the Chalmer arrived at the Chase, and the mode of suspending the shells, and expressed his regret that he could not exhibit more of his plan, or show him the balloon.

20th Nov.—Letter from Lord Ingestre, stating that everything was progressing as fast as possible, and expressing hopes that all would be ready for Monday (23rd), and requesting Capt. Chads and Lt.-col. Chalmer to sleep at Birmingham on Sunday night (22nd), when they should send a letter detailing the movements for the next day.

22nd Nov.—Capt. Chads and Lt.-col. Chalmer left London by the mail train at 8h. 45m. for Birmingham, where they found a letter from Lord Ingestre, stating that the experiment would not take place the following day.

23rd Nov.—Lt.-col. Chalmer and Capt. Chads took a chaise from Stafford to Haywood-park; the day was very wet, foggy, and unfavourable, so that little was done.

24th Nov.—Lord Ingestre drove Capts. Chads and Lt.-col. Chalmer over to Haywood-park farm, where Capt. Warner was located, in a wood near which he was preparing his machine for the experiment. Lord Ingestre went out to seek Capt. Warner, who came to the farm-house by another route. Lord Angelsey rode up to the farm about one o'clock, expecting to find us all there, but Lord Ingestre was not present.

25th Nov.—Capt. Warner was asked when the balloon was likely to arrive. He replied that he must have a northerly wind to give him the necessary range; that he would act from the place on which his machine now was, as it was not necessary that he should see the spot he was to act against. It was mentioned to Capt. Warner, that we ought to see that all was fair, and that no one ought to be up in the balloon. He objected to our seeing his operations, and, as to any persons going up in the balloon, he stated 'that would be impossible,' as, when the last flight of missiles took place, the balloon would be burnt; that he should drop more balls than specified as the balloon went along; that if two or three of the bags of small flags that they might be the more readily found and seen. One of the balls he showed us, made of copper filled with lead, about the size of a 12lb. shot.

"The Fair Oak, a large old tree, about three miles distant from the station, or ground of 140 feet, was fixed upon as the mark for the flight of shot, and there Capt. Chads was to be stationed, and Lt.-col. Chalmer to be near the machine. It was pointed out to Capt. Warner that he should place the same confidence in us as in those who were assisting him; further, we did not wish to pry into his secrets."

"Lord Angelsey met Lord Ingestre after the meeting, and told him what had passed."

25th Nov.—The following arrangement was agreed upon between Lord Ingestre and Capt. Warner, on one part, and Capt. Chads and Lt.-col. Chalmer on the other:

1. Capt. Warner to send over to Lord Angelsey as early as possible on the morning of the day on which he means to operate.—2. The time of operation to be as near noon as convenient.—3. A pilot to be sent up half an hour before the firing, and another five minutes before the operation begins. 

4. Capt. Chads will place himself as near the Fair Oak as he judges convenient.—5. Lt.-col. Chalmer will be at the starting point.—6. Lord Angelsey will place himself where he thinks proper.

7. Lt.-col. Chalmer left 12o'clock for Beau Desert, having received the honour of an invitation from the Marquis of Angelsey.

27th Nov.—Capt. Chads and Lt.-col. Chalmer addressed a letter to Capt. Warner, recommending to him the inconvenience the detection occasioned by the noise that he would make to a ship from this side would have greater chance of operating; or that he would inflate the balloon at its present station, and remove it so to a position proper for its ascent, so as to command the necessary direction of range. Mr. Warner replied, that if the wind stood as it then was, he would be able to operate in the course of the day, and that he would send over to the party early in the morning to let us know whether he would be able or not.

28th Nov.—The morning appearing fine, with the wind at north, gave us reasonable hopes that the long-expected experiment would now take place. Lt.-col. Chalmer left Beau Desert at half-past ten o'clock, a.m., for Haywood-park; when within a mile of that position he fell in with a messager bearing a letter from Lord Ingestre to the Marquis of Angelsey, dated Haywood-park, Nov. 28th, 11 A.M., requesting that Capt. Chads and Lt.-col. Chalmer might be at the four cross roads on the Chase at two o'clock, everything being ready.
were sent for to take charge of the balloon, etc., and directed by a magistrate to retain it.

Lord Ingestre told the police that he was a magistrate, and that there was nothing wrong. He ordered a rope to be fixed on the deck, and asked the person claiming it, and that he (Lord L.) would be responsible for their doing so as they wished. This person then went with Lord Ingestre and Capt. Chalmer to a stable; showed them the balloon, and explained the circumstances of the case. The balloon had been stolen; it was quite full of air, and a thick mist. On H.M. Brigg. Chalmer’s entering the stable, he recognized this person to be one of the Messrs. Green (the aeronauts), and who stated that the balloon was his property, and named the ‘Albion.’ Mr. Green was passing under the cover of smoke, to prevent all proceedings as to a balloon being in the neighbourhood a secret.

Lord Ingestre said that further search should be made to afford the keepers for the shot, but that then we could do nothing more. We left Rugeley for Beaure for dinner during the time. The Marquis of Anglesey, reporting what we had seen and heard, Lord Ingestre acknowledged that he considered the experiment a failure, in which Capt. Chalmer and H.M. Brigg. Chalmer fully coincided.

Capt. Chalmer directed Mr. Cockayne, to make diligent search for any of the shot that had dropped from the balloon in its course from Haywood-park to Rayleigh. Reports were received from Mr. Cockayne, dated 8th to 10th, 11th, 12th December, 1845, and 10th January, 1846, showing the number that had been recovered, the direction in which they were found, and their penetration into the ground. He also sent up two diagrams, exhibiting (as the positions the shots were found in) the tortuous course of the balloon, which twice crossed the turnpike road from Haywood to Rugeley.

Mr. Cockayne’s 18 shot had been recovered: five within 100 yards of where the balloon fell; eight at about three miles from Haywood-park; and five one mile from whence the balloon started (Haywood-park). The penetration was from one to four feet, in hard gravelly soil.

(continued)

[signed]

May 28th, 1846.

J. A. CHALMER, Lieutenant-Colonel, R.A.

[We propose next month to give an analysis of Sir Howard Douglas’s account of the proceedings of himself and the other commissioners appointed to consider Captain Warner’s claims.]

ARMAMENT FOR WEA STUDIES.

The Lords Commissioners of the Admiralty, after considerable experience of the power of the various steam frigates and other steamers in the Royal Navy, as regards their capabilities of bearing heavy armament, have ordered, in the case of the various steam frigates and other steamers. Vessels of similar, or nearly similar, tonnage and horse-power, to be arranged in classes as

Steamers Propelled by Paddles.

STEAM SHIPS.—9470 tons, 600-horse power; main deck: four 66-pounds of 97 cwt., 11 feet in length; four 8-inch guns of 65 cwt., 9 feet on pivot slides and carriages; four 10-inch guns of 65 cwt., 9 feet 4 inches on common carriages—upper deck: four 66-pounds of 97 cwt., 11 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on common carriages; total guns, 16. Penelope, 1,618 tons, 650-horse power; main deck: eight 66-pounds of 97 cwt., 9 feet 4 inches on common carriages; upper deck: four 66-pounds of 97 cwt., 9 feet 4 inches, on common carriages; total, 12. Hotspur, 1,611 tons, 600-horse power; main deck: eight 66-pounds of 97 cwt., 9 feet 4 inches on common carriages; total, 6.

STEAM FRIGATES.—Class 1. Avenger, 1,444 tons, 650-horse power; and Birkenhead, of 1,400 tons, 500-horse power. Upper deck: two 66-pounds of 97 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on common carriages; total, 6. At present the Avenger carries, by way of experiment, two 38-pounds of 65 cwt., instead of two of the 10-inch guns.—Class 2 (A). Odin, 1,385 tons, 500-horse power. Main deck: 26-pounds, 66 cwt., 9 feet 6 inches on common carriages. Upper deck: two 66-pounds, 95 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on common carriages; total, 6.

STEAM SCHOONERS.—1st class. Gorgon, 1,111 tons, 320-horse power; and Longfellow, 490 tons, 100-horse power. Upper deck: two 10-inch guns, 65 cwt., 9 feet 4 inches, on pivot slides and carriages; Four 38-pounds of 42 cwt., 9 feet 8 inches, on cars; four 26-pounds of 35 cwt., 6 feet, on carriages. Telescope (450-h.p.); Centaur (450-h.p.); Dragon (600-h.p.); Firebrand (600-h.p.); Vulture (400-h.p.); and Cyclops (250-h.p.).

MILITARY AND NAVAL ENGINEERING.

LIEUTENANT ROBERTS’S MORTAR.

Some experiments were recently made at Portmeirion, to test an improved mortar, suggested by Lieut. Julius Roberts, of the Royal Marine Artillery. The mortar tried on board the Curfew, a 10-gun brig, was a 13-inch, weighing 5 tons. It was suspended between two beams or brackets by means of a handle of 1¼ inches thick, which was fixed to the underside of the mortar and to the gun during the firing. Two wrought iron shafts of 4 inches diameter to the trunnions, and a short shackle chain under the muzzle, by which the elevation is altered or maintained to 45 degrees. The brackets were made of cast steel, and firmly bolted to the circular wooden platform, forming a square hole cut through it, which platform is placed to revolve over a circular hatch or hole on the deck with sufficient bearings for support, and a combing round it, in which two opposite key bolts are allowed to work to prevent the platform rising. The square hole in the platform being immediately over the circular one in the deck, the mortar, by a single 6-inch rope, passed for the purpose, when hanked over the hand and looked to a cheek and ring placed into the muzzle, is lowered, muzzle downwards, at a moment’s notice, into the hold, and so secured there, by which the enormous weight of five tons is instantly removed from off the upper deck; the same rope as easily returning it to its mounted position, the muzzle chain being unslacked, or shackled when raised in position for fire. The platform is 10 inches thick, 8 feet 6 inches long, and 6 feet 6 inches wide. A special exception is made in this case of the Janus, 768 tons, 220-horse power, which carries only two 10-inch guns of 65 cwt., 9 feet 4 inches, on pivot slides and carriages.

Bore: 13 inches. — Weight: 1,114 tons, 420-horse power; upper deck, one 66-pounder, 93 cwt., 10 feet, on slide and carriage to pivot; one 13-inch mortar; total, 2.

STEAM GUN-BOATS.—Class 1. Eddy, 340 tons, 220-horse power; and Peaceful, 180 tons, 64-horse power. Upper deck, one 66-pounder, 42 cwt., 8 feet on slide and carriage to pivot. Two 38-pounds carrioludes, 17 cwt., on Hardy’s carriages.—Class 1 (A). Grappler 559 tons, 220-horse power, Pluto (100), Columbia (100), Ombres (200), Triton (200), Antelope (200), and Spirit (100). Two 42-pounds, 56 cwt., 9 feet 6 inches, on slides and carriages to pivot; two 23-pounds, 25 cwt., 6 feet, on compressor slides and carriages; total, 4. Class 2 (A). Spitfire (432 tons), 140-horse power. Fiercepaw (185), Gleaner (180), Shearwater (160), Lilac (170), Lightning (160), Meteor (100), and Constel (90). One 18-pounder of 30
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May,

NOTES ON FOREIGN WORKS.

Munich Art-Union.—Aussturz et altera pars.—The Munich Union is on the decrease, evidenced by the reports both of 1845 and 1846. Surely an art-union which has to pay out a sum of 9,000 florins (a large sum of money at Munich)—might, all other advantages combined, have done more. The public taste, to mention one incident, does not seem to go space with higher art-tendencies, for amongst 127 pictures open to exhibition, not only tried specimens, but also some very fine hunting after portraits and genealogical painting. Compared with this decline of the Munich art-union, even that of the Düsseldorf art-friends does not bear a comparison—which latter have had painted an altar-piece for the Church of Cologne, adorned the galleries with frescoes, and provided similar embellishments for the Emperor's hall of Aix-la-Chapelle. Even the Art-Union publication (Verblendblatt), which might easily have been elevated to an organ of real art-value, very seldom breaks through the sparseness of prose; and the whole is hampered by frequent mistakes of spelling and style.

The Valley of Chamonix has been the scene of an awful event. By an avalanche which fell from the Aiguilles-Bouges, and filled the bed of the Arve, the small village of Aix-les-Bains, which was completely buried in débris of rock and snow, with some considerable loss of life. Another avalanche which came down lately from the crags of the Eissenein, in Tyrol, buried several persons who were on the return home.

Road over the Alps.—The Sardinian government has given orders to repair and open the gigantic road, which leads from the south of France (Briançon) to Italy. This road over the Mont Genevieve was constructed in 1816, and is not a difficult one. The port has since been neglected and got out of repair and use. It will be of great importance when Turin and Pigier are connected by a railway.

Public Works in Senegal.—Captain Grammont, R.N. of France, the governor of the above settlement, in opening the legislative assembly, addressed, at some length, to the public works to be executed in the colony. Amongst these, a regulation of the harbour of St. Louis, embankments of the river, and draining of its banks are conspicuous. His excellency very properly observed, that by such improvements the native (Neger) workmen will be formed, and the process of material civilization of Africa advanced.

Legislation of Rivers and Watercourses.—The French Congress Agricole, presided by Prince De Cazes, has discussed the above subject at great length, when Messrs. Toucagneville, Beaumont, and others, were heard. The first fact resulting from these debates is, that there is in France an act of the Legislature relating to these subjects—viz., that of 14th floréal on X. Some, however, thought that this law is rather for the protection of riparian rights, than for the realization of the hydraulic advantages of their position in the improvement of their lands. The congress, in fine, emitted several opinions, which will have some weight on the legislature and the government. Amongst these, was the suggestion of the government undertaking the embankments of the carriage (flowing) of water not available to navigation—lakes, ponds, and brooks; that the former usages, local regulations, &e. of each county, related to this subject, be collected, and laid before a board of magistrates and proprietors, for bringing them into a uniform legislative state of the land. The congress recommended to the government the appointment of regular officers of the cours d'eau. It was also suggested, that the forced participation of proprietors interested in the execution of public works, might be merely restricted (by the law of Sept. 16, 1807) to the dyking of the sea shore and the banks of rivers—should be extended to all works relating to the management and distribution of water. The congress likewise made a point of the abolition of bogs and marshes, by the cutting of great draining canals (fausses d'assainissement), to allow the escape of the waters and moisture of whole districts—on which account, no legislative enactment has been hitherto made. (C'est tout comme ça.)

Navigation of the Seine.—Important works have been begun at Paris for improving the navigation of the river. At La Rapée the basin (part) is dredged of drudge. Nearly at the embouchure of the canal of St. Martin, a jetty is building for the discharge of goods, for which the Boulevard Contades will be safeguarded and all its houses demoli'd. The whole quay on the left bank, from the Pont de l'Archevéché to the Petit Pont, is taken off, and is to be rebuilt with an inclined road.

Strange Inauguration of a Public Building at Constantinople.—The foundation stone of the new branch building of the College of Medicine, which is to be erected near the mosque of Karaman, has been laid with much ceremony. The work has been for some time delayed, because the chief architect (M. de la Hire) had been prevented, that no other day could be more propitious for that purpose. Still, the atmosphere did not concur with the right reverend gentleman, as the cemetery presented a lake of mud, caused by the incessant rains and snow which fell during the day.
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NOTES OF THE MONTH.

The New House of Lords.—Mr. Barry has given us what may be called the first instalment of the new Palace of Westminster, in the opening of this month. Of this building we have had drawings in preparation, which we expect shortly to lay before our readers, when we shall proceed to give a description of this great work. In the meantime, we may say that it has been received with much applause, and is considered as justly the most magnificent of all the grand halls in the world, becoming its purpose of the throne and seat of empire of the most powerful and most wealthy nation in ancient or modern times.

The New Club House.—There were 69 designs sent in for competition for the New Club House. We understand that during the last month the members of the club were regularly besieged with canvassers for favour; such a practice is highly disgraceful to a profession like that of architects. They are to be invited to the Institute meeting in May, but will the Institute sit in the affair? Mr. Tattersall is the successful competitor for the first premium, and Messrs. Fowler and Fisk for the second premium. The design will be exhibited to the public by tickets, to be obtained of the secretary, until Thursday, 6th inst.

The great engineering achievement of the last month is the opening of the Birkenhead docks, which was celebrated by a sumptuous ceremonial. It seems now to be decided that the railway from Calcutta to the Upper Provinces of India is to be guaranteed by the Government.

The Great Western steamer has been sold to the Royal Mail Steam Packet Company for 26,000l.

In the course of the last month, the new entrance of the British Museum was thrown open to the public. It is on a large scale. It is understood that Barry has executed for the Baron de Goldsmid a grand ball-room, which no stranger has yet seen, and the opening of which will be one of the attractions of the season. It is said to be one of the best pieces of decoration in this way yet executed, and to be the most magnificent style—worthy of the great capitalist and the great architect.

Royal Botanic Gardens.—The winter garden of the Royal Botanic Society in the Regent’s Park, which is nearly an acre of garden under glass, has, during the past month, improved in appearance, and has been so successful, that with the reduction of the price of glass, this kind of construction is likely to extend. At the present moment, however, we have only the Regent’s Park specimen by Decimus Burton, and Marnock, to set against the large winter gardens of the Thames.

New Gardens.—The great palm-house at Kew, by Decimus Burton, is getting on. The ground part constitutes a hot air vault or chamber, over which is laid an acre of gravel, on which the tubes and pots containing the plants are placed. The design is grand and novel.

A vote has been carried through the House of Commons for the completion of the base of the Nelson column.

The foundations of Miss Burnell Coutts’s church in Westminster have been laid.

Among the novel suggestions for the improvement of architecture lately promulgated, is one from New Jerusalem by Mr. D’Israeli, who says in it:—What is worst is—Will the public by the mere doing of these things, be by the public itself. What is worst is—Shall we find a refuge in a committee of taste? Escape from the mediocrity of one to the mediocrity of many? We only multiply our feebleness, and aggravate our delicacies. But one suggestion might be made. Ethiopia in England be made the shield of Hercules; it is easy to be brave in bronze and gilt. The original is destined for the Emperor of Austria, and four copies for other sovereigns.

A New Theatre at Vienna.—The foundation of a grand new theatre near the Känzelmur-Thor, at Vienna, has been laid. The theatre is to bear the same of the National Theatre, and is to be fitted up on a scale of great magnificence. It is to be finished in two years.

Railway in Switzerland.—The project for a railway running from the Mediterranean, through Switzerland, to the North of Germany includes two gigantic works of art, that by most of those who have been consulted are deemed impossible of execution. These are the piercing of Mount Lankmaner (the Locus Magnus of the ancients), to gain access from the Valley of the Tessin to the Valley of the Rhine—and that of the Alps for the line which will link Sarindistilain the portion comprehended between Oulx and Modane. The engineer Ricci, however, to whom the Sarindit government has intrusted the work, and whom the Swiss and Bavarian government have adopted for their respective shares in the undertaking, has decided on the design of a tunnel of these granite masses is practicable; and has invented a mechanical apparatus for the excavation of the huge tunnels, which has been approved by the Committee of Public Works, and is to be put into immediate operation.

India.—The Ganges Canal, on which £200,000 annually has hitherto been grudgingly bestowed, is now to be proceeded with at the rate of £500,000 a year; it will be completed by 1861. It will irrigate 8,000,000 of acres of land, at a cost of £100,000 of gold from the periodical visitations of famine. Another canal, leading from the Satlej, 90 miles into the Bhittee country, is being surveyed.
LIST OF NEW PATENTS.
GRANTED IN ENGLAND FROM MARCH 27, TO APRIL 22, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Charles May, civil engineer, of Ipswich, Suffolk, for "Improvements in railway chairs, the fastenings to be used therewith, and in trellisa."—Sealed March 27.

John Henry Griesbach, of Carlton Villas, Malia Vale, for "Improvements in the construction of railways, and in engines and carriages to run therein."—March 27.

Alexander Morton, of Morton-place, Kilmarnock, for "Improvements in printing warps."—March 29.

Samuel Hardacre, machinist, of Manchester, for "Certain Improvements in machinery for the purpose of removing foreign substances, and for grinding the cards of carding machines." (Partly a communication.)—March 29.

Henry Woodhall, paper maker, of Footscray, Kent, for "Certain Improvements in paper making machinery."—March 29.

Samuel Millboard, paper maker, of Saint Mary's, Cray, Kent, for "Improvements in the manufacture of paper."—March 29.

John Fisher, the younger, mechanic, of Bedford Works, Nottingham, for "Improvements in the manufacture of leak or weatings."—March 29.

Benjamin Tucker Stanton, agricultural machinist, for "Improvements in railroads, and in wheels and other parts of carriages for railways and common roads; partly applicable to the construction of ships or other vessels, and for improvements in the machinery for manufacturing certain parts of the same."—April 6.

Phineas de Boerge, of Beeston Rectory, Horsley, Wigan, for "Improvements in London, engineer, and John Coope Hadden, of No. 11, Upper Wobur Place, in the county of Middlesex, civil engineer, for "Improvements in wheelless carriages, and in panels and springs for carriages to other purposes."—April 6.

William Thos. Stevenson, of Upper Baker Street, Lloyd-square, Middlesex, gentleman, for "Improvements in regulating the governing of steam in steam-boilers."—April 6.

David Napier, of Gleeshallish, Strachen, Argyleshire, for "Improvements in steam-engines and steam-vessels."—April 6.

Stephan Monton, of Norfolk-street, Strand, Middlesex, gentleman, for "Improvements in the construction of bridges." (A communication.)—April 6.

Peter Glassman, of Leicester-square, Middlesex, gentleman, for "Certain improvements in weaving machinery, and in the preparation of the materials employed in weaving." (A communication.)—April 6.

James Robson, of Dover, engineer, for "A new and improved instrument to be used in crushing or expressing oil from vegetable and other substances, and in making oil cake, for the purpose of separating therefrom, which instrument is also applicable to the grinding and manufacturing the same and other articles from plastic materials."—April 15.

Stephen White, of Winchester-row, New-road, clerk, for "A new means of producing paper, and certain apparatus and appliances for that purpose."—April 15.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "Improved apparatus to be applied to steam boilers." (A communication.)—April 16.

Samuel Childs, of Earl's-court-road, watchmaker, for "Certain improvements in the manufacture of candles, and in preparing and combining certain animal, vegetable, and mineral substances for the purpose of said combination; and also in apparatus for applying the same."—April 15.

George Holsworthy Palmer, of Surrey-square, Old Kent-road, civil engineer, for "An improved method or mode of producing inflammable gases of greater purity and higher illuminating power than those in use, and also in the arrangement of the apparatus employed for the purpose, and which apparatus may be applied to other similar purposes."—April 17.

Joseph Woods, of Backbury, engineer, for "Certain improvements in springs for supporting heavy bodies and resisting sudden and continuous pressure." (A communication.)—April 20.

Osmen Giddy, of Hereford Lodge, Old Brompton, gentleman, for "Improvements in apparatus for sweeping and cleansing chimneys and flues."—April 20.

John Russell Ayres, of Holland-street, Fitzroy-square, doctor of medicine, for "Certain plans and improvements in preparing potteries, organic matters, such as night soil, the matter in suspension in the water of sewers, and other similar matters, for the purpose of measure for, and other purposes, and for the products thereof."—April 20.

Thomas Brown, of Muscovy-court, Tower-hill, for "Improvements in machinery for raking and levelling waters." (A communication.)—April 20.

ERRATA. — In the article "Combination of Telegraphs," 8c., in our last number, page 198, line 29, for "instead of telescopes—microscopes will come into use," read "instead of microscopes—telescopes,"
Sensible of the influence of the beautiful, all highlycivilised nations have surrounded themselves with it as much as possible. The Greeks continually placed before their eyes the statues of the most famous sculptors and the creations of their most famous painters; art and nature reciprocally acted upon each other;—the lover of art, quick in his perception of beauty, grew inwardly like what he beheld; whilst the natural symmetry of the sons of Greece, the grace of the female form, and the proportions of their athletes, filled the soul of the artist with those vivid conceptions which we see embodied to a great degree in the Apollo, the Venus de Medicis, the Gladiator, and other well-known statues of antiquity; and in the highest degree in the works of Phidias. So Michael Angelo imbedded his mind with grandeur by the incessant contemplation of the renowned Torso; so the pictures of the Venetian masters seem as though steeped in their city's rosy twilights and splendid sunsets. Still, beauty will not incorporate itself with the feelings of man, nor shape his works, if he be insensible to its charms. A country has boasted the finest productions of art, whilst her people remained unconscious by an admiration for them. At a period when Italy, for instance, was in possession of her exquisite monuments of taste, and abounded in all the luxuries of its climate, her people sank deeper and deeper into barbarism.

The loss of the advantages derivable from magnificent scenes, owing to a perverted temper of mind through which they are regarded, is eloquently described by Sterne:—"The learned Snelfungus travelled from Boulogne to Paris; from Paris to Rome, and so on; but he set out with the jaundice, and everything he saw was discoloured and distorted; when he returned, he wrote an account of his travels; but 'twas nothing but the account of his miserable feelings." It is not usual to meet with those who presume to be critics, but show themselves to be only cynics. These are men with hearts too much hardened, and with eyes too much blinded, to enable them to recognize the intrinsic greatness of an object. But the beautiful cannot be justly appreciated, if the mind be not in harmony with it. We can only form a judgement of a work whilst we are in similar disposition with its author; and in possession of the same, or a superior, taste and intelligence to that with which it displays. Criticism, as it relates to the fine arts, requires the exactness of the finest, the kindest, the most generous, and the most exalted sentiments and attributes of our nature. It depends upon a knowledge of our internal nature,—upon a habit of turning the mind inwardly upon its own operations, with a frequent observance of external objects. The ancient metaphysicians threw great light on the theory and practice of art,—grounding it on the philosophy of the human mind, as the moderns,—especially the Germans,—have done;—and a theory that would rest in security, must rest upon such a basis. Our notions of what is good in art are to be built upon certain great truths, and upon unchangeable principles; for the proof of the goodness of all principles consists in their durability; and such laws and elements of beauty can we only consider fixed and settled as are deductible from, and conformable to, the nature of the human mind.

Truth—Utility—Adaptation. Truth is defined the standard of

GLANCE AT SOME OF THE ATTRIBUTES OF ARCHITECTURE.

By Frederick Leis.

O noble Art! to honour whom sole,
Beauty, with Grandeur and Simplicity,
And bright sheen'd O'lier, lovely child of Light,
In's by the fairy hand of Symmetry.
O noble Art! how much we owe to thee,
Of calm and holy thought, of feelings high,
When in some splendid sky the power we see;
And broad, broad'nerd tower that bows the sky,
The hall by Commerce, or by Science Astrd,
The palace home of kings, or science home of God.

Anne A. Ferron.
proportion, as applied to the entire design as well as to the minutest ornaments, are observable both in ancient architecture and in the Pointed style of the middle ages. Alberti, Cicogna in his work "Bull Bellos," and other give examples of arithmetical and geometric proportions for halls, apartments, &c. Different proportions belong to different edifices; and one of small dimensions, if its parts are symmetrically disposed, will affect the mind with a greatness of manner which impresses us with an idea of something superior to works bulky in themselves, though ill-contrived. The art of adjusting quality to various circumstances is noticed by Hope in his "Historical Essay," The Greeks reserved to themselves the right of giving to each, forms more restricted or multiplied, more simple or rich, and proportions more sturdy and delicate, according to the peculiar exigencies of the edifice or situation. To so great a degree was this their practice, that in these respects, between each other and the two others, an almost insensible transition exists, and that every individual instead of uniformly maintaining a vast interval between itself and the two others, such as all extreme specimens of every style present, borders closely upon the next in succession, and almost appears amalgamated with it.

In great works some disproportions far removed from the eye are not discernible; because the grand arias mangia. Without this exaggeration, small parts are swelled up by the aerial perspective, and no grand effect is produced. Hogarth in his "Analysis of Beauty," refers to the marked variety and relief given by Sir C. Wren to his spires, especially that of St. Mary-le-bow, as proofs of his superior skill on these points. The ancients, and also the medieval builders, enhanced the importance of their works, and made them at once striking and eloquent, by the care they bestowed on certain features; the power of which spoke immediately to the soul, and excited not merely admiration, but wonder. Yet these things were dictated by optical considerations. "Objects do not appear as they are in reality, therefore the architects endeavour to make their works appear not in their true proportion, but in what they should appear." (Ancient Maxims.)

In our observations of ancient constructions, we must have remarked the various artifices had recourse to for increasing the effect of the ornaments; of boring deep holes by a drill in some parts in order to give them a more decided character when seen from the point at which they would be mostly viewed; of making certain masses stand prominently in advance of the groundwork, and the habit of working the ornaments on their plain blocks in the places they occupy in the building.

Novelty—Variety.—We estimate an architect according to the taste he evinces in forming new and pleasing combinations; combinations in which we see the feelings which characterise the poet—which bespeak an imagination analogous to that of the poet; the goodness of the originality is the criterion of their talent. Mena hominis arida noctisitis est; and a necessity forces itself upon the artist to supply this want—a power of invention which does not imply a neglect of what our predecessors have done, but on the contrary, a profound study and love of their best works; as there was scarcely, for instance, any one so versed in, and so thoroughly pervaded by, the spirit and principles which animated the ancients, as M. Angelo; yet not one so independent of them—always their equal, often their superior. It is in the command of beautiful forms—in breathing new life and vigour into the marble, that man shows his sovereignty as a poet. The attempt at novelty will often yield more delight than an affectation of taste which is foreign to us; for it is an evidence of the exercise of thought, a desire to create, and a disdain of mere imitation. The mind sometimes embodies ideas which are nothing less than mental phenomena, or the effects of a peculiar organisation; which the reason finds it difficult to account for, and the judgment to approve; yet they are valuable on account of their power of awakening curiosity and stimulating reflection. Stewart in his "Philosophy of the Human Mind," speaking of the power of Imagination as connected with Fine Art, says:—"Without taste, imagination can produce only a random analysis and combination of our conceptions; and without imagination, taste would be destitute of the faculty of invention. These two ingredients of genius may be mixed together in all possible proportions, and where either is possessed in a degree remarkably exceeding what falls to the ordinary share of mankind, it may compensate in some measure for a deficiency in the other. An uncommonly correct taste with little imagination, if it does not produce works which create admiration, produces at least nothing which can offend. An uncommon fertility of imagination even when it offends, excites our wonder by its creative powers and shows what it could have performed, had its exertions been guided by a more perfect model."—Art that is the result of this uncontrolled imagination, must be tested not so much by rules and precedents to which it does not profess strictly, but as those, as to the feelings or impressions which its effects make on our minds. Our attention must not be drawn to little errors, but to the prevailing beauties which alone for them. Small blemishes are excusable in a grand building—though of course the fewer the better; yet a building, faulty in parts, the great effect of which is imposing, is greater in art than one whose only praise is, you do not see any faults, neither do its beauties impress you. We must adjudge an architect's place in the rank of artist, by virtue of the quantity of sound intellect and true taste which he displays. On this subject Sir C. Wren says:—"An architect ought to be jealous of novelties, in which fancy blinds the judgment; and to think his judges, as well as those that are to live five centuries after him, as those of his own time. That which is commendable now for novelty, will not be a new invention to posterity, when his works are often imitated, and when it is unknown which was the original: but the glory of that which is good of itself is eternal."—Hence the necessity of referring to and studying those principles of grace, harmony, and proportion which exist in the human mind, and making them the foundation on which we proceed in all matters of design.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.
A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."

Sir Henry Wotton.

Although the ancient Britons may have dug caves in their hill sides and built huts in their woods for dwellings, like most aboriginal people, and formed temples from the intersected boughs of trees in their groves—all of which are types and prefigurations of styles in architecture; yet its first approach to the dignity of a Fine Art in Britain must be attributed to its Roman discoverers. This great and powerful people carried their arts into every country they subdued, and civilization followed their eagles among the remotest barbarians of the North. When Caesar landed in Britain, he found its inhabitants in as rude a state of barbarism as we did the New Zealanders or the inhabitants of Tahiti, on our first visit to those places. The newly discovered country benefited greatly by the arts, learning, and civilisation of their invaders, who, wisely appreciating the natural wealth and resources of the country, planted it as a Roman colony, to the reciprocal benefit of both people.

From the period of the establishment of the Romans in Britain to about the middle of the fourth century, the arts of civilised life made rapid progress; domestic architecture brought comfort and taste into their dwellings; and the sister arts of painting and sculpture added taste and elegance to the most wealthy. A Roman army always brought in its train a body of artists, artisans, literati, and priests. Their commanders, who were always liberal and well educated men, of the equestrian order, were often, like
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Jalins Casar, their own historiographers, or were accompanied by historians and poets to celebrate their achievements. In addition to the Roman and native writers, Britain furnishes in every corner of its island architectural and sculptural remains of much grandeur, whilst tessellated pavements of exquisite designs, pottery, arms, and other relics of the Roman period of British history, attest their accuracy.

The same style and taste in art, and that love of convenience, comfort, and splendour that was found in the chief provinces of Italy and Gaul, which fell short only of imperial Rome itself, pervaded the palaces of the Roman generals and the British chieftains—their coedjuditors and allies; and Roman luxuries in architecture, such as hot, cold, and vapour baths, with gymnasia, hypocausts, theatres, and amphitheatres, were to be found, as their ruins testify, in every Romano-British city or station in the island. Britain abounded at this time with well-built villages, towns, forts, and fortified stations; and the whole country was defended by that high and strong wall, with its numerous towers and intervening castles, which reached from the mouth of the river Tyne on the east, to the Solway Firth on the west.

This spirit of improvement that distinguished every spot wherever the Romans formed a settlement, so much advanced the taste and increased the number of British artists and artificers, that in the third century this island was celebrated for artistic knowledge. When Constantius, the father of Constantine the Great, was about to rebuild the city of Autun, in Gaul, in the year of Christ 206, being well acquainted with Britain, of which country his wife Helena was a native, he procured the ablest of his workmen from there, which, according to Eusebius, greatly abounded with the best artificers.

After the abandonment of Britain by the Romans—whose attention was called by insurrections against their imperial authority in states nearer home to think much of this distant colony, which had been severely ravaged by the Picts and Scots—the classical taste in architecture gradually declined, and was succeeded by various, and in some instances depraved, styles. The country, although divested of Roman armies, had been thoroughly Romanised by the enlightened conquerors; and if no Roman general or person of inferior rank remained behind, the Britons who had been intrusted with command had become half Romans by education.

The earliest city recorded to have been built by the Romans was on the site of our present metropolis, near the spot on which St. Paul’s Cathedral now stands, as proved by the remains of a Roman temple discovered when digging for its foundations by Sir Christopher Wren, and others more recently found in taking down a part of old London wall, on the back of the houses on the south side of Ludgate-hill. This city was founded as early as the fifteenth year of the Christian era, and was called Camulodunum; it was destroyed about eleven years afterwards by the Britons, in revenge for the cruel treatment received by Boudicca, queen of the Iceni, from the Romans. It was at that time perhaps a large and well-built town, embellished with stateros, temples, theatres, and other public structures. From the circumstances of this rapid destruction, perhaps by fire, it is probable the principal buildings of that city were of timber; till the time of Agricola, who finally established the dominion of the Romans in Britain, from which period may be dated the first construction of public buildings in the British capital of brick, stone, and other combustible materials. Agricola governed the colony during the reigns of Vespasian, Titus, and Domitian, with equal courage and humanity; his residence and seat of government being the new city of Camulodunum, then as now the metropolis of the country.

These points are of some importance, as proving that the Roman style of architecture preceded every other in this island—the hot and cabin alone excepted. The Romans not only erected a great number of solid, convenient, and magnificent edifices for their own use and accommodation, but instructed, exhorted, and encouraged the Britons to imitate them.

At the time when the Saxon dominion was gaining ground in Britain, and before the disturbed times of Hregist and Horda, public and private dwellings are related to have been constructed with strength and magnificence. In the year of our Lord 480, Ambrosius, a British commander, of Roman descent, who had assumed the regal government of Kent, built for his residence a splendid palace at Canterbury, which he made the metropolis of his small kingdom. During the Saxon heptarchy, domestic and sacred architecture continued to flourish, and buildings of both denominations were erected in the most populous parts of the seven kingdoms. The monks, who were the only architects of the times, and who travelled in fraternal orders from place to place, as their services were required, were a species of operative Freemasons, keeping their skill and craft within the circuit of their own lodges. In their travels they visited Rome or Roman cities, and the least skilful of them carried away the types of their art in their memory only. From their works arose the style called Saxon, which, as its earliest efforts prove, is a corruption of the Roman style—perhaps provincial, and therefore not in the purest taste,—made by memory, or rude sketches by untaught artists. The Saxon style was called by the monkish writers of those days " Opus Romanum."

The elements of the Saxon style are too well known to the readers of this Journal to need description,—but a reference to the crypt of Lartington Priory, in Suffolk; the remains of Bovagraw Church, near Chichester, Sussex; Waltham Abbey Church, in Essex; among other very early specimens of this style, undoubtedly well known to our archaeological readers, bear witness to this hypothesis. In these examples will be found rude imitations of bad specimens of Tuscan, Ionic, and Corinthian capitals, with or without entablatures, and with or without archivolt, as seemed best suited to the architect's purpose or his erratic fancy. Bound by fewer rules than the architects of ancient Rome and Greece, the builders of these structures, by giving way to the picturesque fancies, choosing or rejecting what they had seen at pleasure,—following however the best constructive rules, among which "a little stronger than strong enough" was not among the least,—they erected buildings which are still in efficient use; and created a style which is at once picturesque and, with certain effects of natural scenery, worthy the living architect's attention, from its majestic simplicity in some portions, and its singular richness of sculptural embellishments in others.

This native Anglo-Saxon style is well suited for entrance lodges on a large scale, or prospect towers appertaining to an extensive demesne, where the scenery is grand and majestic. Its preponderating, massive, and gigantic features, if well applied, accord with such purposes; particularly where the material is solid and durable, and of rather sombre hue in its colouring tints. A Saxon castellated entrance tower and portals of dark blue limestone, so common in the mountainous districts of North Wales and the central parts of Ireland, would form an appropriate adjunct to any of those romantic spots with which these islands abound.

As excellence is always advancing, so did architecture and its sister arts advance with varied steps in this country. Its vicissitudes may be arranged into epochs or eras in something like the following manner, and will be so considered in this inquiry. Namely, from the splendour of the Augustan age—an emanation of which had reached us during the administrations of Claudius, Antoninus, and Agricola—till the declension of pure taste by the expulsion of the Romans, and the substitution of other arts, literature, and customs, formed by the association of the ancient Britons—their Saxon colleagues, which completely established the style called Saxon.

Next arrived that state of transition in which the art continued from the pure Saxon times till the rise, progress, decline, and fall of that eminently beautiful style called Gothic. This style is so varied and so expansive, that it is nearly impossible to catch it within the limits of a definition—it almost eludes description, and has occasioned more schisms among writers on art than other style of architecture exist. It has rules—but they are so discursive and ideal that no true code, like the Vitruvian or the Classical styles, has yet been formed. Some admirers of this style object to the epithet applied to it as derogatory to its importance;—but the Society of Friends scarcely ever object to the title given them originally in derision, and are not offended as being described as the people called Quakers. However objectionable the title may appear, it has become too general now to be altered; and the friends of the style are bound to receive it as an honourable distinction. Perhaps a more satisfactory title may be obtained by calling it the Anglo-Germanic style. The late Sir John Soane used to tell us students of the Royal Academy, in his lectures, emphatically that Gothic architecture was any thing that was not Grecian. Wren unfortunately called it "a gross coarsening of heavy, melancholy, and monkish piles." But Wren was blind to the beautiful details of Gothic architecture, although he appreciated those of its scientific construction and its general forms, as his well known reverence for King's College Chapel, which he declared, while he was building, would be the Minster in his west front of Westminster Abbey; his pseudo-Gothic of St. Mary, Aldermanry; his almost beautiful imitation of Magdalen Tower, Oxford; in that of St. Michael, Cornhill, tackled by the way to a Doric interior; and his singularly beautiful spire of St. Dunstan in the East, although disfigured by Roman mouldings, abundantly testify. Nor must the
Gothic construction of some of the concealed parts of St. Paul's Cathedral be omitted in this category of Wren's blindness to the beauty of this style, or of his willingness to be the brain assistant of a man like Wren, but his fame as a mathematician, and as the greatest constructive architect that England has produced, besides his many other eminent qualities in the highest branches of learning and science, will more than counterbalance this defect, although not a small one.

An eminent living architect and writer on his art, has, on the contrary, pronounced his fast ex cathedra (that is of his own chamber) that Grecian, Roman, Byzantine, or such like architecture, used in ecclesiastical edifices is Pagan and unchristian; as did Taylor the Platonist declare, in a dispassionate manner, that all who did not believe in the religion of the Platonic school were infamous, daring, and Galilean. What says the mathematician of Pagan and unchristian edifices, to the "Pagan and unchristian" style of the (so called) Cathedral of the Christian world, the throne of gods, vicegerent upon earth; whereas in by-gone days were fulminated the anathemas of the head of the Christian church against all heretics and unbelievers! or, of any other of the Christian churches in that self called capital of the Christian world! or, of the beautiful Christian churches of Michael Angelo, Raphael, Bramante, Palladio, Scamozzi, and other Christian architects of the Italian period of Italian art,—to say nothing of the more recent Christian church, designed and executed by the catholic and tasteful Canova?

William Hazlitt justly compares the correctness and chastened rules of Grecian architecture to those of the Greek tragedians, and the elements of its style to the purity of their incomparable language. "A Doric temple," he observes this discriminating critic, " differs from a Gothic cathedral, as Sophocles does from Shakespeare." The principle of the one being simplicity and harmony, governed by certain rules; that of the other richness and power directed more by fancy and taste than by too rigid an observance of scholastic discipline. The one relies on form and proportion, the other on quantity and variety, and prominence of parts. The one owes its charm to a certain union and regularity of feeling, the other adds to its effects from complexity and the combination of the greatest extremes. The Classical appeals to sense and habit, the Gothic or romantic strikes from novelty, strangeness, and contrast. Both are founded in essential and indestructible principles of human nature.

If the Gothic style be considered as a grace in architecture, it may be divided into three species—the robust, the ornate, and the florid. Under the term robust, may be classed all the varieties of Saxon or Early British architecture; under the ornate, the Anglo-Norman or English; and under the florid, the gorgeously embellished works of the Plantagenet and Tudors, which romantic species flourished resplendently till it reached its meridian grandeur in those ages, and may date its decline from the introduction of classical literature in the reigns of Henry VIII. and Elizabeth, when Roman, or rather Italian, architecture began to mix itself with our native Saxon and British styles, as its words did with our language, and we were then, Shakespeare and Bacon excepted, pedants in both.

Various hypotheses have been formed upon the origin of this beautiful and original style. The learned German critic, Dr. Möller, principal architect to the Landgrave of Hesse, in his Essay on the Origin and Progress of Gothic Architecture, traced in and deduced from the ancient edifices of Germany, with reference to those of England; and the English Architect, Sir James Hall, in his profound work on the same subject, derived them from a similar source, namely:

1. From the sacred groves or thickets of the ancient Greek nations.
2. From huts made with the entwined branches of trees.
3. From the structure of the framing in wooden buildings.
5. From the imitation of pointed arches generated by the intersection of semicircles.

Holbein, and other painter-artists, who adorned in the last year, and his daughter Elizabeth, introduced the mongrel style affectedly called Elisabethan, which is neither pure nor classical, but a rambling picturesque style of shreds and patches.

Palladio, the father of that style of architecture which was introduced into England by Inigo Jones, read Vitruvius in the true spirit of his author; and delineated restorations of ruins of ancient Rome in a manner that perhaps existed in some of their original. The style of domestic architecture which this great Italian master formed from his study of these splendid ruins may be gathered from the numerous Roman villas and palaces with which he studded almost every part of his native Italy. Two
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haps in Europe, can be better imagined than described. Of the propriety of adding a Roman portico to a Gothic cathedral, much cannot be said; but perhaps the architect contemplated the completion of a Christian cathedral in a similar style with his portico. It has been compared to a pension given by a prodigal king to a parasitical favourite, as being a great deal ill applied. Lord Burlington said of it, on seeing the new cathedral—"When the Jews shall see this, they will weep."

These works, and some unexecuted designs, published by Kent at the expense of the Earl of Burlington, show the fertility of this architect's mind, and the skill with which he adapted the best styles of Roman architecture to the domestic conveniences required by an English family in our variable climate. His church of St. Paul, Covent Garden, which he built for the parsimonous Duke of Bedford, who desired a mere barn for the use of his Covent Garden tenants, and was informed his desire should be complied with, but it should be the finest barn in Europe, also shows the dexterity with which Jones could use the plainer materials. It produced the desired effect, and stands aless as a masterpiece of Frasul architecture, proving how the mind of a man of genius can overcome difficulties. It is the only specimen of the true Vitruvian Tuscan ever known to have been executed. The late Mr. Hardwick displayed becoming reverence for the master mind of his great predecessor, by attempting no improvements upon this singular example of church architecture, when he repaired it after a destructive fire.

Hertford's Hospital, near Edinburgh, an early work of this architect, before he bad matured his taste by foreign travel and the study of the great Italian masters, has little to recommend it, excepting the simplicity and aptitude of the plan to its purpose. The architectural world is indebted to Mr. Goldstueck for some tasteful etchings of the plan and details of this building. The only other work of Jones in Gothic architecture is the Chapel in Lincoln's Inn, and proves that neither he nor Wren comprehended the spirit of this beautiful style.

His greatest work, however, was the magnificent palace which he designed for James I., the Banqueting House, Whitehall, now used as a military chapel, being the only part executed. It was to have covered an immense plot of ground, extending from Charing-cross on the north, to Richmond-buildings, Parliament-street, on the south; and from the river on the east, to the Parade in St. James's-park on the west. Four such buildings as the present chapel were designed: one opposite to it, near the site of Melbourne House; the other two, one in a line with it, near Scotland-yard, and the other opposite thereto, on the site of the Admiralty,—and were to be used as a banqueting room, a royal chapel, a throne-room, and a hall of audience. They were to be connected by a variety of state and domestic apartments, official residences, spacious courts for air and exercise, and every accommodation for a royal palace, suited for the greatest monarch in Europe. The circular court surrounded by an arcade supported by statues, throne called the court of the Caryatides, was one of the finest conceptions that ever emitted from the mind of any architect—ancient or modern. The whole design, which, thanks to the liberality of the great Earl of Burlington, has been published, with numerous and ample details of all its parts, is a perfect school in itself for an architectural student: the masterly skill with which the architect has conquered the difficult arrangements of the state and private apartments, without unnecessary interference with each other,—the manner in which he has arranged the various courts for light and air,—and the underground apartments for domestic use,—and complete drainage necessary for the salubrity of such a vast assemblage of buildings, combined with consummate skill into one perfect whole, should form, with his mansions and villas, the study of every aspirant to architectural honours. These works of Inigo Jones would alone furnish a series of lectures on the skilful adaptation of architectural grandeur to domestic comfort and internal convenience, worthy the talents of the greatest master of the present day. This great English architect and his worthy successor, Sir Christopher Wren, are, to our national disgrace, better understood and more highly appreciated in France and Germany than in their own native England.

The only executed portion of this magnificent design—namely, the military chapel or banqueting house—is, like the part from which it is detached, grand in style, but unequal in some of its less important details. The conception of which, considered as the small part of a mighty whole, is in itself noble; its primary divisions are few and simple; its openings large and handsome—but as a whole it is unequal in compositions and in style. The play of light and shade produced by the breaks over each column is, in a minute taste, the very opposite to grand. The Ionic specimen—the invention of which is attributed to Scamozzi, but is really a

straw, bows, niches, grotesque imagery, and foliage,—"gorgeous and by-
dress and chimeras dire," throws about with all the redundance of picto-
rial wantonness;—half-timbered houses of divers colours;—"black spirits and white, blue spirits and grey," grinning horrible defiance to good taste, is this pedastic style, which alike inflates our language and our architec-
ture. It closed—to show what height architectural absurdity may be reached when a foreigner dares, in the name of the Arians of Italy and the deuced Scot, not even in the worst taste, are pilled one upon the other—the brawnay Tuscan at the bottom, almost crushed by the superbimient weight, and the lanky Composite at the top.

This aberration—for style it cannot properly be called—thanks to the improved taste acquired by Prince Charles and his gay companions, who rubbed off their pedastic rust by continental travel, a better style in art preserved;—Vandyke superseded Holbein, substituting nature for dry affectation; and Jones threw the nameless and irresponsible architecture of the monstrosities of the Elizabethan period into that obscurity which all the eudavours of the elegant pencil of modern draughtsmen have not been able to revive.

The Roman or Italian style of architecture, adapted to domestic econ-
yomy, was first introduced with classical purity into this country by Inigo Jones, who flourished in the reigns of James I. and his son Charles, and died neglected in the tasteless times that succeeded the beholding of his royal patron. The most distinguished works of this eminent English architect, are the before-mentioned mansion at Avesbury, in Wilts.; that on the northern side of Greenwich park, which now forms the central building of the Royal Naval School; and at the same time, an appropriate house at the Royal Hospital as viewed from the river; Shaftesbury House, in Aldersgate-street, formerly the town mansion of the nobleman of that name, and now subdivided into a series of shops and the establishment of the General Dispensary; some town houses on the southern side of Long-
acre, the pillarars and Corinthian capitals of which are still in existence; some mansions on the west side of the square called Lincoln's-inn-fields, the ground plot of which he set out the same size as the large Egyptian pyramid; and the grand piazza of Covent Garden, which is fast disappearin under the hands of the building innovators. Among his most celebrated town mansions, may be mentioned that of the Duke of Bed-
ford, on the north side of Bloomsbury-square, which, with its gardens and pleasure grounds, occupied the whole areas of Russell and Tavistock squares, almost up to the New road. It was taken down to make way for the profitable improvements by building speculators of that brown brick suburb of the metropolis. It was a perfect Italian villa, carefully adapted to our climate, and contained among its state apartments an ex-
tensive picture gallery. Among its pictures was that fine set of copies from compositions of Raphael, which is now in every collection of a peer's or nobleman's house, in London and the provinces colours by Sir James Thornhill, and presented by Francis, Duke of Bedford, to our Royal Academy of Arts.

For the satisfaction of such of our architects who have not yet learned to despise old "Iniquity Jones," as Ben Jonson called him in one of his satires, Harcourt House, on the west side of Cavendish-square, still remains in almost its pure pristine state, for their contemplation. But let them be quick about it, for it has already been looked at by the architect of an innovating Joint Stock company, for the purpose of converting it into a series of club chambers, like those of the Albany, Piccadilly. It is not an ophosterlayer's mansions—all carpeting, flock papering, gilt paper marbled, and gawgaws: but a solid substantial structure, of sound brick and stone, marble sculptures, and fine oak carvings; built for ages and for the occupation of a noble English family, who could boast, like the Italian notables, that it was built by their ancestors, generations ago, and had never been occupied but by their own race. The noble seounder, to do justice to his architect, has placed his bust in a conspicuous part of the principal front.

Among his works that are still extant is the Dormitory, at Westminster School; its exterior is strongly marked by the prevailing character of his style—a correct manly simplicity, and a just proportion of the component parts characteristic of its use; the interior of the upper story is well enough for the use of the scions of aristocracy who occupy it, and is annually used as the theatre for the performance of the Latin plays by the Westminster scholars.

In enumerating the works of Inigo Jones, his vast and splendid portico to the old cathedral of St. Paul, that was destroyed by the great fire of London, is not to be omitted. Its proportions and dimensions are seen in Kent's publication of his works; but the vastness and grandeur of this stupendous portico, so far superior to any other in England, and per-
corruption of the angular capitals of the temple of Minerva Polias—is one of the worst and the most impure that he could have selected; the modifications do not belong to the order, and approach too nearly to those of the Corinthian. If one order upon another be ever admissible, the Corinthian should not have been excluded for the purpose of introducing the Composite.

ON THE SCREW PROPELLER.

In the following paper we propose to examine theoretically the best angle for the worm of the screw-propeller—taking for granted the theoretical formulae for the resistance of fluids. At some future opportunity, we propose to investigate the problem in a more practical manner, and to supply conditions for the best form of the screw itself, with reference to strength and useful effect.

Let \( B E D \) be a small plane rectangular lamina of rigid matter, attached by means of a rigid rod \( A B \), without weight, to an axis \( A L \), which is horizontal, and about which the rod \( A B \) can revolve in a vertical plane. Let the rod \( A B \) be in the plane \( B E D \) and perpendicular to the side \( E C D \); also, let the small lamina \( E B D \) make an \( \angle \theta \) with the vertical plane in which \( A B \) rotates; and let the area of the plane \( E B D = k \).

If the axis \( A L \) be fixed to a vessel floating in water or any other fluid, and the point \( A \) be at such a depth below the surface that \( E B D \) will always be in the fluid, and \( A B \) be made to revolve rapidly in the direction \( C A \)—the resistance of the fluid upon \( E B D \), resolved in a direction parallel to \( A L \), will cause the vessel to move in the direction \( A L \).

Now, the worm of a screw, having \( A L \) for its axis (the plane of any element of the worm being supposed to contain the line \( A B \)), may be supposed to be made up of an infinite number of small elements, similar to \( E B D \). The rotation of such a screw would, therefore, cause the vessel to move through the water. If the propulsion were caused not by one unbroken worm, but by several portions of the same worm, symmetrically and oppositely disposed about the axis, the resolved parts of the resistances perpendicular to the axis will destroy each other, and the motion of the vessel will be steady and in a straight line. When the vessel is moving with a uniform velocity, the resistance of the water to its motion will exactly equal the resistance to the screw, resolved in the same direction; and the sum of the moments of these two resistances about the centre of gravity of the vessel will be zero.

To return to the consideration of the single element \( E B D \), suppose the vessel moved has a velocity \( v \), and the resistance to its motion is \( R \); let us determine the value of the \( \angle \theta \), when the amount of moving power expended is a minimum. Let \( \rho \) be the density of the fluid; \( r \) is the distance \( A B \); \( m \) the angular velocity of \( E B D \). Let \( F_r \) be the moment of the pressure about \( A \), \( E B D \) exerts when moving with an angular velocity \( m \); then, if the moving power be constant, \( \cdot \cdot \cdot \) will be the moment of the pressure exerted by \( E B D \) when moving with an angular velocity \( m \). Consequently the resolved part of the velocity of \( E B D \) perpendicular to \( E B D \) is \( \frac{m r \sin \theta - v \cos \theta}{\cos \theta} \); and the resistance against \( E B D \) is \( \frac{\rho k \left( m r \sin \theta - v \cos \theta \right)^2}{\cos \theta} \); \( B C \) being supposed indefinitely short compared with \( A B \).

The resolved part of the resistance parallel to \( A L \) is

\[
\frac{\rho k \left( m r \sin \theta - v \cos \theta \right)^2}{\cos \theta}, \quad \sin \theta \times r = \frac{F_r}{m};
\]

\[
E \cos \theta = R \cot \theta; \quad \therefore \quad m \cos \theta = \frac{F r}{R}.
\]

Let \( r \) be the radius of the vessel, and \( v \) its velocity. Also, since the motion of \( A B \) is uniform,

\[
\frac{\rho k \left( m r \sin \theta - v \cos \theta \right)^2}{\cos \theta}, \quad \sin \theta \times r = \frac{F_r}{m};
\]

\[
E \cos \theta = R \cot \theta; \quad \therefore \quad m \cos \theta = \frac{F r}{R}.
\]

\[ F R = R v + \sqrt{\frac{\rho k \left( m r \sin \theta - v \cos \theta \right)^2}{\cos \theta}}. \]

In this expression, it is clear that \( F \) is least when \( \cos \theta \) is greatest—that is, when \( \cos \theta = 1 \), and \( m \) is \( \infty \).

The interpretation of this apparently paradoxical result shows that the smaller the angle of the worm of the screw, the less the power lost in transferring motion to the vessel.

There are, however, certain practical considerations which cannot be neglected in determining the best value for \( \theta \). In the first place, we have supposed the lamina \( E B D \) to be indefinitely thin, and that all the resistances are perpendicular to \( E B D \); this, in practice, is not the case: the resistance against \( E B D \) being very considerable, it follows that—in order for the material connection of \( E B D \) with \( A L \) not to be destroyed by so great a strain—\( E B D \) must be of appreciable thickness.

Let the area of edge of \( E B D \) be \( k \); then neglecting the effect of the mass of \( E B D \) and its weight, we should have the following equations:

\[
\frac{\rho k \left( m r \sin \theta - v \cos \theta \right)^2}{\cos \theta} - \frac{\rho k \left( m r \cos \theta + v \sin \theta \right)^2}{\sin \theta} \sin \theta = F_r
\]

and \( \frac{\rho k \left( m r \sin \theta - v \cos \theta \right)^2}{\cos \theta} \sin \theta + \frac{\rho k \left( m r \cos \theta + v \sin \theta \right)^2}{\sin \theta} \cos \theta = \frac{F r}{m} \).

In these expressions we find that \( R \) is diminished, while \( F \) is increased; consequently, there is a double loss of power. \( F \) must be increased to balance a resistance which not only does not accelerate, but actually retards, the motion. Also, the new terms introduced rapidly increase by diminishing \( \theta \); a value of \( \theta = 20^\circ \) would probably make \( F \) nearly a minimum.

The whole theory of resistances is, however, so little to be depended upon, that the results we have obtained can only be regarded as a rough method of approximating to the truth. In a future number of the Journal, we hope to be able to continue the subject, founding our investigations on data of observation and experiment.

[In the number for April, in the article "On the Motion of Fluids," p. 98, for "the equal number for e,"—read, "the equations for e;" and, p. 98, col. 2, for the "mean vertical velocity of the particles,"—read "the mean velocity of the particles in direction of the tube."

SEWAGE AND DRAINAGE.

Since our last number, we have seen with the deepest regret, that the Government have agreed to leave out from their sanitary measures for the present year the metropolitan districts. It is most painful to reflect that two millions are left exposed to the evils of a most inefficient system of sanitary administration, at a time when the scarcity of food is sure to produce severe disease, and when there is every likelihood of the Asiatic cholera spreading through Europe to this country.

If there be one fact that admits of no doubt in the public mind, and of no doubt in the minds of any but aldermen and commissioners of sewers, it is that the sanitary administration of the metropolis is most shamefully misconducted, while it is imperative that the administration should be concentrated and carried on with vigor. Whatever superiority we may have over other countries in such matters, it is nevertheless true that we are miserably behind-hand, so far as our own enlightenment is concerned. We want no facts to prove this beyond the experience of every individual, though the reports of the Registrar-General and of the officers of sewers are convincing.

One great good we expect from the abolition of the present system—or no system—is full scope for the exertions of able and intelligent engineers and surveyors. Indeed, it is by such only that any amendment has been effected, as the Labours of Mr. Roe, in the Finsbury Division, and lately of Mr. Phillips, in the Westminster Division, fully show. We have now before us a report of the latter gentleman, to which we shall direct attention in preference to any other branch of evidence.

This report is produced in pursuance of an order of the commissioners of sewers, on the 1st May, 1846, and ordered to be printed 16th April last, to ascertain the condition of a part of the eastern division of the sewers north of Oxford-street, and east of Portland-place and Regent-street. This district (called All Souls) contains an area of about 130 acres, with a population of 27,000 persons residing in 3000 tenements. The density of the population is not great, considering the extent of the district and the number of houses inhabited—being on an average nine persons to each house. Mr.
1817.]

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Phillips says, that the situation of this district, although not quite so airy and salubrious as others in the parish of St. Marylebone, is far from being close and unhealthy. The houses generally are large, being chiefly third-rate, and narrow streets, courts, and alleys are not numerous. The streets indeed are most of fair width, running in straight lines north and south, and east and west, and communicating with other wide streets running in those directions; and having therefore currents of air running freely through them, and keeping up good ventilation. The district is, further, seventy-four to eighty-three feet above the level of Trinity High-water datum in the Thames. The paving is generally in good condition; and being well supplied with gully drains, the surface water is carried off speedily. Nearly all the public ways have sewers running along their sides.

The above description appears to be that of a healthy and comfortable district, but Mr. Phillips gives full proof of its real state, and of the operating causes. He contrasts it with the neighbouring district of Cavendish-square, and he finds from the return of the Registrar-General in 1845, that whereas in Cavendish-square the mortality was one in fifty-nine, in All Souls it was one in twenty-eight, or more than twice as great. The rate of mortality per hundred stands thus—

Cavendish-square ... ... 1:7
All Souls ... ... 3:6

Excess on latter ... ... 1:9

The excess of mortality in All Souls district is more than equivalent to that of a healthy district; so that, literally and truly, the Cavendish-square people have twice the health of those of All Souls. The number of persons murdered in All Souls district cannot be calculated at less than 200 persons yearly, whereas it is very likely 500. The average per centage of mortality in the parish of St. Marylebone is one in forty-four, or 2:27 per hundred, which average, of course, is made up by such districts as those of All Souls. The fact that the population of All Souls is of a poorer class than that of Cavendish-square, is not enough to account for the greater mortality of 529 persons yearly, or 10 weekly.

The cause of this wholesale murder is the neglect of the sewers by the Westminster commissioners. The sewers appear to have been built between seventy and a hundred years ago, and are all built with flat paved bottoms and upright sides, spanned by half-round arches. They vary from 4 feet to 5 ft. 6 in. in height, and from 3 feet to 4 feet in width—being of ample size; but all the junctions are formed at right angles, many of them being broken through the side walls and not made good. The materials used in their construction are the worst of their respective kinds, being place bricks, and mortar composed of chalk lime and loamy pit sand. They are now, Mr. Phillips says, "very much dilapidated, considerable lengths of the side walls being now in ruins, and the remainder falling fast to decay."

As a fit appendix to this, Mr. Phillips states that—"It would appear the court of sewers exercised little or no authority over either the arrangement or construction of these old sewers; as the only record respecting them that I can discover in this office, is the report of a committee, on view in August, 1726, stating that the side wall of a sewer at the north end of Norton street had bulged for a length of ten feet; that the sewer at the north end of Titchfield-street had been built with place bricks, that the arch had fallen in in several places, and that a great quantity of rubbish was in the sewer." Thus, what the sewers were sixty years ago they are now; and during that period, at least, their neglect by the commissioners has been consistent—which is the most corteous term we can employ. We cannot, however, find that the inhabitants have been exempted during that time from sewers rates—that would be too much to expect. Indeed, when we look at the further evidence, we cannot but think that the inhabitants would have been better without sewers, and that they only paid for being poisoned. In London, and other unhealthy cities, they have no sewers—and yet the mortality is not higher than in All Souls, Marylebone, where the sewers can only be regarded as what Mr. Phillips in one place calls long and narrow cesspools.

Mr. Phillips informs us, that for many years past, the inhabitants have complained of these sewers being choked up and stopping their drains, and of serious exhalations arising in the streets and houses, and that they still continue so to some extent—havincg, in order to acquaint himself with the extent of the evils, on numerous occasions passed through the sewers. In doing this, he waded and crawled, sometimes in darkness, through vast accumulations of half-fluid black matter, and his health suffered greatly in consequence.

It seems, that from 1834 to 1844, 186,068 cubic feet of soil or poison were taken out of the sewers, and carted away, at an average annual cost of £118 St., besides contingencies, which perhaps doubled the outlay. The relief, however, was but temporary, and the disbursement of this trumpery pitance did not abate the evils.

These sewers are described as containing, throughout, an immense accumulation of detritus and decayed animal and vegetable matter; and they are thus becoming worse every day. From their bottoms being flat and broad, and the fall but little, and that irregular, directly they are cleared they begin choking up again. This, Mr. Phillips says, goes on increasing backwards, until the surface of the soil forms an artificial fall, whereby the capacity of the sewers is increased, and any further deposit from taking place. This is in obedience to a natural and well-known law, and it illustrates the futility of laying down sewers with too little fall—for if the fall be not given to them, they will make it for themselves. On account of this "grading," as the Yankees call it, of the main sewers, the soil in many of them is now on a level with, and in others it is above, the mouths of the house drains, which are in consequence fast choking up, many being stopped already. This is the state of affairs in a large and wealthy parish, paying a large sum to the sewers rates—and certainly willing to pay for health and life.

The house drainage, as may be expected, is most defective. Cesspools and common privies abound. Some of the cesspools have no overflow drains, so that the more flowing portion of the matter soaks away through the neighbouring ground, choking it with filth, and leaving the solid matter to rot. Those having overflow drains are always full of soil, and send forth such pestilential exhalations as almost, in many instances, to prevent any one from going near the privies. The side drains from the houses are large, and have flat bottoms, so that the small quantity of water flowing into them is not kept from polluting the basements; houses cannot keep them washed out; and they consequently choke up, requiring often to be broken into so that they may be cleansed—thereby causing outlay and annoyance. As often, however, as they are cleansed, voids are formed, which are again and again filled up.

Mr. Phillips, we are glad to see, agrees that it is needful that house drainage should be a part of the entire sewerage,—and says that "the sooner the legislature place house drainage and sewerage under the same control, the specifier will be the removal of many and glaring evils. A skilful combination into one system of house and street drainage, conjointly with a full and efficient supply of water, would ensure the removal of filth and waste water into the sewers, nearly as fast as produced, instead of being detained as at present in the drains and cesspools in and about the houses, for months and years together." Certainly until this is done, nothing is done; and uniform sewerage is quite as important as uniform postage. To the wealthy, it is essential that the houses of the poor should be drained, for in them are the great seats of fever and disease;—sewerage is not a luxury for an individual, but a duty towards the community; and as the expenses of communicating with sewers are about the same in the case of a poor house as of a wealthy house, none would demand on the whole charge being thrown upon property.

The cleansing of the sewers in All Souls district would require the removal of 50,000 cubic feet of soil—and then only temporary and inadequate relief would be obtained. The sewers are, indeed, in such a shameful condition, as is well known to the officers and workmen employed, that when called upon to make examinations and to work in them, they show great dislike, from the feeling of danger they have. They are fearful when entering them, at every step they take, of setting fire either to explosive gases generated from the soil or escaped from the gas mains in the streets, or of being overpowered by the heat and fœtidness of the atmosphere, "which, from want of ventilation, causes great dimness of sight, giddiness, and sweating, and also makes breathing very oppressive, as from experience I can testify," says Mr. Phillips. It is right to observe, that the parish and other authorities have complained of such a state of affairs.

Some curious illustrations of the vigorous administration of the commissioners are given incidentally. The great sewer in London-street was rebuilt in 1832, nearly twenty years ago, more than two feet lower than the present one in Cleveland-street, in anticipation of the line of outfall being lowered—and it now continues an account every of nearly four feet in depth. The sewer in Newman-passage was likewise rebuilt in 1829, between two and three feet below that in Newman-street, for a like reason, and is so full of soil that parties who have obtained leave to lay drains into it have been unable to do so.

Mr. Phillips justly observes, that no temporary expedient can be applied in such a state of affairs, and he proposes to rebuild all the sewers and to
improve the outfall through the main Hartshorn-lane sewer by a work of considerable labours, which will need 1,500 feet of tunnelling. Upon this, we cannot help observing, as we did last month, that it is really a pity to see the waste of money and the inefficient measures, which are the result of the present system. We then pointed out that a large sewer, belonging to the Regent’s-park and Regent-street commission, runs through the centre of the Westminster district; and yet, that for the latter, distinct outfalls are sought and the channels constructed, at an enormous expense. If an arrangement were now entered into between the two commissions, for the purpose of allowing the sewers in the vicinity of Regent-street to communicate with the Regent-street sewer, a vast outlay would be saved in building the sewers, no doubt, by partly raising and partly lowering the bottom of all the sewers on each side of Regent-street, to the distance of 600 yards. The accumulation of the filth in those sewers might be got rid of, particularly if a new bottom were made to the sewers of a circular shape; in fact, this latter arrangement could be done to most of the old square-built sewers.

In the present case, Mr. Phillips canvasses the propriety of communicating with the King’s College Pond sewer; but he says not one word of the Regent-street sewer, which runs through his district. The drainage of Devonshire-street, which lies on the latter sewer, is therefore proposed to be carried through several bends and at right angles, down to Broad-street, Bloomsbury, a distance of many thousand feet—when the Regent-street sewer can be entered at the bottom of Devonshire-street. We say nothing as to the necessity for improving the Hartshorn-lane sewer and outfall; but we do urge, so far as the streets in the neighbourhood of the Regent-street sewer are concerned, that the Westminster Commissioners should have a conference with the Commissioners of Woods and Forests, and come to some arrangement.

Mr. Phillips estimates that his plan will require the rebuilding of 25,176 feet of sewer, at a cost of £29,140 10s.; but he does not dare to recommend the immediate execution of his plan and the disbursement of this sum—yet proposes, as a first instalment, the outlay of £1,037. Supposing this to be one year’s outlay, and that the saving of human life should be in proportion to the average of Cuycesh-square, and to the gradual extension of the sewers,—the number of persons destroyed during the gradual execution of the plan would not be much more than 1,539, or the population of a good sized market-town; whereas, by the immediate disbursement of about £128 a-head, the destruction of so many human beings might be averted. Supposing the money borrowed at 3 per cent., for the purpose of making the immediate outlay, the additional charge for this would be about thirty shillings per head on the whole number of individuals proposed to be murdered. Perhaps the Humane Society, or some other Society, might think it worth while to advance the money as a gift, and thereby save so many human lives.

The public have been greatly scandalised by the promulgation of the fact, that the mortality in parts of Whitechapel and the eastern districts is 1 in 24 yearly;—but we believe they were not prepared for a mortality of 1 in 27 in Marylebone—and that mortality, as a public officer has shown, caused by the shameful state of the sewers alone. It is in the possession of such facts, that Lord Morpeth has taken on himself the responsibility of withdrawing that measure of legislative relief, to which the inhabitants of the metropolis have so long looked forward; and he has thereby taken the further responsibility of sanctioning a system of administration which the medical profession, the engineers, and the press have justly pronounced a system of wilful murder.

After the engineering profession have so long exerted themselves for the improvement of the state of the metropolis, it is quite disheartening that they should be deserted by the minister of the department which professes to take charge of the subject. So long as there was a prospect of a Government job in employment military engineers to make a metropolitan survey, to superintend civil works, and to receive the remoulmains of civilians, the government were sensible enough; but when this inducement is taken away, the commissioners of sewers are allowed any requisite they choose to claim.

If the removal of the filth of the metropolis be an important object, the saving of the valuable manure which is now wasted is no less deserving of consideration: but we are afraid this also is likely to meet with the fate of other measures of improvement. The Metropolitan Sewage Manure Company have this session applied for a new act to enable them to lay down a receiving sewer, which shall cut the sewers at a mean distance of 690 yards from the river, involving very expensive works. To this, Mr. John Martin, the founder of the company, objects,—and proposes an alternative plan, for receiving the contents of the sewers near their outfall, which certainly appears a more rational plan,—and we cannot, from such evidence as we have before us, see any reason for the company’s plan. 690 feet would be a great distance from the river, but 629 yards seems monstrous—for thereby the large intervening district is left unwrought.

We may here observe, that we look upon the useful application of the manure of towns as a great boon, which engineering knowledge will confer upon the tillage of this island. From a town population of four millions, and with the great body of horses employed by them, a quantity of valuable manure is obtained, which cannot be reckoned at less than equivalent to the production of half-a-million of quarters of corn yearly, or the yearly food of half a million of human beings. Where it is considered how the refuse of the dustyards of London is economised, it is strange that the produce of the sewers should be wasted. The old mortals, the broken pots and pans, called pickings, the rags, bones, cinders, small coal of the dust bins, are all saleable; the produce of the cеспools is made an incresive branch of business, and manures are made from it in London which are sent out even to the sugar plantations in the West Indies—but the greater part of the manure of the metropolis is sent into the Thames to pollute its waters.

MEASURES OF FORCE AND LAWS OF MOTION.

Six—In your last number, you state (page 292) that—"If when a body is in motion, it is acted upon by an invisible force, in the direction of its motion, the quantity by which the velocity of the body will be increased or diminished (according as the force is accelerating or retarding,) will always be the same in the same time; and is quite independent of the initial velocity which the body possessed before it was subject to the influence of the force." Further—

"This fact at once furnishes us with a convenient dynamical measure of force, known by the name of the measure of accelerating force." . . .

Thus gravity accelerates the velocity of a body falling in vacuo by 33.1 feet a second; taking feet and seconds as units of space and time, the accelerating force of gravity is represented by 33.1—this is all perfectly true; but there is considerable danger of an erroneous inference of great practical importance being drawn from it, which it is well to guard against.

Suppose a heavy body to fall from a height so as to occupy several seconcs in falling; the effects may be tabulated thus:

<table>
<thead>
<tr>
<th>Seconds occupied in falling</th>
<th>Space fallen through in each second</th>
<th>Total space fallen through by the end of each second</th>
<th>Acceleration during each second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet</td>
<td>Feet</td>
<td>Feats</td>
<td>Ft.</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>16</td>
<td>from 0 to 32</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>64</td>
<td>from 32 to 64</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
<td>144</td>
<td>from 64 to 96</td>
</tr>
<tr>
<td>4</td>
<td>64</td>
<td>200</td>
<td>from 96 to 128</td>
</tr>
</tbody>
</table>

Now, as the amount of accelerations communicated to the falling body by gravity in any one second is precisely equal to the amount so communicated in any and every other second, an unguarded reader may easily fall into the error of supposing that the amount of gravitating force exerted (if I may so term it) upon the falling body in any one second is, in like manner, precisely equal to the amount so exerted in any other second.

In fact, not only unguarded readers, but also very able writers, appear to have fallen into this error; imbibing it in the astral doctrine, that the momental of a moving body is as its weight (measure) multiplied by its velocity. The truth being that the momental is as the weight multiplied by the square of the velocity; a truth of the greatest importance in questions concerning the effects of hammers, fly-wheel, ordinance, &c., and of winds, waves, and currents of water,—the resistance of water to the passage of vessels, &c.

If it be necessary to prove this truth, a mere inspection of the foregoing table is enough, as respects falling bodies; for it is therein seen that while a fall of 16 feet produces the velocity of 32 feet per second, a fall of 64 feet, that is four times the fall, only produces double velocity; nine times the

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* Perhaps the real difference may lie in the different understanding the word moment signifies. 
* The understanding of the term is as least practical one, viz. that it means the amount of power which can be communicated to a body by putting it in motion, and which can be taken back from it by stopping its motion; this amount of power being measured in the manner in which the animal power, mill power, &c., are ordinarily measured.
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Let \( m \) be the mass of a body caused to move from rest by a pressure which is \( X_x \) at the distance \( x \): then if \( v \) be the velocity acquired at the distance \( x \), we shall have \( m \cdot dv = X \cdot dx \), by the equations of motion.

Consequently, \( \frac{mv^2}{2} = \int x \cdot X \cdot dx \);

but \( \int x \cdot X \cdot dx \) is the "work done"—which, therefore, varies as the square of the velocity. There is considerable confusion manifested by Mr. Hill in the use of the word "force"; he talks of a bullet penetrating with nine times the force, instead of nine times as far; in this instance, Mr. Hill uses "force" to mean what he misconceives by the term "momentum"—viz., \( \int x \cdot X \cdot dx \), or "power expended." We are sorrowfully willing to concede, that much time and money have been wasted in engineering matters—not, however, as Mr. Hill would insinuate, from a too rigid regard for the laws of motion and measures of force, but from gross ignorance of both. Unfortunately, the confused ideas of men unacquainted with mechanical principles, by jumping together force and its effects, and giving birth to vague and useless terms, such as "living force"—and "power expended"—and "power absorbed," and the like—have done considerable mischief to the science of engineering, by diverting it of its simplicity, and basing it upon nothing rather than what it ought to be based upon—namely, the six equations of statical equilibrium, and the six dynamical equations of motion.

ARMY AND NAVY CLUB.

We do not think it necessary to make any lengthened remarks on the competition of designs for the Army and Navy Club, or to enter into any detail with regard to them, as the designs were, according to our views, far below the proper standard, and we are glad to perceive that the Committee have had the good sense not to carry out those which received the prizes. So far as the competitors were concerned, the whole affair must be considered highly derogatory from them, for they came before an irresponsible tribunal, they subjected themselves to the consequences of a ballot, and they resolved to canvassing—some of them, we believe, sending round bills and testimonials, like the Morrison's pills or Holloway's ointment sellers. It is in perfect keeping with these proceedings, that some competitors resorted to false perspective views and other tricks to catch the unitiated. Thus ended the lottery at the Army and Navy, or Derby Club, with the loss of time and money to between sixty and seventy architects.

Preston men among the architectural profession of course refrained from engaging in a competition which depended upon the votes of a number of members of a miscellaneous club, passed through the dark ordeal of the balloting box. The Committee Club, we presume, indulged the members in this mock election, as the cheapest way of getting rid of the clamour of those ultra members, who are sticklers in principle for competition and vote by ballot, because of course it could have only one result—the utter impossibility of getting a good and feasible design. A first rate competition is not to be got by such haphazard proceedings, for neither old men of talent, or young men of talent, like to expose themselves to the chances of defeat before an incompetent tribunal, while they are really to afford at their own expense the materials of their own overthrow. A painting executed in competition for a prize, if unsuccessful in gaining the prize, may be exhibited and sold elsewhere; but competition for a club, which cost weeks of labour and entailed much expense, cannot be offered at an alms-house, a theatre, or a church—though in the paucity of ideas the same Ionic portico, or Italian campanile are made to figure as the stock of all and sundry the compositions of some of our inspired artists.

Southampton Docks.—The Dock Company have, we understand, contracted for and commenced the construction of a second dry dock, to be completed in November next. Messrs. William Cubitt and Co. were the successful competitors, the amount of their tender being a little above £17,000, whilst that of Messrs. G. Baker and Son, the contractors for the new custom-house now so near completion, was we believe near £18,000. The dock is to be 550 feet in length upon the blocks, and hold two 500 ton ships at once, or one of all but the largest of the gigantic steam-ships so familiar to our waters, and one sailing ship of 800 tons burthen.
THE ROYAL ACADEMY EXHIBITION: ARCHITECTURE.

The competition for the Army and Navy Club-house, and the designs having to be sent in only a week before the receiving-days at this Academy, no doubt hindered some architects from preparing anything for the Exhibition:—not that there is this year any deficiency as to quantity, there being no falling-off from the usual number of architectural subjects—and as usual, too, a good many of them might, as far as seeing them is concerned, just as well be away. There is, however, less variety than usual, or than used to be the case some seasons ago—since designs for churches greatly outnumber the subjects of any other class. One very noticeable circumstance is the extreme paucity of design for public buildings of any kind—that kind excepted which consists of houses produced by wholesale, under the somewhat dubious title of "Improvements." One design (No. 1077) shows us after what fashion the Castle Hill, at Dover, has just begun to be improved; and another (No. 1111), Dower Court new town, near Harwich—as to which last we cannot speak, not having noticed the drawing, whereabouts it is perhaps luckier than the other. Churches alone excepted—and of them there is a full quota—there is very little to show us what has lately been done in architecture, or what buildings are either now in progress or about to be commenced. Even among the church subjects, too, we miss one that we should have been glad to meet with here; for the edifice is intended, we presume, to be superior in taste to most of the modern ones in the metropolis—to be a monument of its architect's skill as well as of its founders munificence. The church we allude to is the one which Mr. Ferrey is now erecting, in Westminster, for Miss Hurdlet Coutts. Therefore, supposing the design to be, as we have no reason to doubt, a worthy one, it would have been more than a suitable compliment to that lady to have exhibited it. Like a good many others, however, Mr. Ferrey seems to have quite cut out the Academy's exhibitions. There is a growing reserve on the part of those who either rank, or would be thought to rank, high in their profession, to contribute anything whatsoever to the Exhibition. This year there is not a single drawing by the Academy's own professor, or any of the other professors of architecture; and only a very few by members of the Institute. This is not exactly what ought to be, since it bespeaks indolence or apathy, if not contempt; and is, moreover, attended with one injurious consequence—namely, that the number of uninteresting and mediocre subjects can hardly fail to produce an unfavourable impression as to the actual state of the art among us.

It would be a monstrous untruth, were we to say we had some idea of being favoured by Mr. Brode with a peep at his design for the alterations at Buckingham Palace. That gentleman seems determined to carry on his operations with the utmost secrecy, and to keep out of harms way—that is, out of the way of criticism—as long as he possibly can;—a species of mistrust that contrives very strongly with the unquestioning confidence the public reposes in him. To nothing else than perfect confidence can we attribute that universal silence in respect to the Palace, which contrasts so very remarkably with the universal commotion in significant matter at the other end of Constitution-hill. We must, therefore, wait with patience till time reveals to us what neither Mr. Brode himself, nor any one of those who pretend to be in the secret—at least, to have seen a "sketch" of the design—chooses to let us know—namely, into what sort of a building the Palace will be metamorphosed. Architecture, transformations seem to be just now the order of the day, for while Barry, who is now operating upon the Treasury Buildings, is, it seems, about to undertake the transformation of both the Horse Guards and Treasury, Mr. Sydney Smirke is not only altering the present Club-house but changing it into quite a different piece of architecture, as may be seen by the drawing of it at the Exhibition (No. 1100), which shows what the entire façade will be—and that the east front, if not the south one also, will be similar in design to the Pall-mall one. The change cannot fail to acquire for the Carlton considerable architectural rank and reputation, whereas the present club-house never had, notwithstanding its rank as such, any reputation at all as a building. The new structure will most assuredly add very greatly to the architectural character of Pall-mall; but it is not so certain that it will be altogether favourable to its neighbour, the "Reform"—it being, apparently, intended to eclipse the latter. At all events, the Carlton will present the larger façade of the two, and will be in a more florid style of Italian—in fact, a particularly florid one, the spandrel-spaces over the arches of the second order being entirely filled in with figures in relief—both a degree and a species of embellishment which we as yet possess no examples of in town. The upper or Ionic order is also a peculiar example in itself, at least as regards its estabhshure, whose frieze is unusually deep—so greatly exceeding the established proportions, that it would scandalise the sticklers for such matters, and bring down their cabeeres upon Mr. Smirke, had he not sheltered himself under the authority and precedent of Sansovino, whom he has on this occasion chosen to follow pretty closely for the whole design of his exterior. Were it not for the drawing we have just been speaking of, there would be nothing in the Exhibition to show any building (besides churches) either erecting or about to be erected in the metropolis,—if we except No. 1294, a very tiny model of the new Coal Market which is about to be built in Lower Thames-street, at the corner of St. Mary-at-Hill. It will have two uniform, low houses, with two corner rounded offices, the two flower floors of the building, above which that portion will be carried up as a small insulated circular tower or campanile, that will be recessed within the re-entering angle, cut out there between the two fronts. This promises to be a novelty, but the model itself is such a mere toy as to seem—as is indeed, the case with all the models this year—that it is impossible to judge of more than the general shape of the structure. The idea of rounding off the corner of a building in such a manner as to render it an important—albeit very ornamental—feature in the composition, is also displayed in No. 1294 (Exhibition). A design for the new Imperial Insurance Office, to which the second premium was awarded. There is also another design (No. 1196), by the same architect, for the same building; but we do not find here the design for it, which is to be executed; nor that for the Museum of Geology, in Piccadilly.

While usual dearth prevails this season in regard to fresh subjects, representing actual buildings, there is the usual show of "old familiar faces"—familiar even to stateness—things that are known by heart: the Temple of Erothous, the Arch of Titus, the Bridge of Sighs, the Temple Church, with sandry and cetera, whose titles in the Catalogue spare us the trouble of looking at them. We might, perhaps, had we observed its title at the time, have looked at No. 1190, "Edinburgh from the South,"—if only to ascertain whether, as an architectural view, it was more satisfactory than No. 560, Roberts's large oil-picture of the Northern Metropolis, which has obtained from the critics a degree of laudatory admiration perfectly unaccountable to us—it being, in our opinion, neither good as a pictorial composition nor displaying any particular beauty of execution. On the contrary, it is heavy and opaque in colour. To our eyes, the architecture—for the most part very queerish in reality—looks very slovenly executed in this representation of it, and more like the work of a mere landscape painter than of one who has exercised his pencil chiefly upon subjects more or less strictly architectural. But we are playing the truant, so let us return to our own proper subject.

Next year we shall, in all probability, find here several of the designs for the Army and Navy Club-house; in the meanwhile, No. 1121 (W. A. and J. W. Papworth), has got the start of any of the others, that drawing being a coloured copy of the perspective view sent in by Messrs. P. to the competition. We cannot say we admire the approval of the design itself, any more than we do of the license taken in regard to scale, the Club-house being represented two or three feet higher than Winchester House, which innocent (?) species of untruth is contradicted by the proportions of the Pall-mall front—the latter being limited in width to sixty feet; consequently being, in that design, little if at all higher than it is wide—instead of being lofty, it would be about fifteen feet lower than Winchester House. Really, architects seem to be as little scrupulous about scales as they are about estimates. There are not always the scales of justice, or of judgment either. Apropos of estimates—there was wonderful licence in the estimate submitted among the competitors for the Club-house in question: even the estimate for one of the Gothic designs—which certainly looked as if it would cost double, or more than double, some of the others, it being stated all over with statues, canopies, and pinacles—was only £30,000, although the two fronts and their ornaments were to be, not in paper maché, but in real Caen stone!

No. 1129, "Study for a Portal," appears to be a study for that in his design for the Club-house above-mentioned. It is not very favourably placed, being put over the door, although it is a rather large sized drawing, it cannot be fairly seen—and yet seems as worth looking at, the general composition being very happy, and manifesting both originality and gusto. That subject, however, is not the only one that is disadvantageously placed, while many others, that are of comparatively little merit or interest, are perked just in our faces. Nos. 1199 and 1218, for instance, both of them two admirably executed interiors—the only ones of that class in the room—
are brought, at right angles to each other, quite in a corner, and that an obscure one—so much, too, below the eye, that they cannot be inspected without stooping; and the one and the other is so full of elaborate detail, that if once assumed, the stooping posture is likely to be prolonged to weariness. No. 1199. "Design for the Decoration of the Old Billiard-room at Stapleford Hall," (J. Dwyer), would have been all the better, had the figures introduced in it been omitted—unless the artist had employed some one more at home in figure-drawing than himself, to put them in: but in his own department he is admirable. The other subject, No. 1188, (L. W. Coellmann), which is simply styled "View of a Library," represents a room which has lately been decorated in a highly recherché manner by Mr. Coellmann himself, whose taste seems to be far more refined than that of S.ang. This drawing has the advantage over the other in having no figures; though we would at any time readily tolerate poorly drawn figures, for the sake of similar subjects—which, being apartments in private residences, cannot be generally seen, or even known of, except they are portrayed by the pencil. Right glad, therefore, should we have been to see here a drawing of the Ball-room which Mr. Barry has just fitted up at St. John's Wood Lodge, for Sir Isaac Goldsmid, and which is reported to be a fine specimen of the Cinque-cento style. Of that style there is a specimen here, viz.: No. 1202. "Ceiling by Pietro Perugino, in the Sala di Combio at Perugia," (D. Wyatt)—an exquisite drawing, that requires to be looked at as closely as the illuminated arabesque and borders of some precious manuscript, yet here hung where it is hardly observable. A somewhat similar fate attends No. 1238 (J. Thomas), a composition for a magnificent chimneypiece, forming, unlike those of these degenerate days, a stately mass of sculpture.

Churches—both old and new—form the great mass of architectural subjects; nor do they display much variety, or attempt at originality—for they all affect to adhere most literally to the medieval character, and to medieval ideas, as if the aim was to resist all further progress in art. At any rate, so many subjects, all of the same kind, gives a great sameness to this part of the Exhibition,—the appearance of much greater sameness than there perhaps really is; because, where so many drawings are so much alike in their general subject, one effaces the recollection of another;—with which remark we will bid adieu to our own subject, if not finally—as may prove the case—at all events for the present.

THE TUSCAN MAREMME—AND THEIR IMPROVEMENTS.

These, geologically speaking, recent abodes of, or upheapings from, out, the bed of an old sea, believe much of public attention, and many interesting memoirs have been published on them, in the Transactions of the Academia dei Georgofili, and elsewhere. The most characteristic of the Maremme is the north-west part on the sea shore, where the river Cecina, descending from the hills of Volterra, reaches the Mediterranean. Those, as well as the Piombino Maremme, were once Sicure territory, and remained deserted and most unworthy for centuries past. The lower Maremme were still more so,—also for the reason, because there are no large swamps north of the lake of Piombino. Beyond that lake and the promontory of Populonia, the land assumes a less frightful character, and the awful devastation decreases gradually, as we pass the Cecina. The tier of mountains, which south of Leghorn extends close to the sea (the Monte Nero), encompasses the flat sea-shore lands, as by a semi-circle; and the river Cecina descends, bifurcating, into the sea; along the coast, water stagnates in numerous bogs, while the more depressed parts are filled with forests. The land of the Maremme belongs, mostly, to a small number of proprietors. It is here where the greatest improvements have taken place. Government having made the necessary arrangements with them, the land was divided into acentic (1 = 6,500 square metres), the forest, or rather scrubbery, cut down, and the land put to pasture. This division of the sea shore was to be examined and dried by government itself. The dense forest, mostly covered with underwood, and completely in its primitive state, and which, on the slightly inclined terrain, had greatly contributed towards the emboguing of the land, was cut down. The soil which thus was made to appear, proved to be, mostly alluvial earth, resting on a stratum of gravel in fossil shells, and has already yielded the finest crops of wheat and maize. Drains of all sizes have completed the work of desiccation.

Sowever differently the long sea on the sea shore was to be treated—but here, an elevation of the terrain was to be effected, which was done by using the slime and silt of the Cecina; an expedient which has yielded triumphant results in the Valley of the Chiana and elsewhere.* On this sea, the forest has not only cut down, but even completed by systematic plantations, for opposing a barrier to the sweeping of the sea breeze. A number of vicinal ways have been opened—all to converge to the splendid Via Marittima, a line of road undertaken at the especial command of the Grand Duke of Tuscany. It traverses these swamps in their whole extent, and abuts at one side at Leghorn, and on the other extends to Florence and Sienna—and the Roman road by the southern valleys of Tuscan. The air, most delectable hitherto, has, on account of the many drains, dykes, and other hydraulic works, of the many fires and other domestic operations, improved most wonderfully, and will, no doubt, improve still more. The projected railway from Leghorn to Civita Vecchia will greatly increase the importance of these new lands.

The products of the Maremme, hitherto of little value for want of communication, consist of timber for construction, charcoal, potash, iron, sulphur, borax, alum, &c.; and the number of ships employed on the coast increases rapidly. The harbours of this coast, however, are in a deplorable condition, as there are none of any importance between Leghorn and Civita Vecchia. That of Piombino is full of sand and slime, but it would be possible to correct it. The embouchure of the swamp of Castiglione della Descia, hitherto merely used for small coasting vessels, could, no doubt, be also improved. The southern part of the Maremme has three small harbours—Palamone, famous in antiquity, now blocked up with sand and slime, with the pernicious air resulting therefrom, and Port Ercole. More important is Port St. Stefano, founded by fishermen on account of its healthy situation, which, by the aid of a few judicious constructions, could become very important. The improving of these sea-outlets would much increase the industrial resources of the Maremme, whose mineral riches may be shortly adverted to. The iron stands in the first rank, but the making of borax in the hills of Volterra is also of great importance. Timber of all kinds also abounds, as the forests of the crown alone extend over 10,000 hectares. The clearing of the terrain began here at the end of the last century,—first, with the nearer slopes on the slopes of the Appennines. The destruction of these forests was soon followed by great calamities, but, and elsewhere. In that of Pratovecchio, government has made, of late, great improvements, and during five years, 1,300 hectares have been planted with different sorts of pines. Being placed at a distance of three yards from each other, 3,000,000 trees have been planted, which, in 40 years, will yield 15,000,000 trees fit for construction.

A few observations on the geological character of the Maremme may best conclude this paper. It cannot be doubted, that it was the alluvium poured forth from the rivers, which has filled up the gulf which once occupied this place. This, however, was again modified by the rise of the sea, which formed on the marl various dykes and elevations, and thus shaped the whole surface of the land. V. Fossombroni, an author of note, says that this took place in the first centuries of the Christian era—to prove which, he cites the Peutinger tables, &c. Against this, M. Salvagnotti asserts, that along the whole sea shore, in parts quite close to it, there is a deposit of sand (at times one mile broad), on which the remains of a Roman road have been found, which is the Via Aurelia, built 100 years b.c.; that parts of it, going in the direction of Rome, have been used for making the new road, &c., in 1326. These latter are forcible facts, and prove—that the formation of the Maremme, albeit recent, still preceded the Christian era. Hence it follows, that the alluvium of the rivers formed that land, and that for draining the swamps, which are the remnants of old gulps of the sea, the means hitherto employed have been all right.

We need scarcely state, that the above remarks will be useful not only in reference to the coast of Ireland and Scotland, but still more to many of our distant colonies.

J. L. Y.

* The geological neutralisation, if we may say so, of extensive sand lands with the ad. Increas, has been lately well illustrated in the "New South Wales", where the same, New South Wales, has been hitherto quite overlooked. By placing two substances, quite different from each other, in such close juxtaposition, nature seems to have urged us to make them reciprocally available.

There has been a great contest this month about the ventilation of the House of Lords, Dr. Parday having lectured at the Royal Institution in praise of Mr. Barry's plan, and Dr. Reid having lectured in answer at Willy's Rooms, and in defence of himself.
ON THE INDUCTION OF ATMOSPHERIC ELECTRICITY ON THE WIRES OF THE ELECTRIC TELEGRAPH.

By Professor Joseph Henry.

The action of the electricity of the atmosphere on the wires of the electrical telegraph is at the present time a subject of much importance, both on account of its practical bearing, and the number of purely scientific questions which it involves. I have accordingly given due attention to the letter referred to me, and have succeeded in collecting a number of facts in reference to the action in question. Some of these are from the observations of different persons along the principal lines, and others from my own investigations during a thunder-storm on the 21st of June, when I was so fortunate as to have a copy of the telegraph in Philadelphia, while a series of very interesting electrical phenomena was exhibited. In connexion with the facts derived from these sources, I must ask the indulgence of the Society in frequently referring, in the course of this communication, to the results of my previous investigations in dynamic electricity, amounts of which are to be found in the Proceedings and Transactions of this Institution. *

From all the information on the subject of the action of the electricity of the atmosphere on the wires of the telegraph, it is evident that effects are produced in several different ways.

1. The wires of the telegraph are liable to be struck by a direct discharge of lightning from the clouds, and several cases of this kind have been noticed during the present season. About the 20th of May the lightning struck the elevated part of the wire, which is supported on a high mast at the place where the telegraph crosses the Hackenack River. The fluid passed along the wire every way, from the point which received the discharge, for several miles, striking off at irregular intervals down the supporting poles. At each place where the discharge to a pole took place, a number of sharp explosions were heard in succession, reminding the rapid reports of several rifles. During another storm, the wire was struck in two places in Pennsylvania, on the route between Philadelphia and New York; at one of these places twelve poles were struck, and at the other eight. In the latter case, it was remarkable that nothing was observed, but from the nature of the storm, and the fact of the discharge being cut off by a pole, no phenomenon was observed, though in a less marked degree, near the Hackenack River. In some instances the lightning has been seen coursing along the wire in a stream of light; and in another case it is described as exploding from the wire. It is evident, therefore, that there were no bodies in the vicinity to attract it from the conductor.

In discussing these and other facts to be mentioned hereafter, we shall, for convenience, adopt the principles and language of the theory which refers the phenomena of electricity to the action of a fluid, of which the particles repel each other, and are attracted by the particles of other matter. Although it cannot be said that this theory is an actual representation of the cause of the phenomena as they are produced in nature, yet it may be asserted that it is, in the present state of science, an accurate mode of expressing the laws of electrical action, so far as they have been made out; and that though there are a number of phenomena which have not as yet been referred to this theory, there are none which are proved to be directly at variance with it.

That the wires of the telegraph should be frequently struck by a direct discharge of lightning, is not surprising, when we consider the great length of the conductor, and consequently the many points along the surface of the earth through which it must pass peculiarly liable to receive the discharge from the heavens. Also, from the great length of the conductor, the more readily must the repulsive action of the free electricity of the cloud drive the natural electricity of the conductor to the further end of the line, thus rendering more intense the negative condition of the nearer part of the wire, and consequently increasing the attraction of the metal for the free electricity of the cloud. It is not however probable that the attraction, whatever may be its intensity, of so small a quantity of matter as that of the wire of the telegraph, can of itself produce an electrical discharge from the heavens; although, if the discharge were started by some other cause, such as the attraction of a large mass of conducting matter in the vicinity, the attraction of the wire might be sufficient to change the direction of the descending bolt, and draw it in part or whole to itself. It should also be recollected that, on account of the perfect conduction, a discharge on any part of the wire must affect every other part of the connected line, although it may be hundreds of miles in length.

* American Philosophical Society, 1846.
snow-storm was falling at one end of the line, and clear weather existed at the other. On another occasion a continued stream of electricity was observed to pass between two points at a break in the wire, presenting the appearance of a gas-light almost extinguished. A constant effect of this kind indicates a constant accession of electricity at one part of the wire, and a constant discharge at the other.

3. The natural electricity of the wire of the telegraph is liable to be disturbed by the ordinary electrical induction of a distant cloud. Suppose a thunder-cloud, driven by the wind in such a direction as to cross one end of the line of the telegraph at the elevation, say of a mile; during the whole time of the approach of the cloud to the point of its path directly above the wire, the repulsion of the redundant electricity with which it is charged would constantly drive more and more of the natural electricity of the wire to the farther end of the line, and would thus give rise to a current. When the cloud arrived at the point nearest to the wire, the current would cease for a moment; and as the repulsion gradually diminished by the receding of the cloud, the natural electricity of the wire would gradually return to its normal state, giving rise to a current in an opposite direction. If the cloud were driven by the wind parallel to the line of the telegraph, a current would be produced towards each end of the wire, and these would constantly vary in intensity with the different positions of the cloud. Although currents produced in this way may be too feeble to set in motion the marking apparatus, yet they may have sufficient power to influence the action of the current of the battery so as to interfere with the perfect operation of the machine.

(To be continued.)

LOCOMOTIVE SLIDE VALVES.

Sir,—The following is a scheme for relieving the slide valves of a locomotive engine from the great pressure which is upon them (in the ordinary valves). It is thus:

[Diagram of locomotive slide valves]

In this sectional view, the slide will be seen to have two ports a, a' connected with each other, and of equal area to those on the cylinder face, b, b': c is a plate placed on the back of the valve, and kept there by means of a strong spring, which should be tested, to stand the amount of pressure there would be on a space equal to the area of the two ports a, a'; c is a steam-way, through which the steam is admitted, passing from thence through the ports into the cylinder. The pressure on the space between the ports is neutralised by the strip e, to which I think there can be no objection, as it would only open and shut the steam-way simultaneously with the steam ports in the cylinder; therefore, the supply of steam would be as regular as were it full open during the entire travel of the valve. The exhaust is formed through the chamber R, and the blast-pipe P. The lap of the valve is of course at the will of the engineer. Roping that the scheme will meet with your approbation and insertion in your next.

I am, Sir, yours, very respectfully,

F. A. BUCKNALL.

Bristol, May 22, 1847.

WATER-BALANCE WINDING MACHINE.

We are indebted for the following description and engravings to the Mining Journal.

Description.—A A A A, the pits; B B B B, plate-iron water-tanks; C C, two waggons; D D D D D D D D, part of the rails, and the bridge across the top of the tanks; E E E, different views of the cross connecting the tanks and wire ropes; F F, water-pipes, provided with valves, for filling the tanks—to be opened and shut by levers, under the command of the attendant; G G G G G G, the walling, or steaming, of the pits; H H, exit valves, at the bottom of the tanks. The large wheel has a groove to receive the rope, or chain, as the case may be, and furnished with a brake, to regulate the motion and grip tight, as the waggons reach the proper places for pushing off and on. It will be necessary to attach a rope (or chain) to the bottom of the tanks, similar to that annexed, in order to keep up the equilibrium through the whole depth of the pit, for, where the ground is favourable, one elliptical pit will be a saving in sinking and steaming, as well as in the size of the wheel, which may be proportionably less. The upright pipe, seen behind the wheel, may be surrounded by a cistern, to relieve the pipes and joints from the shock occasioned by suddenly checking the momentum of the water-current along the horizontal pipes.

It should be understood, that guide-rods, though not shown, are necessary to keep the tanks steady.

It is now 20 years since I erected one of these machines, which has been in constant work ever since, and is still raising 500 tons, from a depth of 50 yards, in 12 hours.

CARDIFF, May 6.

JOHN WALKINSHAW.
SHIPS AND PROPELLERS.

JOHN BUCHANAN, of Queen-square, Westminster, gentleman, for "Improvements in ships or vessels, and in the propelling thereof, and in securing the same from fatal damage, certain parts of which machinery may be used for motion on land." Granted August 15, 1846; Enrolled February 4, 1847.

The improvement consists, first, in the formation or construction of ships or vessels, by means of lines, as hereinafter described; and, secondly, to the application of a blade or blades for the propelling of ships or vessels, so constructed as to yield to the adverse pressure of the water when required.

The patentee states that the object of the first part of his invention is to enable the lines of a ship or vessel to be drafted so that all the lines will correctly run into each other, and that they will not require adjustment by shifting the transverse sections.

The work is done according to true geometrical bases throughout, beginning with the main frame, and in lieu of water lines, ribband lines, and buttock lines, with their necessary accompanying balance and adjusting frames, the patentee only makes use of the midship section, an upper extreme height-of-breath-line, and one main diagonal on each side of the hull, uniting or fitting in all the transverse sections from the upper height of breadth to the main diagonal, and thence down to the keel, in the same manner as if followed in constructing the main frame, viz., bisecting, or halving the angles contained within the several perpendiculars, (or straight lines approaching more or less to the perpendicular,) and also all the angles within the straight lines crossing these perpendiculars and the diagonals at the points where the transverse sections respectively cross the main diagonals. Lines traced through these bisections of the angles form the outside of the frame of the ship. The longitudinal curves being formed nearly in the same manner, viz., halving the angles contained within the perpendiculars or lines bounding the ends of the oblong figures and sides or bottom of the said figures, whether vertical, horizontal, or diagonal, and lines connecting the extreme points or base lines of these triangles, such being a pure trigonometrical and geometrical formula for determining the transverse and longitudinal lines of a ship or vessel, according to this invention, regulating her form from the straight lines of the stem, stern post, and keel, to the greatest extent of breadth and depth, beautifully proportioning all her lines, and each line relatively partaking of each other's qualities upon the principle of the two sides and base of a cone regulating all the lesser diameters thereof in due proportion.

The second part of the invention is for improvements in propelling vessels, as shown in the annexed engraving:

Fig. 1.

Fig. 2.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

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1847.

premising elasticity of such springs. The shaft, a, is connected or coupled at, to the shaft, b, which carries the propelling-blade, d, formed as a cylindrical axis, which passes through the shaft, c, and the boss, e, where it is held by means of the cotter, f. The cotter is cut or split in a different direction to that generally practised. This form of cotter is fixed by opening the slit by a drift or wedge, and, while open, riveting in the small bolt, which leaves the cotter securely accommodated and safe. The blade, d, is supported on the shaft, c, partakes of the revolution of such shaft at the same time that it is free and at liberty to move on its own axis; so that, supposing the shaft, c, to revolve in the direction indicated by the arrows, the resistance of the water will place the blade, b, in the position represented, so that the blade, or its form or face, as seen as fig. 3; but when the revolution of the shaft, c, is reversed, the blade will vibrate on its axis from the same resistance of the water, and assume the opposite position, resting on the shoulder or face, f. The angles formed by the shoulder, f, and g, with the shaft, c, are slightly varied, so that the angle formed by the shoulder, g, being more acute, will drive quicker when required, without any increase of speed in the rotation of the shaft, c. By this arrangement the blade, d, having free play on its axis between the shoulders, f and g, will at all times yield to any adverse pressure which may arise from the superior velocity of the vessel to that generated by the propulsion of the blade, d, to the vessel, and so that, supposing sail to be on the vessel at the same time that the propeller is in action, and that the sail should suddenly carry the vessel beyond the speed due to the propeller, it will instantly yield to the adverse pressure, and present no resistance to the course of the vessel. And in like manner, when the vessel is under sail, and the blade, d, is impelled to the shaft, c, the blade, d, will yield to the adverse pressure of the water, and assume that position which prevents the least resistance to the onward course of the vessel. The shaft, c, is supported in a hollow tube, x, z, passing through, and firmly fixed in, the dead wood of the vessel's stern, and lubricated at various points by means of pipes, marked y, carried to such an elevation as to support a column of oil sufficient to overcome the pressure of the external water, and ensure the necessary supply of oil where required, which is not always the case in the ordinary arrangements of machinery of this nature. It will be seen, in this respect, that the force or pressure imparted from the rotation of the blade, d, to the vessel, is received from the boss, x, resting and revolving against the fixed tube, x, z, which carries the shaft, c, at a point immersed in the external water, which prevents it heating whilst the superior column of oil, supplied by the small tube, y, lubricates the parts in contact. The shaft, c, is formed of two semi-cylindrical halves, the centre or flat surface of each being planed or polished out, so that where placed face to face, they form a cylindrical hole shaft, through which is passed a rod or bolt, o, for the purpose of fixing or bolting the blade, d, when in a propelling position, which boiling or fixing is practised only when backing or steering is required. The bolt, or rod, o, is traversed by the lever, u, and brought into the position required by the cross-trees or ropes fixed to the blade, d, resting on either one or other of the shoulders, f, or g, holes being provided in the cylindrical axis of the blade, d, in the proper position to receive the bolt, o, and when bolted, the reverse rotation of the shaft, c, necessarily backs the vessel.

GUTTA PERCHA SAFETY FUZE.

GEORGE SMITH, of Camborne, Cornwall, safety-fuze manufacturer, for "Improvements in the manufacture of safety-fuzes." Granted November 12, 1846; Enrolled May 8, 1847. (Reported in The Mechanics' Magazine.)

The safety fuse is to be made in such manner and material, to render them less liable to injury from changes of atmospheric temperature, damp, the action and pressure of water, when employed in submarine operations, by employing gutta percha to enclose an interior cylinder of gunpowder; or as a coating, or covering, for the ordinary hæmpen fuses. The cylinder for gunpowder is made with gutta percha in the following manner:—A cylinder of iron, capable of supporting a pressure of 500 lbs. to the square inch, and made at its lower end exactly in the form of an inverted cone, is surmounted with a casing, between which and the cylinder steam is allowed to circulate. The lower part of the cylinder—that is, the apex of the inverted cone—terminates in a pipe, which is carried down through a cylinder of cold water. A gunpowder chamber, or funnel, is supported by saltated wattles, and centred on the centre, and, past the inverted cone, terminates in the pipe below the joint. The funnel is filled with gunpowder, having a thread through the centre thereof, to facilitate its passage; and the cylinder with gutta percha. The steam is made to circulate between the cylinder and outside casing, until the gutta percha assumes the consistency of putty. It is then pressed through the pipe, and, passing round the gunpowder funnel, takes the form of a hollow tube, while it becomes filled with gunpowder. The fuse, in passing through the cold water cylinders, acquires a degree of firmness, which may be increased by causing it to pass between two rollers, ground on their peripheries, and made to revolve in opposite directions. The ordinary hempen fuses are also coated with gutta percha in the following manner:—An iron cylinder, similar to the preceding, and heated in like manner, is filled with gutta percha, which is subjected to the pressure of about 500 lbs. to the square inch, and cooled in cold water, when the cylinder is made with holes of different diameters, to suit the size of different fuses, to which inlet and corresponding outlet pipes are attached. When the gutta percha is sufficiently softened, a wire, hooked at the end, is made to enter one of the inlet pipes, and, passing through the mass of gutta percha, to come out at the exit one opposite. The fuse is cooled in its passage through the exit pipe by an arrangement similar to the one described.

SHIPS' ANCHORS AND MASTS.

JOHN JAMES ALEXANDER MACCARTY, of Sidney Terrace, Brompton, gentleman, for "Improvements in anchors, and fids for masts for vessels." Granted Oct. 22nd, 1846; Enrolled April 22nd, 1847.

The improvements relate, firstly, to an improved form of anchor for ships, as shown in the engraving, in which the only one fuse, and a stem or shank of the form shown in the engraving, in order that the centre of gravity of the mass shall be as near as possible to a line drawn from the point of the fluke to that part of the shank where the stock is attached. The stock is of a heart shape, made of iron, welded to the shank, or it may be formed separately, and secured by any suitable means. This stock is constructed with the greatest proportion of metal nearest the shank, to render it stronger, and more capable of resisting the shocks and strains it may be subjected to, and, at the same time, it keeps the greater proportion of the weight near the desired point. If an anchor be constructed as described, whichever way it may fall, it will, by its own gravity, take the position shown in the engraving.

The second part of the improvements consists in introducing a ratchet and bail for supporting the top-masts of vessels; the ratchet, being secured to the top-mast, and the bail hinged to the lower mast, the mast is raised and lowered in the usual way by a pulley let into the lower end thereof, the mast as usual passing through holes in the cap and cross-tree; when it is desired to lower the mast, the bail is withdrawn from the ratchet, by means of a cord or rope fastened to the back of the bail, and passes over a pulley in the mast down to the deck. In raising the mast, the rope is slackened; the bail, falling by its own gravity against the top-mast, enters the socket of the ratchet on the mast, attaining the requisite height, and securely holds it in the required position till again released by removing the bail as before described. Another improvement consists in using a hoop, supported from the cross-tree by staples or hinges, in such a manner that it may be drawn towards the lower mast and from under the upper end, thus forming a chain, the hoop being lowered by the pulley as usual. When the mast is raised, the chain is slackened, and the hoop or fid falling by its own gravity in a perpendicular position, receives the weight of the mast, and in order to retain it to a proper position, that part of the end of the mast which rests on the fid is cut somewhat shorter, the fid being drawn by the chain against the shank thus formed, and retains it securely in the desired position.

IRON TUBING.

JAMES ROOSE, of Darlaston, in the county of Stafford, tube manufacturer, for "Certain improvements in wrought iron tubing." Granted August 29, 1846; Enrolled February 27, 1847.

The improvements consist, first, in taking a strip of iron of a required length, breadth, and thickness, according to the size of tube, and bevelling or chamfering the two edges of the lap joint, as is well understood amongst tube manufacturers; then turning the two sides
of one end of the skelp or strip when at a red heat, the two edges curling towards each other, and one lapping under the other, so that the first end is made smaller than the size of the tube when finished; the skelp, or partly turned and partly flat strip, is then put into the furnace, and when brought up to a welding state, it is introduced into a bell or mouth-piece, D, similar to that shown in the engraving, and the turned-up end is sufficiently inserted through the bell and between the rolls, H, H, to allow the pliers on the drawbench to catch hold of the end of the skelp; the chain being then set in motion, the skelp will draw through the bell, and, owing to the ridge on the bell, the one end of the skelp will be caused to overlap the other, the other end has left the bell, and it is in the pinch of the rolls, the place of contact of the rolls being the point which gives the welding pressure, the mandril being within and offering resistance to the internal part of the tube. Between the back part or small end of the bell, and the entrance of the rollers, there is a tube, c, through which is conveyed either hot or cold blast, blown by the engine; the end of this tube is fixed over the seam of the skelp or tube. The blast will have the effect of producing the metal at the seam or joint into a partly liquid state, or state of fusion. The rolls revolve by machinery, and traverse at the same surface speed as the chain on the drawbench, so that the draft on the tube is eased, and the draft has not the tendency to stretch the tube more in one place than another, nor to pull the tube in two. The mandril is placed in front of the bell, the bulb protruding through and into the groove of the rolls. By this process, the skelp, with the one end turned up, is produced at one heat, and at one operation, into a lap-joint welded iron tube. This process will be found most advantageous in the production, particularly of lap-joint iron tubes, on account of the small quantity of hands required, the very great facility it offers in their production, and the superiority of the article produced. They will be found to stand a greater pressure on the latch, according to the substance of metal, than other similar tubes produced by any of the other known processes, on account of the properties of the iron being retained, the tube only having been heated once. By other processes the tubes are repeatedly heated in the furnace, which tends to destroy the fibres of the iron. Another very great advantage resulting from this process, is in the blast playing on the seam or joint of the tube before it goes under the welding pressure, so that in all cases dependence may be placed on the joint being in a good welding state, which joint might in some degree have got chilled in the bell or mouth-piece, in the bendings.

SHEATHING FOR SHIPS.

GEORGE FREDERICK MUNTER, Esq, M.P., of Ley Hall, near Birningham, for "An improved manufacture of metal plates for sheathing the bottoms of ships or other vessels." Granted October 15, 1845; Enrolled April 16, 1847.

This invention relates to an improved manufacture of the sheathing metal of copper and zinc, described in the specification of a patent granted to the present patentee October 22, 1832, containing 69 parts copper and 40 parts zinc. The present improvements consist of an alloy of 56 parts of copper, 40 parts zinc, and 34 lead; in making the alloy, an additional quantity of zinc is used, on account of the loss of that material during the operation, so as to obtain an alloy containing the different metals in the above proportions. The lead acts as an important part in the alloy, as, without it, the alloy would not oxidize sufficiently to keep the ship's bottom clean. The alloy, after being cast into ingots, is rolled into sheets (by preference, at a red heat), and then annealed: and, if desired, the sheets may be cleaned with a mixture of sulphuric and nitric acids, properly diluted.

The patentee does not confine himself strictly to the above proportions, for the quantity of copper may be increased (which will, however, increase the cost of the sheathing metal), or it may be decreased to a slight extent; but it must not be reduced to fifty per cent. of the alloy produced. Although lead is mentioned in the above description, any other suitable metal may be used in place of it, but not with equal advantage.

The patentee claims the manufacture of sheathing metal, by so using other suitable metal or metals, when copper and zinc are combined for the purpose of sheathing, as to allow the mixture to contain a lower proportion of copper and forty parts of zinc, and at the same time attain a sufficient degree of oxidation, and prevent separate action on the zinc.

IRON WIRE.

WILLIAM REDD, of St. Pancras, Middlesex, engineer, for "Improvements in the manufacture of Wire." Granted October 29, 1846; Enrolled April 29, 1847.—Reported in the "Patent Journal."

This invention relates specially to the manufacture of iron wire, and also to the cleansing, or preparing the surface of the same, to receive a metallic coating, for the purpose of preventing oxidation, and has for its object the producing wires of greater length, and more perfect throughout its entire length, than can be effected by any means at present in use, and consequently better calculated for the purposes to which it is applied; more particularly to the iron used in electric telegraphs. For, whereas the bundles of wire, which average about 192 feet in length, and weigh 14 lb., are welded together when reduced to the size which they are intended to remain, the parts joined almost invariably being thicker than the rest, and at the same time rendered more brittle and more frequently useless, the wire now produced in the first part of this invention consists in welding each end to end, scarf-wise, two, three, four, or more bars of iron, suitable for the purpose, and afterwards drawing them through the drawing machine, which process not only renders it the same size throughout, but by the strain required, effectually tries the different joints, which, if not sound, will give with the detecting any imperfections that can arise in the construction. By this means, the patentee states he can readily furnish bundles of wire, of ten times the usual length, or even any length that may be required. After drawing, the wire is submitted to the annealing oven, which renders it as near as may be of a uniform quality throughout. With regard to the welding and drawing the iron, he does not lay any claim to the different operations when considered without respect to the order in which they are performed. Although these improvements have been specially mentioned as desirable for the manufacture of iron wire, it may also be equally well applied to the manufacture of steel wire. The second part of these improvements relates to the preparing wire to receive a coating of zinc or tin, in order to prevent it oxidising; the ordinary method being to immerse it in a solution of nitric or sulphuric acid, from the unequal action of which, or one part remaining longer in the solution than another, the quality of the iron is much deteriorated. Now, according to the present invention, the process done solely by a mechanical agency, or at least so far as to require only the acid very much diluted, the apparatus for which is as follows:—the coils, as they are taken from the annealing oven, are placed on reels, which revolve freely on vertical spindles, from a suitable frame-work. The form of these reels is the frustum of a cone, the small end being open, so as to admit of the coil of wire being easily placed thereon; the ends of these coils, which may be five, six, or any convenient number, are led round, or rather half round three rollers, whose axes are vertical; the sinuous route passes throughout, bending the wire alternately in contrary directions, as it turns over each roller; it is then conducted through another series of five rollers, whose axes lay horizontally; the wire, in passing the sinuous course prescribed by them, is bent in a contrary direction to that in passing the previous set of rollers. In order that one wire shall not ride on the other in its passage through the different sets of rollers, the wires are passed through suitable guides, and for the purpose of changing the point of contact on each roller, so that it shall not wear the same into grooves, the first series of rollers is caused to traverse backwards and forwards, in a direction at right angles to the motion of the wire; thus the process is merely for breaking up any scale or oxide on the surface of the wire; it is then passed between two pieces of wood, faced with leather, or other substance, on which a constant stream of emery is permitted to flow from a hopper above; these pieces of wood are squeezed together with sufficient pressure to clean the surface of the wire, as it passes between them. Instead of leather, he sometimes applies ground surface of paper, or the surface of a flexible file, suitable to remove the size of the wire to be cleaned. The wire, thus prepared, is conveyed by means of a solution of weak sal-ammoniacal or muriatic acid; this is effected by passing it down into a trough filled with the liquid, turning it over two rollers immersed therein; it is then conveyed to the bath.
of metal with which it is intended to be coated, and from thence to reeke, on which it is to be wound; these having motion communicated to them from some primary moving power, effectually pull it through the different machines, by which it is cleansed as hereinbefore described.

Having thus set forth the nature of his invention, and the manner of carrying the same into effect, he wishes it to be understood, that although he has described it as being peculiarly applicable to iron wire, for telegraphic purposes, he does not confine himself thereto, as it is equally well adapted for steel wire; and the second part thereof, preparatory to receiving a coating of other metal, may be applied to various other descriptions of wire. He claims, first, the welding iron bires end to end, scarf-wise, and afterwards drawing them through suitable machinery, with regard to the order in which the same is performed; second, the cleansing the surface of wire by the machinery before described, preparatory to receiving a coating of zinc, tin, or other metal suitable for the prevention of oxidation.

STEAM BOILERS.

George Lodge, of Leeds, Yorkshire, engineer, for "Improvements in heating water, generating steam, and saving fuel."—Granted August 10, 1846; Enrolled February 19, 1847.—(Reported in Henning's London Journal.)

This invention consists in an improved arrangement of apparatus whereby the heating of water may be economically effected (as increased heating surface being exposed to the action of the flame and heated gases), and a large supply of steam may be quickly generated. The apparatus employed for this purpose is shown in figs. 1 and 2, as applied to a furnace in conjunction with an ordinary wagon-shaped boiler. It consists of two rectangular vessels or chambers of iron, set parallel to each other, one on either side of the fire-place, and connected together in front by a hollow arch, made also of iron. These vessels or chambers are intended to receive the water from the force pump, and, by means of pipes, with which they are provided, to conduct the water over a considerable heating surface before it enters the wagon-shaped boiler. Fig. 1, is a sectional elevation of a furnace, fixed according to the invention, the front end plates of the chambers before-mentioned being removed; and fig. 2, is a sectional plan of the improved generating apparatus, taken in the line 1, 2, of fig. 1.

VALVES FOR SEWERS.

James Lythander Hale, of Hackney, Middlesex, civil engineer, for "certain improvements in sewerage and drainage, and apparatus connected therewith, parts of which are applicable to steam-engines."—Granted October 27, 1846; Enrolled April 27, 1847.

The improvements relate to preventing the escape of noxious air, vapours, steam, gas, &c., from drains, engines, &c., and obviating the corrosion of the hinges used in apparatus connected therewith. For this purpose, instead of forming the common trap for drains of iron, as usual, the inventor makes the frame of brown earthenware or other suitable lasting and non-corrodible substance, placed in the usual way at the entrance to the drain. The valve is constructed of a piece of vulcanized india-rubber, large enough to cover the opening of the trap, and to give sufficient lap; the edge is secured to the frame of earthenware by rivets, or cement manufactured for similar purposes, by the Kampfluteon Company. The sheet of vulcanized india-rubber has a metal plate, or a stone, placed on the back, which, by its weight, keeps the face of the valve close to its seat.

Another trap for sewers is made with a number of bars on the back, instead of the metal plate or stone as above described; the vulcanized india-rubber is affixed to the earthen frame as before the bars are secured by cement or rivets, in the direction or length of the part secured, forming the hinge; the water, as it issues from the pipe into the sewer, causes the valve to rise to the extent necessary to admit of the passage of the water escaping; the space between each bar forming a bluge, on which each bar moves, consequently there is no room for the escape of noxious vapours, the valves being always closed down to the surface of the water. The metal for the bars the patentee presents galvanised, or tinned iron.

The next improvement is for a ventilator, to be placed on the top of pipes leading from places requiring ventilation—consisting of two cylinders of galvanised sheet iron or zinc, of different diameters; the smallest is placed on the top of the chimney; it has several openings in the sides, the upper end of the top is closed by a plate of metal; the large cylinder is only about half the length of the other, but at the same time sufficient to protect the openings in the smaller one (over which it is placed) from side currents, while, at the same time, space sufficient for the escape of smoke or vapour is allowed between the two; the external cylinder is supported from the smaller one by stays, and in such a way as not to obstruct the passage between them.
### RAILWAY EXPENSE AND ARCHITECTURAL JOURNAL.

**JUNE.**

**RAILWAY EXPENDITURE.**

Return, to an order of the House of Commons, showing the Amount of Money expended in the actual Cost of Construction, and of Working Stock (including Locomotive Engines, Carriages, Tolls, &c.), of all Railways in GREAT BRITAIN AND IRELAND, in each Triennial Period, previous to the 1st day of January respectively, in the Years 1841, 1844, and 1847.—[Fractional Parts of a Pound are omitted.]

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</tr>
<tr>
<td>Manchester, Sheffield, &amp; Lincolnshire</td>
<td>173,523</td>
<td>533,084</td>
<td>845,820</td>
</tr>
<tr>
<td>Maryport and Carlisle</td>
<td>74,796</td>
<td>166,296</td>
<td>142,281</td>
</tr>
<tr>
<td>Middlesborough and Redcar</td>
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<td></td>
<td></td>
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<tr>
<td>Midland</td>
<td>4,011,846</td>
<td>812,582</td>
<td>1,454,158</td>
</tr>
<tr>
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<td>122,436</td>
<td>48,775</td>
<td>9,446</td>
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<tr>
<td>Newcastle and Carlisle</td>
<td>276,232</td>
<td>63,261</td>
<td>91,245</td>
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<tr>
<td>Newcastle and North Shields</td>
<td>234,485</td>
<td>12,716</td>
<td>2,485</td>
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<td>Norfolk</td>
<td>124,539</td>
<td>792,929</td>
<td>1,054,069</td>
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<td>North British, including Edinburgh and Dalkiet</td>
<td>515,215</td>
<td>562,542</td>
<td>1,015,075</td>
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<tr>
<td>North British</td>
<td>515,215</td>
<td>141,710</td>
<td>30,063</td>
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<tr>
<td>Newcastle and Berwick</td>
<td>688,259</td>
<td>628,670</td>
<td>628,670</td>
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<tr>
<td>Prestone and Penrith</td>
<td>25,327</td>
<td>4,030</td>
<td>4,030</td>
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<tr>
<td>Preston and Wyre</td>
<td>268,673</td>
<td>209,215</td>
<td>21,749</td>
</tr>
<tr>
<td>Poston and South Shields</td>
<td>225,435</td>
<td>2,075</td>
<td>2,075</td>
</tr>
<tr>
<td>Saint Helen</td>
<td>149,166</td>
<td>1,011</td>
<td>14,861</td>
</tr>
<tr>
<td>Scottish Midland Junction</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Shrewbury and Chester</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>South Eastern</td>
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<td>2,668,950</td>
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<td>Stockport and Daffington</td>
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<tr>
<td>Stockport and Hartlepool</td>
<td>234,624</td>
<td>1,053</td>
<td>1,053</td>
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<td>219,313</td>
<td>20,676</td>
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<td>Whitehaven Junction</td>
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<td>Wiltfonton, Morningside, and Coitness</td>
<td></td>
<td>47,968</td>
<td>28,000</td>
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<tr>
<td>York and Newcassel</td>
<td>159,576</td>
<td>315,250</td>
<td>134,065</td>
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<td>York and North Midland</td>
<td>370,183</td>
<td>293,132</td>
<td>149,808</td>
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### COST OF VARIOUS RAILWAYS PREVIOUS TO 1841.

<table>
<thead>
<tr>
<th>Year</th>
<th>Great Western</th>
<th>London and South Western</th>
<th>London and</th>
<th>London and North Western (Southern Division)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>£</td>
<td>£</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>1833</td>
<td>84,548</td>
<td>37,574</td>
<td>3,897</td>
<td>356</td>
</tr>
<tr>
<td>1835</td>
<td>95,920</td>
<td>54,200</td>
<td>4,235</td>
<td>1,350</td>
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<tr>
<td>1838</td>
<td>330,983</td>
<td>150,750</td>
<td>6,357</td>
<td>2,230</td>
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<tr>
<td>1837</td>
<td>956,574</td>
<td>385,925</td>
<td>1,083</td>
<td>3,120</td>
</tr>
<tr>
<td>1839</td>
<td>1,136,550</td>
<td>405,521</td>
<td>3,831</td>
<td>2,120</td>
</tr>
<tr>
<td>1840</td>
<td>1,222,344</td>
<td>432,482</td>
<td>3,722</td>
<td>1,953</td>
</tr>
<tr>
<td>Total</td>
<td>5,288,044</td>
<td>2,293,857</td>
<td>1,691,380</td>
<td>5,792,475</td>
</tr>
</tbody>
</table>

### PROCEEDINGS OF SCIENTIFIC SOCIETIES.

#### ON THE MANUFACTURE OF CASKS AND VESSELS, AND SEASONING TIMBER.

At the Western Literary Institution, Leicester-square, May 5, the following papers were read on "The Manufacture of Casks and Vessels, and the various methods adopted for Cleaning and Purifying such Vessels":—

When it is borne in mind that in some establishments in London, there are few rooms from 78,000 to 92,000 casks employed in sending out per year; and when it is further believed that the annual trade in port in London is not less than 150,000 of such casks is not sufficient to keep them in a fit and proper condition for the purpose for which they are intended, becomes one of immense importance. It would be folly to say that the subject has not had much attention devoted to it. Large sums of money have been expended in fitting up various kinds of machinery for this purpose. Many persons incur great expense in removing a head of each cask and thoroughly scouring and cleaning them; also "firing," steaming, the use of chemicals, and other means have been resorted to, in order to effect the great desideratum of clean and sweet casks; but after all, the greatest difficulty is experienced in effecting this, and a serious loss of property is sometimes the consequence.

Before going more fully into the subject, it is necessary that the several methods which have hitherto been adopted and which are still in use, should be fully explained, and we will consider in the first place, unheading casks.

For the head of a cask is no doubt the most desirable and best mode, so far as regards getting it clean, and one which, in many establishments, is carried out completely at no small expense for labour, damage to heads, proving, loops, &c. These drawbacks, great as they are, might be overcome, provided by such means as could be insured as sweet. But this by no means always happens; there is then the alternative of either allowing it to remain (without the head) for a considerable length of time exposed to the sun's rays, or extreme frost, or subject it at once to the—"firing process,"—which is that of placing of what is called a "cresset," consisting of fuel inside the cask, and thus heating the wood until the "must," or mouldy smell is destroyed. During this process it not unfrequently occurs that a piece of burning wood drops upon the bottom head of the cask, or perhaps the flame escapes, and, if that takes place, at a probability, to a serious extent, and if so, a non-conductor is thus formed, which must necessarily prevent any taint still existing in the body of the wood, from being evaporated. Casks so treated are often found to give out a pernicious flavour to the beer or other liquid, with which they may be afterwards charged, to the serious loss of the brewer, insomuch as it may be may have to pay double freightage or carriage on "returned beer," if not the entire loss of it; besides the repetition of the above ruinous process, which is admitted by those who adopt it, as only advisable in extreme cases.

The next process is that of "steam."—For this purpose many brewers have boilers of large capacity, in which is generated steam of 5 or 6 lb. pressure, connected to a pipe leading all round, or by the addition of a building, with nozzles inserted at the same, about 3 ft. 6 in. apart, or according to the diameter of vessels requiring to be steam. These nozzles, on being inserted into the bung-hole, open the steam forced through them into the casks, in many cases for 2 or 3 hours consecutively, but the more common period

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* We are indebted for this Report to the "Patent Journal."
bev died in plaque, and the heat is the thing needed between the fibers of the wood. In the instance of a chip from a mauls, cask, and carry it in the waistcoat pocket for an hour or more, and it will be found that the warmth of the body alone has materially, if not wholly, removed the unpleasantness of the heat. In the process of firing a cask, it was found that the average heat of the cresset against the sides of the cask, was equal to $350^\circ$, and the application of this temperature for half an hour is usually considered sufficient to remove the moisture and smell; but great difficulties may be encountered in applying the heat uniformly, and it is at all times too sudden to effect a complete removal of the moisture and taint from the body of the wood, in addition to the ill effects of charging. The new process assures one temperature throughout every portion of the cask, and as it requires only five seconds of time (from the rapidity with which the air is propelled) to give every crevice of a $26$ gallon cask a fresh supply of heat, it will be readily understood that by such means, all danger of the wood being burnt in two, or any consequent injury to the quality of the wine, or with it the complete evaporation of the "must" with which that moisture is impregnated.

Contrary to the opinion of some, this process is not attended with any injury. As a test of the incident, it was found that when the pores were closed by the process of burning, it did not matter how far the wood was burnt, whether the wood was burnt, or whether the pores were closed by any other means. The latter, at least, is a matter of importance, for some kinds of beer to have the casks free from all coloured juices, it is equally so for other articles, such as bread, beef. In proof of the heated air so removing these aqueous matters, Dr. D. B. B. B., who was professionally engaged in investigating the merits of this invention, states—

"A new cask of green wood, subjected to the action of heated air, gives out a volatile matter along with a large quantity of water, which, when condensed in a refrigerator at a low temperature, makes a liquid, limp, and colourless, like water, but strongly impregnated with the odor of the wood. Also, the wood not only becomes denser, but has less taste, at least at first, and must necessarily vary in its texture, according to the extent to which it has been heated, and the amount of moisture expelled."

The new cleansing machines consist of two frames made of iron, one revolving inside the other; the inner may be termed a cradle, in which the cask is secured by means of a chain, lever, and catch; motion being given to the outer frame, either by hand or engine power, causes the inner one to revolve in a contrary direction, which is accomplished by an eccentric near the axis of the outer frame, and to which is connected a set of jointed rods communicating with a ratchet, which is fixed on the axis of the inner frame. The action is thus for every turn the outer frame makes in the direction of its length, the inner one, which contains the cask, moves at right angles with the other frame, a distance equal to one tooth of the ratchet, or $1/20$th of the circumference of the cask; this is, by the time the cask has made twenty revolutions on the outer frame, the inner frame has moved the cask round once only sideways. Thus by means of a chain of peculiar construction, attached to a plug suited to the bung hole, which is in the first instance inserted in the cask, together with two or three gallons of hot water, every inch the cask is moved, and the water is forced out and freed from all adhering matter in a very short time. For the purpose of more thoroughly cleansing a very bad cask, it is usual, after the first turn, to give a further quarter of an hour, and allow the first water and dirt to run out, then, from the main over the machine, to let in about a gallon of clean hot water, for the purpose of giving a second rinse. The very worst description of casks are, by this process, perfectly clean in the course of half an hour, it being necessary further to observe, that any number of machines may be made to revolve at the same time, by applying adequate power. To test the merits of this part of the invention, a great number of very interesting experiments were gone into, some of which were made immediate, and the direction of Dr. H. H., from which it would appear that the rapid currents of heated air in passing through a mouldy cask becomes loaded not only with moisture, but also with minute particles of mould, or at all events, with some material from the mould, which is proved to develop moids into other substances; which was ascertained by condensing the vapour which passed from a mouldy cask, by a current of heated air, being found to deposit on the walls of the bottles containing the liquid, a great quantity of mould, whilst no such appearance was traced in the liquid condensed from fresh casks; showing that the fact referred to is one of the greatest importance, as indicating that the action of heated air is not merely exsiccative but that it does dissipate mould.

In order to guard against this, it has been satisfactorily proved lately in Syria, that even the old casks that had died of the plague, were rendered perfectly harmless by being exposed to $210^\circ$ Fab.; but lest this should be going too far away from the subject in question, one or two observations may be mentioned, as showing that the heat is the thing needed between the fibers of the wood. For instance a chip from a mauls, cask, and carry it in the waistcoat pocket for an hour or more, and it will be found that the warmth of the body alone has materially, if not wholly, removed the unpleasantness of the heat. In the process of firing a cask, it was found that the average heat of the cresset against the sides of the cask, was equal to $350^\circ$, and the application of this temperature for half an hour is usually considered sufficient to remove the moisture and smell; but great difficulties may be encountered in applying the heat uniformly, and it is at all times too sudden to effect a complete removal of the moisture and taint from the body of the wood, in addition to the ill effects of charging. The new process assures one temperature throughout every portion of the cask, and as it requires only five seconds of time (from the rapidity with which the air is propelled) to give every crevice of a $26$ gallon cask a fresh supply of heat, it will be readily understood that by such means, all danger of the wood being burnt is removed, and the pores of the cask then become impenetrated by the pores upon each application of heated air, and would eventually effect an internal protecting crust or glaze on the surface, which would materially facilitate the future cleansing of the casks.

The advantages of the new system are these—First, that casks can be made out of green wood instead of very dry and seasoned wood, and by this means be free from blisters, and in every way better fitted to resist moisture and its evil consequences. Secondly, that the cleansing of casks is not attended with any injury. It is impossible to measure the external heat of which tends greedily to forward the generation of steam, which is used for the purpose of warming and slightly moistening the casks previous to being finished off with the heated air. The water in the boiler serves for charging the casks during the time the air is being made warm. An apparatus such as now described, consisting of cleansing machines, and 11 nozzles, for heated air, has been in operation at Messrs. Truran, Witham, Buxton, and Co.'s brewery for upwards of two years, during which time upwards of 70,000 mouldy casks have been cleaned and purged; a great proportion of which would have required, under the old system, to have been either unheaded, and remained so for a considerable time, or have been subjected both to "raking" and hard steaming, at an expense of at least $100 per cask. It is capable of cleansing and purifying 230 casks per day, or $1,820 per week, at an expense as under, viz.:

<table>
<thead>
<tr>
<th>Description</th>
<th>Rate of Pay</th>
<th>Rate of Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel for furnace</td>
<td>$100</td>
<td>$250</td>
</tr>
<tr>
<td>Steam of 11 pipes, 18 feet long</td>
<td>$12</td>
<td>$18</td>
</tr>
<tr>
<td>2 men and 1 boy, but any 8 labourers, to attend to machinery and box air apparatus, each 20s.</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

Total $208

Or under 14d. per cask.

This does not include the interest of money sunk in setting up the apparatus, or the cost of wear and tear; but including the whole after two
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years' hard working of the apparatus, it is found that each cask (including bate, pence, chasizes, and the larger description of casks), exceeds little beyond B'd., or one-fourth what it costs by the present system.

Wood seasoned by this process is particularly applicable to floor boards, and house fittings generally, for cabinet work, musical instruments, carriage building, etc., as shown by the annexed table:

Comparative Strength of various kinds of Wood in a "Seasoned" and "Unseasoned" state.

<table>
<thead>
<tr>
<th>Name of Wood</th>
<th>Weight of 1 ft.</th>
<th>Weight of 1 inch squared</th>
<th>Flexure in inches &amp; tenths</th>
<th>Breaking Weight in lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fir seasoned</td>
<td>1 1/2 1/2 09 07 3 0 201 8 8 0 9 9 9 214 3 9 190</td>
<td>1.2 1/2 09 07 3 0 201</td>
<td>8 8 0 9 9 9 214 3 9 190</td>
<td></td>
</tr>
<tr>
<td>2. do.</td>
<td>1 1/2 1/2 08 09 3 3 190</td>
<td>1.2 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. do.</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. do.</td>
<td>1 1/2 1/2 08 09 3 3 190</td>
<td>1.2 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. do.</td>
<td>1 1/2 1/2 08 09 3 3 190</td>
<td>1.2 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. do.</td>
<td>1 1/2 1/2 08 09 3 3 190</td>
<td>1.2 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Elm seasoned</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. do.</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. do.</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. do.</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Ash seasoned</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Beech seasoned</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Oak seasoned</td>
<td>1 1/2 1/2 1 1/2 08 09 3 3 190</td>
<td>1.2 1/2 1 1/2 08 09 3 3 190</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The entire mass of solid basalt has been swept away by the torrent, so that the formerly contiguous to the upper current is interrupted for several hundred yards, but it is being cut away by the more superficial rocks and the current will be allowed to collect on its flanks. It is clear that if any flood of water enters the Avuege, if any inundation had raised the Lake of Chamoey thirty or forty feet, it must have carried away the passable cause. The lake alluded to the damming up of the river of the Couns by the volcano and by landslips which accompanied the eruption.

The most conclusive evidence, according to Mr. Lyell, of the remoteness of the period at which the cone and lava of Tartaret originated has yet to be set forth, and has only been distinctly brought to light since he published articles in 1843, when he occupied the ancient river-bed. The means is to be found it locality near the lower extremity of the great current, where fossil bones of extinct animals had been discovered in a meadow, between the base of the lava and the channel of the Couns, now ten feet lower in level than the lava. Thus, in company with Mr. Bory, a Mr. Ménétrier, who accompanied them, they convinced themselves that the deposit passed under the lava, which here forms a mass thirty feet thick. Subsequent investigations not only confirmed this view, but have enabled Mr. Bravard to obtain from beneath the stony current a species of horrid skeleton, remains, referable to the genera Equus, Sus, Tarandus, Cervus, Capra, Felis, Martes, Putorius, Sorex, Talpa, Arvicola, Spermophilus, Lagomys, Lepus, and according to Mr. Waterhouse, Cricetus or hamster, and others,
besides the remains of a frog, lizard, and snake, and the bones of several birds. Mr. Owes has examined some of these remains for Mr. Lyell, and recognises among them the Eupyx fossilia and Tumrusca prius, both extinct species, occurring in the caves of composition, with the contents of which generally this assemblage of fossils from Avegnorge appears to agree very closely—there being a predominance, according to Messrs. Cuvier, Brut, and Pumel, of species not known to exist at present with an intermixture of the contents of the Paris basin. The sandstone of Avegnorge is pebbled, and the deposit of red argilaceous sand under the lava containing these remains, was derived chiefly from volcanic matter, which the eruption of Tartagrat threw out, and that the fossil animals perished by floods occasioned by this. It is a gap of nearly three feet after the latest eruptions, is inferred from the discovery of the remains of many of the same group of animals—Spermophylax, Lepus, Dastor, and others, as well as bones of birds, which are preserved in the vegetable lap, of which the talus was observed at Ambro, near Clermont. This fauna, so different as a whole from that now living in Europe, evidently inhabited Avegnorge, when the valley of the Combe had been excavated down to the same level as that over which the lava of Tartagrat flowed;—yet its antiquity must be extremely great—the gradual dying-out of species and the introduction of new ones taking place, according to Mr. Lyell's views, with extreme slowness. The fact that the shells belonged all to living species (which possibly may not be the case if a larger area were examined) affords no presumption against an indefinitely remote origin as compared to the periods of history and tradition, because the lecturer has shown that the ravine of the Niagara ("Travels in N. America," vol. 1. ch. 3) and the Delta of the Mississippi ("Reports of the Brit. Assoc., for 1848"), both of which must have required an enormous period for their formation, are, nevertheless, posterior in date to deposits full of the recent land and freshwater shells of North America, associated with the remains of quadrupeds, nearly all of which are extinct. It was shown that all the volcanoes of the modern class of which the Puy de Tartagrat is a type, were not formed at once, for the lava of some (as for example, at Chalmas, in the same valley of the Combe) stand at a greater height above the actual river, or stream, than the lavas which formed when the valleys were shallower. To allow time for the execution of these numerous cones and lava-currents, of which there are several hundreds in Central France, we require a long series of ages, all successive, and of the same period, to which the uselessness of its weight of earthly salts—such as sulphate of lime—ought never to be used as a beverage when kept in leaden cisterns. These earthy salts prepare the lead from the action of the water. Mr. Solly referred to the attempt to render lead insoluble by alloying it with small of its weight of arsenic. He then spoke of the signal failure of an endeavour to protect lead from the action of water by placing it in contact with zinc. The result of this experiment was a vast increase of corrosion of the lead by the water in which it was immersed; which, was, therefore, rendered additionally poisonous.

VULCANIZED INDIA-RUBBER.

At the Royal Institution, April 30, Mr. Brookedon explained "The Preparation of India-rubber by Vulcanization and Extrusion."—Mr. Brocketdon's object in this communication was to describe—1. A mode of treating India-rubber by which new properties are imparted to this substance. 2. The new uses in the arts to which these acquired properties now render India-rubber applicable. Vulcanization and extrusion denote that combination of India-rubber with sulphur by which the new properties about to be described result. The process of conversion consists in submitting India-rubber to the action of bisulphite of carbon mixed with chloride of sulphur. The caoutchouc cannot, however, be penetrated by this process to any depth; and therefore it is inapplicable when the mass to be acted on is thick. The process of vulcanization, which seems to be more applicable, was due to the result of many experiments made by Mr. Heilmeier of Nuremberg; who found that caoutchouc, when immersed in a bath of fused sulphur heated to various temperatures, by absorbing the sulphur, assumed a carbonised appearance, and lastly acquired the consistency of horn. It was in the course of the latter changes that Mr. Heilmeyer observed the manner in which Mr. Brockett's experimental work was accomplished. The same vulcanised condition can, however, be produced either by kneading the India-rubber with sulphur and then exposuing it to a temperature of 100°, or by dissolving the India-rubber in any known solvent, as turpentine, previously charged with sulphur. Having thus explained the processes, Mr. Brookedon described the effect which they produced on the caoutchouc. 1. The India-rubber, thus treated, remains elastic at all temperatures. In its ordinary state it is very combustible, which the vulcanised rubber is not. 2. It is not affected by any known solvents, as bisulphide of carbon, methyl alcohol, or turpentine. 3. It is not affected by heat short of the vulcanising point. 4. It acquires extraordinary powers of resisting compression. Thus, a canal ball was broken to pieces by being driven through a mass of velvet, which the unvulcanised caoutchouc—the caoutchouc itself exhibiting no other trace of its passage than a scarcely perceptible rent. The application of this substance appears.
SCENERY AND DECORATIONS OF THEATRES.

Abstract of a lecture delivered at the Decorative Art Society, April 14, 1857, "On the Scenery and Stage Decorations of Theatres," by Mr. John Dymond, V.P.

The author stated that the opinion which he had formerly expressed [see Journal, p. 28] on construction had, in the Théâtre Historique, recently opened in Paris, been in many respects exemplified. The criticism upon this theatre state, that every person obtaining a seat is enabled to see the whole of the stage. With reference to the proscenium, he had become more forcibly impressed with the advantages arising from the form which he had seen, and which he had been introduced to, and which since informed him that his instrument (the harp) was more favourably heard in Covent Garden than in any other of the metropolitan theatres. In an ornamental and artistic view, the form which he proposed combined some very essential properties of the coty any division into a frame into the animated picture on the stage; and the broad equal surface offered through his suggestion afforded an ample and suitable field on which to display rich and fanciful embellishments. The Theatre Survey has an example of this frame-like characteristic, especially in the drop-scenes, exhibits thus far a satisfactory effect; and in the Théâtre Historique this has been attended to with success. The usual arrangements within the proscenium of crimson draperies frequently exhibit marvellous combinations—but of that commonplace nature which he would assist in exterminating. A drop-scene, he said, certainly required consummate skill. The pause in the excitement from the stage effects leads to the contemplation of the appearance of the audience in its seat ensemble—thus demanding a two-fold consideration; a subject which he had studied in connection with a proper regard to the general interior of the theatre. Mr. Dymond noticed several devices which have been applied for drop-scenes, such as the looking-glass curtain at the Colurgh some years ago—which formed a costly absurdity. But a drop-scene painted by Stanfield for the opera of "Acta and Galatea," produced at Drury Lane some years ago, he pronounced to be a fine work. It displayed in vignette ideal scenes by the artist from the opera; and thus offered to the mind's eye congenial Art during the pauses between the acts. Nevertheless, these pictures were placed within elaborate frames, contrasting strongly with the general expression of the theatre. A drop-scene again by Mr. P. R. Mitchell in Her Majesty's Theatre, where the design embodied abstract ideas of opera and ballads, but in connection with a massive architectural reproduction quite distinct from the general character of the interior, of which it occupies so large a proportion. He contended that the composition always ought to have relation to the action on the stage; and observed that this principle has been regarded, in some degree, in the proscenial arrangements. He alluded to the fact that he would treat the drop-scenes as a picture to which the proscenium should be an outer framework; but he would have, also, an inner frame, appearing on the stage, and paralleling the style of ornament adopted in other departments. The design should be those of the Princess's and the Adelphi, both of which, however, are defective in some minor qualities. This manner has also the advantage of contrasting with the stage scenery.

Mr. Dymond next directed attention to light. He observed that the reflectors to the foot-lights in our theatres present an objectionable appearance; and he showed a sketch of ornamental screen-work for concealing them. He further suggested a terra-cotta wall on the Budeprin principle with modifying reflectors; and that it would be advantageous to carry off the noxious result of combustion. He advocated the use of stronger side-lights, having their intensity regulated in accordance with the action of the stage. For the lighting of the stage, he observed, would be sufficient to prove that, at the present time, with one or two exceptions, the imitation of outward things is very imperfect. They are but half represented. The benauelling light is required to be gold and silver, and the background should be illuminated with light from the floor; and the forest luxuriates with foliage, and with statues in form and colour, is robed of half its fair proportion of effect by the poverty on which it stands. Mr. Dymond stated that success has usually attended the careful "getting up" of play; and that taste extended to the nearest things has generally been appreciated by the public. A description was given of the arrangement of "wings, flats, and by borders;" and the ladies of contrivance of the mechanism in the working frequently appearing on the stage to remove refractory scenery, together with other accidents incident to the change of scenes during the acts, were adduced as sufficient reasons for advocating a less frequent resort to that practice.

April 28.—Mr. Dymer read the second portion of a paper on the above subject concluding with an examination of the advantage of introducing from placing the scenery obliquely on the stage, referring of course to the wings and set scenes, the flats or back scenes being in the usual position. Some difficulties in perspective having been alluded to, it was stated that for photographs and apartments which were arranged with due regard to the ground-plan of what is to be represented. This would enable actors to enter or take leave in a complete manner; they would not be observable by those in the side-boxes when approaching or departing for that purpose, and their voices would require no introduction into the body of the theatre. A scene in the "Flowers of the Forest," now being performed at the Adelphi, was described as an example, and also as clearly showing that with some attention to ground-plan in setting out an interior, together with a certain characteristic of the architect's art, scenery, &c., the variety and perfection of scenery would be greatly advanced.

Mr. Dymond then directed attention to the principles of design, which he considered as mainly divisible into two classes, ideal and constructive; the former embodying certain characteristics without reference to natural laws, and the latter demanding strict attention to the fundamental principles of composition in art. Ideality, it was said, had in every extravaganza been developed in a surprising and ingenious manner, and delicate combinations in a refined taste were frequently introduced with that remarkable peculiarity peculiar to the School of Art.

Some chalk sketches, designed for the scenery to the "Enchanted Forest," lately performed at the Lyceum, were exhibited as illustrations of the manner and spirit of the design. Mr. Dymond was of opinion that design was described as necessary to architectural subjects. The objections of Prof. Cockrell and others were quoted in acknowledgment of the artistic talent, together with accurate knowledge of the architectural and remote ages; and it was frequently displayed in our theatres, and the result was that if the attention of the students in decorative art at the Government School of Design were directed to the contemplation of the better scenic productions, having the beauty and principles of design explained, this would form one of the most practical and efficient modes of acquiring knowledge.

He regretted that many admirable works of art, executed for theatres should have had such a transitory existence, leaving scarcely a trace behind. The creative fancy and design is numerous instances ought to have been preserved at any cost; and he argued that students of art would, in a careful contemplation of scenery, realize more freshness and originality in the productions from any other class of entertainers. Knowing its power and vast unexplored range, he felt an earnest desire that scene painting should be fully and properly estimated. Engraved examples might offer an interesting collection of the most ingenious fancies of the most eminent artists.

Perspective, the reader observed, constitutes one of the greatest obstacles to perfection in scenic effects, and he alluded to the defects which ordinarily appear in set-scenes, from their being made up of various parts, each of different perspectives. It is, therefore, impossible to have them placed near the centre, so as to counteract the affect of opposition in the horizontal features of the wings, whereby the scenes are frequently made to appear blurred. Some3 scenographical effects, from the junction of the wings and the floor, thus disturbing the illusion of distance attempted by the artist; and he would that the lower portion of the scene should come forward, and that the junction of the wings and the floor, with colour similar to that of the stage. Architectural drop-scenes were
frequently objectionable from the same cause, and he maintained that they should never be thus applied, but only as pictures with frames, if applied at all.

The effect of linear and aerial perspective was adverted to, and the false effects of distance, and perspective were often evident to the least initiated observer. The artist, however, has to contend with serious disadvantages from not being permitted to set out this class of scenes upon the stage instead of in the painting-room; and the manner in which they are to be represented to be borne in mind. Street architecture offers a peculiar difficulty from the actors influencing the scale by their comparative size; this illustrates the great absurdity of placing a façade of the National Gallery or other well-known building within the area of a real scene, without proper regard to distance. As an instance of a favorable effect, he named a scene in the "School for Scheming," at the Haymarket, representing portions of streets abutting on the quay at Boulogne, which he considered far removed from a commonly-acted play, and it also testified what might be obtained by placing scenery obliquely.

Mr. Dyer next alluded to the taste and refinement of Madame Vestris, as having been the first person who popularized the picture-room, elegantly and completely furnished; and he added that within this art, some interiors produced in the Haymarket, in a singular spirit. He admired this perfect kind of representation, and was pleased with the manner in which it had been extended to exteriors, garden scenes, &c., and he referred to the garden scene in the "Vow of Lyons," at Sadler's Wells, in which the stages are covered with a painted cloth imitating gravel walks, grass plots, shrubberies, &c., producing together a very superior effect. In a snow scene in the "Battle of Life," at the Lyceum, the stage was covered with snow and gave very successful effects of the "Forest," the scene of a village church, with well-worn paths, &c., similarly treated, was equally skillful and pleasing.

Mr. Dyer commented upon the fits and starts usual to these matters, stating that the best scenes were exceptions, while the imperfect school resulted. As an example of the earliest stage in which he had ever seen a scene introduced in the opera of "Ariadne and Galathea." The last scene in the ballet of "Coralia," at her Majesty's Theatre, was also fully described, as an eminent example of scenic display.

The author then noticed the machinery pertaining to theatres, and recommended the use of painted canvas placed on rollers sufficiently lofty so as to dispense with the series of curved, sloopied, and straight by borders, ordnance, and represent sky, &c. He next reviewed the inconsistencies which occur in scenery and properties being of a different period in character and style to that of historical dramas, mentioning a scene in "Loca de Lammermoor," at the Italian Opera House, Covent Garden. It represented a street in the street of the opera being in 1669. He contended that those adjuncts are important; and that if costumes, manners, and customs are rendered faithfully, properties should receive equal attention. The playing time of Garrick was noticed, and the properties introduced by John Kemble, Planché, and others, were mentioned with enthusiasm. The increasing taste of actors, shown in careful dressing and wearing apparel with a bearing in accordance, the art of representation was also favourably commented, as displaying research and accurate study of their art. Mr. Dyer drew attention to the force with which the varieties of colours in dresses may be developed, by having regard to the background and to the position of the actors. An acknowledgment was made of the elevated taste and artistic arrangements which Mr. Macready had frequently shown in groupings and tableaux, and he concluded with the expression of a desire to find a proper feeling more generally established between the artistic actors and managers, so that the capabilities of combined talents might produce results at once gratifying, elevating, and promotive of the welfare of the arts.

Institution of Civil Engineers.

April 27.—Sir J. Rennie, President, in the Chair.

"On the use of Isochronism in the Balance-spring as connected with the higher order of adjustments of Watches and Chronometers." By Mr. C. Frobisher.

The first portion of the paper gave an historical sketch of the horological inventions and writings of the artists of the eighteenth century; which appear to constitute the basis of all the knowledge possessed in the present day, and the principles of whose school were still followed in the construction of both watches and chronometers of the better sort. It was admitted that, by the aid of machinery, and the practical skill of the workmen, the separate pieces of clacks and watches are now produced in a high state of perfection; but it was contended, that horology, as a science, had declined since the days of Hook, Bernoulli, Sully, Guillaume, and Grisons, of Mudge, Elliott, Hooke, Ray, Berthoud, and others, whose splendid talents and scientific attainments were all devoted to the elevation of the art of constructing timekeepers. Among these Mr. Hook appeared to have been the only one that was thinking and pure mechanical genius to bear upon the practice of the art, and from his experiments upon the pendulum and the application of the balance-spring—which latter unquestionably laid the foundation of the chronometric art—it is sufficient to say, that he was the only one who carried the law of the isochronism of the spring further, as is demonstrated by his expression "si traccio sic via,"—and it is extraordinary that so plain a hint was not immediately seized on by the able men who succeeded him.—Arnold apposed his observation upon the long pulse following the short; and in the course of his researches he invented the cylindrical spring and compensation-balance, which formed the commencement of a new era in the science. The merit of the discovery of the isochronism in France was contested by Lieut. Berthoud. Bernouilli noticed, in a paper read to the Academie in 1747, the fact of the loss of elastic force in balance-springs, from exposure to heat; and the experiments of Berthoud demonstrated that in passing from 82° to 92° Fahrenheit the loss per diem was 6 minutes 38 seconds.

The paper then considered generally the subject of the isochronism of the balance spring, exemplifying isochronism to be an inherent property of the balance-spring, depending entirely upon the ratio of the spring's tension following the proportion of the area of inferences: a balance-spring, subjected to the number of degrees, the spring will be wound into a certain tension, and has acquired a certain elastic force due to the angle over which it is affected. This elastic force being then transferred to the balance, it will be exerted in overcoming its inertia, and at the same time, will have a reverse effect upon the spring. During the next period, its state will be that of comparative and not absolute inertia (for it decreases as the motion increases), whence it follows that as the spring's force is exerted against a body in motion instead of at rest, it will produce an opposite result; during the next period, it is that of comparative and not absolute inertia.

In other words, the power of the balance-spring is such that the time of vibration will be accurately known, even if the temperature of the pendulum has previously been affected. The first effect of the spring's force being transferred to the balance, it is assumed that the spring has acquired sufficient momentum to carry it through the second half of the vibration, and to the point of the spring equal to that which passed over, and to give it the requisite tension to commence a new vibration.—The greater the distance during the forward vibration the less is the moment of force that leads, but slightly the motion of the balance. After much acute reasoning upon this position, illustrated by numerous examples, the author proceeded to describe the helical and the flat-coiled springs, with their advantages and disadvantages, and the invention of the rubber spring. The advantages to be derived from the innate power possessed by an isochronal-spring of resisting the influences which cause a change of rate—such as change of position, increased friction from dirt, or the viscosity of the oil at low temperature. This was illustrated by an example of three balls falling in equal times through spaces regulated by the densities of the medium, viz., in vacuo, in air, and in water, wherein they traverse spaces equal to the squares of the distances. But it was argued, it would be with increased friction in watch-work; for the elastic forces of the balance-spring being constantly proportional to the angle of inclination, whatever was the amount of friction, the law of isochronism remained unchanged; and friction was considered as an adventitious effect which affects the extent of the arcs of vibration, but not the time of its description.
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The management and improvement of the River Wear was naturally an object of great solicitude, as its entrance was much exposed. In 1669 Charles II granted a patent to E. Andrews, to build a pier, and erect light-houses, and forbade the casting of ballast, &c., into the river. An act was obtained in 1711, appointing river commissioners, for the preservation of the bar. Another act was procured in 1738 for the preservation of the bar, and the tonnage duty on ships entering the port.

The jurisdiction of the commissioners is limited by the last act to an extent of about 11 miles, between Biddick Ford, above the town, and to a distance out to sea of a depth of five fathoms at low water. Little was done to improve the river, and the whole was very intricate, and the two main channels were both very shallow. The south pier was commenced in 1723, for the purpose of directing the full force of the current against the bar. Bustleigh and Thompson's map, published in 1757, shows the bar state at that period. The engineer (Mr. Weston) was appointed for his advice in 1748. He pointed out the principal causes of the then state of the river, and suggested the contraction of the channel at the worst places, so as to increase the scouring power of the stream, deepening the bed and extending the channel. He recommended the employment of engineers, and directed working a south pier, 500 yards from the north pier, as well as a distance of 200 yards between the point of that pier and the south pier. He stated, however, that "after all, no man could foresee the consequences of erecting the north pier, if it caused a greater obstruction than it removed, it must be unbuilt and taken up." He recommended also throwing all the force of the stream into one channel, and cutting away the bar by ballast engines, and cautioned the commissioners against ever permitting sluices or locks to be placed upon their river.

Mr. Vincent, of Scarborough, was appointed engineer to the trust in 1752. Mr. Robin succeeded him in 1755, and under him, the south channel was much improved, the channel was deepened to 12 fathoms, and the bar was raised up with sand. Mr. Smith, of Sheffield, proposed sundry further improvements in 1758. Mr. Wooler also reported in 1757 on Mr. Robin's plan of building mole on the north and south rocks. The work was commenced, and was abandoned for rebuilding on the present plan, which was ordered in 1779. In 1870, Mr. Weston's advice was sought. He recommended the prolongation of the piers on Mr. Shott's plans. The consequence of this constant extension of the north pier seems to have been the warring up of sand into the harbour's mouth. Two timber jetts were therefore, suggested by Mr. Best in 1786, and were the origin of the present north pier. The effects produced were very beneficial, as in a few months a deep and spacious channel was formed by the rush of the waters. The timber work was then cast off, and the work was continued with stone, and the impression was so much improved that Mr. Shott in 1793. He also erected the light-house at the point of the pier. The south pier was also extended. Mr. R. Dood also reported on the works, and recommended chiefly the formation of a wet dock on the present Potato Guth. Mr. M. Shott became the engineer in 1864, and he reduced sons. Mr. E. Jostop made a report in 1807, recommending further extension of the south pier, the reduction of the width of the entrance to 300 feet, and the construction of some embankments at various points to increase the velocity of the stream, and at the same time form a storing basin. Mr. Giles who succeeded Mr. Shott in 1793. He also erected the light-house at the point of the pier. The plans exhibited the changes that had taken place in the estuary, improving the channel, and giving, at least, a better passage over the bar at low water of spring tides. It is narrow and sheltered, with deep water on each side. Formerly the large vessels of commerce in the heights of the tide, affording, at the same time, increased facility for the drainage of the country around. Dredging has been carried on to a great extent, and from 100,000 to 160,000 tons have been raised annually.

The want of floating docks has been much felt, and several plans have been projected for them by Messrs. Dow, Jessop, Stevenson (of Edinburgh), Gilb, Brunel, G. Rennie, Walker, and G. Murray, but none have yet been executed. A small dock, of about six acres in extent, was finished in 1833. A south dock with tide basins, is now in course of construction, under the direction of Mr. R. Stephenson and Mr. Murray, and by its means it is anticipated that Sunderland will become the first port, as to depth of water at its entrance, between the Humber and the Firth of Forth.

May 18.—"An Account of the Sarah Sands, and other Iron Vessels, with directacting Auxiliary engines, and Screw-propellers," by J. Grantham, of Liverpool.

The object of the paper was to show, that a propeller might be constructed of such dimensions that the number of revolutions it would require to make in order to obtain a high velocity would not much exceed that of the ordinary paddle-wheel, and that hence the usual marine condensing engine might be applied direct to the propeller-shaft, without the intervention of a secondary motion. Woodcroft's and Speed's propellers were considered, and it was found to be correct, and that Woodcroft's expanding pitch screw-propeller was the best form that had hitherto been employed. In a paper read to the Institution, upwards of three years since, Mr. Grantham gave his views on this subject, and several vessels that had been since built—the results of the trials of which were communicated to the meeting. The principal of these were the Emerald and Diamond, three-masted steamers, of 300 tons, and 60-horse power; the Nestum, of the same dimensions; the Astilgo, of 600 tons, and 100-horse power; and the Sarah Sands, of 1800 tons, and 160-horse power. Drawings of these vessels were exhibited to the meeting. The capabilities and performance of these vessels were described in the paper, but particular notice was taken of the last-named vessel, which had performed a voyage of 20 days and 10 hours. On her arrival she had about enough fuel remaining for four days' steaming. The paper did not enter minutely into the particulars of the screw itself, as it was considered that too much attention had been given to that branch of the subject to the exclusion of the consideration of the plans for working it, which, after all, had been the stumbling-block to the general adoption of the system. It was necessary with the screw, the theory of which, as a propeller, was so little understood, to proceed with experiments perseveringly in one direction, as variations in the plan would be then necessarily attributed to one cause. After describing several interesting details, the paper concluded by expressing a desire that engineers should examine the drawings of the system laid before the meeting, and endeavour to add to the stock of information already obtained.

After the paper was read, Mr. Grantham added some facts which he had recently gathered, and which strongly confirmed what had been stated. The Diamond had recently made a very rapid passage to Madeira, deeply laden; but, during the whole passage, the engines maintained a very moderate speed, and removed the impressions that under such circumstances they would run too fast from being connected directly to the screw.

An account of the last successful voyage outwards of the Sarah Sands was also given, and it appeared that, in spite of most severe gales, which had driven back almost all other vessels, her passage had been made in the most satisfactory manner. In the discussion which followed, several engineers of eminence expressed themselves much pleased with the facts brought forward in the paper, and perfectly concurred with the views put forth. The principles of the following current of the ship, which had a material influence in insuring a compensation of the pressure to the screw, was also remarked. Mr. Grieve expressed that the screw would eventually supersede all other means of propelling vessels on long voyages.

An account was given also of the auxiliary screw-propellers that ply between London and Rotterdam, and some interesting facts were given of the powerful vessels possessed of working beam engines, and of other material improvements calculated to improve the port, some of which were carried into effect by Mr. Milton. Mr. J. Murray succeeded Mr. Milton, and carried on the designs of Mr. Rennie and Mr. J. Rennie, with great solidity, using the same as a model for the foundation of his. The whole plan was that of Mr. T. 120. He also reported, in an entire mass, the light-house to the extremity of the intended pier, an account of which has already been submitted to the Institution. In 1843, the south pier being in a ruinous state, was partially removed and rebuilt, in a direct manner, and in section of break the swell of the sea. The plans exhibited the changes that...
M. Cornishman added, that the memorandum was communicated to the first rod, and through such individual rod to the last instantaneously, and through it to the hinder van, just as in the case of a number of billiard balls placed in a row. When the first was struck, the last was driven away with all the impetus communicated to the first, leaving the intermediate balls parish at rest.

A member suggested that it would require 300 tons to double up a rod four inches in diameter.

Mr. chocolates—\[Japan\] took it at that calculation, and, say, consequently, supposing the momentum of the collision to be greater than that, it was quite evident that 500 tons must be taken from the amount of collision imparted to the train and expended upon the van behind the train. As the stroke of the side buffer was 13 inches, it was quite clear six inches might be allowed for the stroke of the centre buffer without any injury to the passenger carriages, if the former, if the former 6 feet is the centre buffer in a train of 30 carriages, 54 feet would be gained by the stroke of the side buffer, leaving a surplus of 29 feet.

2. "Disconnecting Coupling."—Mr. Johnson, locomotive superintendent of the Manchester and Leeds Railway, produced a model of an invention for disconnecting the carriages from the engine, in the event of an obstruction which line. The invention, stated the President, was one of the most important of the day, and was designed to prevent the engine and payroll from running away with the train. The model consisted of a series of耦合器 which allowed the connection to be broken in the event of an obstruction. It was described as simple, reliable, and effective.

Mr. Baden, manufacturer, London, produced a model of a railway axle, to do away with the necessity of using the trolley, which line was considered dangerous and cumbersome. The axle was designed to carry the weight of the train without the need for additional support.

Mr. Baden also of opinion that the idea of the invention was not new, as it had been proposed by Mr. Watson, engineer, on the occasion of the Manchester and Birmingham Railway.

Mr. Bunning, of the London and North-Western Railway, declared to the violent oscillation of the carriages would produce the same result. He had seen carriages vibrate very much when not sufficiently tight.

3. "Railway Jokes."—Mr. H. Baden, manufacturer, London, produced a model of a railway axle, to do away with the necessity of using the trolley, which line was considered dangerous and cumbersome. The axle was designed to carry the weight of the train without the need for additional support.

Mr. Bunning, of the London and North-Western Railway, declared to the violent oscillation of the carriages would produce the same result. He had seen carriages vibrate very much when not sufficiently tight.

4. "Description of a new Railway Break," by Mr. F. Kennedy, was read, which requires a drawing to make it understood.

May 15,—Mr. J. E. Morgen, in the Chair.

"On the use of the Fan-blast for manufacturing purposes." By Mr. Buckles, the following papers were read—

1. This paper described a series of experiments on the fan-blasted, as applied to manufacturing purposes. They were made for the purpose of guiding the constructors of engines to obtain the greatest possible amount of power. The original application of the fan was for the purpose of separating and dressing seeds, the speed and density of the air being limited to manual power. But since their application to steam, steam and other motive power have been used, their speed and density has become greater, and the air may be directed from 2 inches to 12 inches per square yard. Various forms of fans have been made, but the one generally preferred is called a centrifugal, with three or more blades radiating from the centre. The advantage of such a machine is one that has a shaft of the highest possible speed, and that the blades are of the greatest possible area. The axis of the blades is fixed at the centre, and in some instances it enables the blades to beat one piece of work while shaping another, the pressure of the blast ranging from 4 to 8 to 10 inches per square inch, with nozzle tyes 12 inches diameter, but in a well regulated engine it is fixed from 1 to 3 inches diameter, to suit the quantity of blast required. As centrifugal fans 4 feet diameter, the blades of which are 10 inches wide by 14 inches long, and running 100 revolutions per minute, will supply air at a density of 40 or 50 square inches, to 40 tyes of 1 inch diameter each, without any falling
off in density. In the first six experiments no discharge of air takes place, the velocity of the fan merely keeping the air at a fixed density or pressure only square feet of one inch area. The next was a discharge of air from the fan discharging air. An inspection of the table will show that, under various conditions of velocity of the fan, the density of the air, and theoretical quantity of the air discharged, varies, but not in a direct ratio.

The observations at the same time coincided with the velocity, and 9-10ths of the velocity a body would acquire by falling freely the height of a homogenous column of air due to its density. This is what we have called the theoretical velocity; or, in other words, the height or density at which the fan discharged air was least expenditure of power when the tips of the vanes move at these velocities.

A recent set of experiments, the inlet openings in the sides of the fan chest were contracted to 12 inches, and 6 inches diameter, or to the same cross section as the 12 inches at the fan. In these experiments, the power expended was 2-3, to 1, compared to the openings of 17 inches, the velocity of fan, the density of air, and the cubic discharge being the same. With the 6 inch opening the same results were obtained as with the 12 inches, and it was the same as if the vanes were all turned over.

These experiments show that the inlet openings must be of sufficient size, that the fan may have a free and uninterrupted action in its passage to the blades; for if we at all impede this action, we do so at the expense of the power. Here follows a copy of the tables of 20 experiments, after which the paper gives the dimensions of fans employed in these experiments—namely, 8 ft. 10 in. diameter; width of the vase, 204 inches; and the length, 14 inches. The fan shaft is 5 in. in diameter, and it is placed at an angle of 6° to the plane of the diameter. The inlet openings on the side of the fan chest are 17 inches in diameter. The collector discharge opening is 13 inches wide and 12 inches deep; the space between the vane blades, and the chest increasing from two-eights of an inch on the exit pipes, to 4 inches at the bottom, in a perpendicular line with the centre.

Mr. Buckle said, that he believed that the area of the discharge and the density of the air required was very nearly. His object had been to show the quantity of the air discharged at a certain density, and the power required to effect that result.

2. Another paper on the same subject, from Mr. Jones, of the Bridge water Pumpery, Bridgewater, was also read.

Mr. Jones states, that, in his opinion, the experiments on which mechanical agents have a greater variety of opinions than that of the application of the fan for manufacturing and other purposes; nor is there any other subject which has caused more disappointment; and I am decidedly of opinion that this has been on account of the apparatus. It is evident that the fans are too small in the fans, as well as the passages leading to the tuyeres. Puffs are always better than opinions; and in offering the following statement, I merely give the result of six months' constant work. Two points of importance in the construction of fans are, an exact balance of the fan upon its axe, and a careful and judicious arrangement for getting up the speed so as to avoid either tight straps, or any slipping up on the pulleys. With this I forward you a drawing of the fans I have constructed. You will perceive that they have the opening of a large scale, but the result is very satisfactory.

With these two fans we have been melting 50 to 90 tons of iron per day, at the rate of 5 to 6 tons per hour, with a consumption of coke of 208 lb. to the ton of iron; in addition to which there is a saving in the blast, as the tuyeres require is about eight horses, the motion being taken from a 12 horse power engine by means of a Y-in. guuta percha belt, the shaft running at 72 revolutions per minute: the speed of the fan is about 720. They are driven by two fans, but it is much better to have both fans than a single strap. The openings at the side of the fans are 3 ft. 4 in. in diameter, and the outlets are 24 inches by 12 inches. The passages from the fan are 3° 24" by 1° 6", leading to a reservoir under the cupola 18° 0" by 7° 0" by 4° 0" deep, from which we have two tuyeres 6 inches in diameter. The pressure of blast is about 50 oz. per inch. The only thing to which I wish to call your attention is the increased size of the air passages; and when we consider the large quantity of iron melted, and the small proportion of coke used, the result is very satisfactory.

Mr. Buckle remarked, that his paper had been drawn up for the purpose of recording a course of experiments made during a series of years at his works, and illustrated by boiler. The results of these experiments were important to those who were about to adopt the fan, as teaching them that size is not a matter of guess-work. When he himself had a fan made, all the advice he could obtain was, "Make it big enough." He had been preoccupied with the size of the fan, and in possession of the results of his subsequent experiments, he should have had his fan made only half its present size. He now found that all required was, that the tips of the fan should revolve with 9-10ths of the theoretical velocity, and that the air discharged should be the largest portion of blast at the least expenditure of power. By driving them at a greater velocity, the power was absorbed without producing a greater quantity of blast.

Mr. Croom asked if the horse-power mentioned by Mr. Jones was indicative or commercial horse-power? Was it the same as that meant by Mr. Buckle?—Mr. Buckle said, he had ascertained the power by a dynamometer, having a spiral spring and a piston attached. Having measured the amount indicated by the wire, when disconnected with the fan, he had deducted that amount from the amount shown in every experiment. The engine was nominally a 14-horse power engine. He had found that by a succession of fans, the first transmitting the blast to the tuyeres, the power was so obtained by the third or fourth a pressure of 24 lbs. on the square inch.

Alderman Glaze remarked, that this plan was in use at a furnace fitted up some three or four months since in Derbyshire, where they proved that it was an advantage that the blast could make better iron, and in a larger quantity, than by the old plan.—Mr. Buckle had not been previously aware that the plan had been tried, but he had ascertained that uniformity of the discharge was greater than the old plan, as the tuyeres were kept full of iron. Mr. Henderson said, that in the works in Scotland with which he was connected, they had a fan so badly constructed that they were about to have it altered, which, nevertheless, turned out 250 to 290 tons of casting per week. They had found that they could get something like double increased pressure by the aid of the ordinary fan, and what it was sold for. He should like to know the proper form of the fan, the proper length of pipe, and the size of the pipe which conducted the blast from the fan to the tuyeres where they wished to use it. In Scotland they were working a shaft 300 feet long; and he should like to know whether they could effect their object by laying down underground piping, instead of having a shaft to conduct the power to the place where they wished to use it. They had enlarged the tuyere pipe, having ascertained that, in melting iron, the density of the air at the low temperature of 600°, and that it was necessary that the air should be admitted in large quantities.—Alderman Glaze knew of one furnace where the cupola was 150 feet high, and the blast was the same. He had some experiments, which went to show, as the Chairman remarked, that, putting from one point of view, the further the blast was from the fire the better. The discussion was then adjourned, to afford an opportunity for further examination.

"Heated Air." The next paper was from Mr. Wilkinson, who, the Chairman observed, had been so bold as to try a totally new plan for economising fuel, by introducing heated air into the boiler of a steam-engine, among the steam, by which the inventor estimated that he effected a saving of 20 to 25 per cent. in fuel. They had had steam and heated air separately, but this was the first attempt to combine them. The following are extracts from the paper:

"It is an unalterable law of Nature that to produce a given quantity of steam, a given quantity of heat must be imparted to the water, and that in the steam produced, under the same gross circumstances, to produce an effect, a certain amount of combustion must necessarily be expanded. Now I find, from repeated experiments, that water alone is not the economic agent to work with; and, by way of illustration, I will explain what is the most successful of my experiments, and this was made on a six-horse power high-pressure engine, working in the manufactory of Mr. J. Burman, Cumberland-street, Curticum-road, London. The principle consists in the injection of steam of air, heated to the hot temperature of 800°, into the steam in the boiler—by which means the temperature, and consequently, the expansive force of the steam, was increased. To effect this object, an iron pipe or tube was bent in a serpentine form, so as to present a great surface of iron, and placed in a correct relation to the iron blast from the glowing part of the fire, after it had passed the bridge on its course to the furnace. One end of this rarefying chamber was connected with an inlet air-pump, proportioned to the size of the cylinder of the engine. This was inserted by means of a pipe, through which a blast of the water into the steam in the boiler. The whole capacity of the tube was greater than the volume of compressed air which it received from each stroke of the piston of the pump, so that the air did not enter the boiler until it had acquired the full heat or near; and it was tubed through which it passed. At every stroke of the piston the same quantity of cold air was injected into the tube. That part of the air which was next to the pump was forced into a hotter place, and the air, which previously occupied that hotter place, was forced on to a still hotter one, and so on, until the furthest and hottest of all was discharged into the steam in the boiler. The pressure of air in the tube, strictly speaking, exceeded that in the steam in the boiler, for it was an excessive pressure that overcame the resistance of the tube. The pressure of air in the tube was caused by the fact that the cylinder of the pump was in equilibrium with the external air, and only opposed a resistance as it became compressed, and gradually increased its compressed force until it arrived at its maximum, which was the point of contact of the cylinder with the compressed air in the hot tube and the resistance of the steam. Taking all things into account, the whole amount of power expended in working the pump was about 8 per cent., or 13th of the force of the steam in the steam cylinder on the engine, as the result of the experiment showed that the increase of pressure of the air caused the consumption of coal per cent. per cent., and this was continued for several weeks, the engine worked slower with them without it; but, as the inventor stated,
ROYAL INSTITUTE OF BRITISH ARCHITECTS.

May 17.—Sir de Gray, President, in the Chair.

The President presented to J. W. Papworth, Fellow, the Medal of the Institute for his Essay "On the Adaption and Modification of the Orders of the Greeks by the Romans and Moderns," and to James Bell, the Medal of Merit for his Essay on the same subject.

The Rev. Prof. Willis read a paper "On the Successive Construction and History of the Church of the Holy Sepulchre, from the earliest down to the present day." After alluding generally to the holy places visited by the pilgrims and grouped together within the walls of the church, and the buildings immediately connected with it, he then proceeded to give a brief history of the circular building. He thought the round church was full of mystery, and that of the ascension. The second, or church in question, remained till the invasion of the Persians in 614, when it was destroyed. It was re-erected by Moslemus, soon after, but was much injured, though not destroyed, in 637, by the order of Mohammedans. The crusaders, however, restored it, and so it continued till 1098, when it was burnt down, and afterward rebuilt in such a manner as to disguise its real character.

The problem was, to discover what Constantine's architects did, and to obtain knowledge of this it was necessary to go to documentary evidence. The writings of the pilgrims, one as early as 335, were of the utmost importance, and had been carefully examined by him. A minute plan of the present church, made by Mr. Scola, he had found of great service. First describing the church on the right hand of the church, he said he considered the tomb not to be a built structure, as often supposed, but a genuine rock sepulchre, paved down and decorated externally; and he showed the probability of this, by tracing the line of portions of the rock yet remaining at the west end of the circular building. About this round church and church was built burrow of three spots, the birthplace of the Saviour, the scene of the resurrection, and that of the ascension. The second, or church in question, remained till the invasion of the Persians in 614, when it was destroyed. It was re-erected by Moslemus, soon after, but was much injured, though not destroyed, in 637, by the order of Mohammedans. The crusaders, however, restored it, and so it continued till 1098, when it was burnt down, and afterward rebuilt in such a manner as to disguise its real character.

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THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

1847.

The invention of the rotary valve, so as it had already been patented by Messrs. Edge and Wright.

Mr. Defries, in reply, stated that he was quite aware that the rotary valve had been primarily patented by Messrs. Edge and Wright; but there was this difference between his and theirs—viz., that theirs was a three-throat valve, and does not shut the gas off from any part of the works, while his is a six-throat valve, and excludes the gas from all the more delicate parts of the machine.

2. By Mr. T. Boccius, "On his Improved Gas-burner."—The two most important points in the combustion of gas, are economy and perfect light; and these desiderata combined, I believe I have attained," says Mr. Boccius, "with my burners. The patent for the present burner was taken out in 1843; and the burner is so constructed as to admit such an amount of atmospheric air as will completely oxygenate the burning hydro-carbon, at the same time keeping up the same amount of intense heat, even to the apex of the flame, which is necessary to the incandescence of the solid carbon, in order to obtain luminosity. In the patent of 1843, (Mr. Boccius says) I did not confine myself to any given form of burner, as my apparatus can be adapted to all forms, whether flat, half-circular, triangular, circular, &c., the result always being the same.

It consists of a series of concentric rings, from the centre of which rises a crescent-shaped tube, with other concentric rings. These latter serve to keep up the required heat at the apex of the flame, and also to steady the light. From the form of burner, it is shadowless, no portion of the light being obstructed either above or below the flame. Mr. Boccius then added to the tulip-shaped burner, for which a patent had been taken out, that particular form being given to the flame by means of a current of air passing through a perforated button or inverted cone, into the body of the flame.

Mr. Boccius stated that the inverted cone was included in his patent; that no action took place from the passage of the air, as stated, the flame being expanded more or less, according to the height at which the cone is placed in or from the flame.

The Secretary described an "Excavating Machine," by Mr. Paidmont. (See Journal for July last, page 319.) The machine consists of a series of scoops attached to arms fixed on an axle driven by a steam-engine. As the scoops revolve, they slice off the earth, and discharge it out of the machine, and is worked by a steam-engine.

Mr. W. E. Newton stated that an American machine, for a similar purpose, had been used on a railway at Brentwood, and succeeded very well. It cut some millions of tons of earth away in the United States. The greatest difficulty they met with, was getting the wagons up to, and away from, the machine.

Mr. Paidmont stated that two wagons could be brought up at once, and there would be no difficulty in changing them as fast as the machine could set them.

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By G. V. GUSTAFSON, late engineer R.N. London: George Herbert.

Mr. Gustafson's work is a small pamphlet of 36 pages—the purport of it seems to be to show that much power is lost in the present existing forms of marine steam engines, as a substitute for which the author proposes an improvement, or rather modification, of his own. The most valuable part of his treatise is a table of the rates of motion of the steamer Acheron, and of the angular velocity and extent of impulse of paddle wheels. A great deal of experiments instituted during the three years that Mr. Gustafson was her acting engineer. This alone, as furnishing very useful and important data for subsequent investigations, we consider a sufficient recommendation of the work to the notice of our practical readers; although we must at the same time add, that adopting the author's mechanical views—which, in statement at least, if not in conception, appear to us extremely confused. The reason assigned for the frequent occurrence of breakage in the various parts of marine engines, exhibit the too common insufficiency of thought concerning pressure and impact which is constantly displayed by men not thoroughly versed in the science of mechanics. The casualties above alluded to are easily explained, and are not at all owing to any peculiar mode of construction in the engines. Marine engines are especially subject to impulse strains, the amount of which is not easy to calculate before hand; they have no relation whatever to the horse power, or any thing of the kind, but are chiefly caused by heavy seas breaking.
against the vessel—and above all, against the paddle wheels. The ordinary straining of tension are, besides, continually varying; and these changes combined continually tend to loosen and weaken the several parts of the machinery, and ultimately to produce disruption. The evident and only way to lessen the probability of such accidents is to make the parts most liable to strains as massive as possible, and to avoid all unnecessary gearing. But the most serious objection which the author urges against the present forms of marine engines is the alleged enormous absurdity of the power by them, and consequent loss of useful effect. The method he adopts to estimate this loss is confessedly merely an approximation—and, as we hope presently to show, an approximation which, being based on unsound principles, is altogether wide of the truth. The resistance of water to a moving surface having previously been determined for an given velocity—resistance being assumed to vary as the square of the velocity—it is clear that if we know the rate of the vessel's motion, and also the rate of motion and the diameter of the paddle wheels, and the depth to which they are immersed, we can calculate the work done during a given time. As the subject is one of considerable importance to engineers, we shall proceed to investigate formulæ for the amount of work done, and useful effect produced by the rotation of a single paddle board. We shall suppose the paddle boards rectangular and perpendicular to the edge of the wheel, so as to radiate from its centre. Let $2a = x$ of the wheel immersed; $e = \text{angular velocity of the wheel}; h = \text{breadth of paddle board; } l = \text{length of paddle board}$. Let $f$ = resistance against an unit of surface for a velocity $v$; $v = \text{velocity of vessel}; \theta = \text{angle passed over from the vertical by the given board at time } t$. Then the resistance against a thin slip of the board, at distance $r$ from the centre, will be $bf = (r - v \cos \theta) \frac{2}{3} \frac{2 \theta}{r}$. If we replace the paddle board by a pointed cone, the work done while it passes through a very small angle $\theta$ will be $bf = (r - v \cos \theta) \cos \theta \frac{2}{3} \frac{2 \theta}{r}$. Therefore, integrating between proper limits, the total work done by one paddle board for one revolution of the wheel is

$$bf = \frac{2}{3} a e \left( \frac{1}{r} \right) - \frac{2}{3} \sin \frac{2a}{r} \left( \frac{1}{r} \right) \left( \frac{1}{r} \right) - \frac{2}{3} \sin \frac{2a}{r} \left( \frac{1}{r} \right) \left( \frac{1}{r} \right)$$

and the useful effect—

$$bf = \frac{2}{3} a e \left( \frac{1}{r} \right) - \frac{2}{3} \sin \frac{2a}{r} \left( \frac{1}{r} \right) \left( \frac{1}{r} \right) - \frac{2}{3} \sin \frac{2a}{r} \left( \frac{1}{r} \right) \left( \frac{1}{r} \right)$$

If $\theta$ be very small compared with $l$, these expressions become

$$bf = \frac{2}{3} a e \left( \frac{1}{r} \right) \sin \frac{2a}{r} \left( \frac{1}{r} \right)$$

and

$$bf = \frac{2}{3} a e \left( \frac{1}{r} \right) \sin \frac{2a}{r} \left( \frac{1}{r} \right)$$

The expression, which Mr. Gustafson obtains by an empirical and not very intelligible method, is equivalent to

$$bf = \frac{2}{3} a e \left( \frac{1}{r} \right) \sin \frac{2a}{r} \left( \frac{1}{r} \right)$$

This subtracted from the correct formula, gives

$$bf = \frac{2}{3} a e \left( \frac{1}{r} \right) \sin \frac{2a}{r} \left( \frac{1}{r} \right)$$

which deficiency will account for, at least, some of the power. Mr. Gustafson asserts to be lost in useless engines.

$$H = \frac{2}{3} a e \left( \frac{1}{r} \right) \sin \frac{2a}{r} \left( \frac{1}{r} \right)$$

This is the above difference $b$ being $b - e \frac{2}{3} a e \left( \frac{1}{r} \right) \sin \frac{2a}{r} \left( \frac{1}{r} \right)$, which deficiency will account for, at least, some of the power Mr. Gustafson asserts to be lost in useless engines.

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To the engineer and surveyor, the object of this little work will be sufficiently obvious from its title. The increase or diminution of earthwork on railways consequent on the alteration of gradients, is here calculated on the supposition that the altered gradient is parallel to the original gradient. It is important to observe that the calculations are based on this hypothesis exclusively, because they are applicable to no other. The case taken is a very impractical one, and of so rare occurrence, and so simple, that it is a very insufficient excuse for rushing into print. Where gradients are altered at all, it is usually their inclination which is subjected to the alteration. Our authors, at page 11, gives incidentally a hint for modifying his formula to these more general cases; but it is to be regretted that the substance might be suggested in which it is. The examples which they were the exact reverse of the truth; that is, results which represented the earthwork to be increased, where it was in reality diminished by the alteration of the gradient; and conversely.

Mr. Ibbetson's formula do not suppose the cross section to be known; they depend on the inclination of the slopes, but not on their comparative height on opposite sides of the railway. No distinction is made between a cutting through a hill and one round it; and no special rules are given for sidelong ground or open cutting. It is quite clear that such a rough method of proceeding could never be permitted in real earthwork for working out estimates. In these circumstances, considerable accuracy is imperatively required, and can be ensured by so method but that of taking out the quantities from the cross section.

For parliamentary purposes less accuracy is wanted. In the preliminary investigations the distinction between equal cutting and sidelong ground, is considered unnecessary. Here then, perhaps, the proposed method might sometimes apply. But, unfortunately, the very cause (laxity of investigation) which would palliate the inaccuracies of the method, at the same time excludes its comparatively inconsiderable results. The results of Mr. Ibbetson's formula then would generally be too minute for parliamentary purposes, and too inexact for the purposes of the contractors.

However, the methods appear to be in themselves neat and simple enough. The propositions are stated in that precise language which always argues well for the correctness of them. There seems every reason to suppose that if Mr. Ibbetson would write another book on the practical cases of alteration of gradients, and confine himself to objects of practical utility, the result would be successful obtained. There are no diagrams or demonstrations in his treatise. Against this method of giving mere recipes in the cookery-book fashion we always protest. But he has taken up new ground, and one in which a qualified labourer is much wanted;—if he will permit the above suggestions to work with him, he may gain the credit of having effected a work, which though of great value and importance, has been hitherto unwaterted.


Though this work of Mr. Browning's is founded on Peter Nicholson's system, yet he has carried it out in a new way, and instead of the labour employed, he proposes to calculate the quantities of materials used, and to give the elements of valuation in such manner as the builder to calculate the cost of the materials. For comparing Mr. Browning deserves particular praise, for he has evidently taken conscientious pains in getting up his work, and bestowed great labour upon it; but we doubt whether the work will be extensively used by practical men, for whom the Builders' Prize Books are found to contain more conveniently the information they want. The mode of working out each case is fully shown by Mr. Browning; and tables and forms are given with each example. In calculating the material for joiners' work, the several thicknesses are all reduced to a standard thickness of one inch, and then multiplied by the value of the inch deal. Thus, according to the price of inch deal, the price of materials will be determined. Mr. Browning, in the case of joiners' work, gives the value of labour and nails, though, in the case of carpenters' work, he gives new tables, instead of the usual estimates.

While we award great praise to Mr. Browning, we must observe that, so far as our experience, where he is concerned, the same mistakes of calculations is employed; but the reason why builders generally do not apply it, is, not from want of appreciation of its value,
or from want of capacity, but because such calculations require special proficiency, and they either use a price-book, or, if the case requires it, resort to a surveyor.

Copyright of Designs as Distinguished from Patable Inventions.


The object of this pamphlet is to show the exact degree of protection afforded by the registration of designs, and in particular to show that it does not supersede a patent. It carries out, therefore, the interpretation of the Registration Act, in the same view that we originally took. The intention of the Act was to provide protection for the principle of a design—only for the form. If, for example, a round cullender were registered, an oval cullender would be held to be no infringement. We may observe, by the bye, that the Registrar takes upon himself to decide on what designs ought to be registered, whereas his jurisdiction is merely limited to the determination of the class in which the design is to be placed. If, however, a Registrar is to exercise any jurisdiction at all, it is desirable that an engineer should hold the appointment; so that at any rate the services of a competent authority may be secured.

DECIMAL WEIGHTS, MEASURES, AND MONEY.

One of the lesser public questions of the day, is of special interest to our readers, is that concerning the tithing of money, weights, and measures. As it is more worthy of notice, as it is seen so often on the road from theory to practice, as the new rupees, two-shilling piece, or tithe of a pound, will show.

The root of the whole matter is this, that our way of numbering, fixed by our mother tongue, is by tens, one, two, &c., ten, eleven, twenty, twenty-one, thirty, forty, a hundred, a thousand, ten thousand, &c. We have also other usual ways, such as by twelves, as one dozen, one dozen-and-a-half, two dozen, and so forth; and by twenties, as a score, two score, three score and five, and so forth.

The way of numbering by tens is that followed in most tongues, and by all the higher races of mankind from the beginning of time; whereas some of the lower races can count only by twos or by threes, or as far as forty at the utmost—all numbers beyond being out of their power to reckon.

The kind of notations now used, called Arabic, agrees well with the words, as 1, 10, 11, 20, 21, 30, 100, 1,000, 10,000.

All this is so very simple—it is so readily learned in our babyhood—it seems so trivial—that we are likely to be blamed for raising it; and yet what is the answer to what we are going to ask,—"Why do we not follow up the way in which we begin?"

One of the evils we now find in all our dealings and reckonings, is that we have all kinds of weights, measures, and money—only one of which, that of the tithing way agrees with our way of numbering and reckoning. Some of our ways of measuring or weighing are by twos, some by threes, others by fours, eights, tens, twelves, sixteens, and twenties; in some cases even by fractions. If we buy by weight, we reckon by twenty, by one hundred and twelve, and by sixteen; we pay by twenty, by twelve, and by four; and we do the sum by ten—whereas if we bought by tens, paid by tens, and counted by tens, the operation would be easy, instead of being needlessly troublesome.

It is now some time since the state of our weights and measures awakened the notice of learned men. In the beginning of the last hundred years, a lawsuit showed that the Customs officers were using a wrong measure; while the Royal Society, having turned their attention to the measurement of the earth, found it needful to look into the standards of measurement used here. The Royal Society exchanged, in 1749, with the French Academy of Sciences, a set of standard measures and weights. These proceedings showed great differences between the standards kept at the Exchequer, Tower, Guildhall, Mint, Clockmakers' Company, Founders' Company, &c. In 1768 and 1769, a Parliamentary Committee was named to look into the standard. This Committee had a standard yard, and standard Troy pound, made. In 1765, bills were brought in for establishing new standards, but fell to the ground. This Committee wished to use the pound Troy instead of the pound.

In 1779, Lord Swinton tried, but fruitlessly, to get the English standards used in Scotland, as agreed in the Act of Union. He wrote—a book upon this matter.

In 1786, Sir George Shackburgh Evelyn made further enquiries into the state of the standards, which he published in the transactions of the Royal Society.

Before this, however, the Rev. Dr. George Skene Keith, who had laboured on the matter for more than thirty years, wrote a pamphlet in 1791, proposing a decimal system of weights, measures, and monies.

In 1795, the French, in their revolutionary madness for sweeping away every old law and custom, decimalized every kind of weight, measure, and money, on a plan which is called the metrical system, its aim being to be a moral part of a great circle. The French supposed they had laid their system on a natural and plain basis; but after investigations have left this a matter of doubt.

Our brethren in America had already adopted the dollar as their money unit, and divided it by tens into dimes and cents; but they have kept our weights and measures.

With the year 1800, a new agitation began for a change here. Professor Playfair and others wanted to have the French system, but happily they did not succeed. It was soon seen that the French metrical system, having no fellowship with the old system of weights and measures, was not followed by the people, who could not be made to understand it; and the end was, that while the pure metrical system was kept for scientific purposes, it was for popular purposes provided with old names, and was called the "usual" system; thus a double metre was called a toise, a third of the metre was called a foot, a half kilogram a pound, an eighth of a hectoliter a bushel, and so forth. This was fully established.

In 1818, a Committee of the House of Commons was named, who published a report, and in 1818 a Royal Commission was named for weights and measures; under which, reports were published in 1819, 1820, and 1821. In 1824 and 1825 acts were passed, which named the standards, called "imperial standards," which were published in all local weights and measures, and reduced the number of standards.

The greatest evil attendant upon the "imperial" measurement is, that the new gallon is made to contain ten pounds avoirdupois weight of distilled water, whereby the size in cubic inches is 277.247, giving a number most inconvenient for calculation.

In 1821, the American legislature took up the subject, and a most valuable report was drawn up by Mr. John Quincy Adams, afterwards President, who was in favour of the French metrical system. No important result has, however, been achieved in America.

Professor Robert Wallace, Mr. John Wilson, of Thornley, and others, proposed modifications of the English system, and published pamphlets upon it. In 1831 and 1832, General Fasley published a work suggesting a new standard and a decimal system, which he further carried in a second edition, published in 1834, and which for the labour bestowed upon it, is well worthy of being read. He proposed as a standard a fathom of the thousandth part of the nautical mile, which he adapted to the present systems of measurement, without causing much change in the value, though he introduces many new terms. His remarks upon the modes of measurement now in use are particularly valuable.

Mr. Babbage has been another labourer on this subject.

Since these, Professor De Morgan has repeatedly brought the decimal system before the notice of the public, and has written upon it. We likewise made some remarks in a former volume of the Journal.

In the present session, the Chancellor of the Exchequer, having been questioned by Dr. Bowring, has agreed, as a first step, to coin a two-shilling piece.

However desirable it might be, in a theoretical point of view, to carry out with that given system, experience has fully shown in France, that the only practicable way of getting an efficient and working system, is by conforming, so far as possible, with existing institutions and the habits of the people. The French "metrical" system has become the "usual" system, and as such works well, while most of the theoretical advantages are already obtained. It is in conformity with this experience that any attempts must be made in England, and indeed this is pretty commonly allowed; although there are many differences of opinion as to details in carrying out a decimal system.

The great difference is as to the units and standards to be adopted. It has been assumed by some that a natural and invariable standard is to be looked for, which can always be referred to; and the measure of a degree of the meridian, the length of a pendulum, a quantity of distilled water, and various other such standards, have been proposed; but the attempt is perfectly futile, for there is no such natural standard. Captain Waller's imperial gallon is just as possible as any other standard, but that it is not a superior standard, that all such units are arbitrary; and that therefore, instead of inventing a new arbitrary unit, it is better to adopt an old arbitrary unit.

Whatever weight may have been at one time given to the French metrical system, it can no longer be allowed, for it is found not to rest on a natural standard, while the French have failed in enforcing it.
There is no reason either why we should adopt the standards of an inferior people like the French, when our own, adopted in our vast empire, and by our brethren in the United States, of themselves secure a wider adoption.

The introduction of a decimal system must be in conformity with existing usages, and it must be gradual. The first thing certainly seems to be a reform in the coinage—and this is determined upon, the pound being taken as the unit.

It need scarcely be said in these days, that a decimal system would diminish the work of children in learning arithmetic, giving them time for other pursuits; it would diminish the work of grown-up people in reckoning; it would enable all ranks to think, that cannot now—to reckon properly; the moral results of which may be expected, so far as prudence, economy, and foresight are concerned, to be much greater than any other.

The pound being taken as the unit, its tenth is the new two-shilling piece. The worth of this is about the same as the rupee, and it is to be hoped that the two will be made to agree, so that our East Indian currency may be uniform. The half-sovereign remains for a half-pound or five-shillings; the crown for a quarter-pound or twenty-five shillings; the half-crown will, in all probability, be superseded; but while it remains, it causes no interference with a decimal coinage, having a fixed value. The shilling is a half-repee, the sixpence a quarter-repee; and the farthing a foureight of a shilling. The farthing, it is hoped will be withdrawn from circulation, so as to leave room for a new four-cent or hundredth of a pound in silver, which will be the tenth of a repee and fifth of a shilling. It has been well observed, that a very little change is involved in leaving the upper coinage, making the pewl half the thousandth, or four-thousandths of a farthing; the halfpenny two thousandths, and the farthing one thousandth.

The effect would be that the decimal monies would be a pound, a repee, a great, a farthing, leaving the others as conventional monies, as the crown, half-crown, and groat are now.

A change in the coinage is indispensable in reference to the change in the weights and measures. It is a matter of convenience now, particularly with women, to reckon by the unit, half, quarter, and half-quarter, the division by halves being one of the simplest arithmetical operations. In effecting any alterations, while a full decimal scale is given on a measure, the unit can be divided by halves, quarters, &c., on the other side, as is very common on rules and scales. This is a mere detail of the rule maker. With a change in the coinage the reasons for a duodecimal division would drop, for a foot or a pound divided into tenths would readily answer to the parts of a repee or a shilling.

In long measure the great dispute is, whether the unit or the foot shall be taken as the unit. If the foot be taken as the unit, it will cause little disturbance of the small measurements, but it will interfere with all the larger measurements. The mile must then be a mile of 1,000 feet, instead of 5,280; the chain will become fractional, and so forth.

If the mile be taken as the unit, it will be divided into 1,000 fathoms, and 5,000 feet, or ten furlongs, one hundred chains, one thousand fathoms, ten thousand links, one hundred thousand half links. The foot will be ten inches (to the present inch 1:055 to -933), and one hundred and hundred hundred. The square mile would be forty square furlongs (of 9-4 acres each) 10,000 yards, or 5,000 chains, and 1,000,000 square fathoms.

With regard to weight, the choice is also disturbed between the pound and the ton. The pound, however, appears preferable. The pound would be of ten ounces, one hundred grey, and one thousand grains; and the rising scale would be one of 1,000 pounds, a last or load of one thousand lbs., and a ton of two thousand lbs. If a load of 1,000 lbs. were used forthwith in calculations, this would very much simplify matters.

As to liquid and dry measures, there are still greater discrepancies, but it appears desirable in all cases to employ the lb. or cubic foot, in preference to the gallon or bushel.

In conclusion, it may be observed, that it is particularly desirable that engineers and manufacturers, who have so much to do with measurements and calculations, should at an early period direct their attention to this subject, particularly in reference to a choice of the units, as their work, thereby, very much advance the progress of legislative measures, and secure their conformity with the views of practical men.

THE GERMAN OVERLAND ROUTES TO INDIA.

The contest carried on, of old, between the seven cities for the honour of Hannover’s cradle, cannot be more fierce than that for the Indian route through middle Europe. As, however (the Black City of the Romans) has attracted some notice, we shall briefly advert to it. It is now two years since Colonel Larica, of the Piedmontese service, made the necessary studies and measurements, which were laid, in 1845, before the Company of Tarrin. He then proceeded to the northern slopes of the Alps, while Inspector Carbonnazi surveyed the southern parts, and made levels and planimetric charts of the whole country, from the valley of the Tessini to the lake of Como.

In July and August last, these surveys were continued by the two engineers, and to which the services of Capt. Riel, of the Piedmontese corps of Engineers, were added. All of them co-incident in the opinion, that the valley of the Cristallina was the fittest point to cross the Rhetian Alps. A supercilious glance at the charts published in the Stuttgart Rhinehke Zeitung convinces one of the labour, at least, bestowed on that survey.

The plan of the route to be traversed, shows especially that the 342 German leagues to be laid over with rails, presents no insurmountable difficulties, and has only to pass one water-way, while the Trieste line has to pass four. An extent of 23 3/4 leagues of that line—vis that from the Boden See to Salzburg (in the Rhine valley), conjointly with that from Prospis to Locarno, is quite adapted for being passed by locomotive engines. A distance of 6 9/10 leagues, however, between the above points, is very mountainous, and could not be passed but with gradients of 3:9 to 4:9 in every 1000. Here, therefore, stationary engines are to be used—unless, indeed, some means should be devised for using the water-power, so abundant in these Alpine localities, for that purpose. But even if that space should be passed over by means of fixed engine, the air of this mountain road, with the distance from the Langen to the Bodenau (239,435 metres), could be travelled over in 9 hours,—a great dispatch, indeed.

Another difficulty, not to be passed over, is a tunnel of 5,200 metres in length, which it could be passed over by the means of the three tunnels, the engineer thinks lightly of it. Pits, certainly, there could be none, except at the two ends of the shaft, as an enormous mass of rock overlays the projected tunnel.

The difficulty of passing this line in winter (here 8 months out of 12), is to be expected by observing the places likely to be overspread by avalanches or drift snow with galleries, as has been done on the Spilunen, the St. Bernard, &c. While, in fine, this line will have to cope with difficulties of troublesome earth-works, and require every aid engineers can afford—the shovelling, the stone, timber, and sand are important.

If the Alps are ever to be passed, this line seems to present the easiest access from Upper Italy and Germany, while also the Sardinian government is undertaking important works for the improvement of the now free port of Genoa, and the railway thence to Arona, which will be completed in 1840. At any rate, an important rival to the Trieste route has sprung up in that over the Lockmanieren—although both, perhaps, are not worth the old Marcellis route.

THE LONG RANGE.


If any one doubts that the "long range" is a gross quackery, we recommend the perusal of Sir Howard Douglas's speech. Mr. Warner has said a great deal about official persecution, but we understand it not in that other sense. Here is a man, general, a highly accomplished member of his profession, forced to undertake a most unpleasant public duty, as a commissioner of enquiry into this "long range," and he is obliged to get up and defend himself in parliament, and to publish his speech, by way of making a kind of weapon against any future attacks. Sir Howard's exposure of Warner is complete, while his professional remarks on explosive power are very interesting; and as the subject is very little understood, we shall take the liberty of making a few extracts from the speech and notes. It will be observed, that before receiving any intimation as to the nature of the invention, Sir Howard Douglas expressed in the following speech, his opinion that a balloon was impossible.

"Mr. Warner asserts a power which sets the most important laws of nature at defiance. Gravitation, by which the system of the universe is maintained—resistance, by which some of the most benign purposes of Providence are accomplished, are nothing to Mr. Warner. When Colonel Chambers, a member of the Society, wrote that the mind of Mr. Warner was with the prodigious powers of resistance to his long range, he exclaimed, 'Who can frame laws to govern a force which has never before been heard of—a force a hundred times greater than that of gunpowder!' More was urged by the colonel, but, as he says, Mr. Warner was too dogmatical to reason with. Who can frame laws to control such a force as Mr. Warner imagines? Why, the Almighty Maker of the universe. . . . . . . .
closely because Mr. Warner's alleged projective force is, as he says, a hundred times greater than that of gunpowder, that it would be met by a resisting force greater in an increased ratio, by which the projectile would be opposed, controlled, and reduced to moderate velocities and limited ranges. We possess in gunpowder greater force than we require. We reject the random use of it to gain accuracy. The power by which one of the cliffs of Ailsen was recently blown into the sea, and the Royal George out of it, is more than adequate to any, that war requires, or can be used with advantage in projectiles. . . . . . The greatest range that ever yet has been attained was by the mortar or howitzer, the trophy that now stands in St. James's Park, which threw a shell filled with lead about three miles into Cadiz, but with such random effect, as to do little or no harm.

"By using the denser metal, lead, that range was procured, and the momentum of the shell, so filled, augmented. A British 13-inch shell filled with lead discharged from a mortar with the full charge, may be projected as far as the Cadiz mortar threw its shell. I do not say that greater ranges may not be attained. . . . . . No great increase, even of random range could be obtained, by increasing the magnitude of the gun to almost any size. And even then it would be a random range. . . . . My life has been devoted in a great degree to matters of this kind, and I assert, that it is physically impracticable to procure a range of six miles by any projectile force. Mr. Warner first asserted, that his long range was not a projectile, he has since asserted that it is. But it may be a balloon, or a kite: if so it is old, and nothing worth. (It was proposed during the threat of invasion in the late war, to endeavour to destroy the Boulogne flotilla by such agents, but this was laughed at. It is well known that Sir W. Congreve proposed to destroy towns and forts by the aid of kites. They were to be made of canvas, and of a very large size, so as to be able to carry very great weights. When the kite had reached its place of destination, and stood over the devoted fort, camp, or ship, the shell was to be dropped into the midst of the place or vessel.) It may be a compound of projection and propulsion. This was still more ridiculous.

"I do not deny that Mr. Warner may have hit upon some explosive compound more potent than gunpowder, and some improved mode of causing it to explode, either by mechanical or chemical action, but as to the modus operandi, so far from there being anything new in Mr. Warner's process, I hold in my hand a work published at Paris fire and twenty years ago,—

*Memoire sur les Mines Flottantes et les Petards Flottants, ou Machines Internes Maritime,* par Montgery, Officier de Marine,—containing a history of many different modes of blowing up ships by marine fougasses from very early times. This work has for its frontispiece, the destruction of a vessel could pass, without coming in contact, either with a torpille, or with the line connecting one with another, causing both to collapse, strike the vessel, and explode. Mr. Montgery, in all probability, on the strength of a vessel of all sizes, but above all steam-boats, may make use of these torpilles connected with each other by lines. A vessel may then sink another by torpilles connected with each other by lines. Vessels or boats chased by superior forces, may deliver themselves from their enemies, by throwing into the sea one or more of these mines flatontes connected with each other. The operation of shutting up an enemy's port, ought to be executed at night, otherwise the enemy having knowledge of it, would easily frustrate the attack.

"It was easy to adduce from Mr. Montgery's work, and many others, abundant proofs that there is nothing new in the proposition for submarine mines, as suggested by Mr. Warner. . . . We find the following in Phipps's Diary:—

"In the afternoon came the German de Kussner to discourse with us about his engine to blow up ships. We doubted not the matter of fact, it being tried in Cromwell's time, but the safety of carrying them in ships. But he do tell us, that when he comes to tell the king his secret, for none but the kings successively, and their heirs (to this Mr. Warner adds prime ministers) must know it, it will appear to be of no danger at all. We concluded nothing; but shall discourse with the Duke of York to-morrow about it."

"To these I may add an infinity of names mentioned, by Monsieur Montgery from the earliest times. And in our own refer to Bushell, 1787; Torpedo war and submarine explosions, by Robert Fulton, Fellow of the American Philosophical Society, and of the United States Military and Phi lospophical Society, New York, 1910; De la machine infernale maritime, où de la tactique-offensive et défensive de la torpille, etc. par M. E. Nunez de Taboada, etc. Paris, 1812; Colt, see New York Weekly Sun; Monsieur Jobart, of Brussels, &c. &c."

**IMPORTANT EXPERIMENTAL TRIP.**

On Thursday, May 13th, there was a grand day with the steam navy at Woolwich, the Lords Commissioners of the Admiralty having ordered an experimental trip with all the steam-vessels that station which were in a state of sufficient forwardness for the purpose. The vessels originally appointed to compose the squadron were, the Amphion, 36 guns (300 horse-power); Sharpshooter (iron screw st.); Riflemen (iron screw st.); 51 gun Rock (wooden screw st.); Teazer (wooden screw st.); Growler (st. acoop); Kite (st. v.); and Princess Alice (iron st. packet). Owing to the arrangements being incomplete, the Sharpshooter and Riflemen did not join the squadron. Between nine and ten o'clock the Lords Commissioners arrived. At ten minutes past eleven the signal was given from the Black Eagle to loose from moorings, and in about ten minutes the fleet started from Woolwich in the following order: Teazer (screw) leading the way, followed by the Amphion and Rock, and this was the order in which they proceeded down Woolwich Reach, and up the galleries. The Amphion was, of course, the principal object of interest, and upon testing her speed, it was found that with the engines making 45 revolutions, and with her jib set, her rate of speed through the water was 8.5 knots. The Teazer proved to be the slowest boat of the fleet. In Halfway Reach the Black Eagle put on her full speed, and soon came up to the Amphion, and then reducing her engines to half speed, she kept within hail of the Amphion during the remainder of the cruise. Their lordships, who took their station on the quarter-deck of the Black Eagle, with Sir J. J. Gordon Bremer, paid especial attention to the Amphion, and signalled to hoist the sparker sail, the wind then blowing stiff from the south-east. The log was again thrown overboard, and the speed with the engines at forty-seven revolutions proved to be 8 knots. When the squadron reached Erith, the Miss, which is a faster boat than either the Amphion or Teazer, soon caught the fleet, the Amphion holding on her way, with the Kite on her larboard, and the Black Eagle on her starboard quarter; the Teazer a considerable distance astern, and the Growler (which had been detained at Woolwich) just bearing in sight. The squadron passed Erith at a quarter-past twelve, and a signal was then hoisted from the Admiralty yacht (Black Eagle) to put on more sail; an order which could not then be complied with, as the wind was unfavourable. In Long Reach, the speed of the Amphion was tried at the measured mile, which was done in 8 min. 53 sees., the tide having just ebbed; this gives a rate of speed equal to 6:166 knots, or about 8 miles, with the engines making 44 revolutions. As the ships neared Greenhithe, their lordships boarded the Amphion, and ordered all sail to be set. The sparker, jibs, and topsails were then set, and this vessel, under the conjoint influences of wind and steam, careered rapidly on her way. A daily sender, which had continued her course uninterrupted, here overhauled the fleet, and passing the Amphion to port, took up her station as the leading steamer on the starboard side. The squadron stood out through Sea Reach, where the full operation of both wind and tide was felt; and here the log gave a speed of 16 knots. Having reached the estuary of the Thames, their lordships signified their wish to return, and the Amphion was brought round with great celerity, and they embarked at once on board the Black Eagle. It may be as well to state, that this is

*Memoire sur les Mines Flottantes et les Petards Flottants, ou Machines Internes Maritime.* par Montgery, Officier de Marine.
NOTES ON FOREIGN WORKS.

Alpine Vienna and Trieste Railway.—This line, from Cilli to the end of the S nonexistent (14 English miles), has just been completed, and works now, by the skill employed therein, as well as the great beauties of Alpine scenery, amongst the most remarkable objects of Styria. The bridge, in fine, which has been thrown across the Saun (near its confluence with the Rare), is the culminating point of the whole work. Conformably with the difficulties presented by the ground, it consists of an oblong arch, whose circular opening is 100 cubits. The three minor arches will have a span of 19 cubits in the height, their being 40 feet. The construction of the protecting dyke was accomplished by iron bars being screwed perpendicularly to the bottom, then, by using the same bars, the dyke was completed. The difficulty of Alpine ground may be guessed from the fact, that from the watering place of Tüffer to Steinbrücke (a distance of four English miles), the embankment of the road amounts to 12,000 cubic cubit. M. Fico, the engineer, has made the choice of the most solid materials, and for the solidity of the works. The Bath of Tüffer was known and restored to the Romans.

Great Central Railway Lines.—A joint meeting of the directors of the different lines forming those from Vienna to Hamburg, and Vienna to Stettin—the first 140, the latter 125, German marriages (15 to a degree), have met at Berlin, and concert a plan, by which the first distance can be accomplished in 44 hours, and the latter in 40 hours, either going or coming. The train will leave Vienna at 7 o’clock, p.m., arrive next day at noon at Berlin, where it will stop four hours; start at 7 a.m., and arrive at 5 a.m. at Berlin, whence it will start for Hamburg or Stettin at 7. It is stated, that the Berlin and Magdeburg company wish to purchase the interest of the Magdalen and Leipzig line, at the enormous interest of 250 per cent.; but, however, afterwards the projected passage of the company may be, it is pretty well acknowledged now in Germany, that over-speculating ought to be rather accused of under-speculating.

Regulation and Drainage of the Rhine.—After the terrible disasters which the overflowing of this river caused, last year, near Vadus (Switzerland), surveys and plans for the above purpose have been made by Colonel Lancia and Mr. Gaul. Mr. Gaul’s work, including the projections of a system of about 6,000,000 square kiloeters (cubits) of arable land could be gained in this spot, hitherto considered most barbary.

Spanish Surveys.—The activity which reigns in some departments of Spain, and particularly in Catalonia, has started a gigantic chart just published—"Gran Mapa de la Isla de Mallorca." Its dimensions are 67 inches (pulgadas castellanas) by 52 inches. Its detail of ports, harbours, bays, and other features of the island of Majorca, are accurately rendered.

Brussels.—M. Peter Dahren, merchant of Cologne, has been introduced to the king, for the purpose of laying before his majesty his new plan for preventing accidents on railways. It consists of an ingenious plan of suddenly detaching the engine from the train, and bringing it to a stand still. The inventor intends, also, to have his discovery tested in other countries.

Literary and Art Property in Austria.—An imperial decree has been lately published—the most important regulations of which are similar regulations enacted previously by the Emperor of Russia. The copyright for any ideal property (ideale Eigentum) lasts during the lifetime of the author or artist, and thirty years, in the main, after his death. Foreign (not German) work is protected for 60 years. It is also declaratory of "not real property." Austria has not joined the Anglo-Prussian convention of literary and art property—but Saxony, Hanover, and others, have.

The Fossil Sea-serpent.—Dr. Koch, who brought to this country the Miocene mammot, exhibited in Egyptian Hall, has also discovered in America the earliest and the most complete of the reptiles, and other genera of the Hydrocorax. It possesses a vast number of very large vertebrae, and is the most extraordinary species of the so-called antediluvian creation extant. It has been exhibited at Berlin, and the king has given orders to purchase it, notwithstanding Dr. Koch requires an extraordinary price for it.

Drainage of Land in Dalmatia.—The valley of the Narenta (Narona of the Romans) was one of the corn-deposits of antiquity, but now presents nothing but a succession of unwholesome bogs and wilds, to which the attention of government has at length been awakened. M. Matteus has been directed to examine and report on the regulation of the river Narenta, the

most considerable between Trieste and Greece. It forms a delta at its embouchure, and its inundations have hitherto spread at random, and the mould being best retained between the couple of rives, is not by any means to increase their fertility. M. Matteus proposes two different systems—first, the so-called bienfaisance per sedimento stream or warping, similar to the old Egyptian method, by which, during the floods, the water, impregnated with rich soil, is directed in and retained in such places where it is most required to aliment and fertilize the soil. Secondly, a system of dykes and channels. The first plan is, obviously, the best, as no land is lost by the cutting of canals, &c.; but the expense is very great. Thus, most probably, the second plan will be adopted with the Narenta: one of the projectors, for its adoption, is the opinion here given to the rising of the silkworm, and as the mulberry trees attain an extraordinary size (some being 15 feet in circumference), it is proposed to plant them along the canals, and thus strengthen and solidify the consistency of the soil.

Australian Antiquities.—Although this title may sound somewhat anomalous, it is delivered of and the evidence, that so soon as man transgresses the limits of animality, he becomes a monstrosity, if we may so term it. Although many other criteria have been assigned to the idea of humanity (speech, use of instruments, &c.), yet it is, after all, only one or other which marks the limits between brute and human beings. In Australia, a continent of extremely novel formation and civilization, these art-traces cannot be but very faint—still, they exist. We count amongst them those same native roads, as they are to be met with in many parts of New Holland and Tasmania; and we ourselves of some notices derived from a colonial publication: "Our savages know of no rule, no system, except where they are absolutely forced to resort to it. In their wanderings through open plains, they follow, even if their numbers be considerable, the same path, unless a native road. A native road presents any particular feature—for instance, is encompassed by swamp, and the like; then, as a matter of course, a certain direction is given, and must be followed. This is the reason why regular roads (paths) of the Pampas and the same country may be sought for the coal-scuttle rocks between Botany Bay and Point Hacking; but the most remarkable are in Byron’s Valley, Australian Alps, where the wandering of tribes of several hundred persons, has worn off the sward of the soil, and even impressed the gravel underlying it. From these to the Llanos roads of Mexico and Peru is but one step. These paths are the only historical monument which the Papus leaves behind him—if we except, perhaps, large accumulations of cyster and cockle shells, near the sea shore; and which, as some instruments to open them which have been found amongst the heaps testify, have been thus fashioned and used by these people for the sake of eating and feeding at such places for a series of years. Transgressing from these aboriginal antiquities to European ones in the Australian colonies, we presume, that a freestone slab above the door of one of Mr. K. Campbell’s warehouses in Sydney Cove, engraved with the kind in Polygnesia."

Her Majesty and the Royal Consort’s Private Art Collections.—Uncostantly as many other of the Queen’s endeavours at general improvement—the establishing of an especial school for the children of the household and the labourers at the royal parks, and other works for the art collections at Buckingham Palace and Windsor Castle are also judiciously, yet uneconomically, increased. As the sovereigns of this country, fortunately, do not possess the power to draw on the Treasury for any amount, their collections do not consist of bulky and costly specimens—but of a number of select and eleven specimens, &c. which, while they pleasantly and worthily occupy the leisure hours of the royal couple, will serve as early incentives to their growing-up family, and at a future time (be it a remote one) merge into the general stock of the country’s arts-approves.

NOTES OF THE MONTH.

The new Roman Catholic church in St. George’s Fields, by Pugin, has been advertised as open to the public.

The Royal Institute of British Architects have published a copious catalogue of their library.

The great east window of St. Peter’s church, at Sudbury, is being restored by Mr. Sprague, of Colchester, at the sole expense of Dr. Maclean.

The Bishop of Norwich, at his last visitation, made some very strong remarks against pewers, and expressed his gratification that his cathedral was never opened throughout the whole year.

The improvements in Durham Cathedral are making most satisfactory progress.

There has been an unfortunate accident on the Shrewsbury and Chester railway, by the falling in of a large viaduct bridge, by a train being thrown in the direction.

The great tunnel for the new station at Liverpool, and running from Clarence Dock to Edgehill, has been begun at the surface.

A beautiful iron steam, named the Oberon, was last month sent out from the yard of the Messrs. Hennie. She is 650 tons, and 200 horse power.
London, Brighton, and South Coast Railway Company.—The directors having in competition for the long distance between these cities, have awarded the premium of £100 to Messrs. J. W. and W. A. Papworth, of Caroline-street, Bedford-square; and that of £50 to Mr. Martin Stutely, of Gower-street, Bedford-square.

The Hanover and Harbury railway has been opened.

The "Typhonic" System of the New York Airway Railroad is at an end ! At a Board meeting on Tuesday, May 4, it was determined that the line should be shut up ; and this was done forthwith.

Prevention of Oxidation of Metals.—A correspondent of the Mining Journal, says:—"I have been led to adopt a simple method of coating metals, by the use of which I have found it to be the most efficiently from the corroding influence of their presence. The article to be coated is first dipped in a dilute solution, composed of two parts sulphuric acid and one nitric acid, nine parts water. After immersion in this solution, the article is to be washed to remove the surplus of the acid, and then allowed to remain in a run of water until it appears to be dry, it is to be brushed over with copal or coal varnish; the varnish attaches itself firmly to the acidulated surface of the metal, and never peels off. The best species of varnish for this purpose is probably copal, to which, and a little linseed; I have subjected sheet-iron thus treated to the continued action of sea water for several months, without its sustaining any injury. It is, perhaps, worth while for ship owners to consider whether a considerable economy would not result from the application of a new manufactured power of preserving ships."

Sawing Engine.—At the Royal Institution, April 16, Prof. Faraday called the attention of the members to a working model of a sawing-engine, invented by Mr. Cochran. By this engine wood can be cut into curves of any form, and two or three curves in two planes. This is effected by the saw being made to turn on a vertical, while the wood is turned at the same time on a horizontal axis.

Recent Depressions in the Land.—A paper was read at the Geological Society, Feb. 24, by J. Smith, Esq., on the above subject. Mr. Smith gives an account of the manner in which the land has subsided, and the apparent extent of the mud-plain of the famous Temple of Serapis near Pozzuoli. These measurements, made independently in the years 1819, 1826, 1835, 1844, and 1845, by Mr. Smith, Prof. Forbes, and the Chevalier Nicolini, prove a gentle subsidence of the land on which the temple stands at a rate of about one inch annually. Mr. Smith gives other proofs of the encroachments of the sea from an engraving in the "Vera Antichita di Pozzuoli," published at Rome in 1825, where the churches are represented as being in a state of decay; in 1837, the church of Tippone, and the church of Pozzuoli are washed away, as well as two sea-walls, built one within the other for the protection of the land. Mr. Smith then gives a variety of proofs, historical and geological, of the subsidence of parts of the coast of Normandy, Brittany, and the Channel Islands. The directions of the sea, in spots where, at high water, the sea is 60 feet deep; and Mr. Smith has ascertained, from MSS. of the ninth century in the Library of Avranches, that these forests were tranquilly submerged about that period. Mr. Smith also states, on the authority of Capt. Martin White, R.N., that on the coast of Normandy, lines, evidently artificial, and apparently stone walls, are seen under water running out to sea, and that the lead party at the coast frequently are engaged in searching for stones and tiles, which he is convinced are the ruins of submerged buildings.

Electrical Musical Instrument.—At the French Academy of Sciences, M. Froment presented a little electrical instrument, with a vibrating blade yielding a sound. It is composed of a small electro-magnet of iron, the copper being so arranged as to allow the iron to be moved, which a spring causes it to bear. An electric current, introduced into the apparatus, passes by the contact in iron and the stop, in such a way that the circuit is cut off when these two pieces are separated. This last effect takes place when the wire of the magnet is interposed in the circuit; for then it attracts the contact which, in abandoning the stop, interrupts the flow of the current. The magnetic power then ceases, the iron blade pushed by the spring returns to strike the stop, and again closes the circuit.

Fresco Painting.—A new method of painting as a substitute for fresco has been discovered by a French artist, M. Chevot. It is called by the author Fresco Modèle, and consists of a composition which combines the action of saltpetre, so fatal to fresco painting wherever there is saltpetre in the walls on which it is laid. The effect of M. Chevot's painting is as bold as that for which it is a substitute, and the colours are as vivid. It possesses not only the advantage of resisting the action of saltpetre, but can be added to fresh water or dust has accumulated upon it with quite as much security as oil paintings.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM APRIL 24, TO MAY 18, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Theodore Eyle Jevonnis, of Birmingham, manufacturer, for "an Improved and improved method of manufacturing paper made with关系，also a new and improved method of manufacturing paper made with关系，which said method of manufacturing paper made with关系，is applicable to paper for printing and printing and printing松和其他 substances."

April 27.

John Morgan, of East Greenwich, manager, for "certain Improvements in the manufacture of paper for printing and printing and printing松和其他 substances."

April 27.

Jonathan Atkinsen, of Liverpool, in the county of Lancaster, soap boiler, for "methods of manufacturing soap."

April 27.

Caroline Watson, of Cheylesmore, in the county of Lancaster, for "Improvements in the measurement and printing松和其他 substances."

April 27.

Vincent Newton, of Middlesex, manufacturer, for "certain Improvements in the manufacture of tobacco and tobacco."

April 27.

Thomas Dixon, of Doncaster, Yorkshire, for "Improvements in the manufacture of tobacco and tobacco."

April 27.

Thomas Denne, of Bembridge, Isle of Wight, for "Improvements in the manufacture of tobacco and tobacco."

April 27.

John Coates, of Seckno, in the county of Lancaster, soap boiler, for "Improvements in the manufacture of soap and soap."

April 27.

George Thompson, of Nottingham, cabinet-maker, for "Improvements in the manufacture of soap and soap."

April 27.

James Walker, of Derry, Ireland, for "Improvements in the manufacture of soap and soap."

April 27.

Louis Poitou, of Paris, for "Improvements in the manufacture of soap and soap."

April 27.

Richard Archibald Brown, of Fleet-street, London, for "Improvements in the manufacture of soap and soap."

April 27.

William Carter, of Stafford, for "Improvements in the manufacture of soap and soap."

April 27.

William M'Kee, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

James Freeman, of Stafford, for "Improvements in the manufacture of soap and soap."

April 27.

John Eadie, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

Richard Biscoe, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

William Newton, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

F. C. J. B. B. B., of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

Gardner Brown, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

William Hemdow, of Plymouth, for "Improvements in the manufacture of soap and soap."

April 27.

Henry W. H., of Plymouth, for "Improvements in the manufacture of soap and soap."

April 27.

James Wills, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

Charles Fox, of No. B. 3, Pimlico, for "Improvements in the manufacture of soap and soap."

April 27.

Herbert Spencer, of Oxford, for "Improvements in the manufacture of soap and soap."

April 27.

Thomas Poole, of London, for "Improvements in the manufacture of soap and soap."

April 27.

Johann Gessow, of Newington, in the county of London, for "Improvements in the manufacture of soap and soap."

April 27.

Isaiah Begg, of Holford-square, Middlesex, for "certain Improvements in the manufacture of soap and soap."

April 27.

John Verity, of Holford-square, Middlesex, for "Improvements in the manufacture of soap and soap."

April 27.

Johann Gessow, of Newington, in the county of London, for "Improvements in the manufacture of soap and soap."

April 27.

William Norman, of 27, Queen Square, Middlesex, manufacturer, for "Improvements in the manufacture of soap and soap."

April 27.

William Martin, of Aulton, Yorkshire, for "Improvements in the manufacture of soap and soap."

April 27.

John Tattersall, of Manchester, for "certain Improvements in the manufacture of soap and soap."

April 27.

Richard Bevan, of Manchester, for "Improvements in the manufacture of soap and soap."

April 27.

Thomas Gray, of Wander-street, Middlesex, for "Improvements in the manufacture of soap and soap."

April 27.

Thomas Shippe Greaves, of Wetherby, for "Improvements in the manufacture of soap and soap."

April 27.

Richard Price, of the Boundary Works, Acres, for "Improvements in the manufacture of soap and soap."

April 27.

Thomas Pascale, of Holford-square, Middlesex, for "Improvements in the manufacture of soap and soap."

April 27.
THE NEW PALACE OF WESTMINSTER.
THE HOUSE OF LORDS.

With an Engraving, Plate X.

Architecture is pre-eminentiy a royal art—princes, potentates, and princes have paid more direct homage to it than to any other of the fine arts. In the pellucid days of Christian architecture—ere its decay was insinuated by the mongrel abeyance which we call Classicæ—the spoils of conquerors, the revenues of rich churches, the votive treasures of pilgrims, the dowries of king's daughters, the gains of merchants and burghers, the tribute of provinces, were not considered contributions too munificent for the erection of those stupendous edifices which adorned every town and city of mediæval Europe. In our own country, from the time when the Saxon Edëholm founded the abbey of St. Augustine at Canterbury, till Henry the Seventh reared the magnificent chapel at Westminster which bears his name, seal, wealth, and power had scarcely any other historical records but palaces, colleges, and cathedrals. Architecture seems to have been a ruling and pervading idea in the minds of the people of those times. The mailed knight, returning from the wars, made it his chief care to adorn the abbey adjacent to his castle—or, at least, to found a costly chantry in which prayers might be made for him when departed. Ritual monstrosities strove with all the might to outvie each other in the magnitude and decoration of their edifices; their brethren travelled far and wide to confer privileges; and every art which zeal and experience could suggest, or superstition and credulity render available, was put in requisition.

All this took place in days when competition designs and tenders for building by contract were not yet invented. The common people shared in the architectonic enthusiasm of their superiors. There were more pen-nies than golden pieces among the offerings: and they who were too poor to give even pence, freely bestowed their labour—felled trees, quarried stone, dug earth, carried burdens—and considered no task too toilsome, so that they might be gladdened by seeing their beautiful church rising, day after day, before their eyes. It was a sorrowful sight when the work stood still because of war or for lack of means. The pride taken in the task by these men, who were the lowest and humblest that lived in what have since been called the Dark Ages, is now so entirely out of date—so utterly unlike any modern popular feeling—as to seem incomprehensible, and almost improbable. To them the great fabric, as it gradually towered above their cottages, and became the way-mark of the country round, was the chief boast and glory of their native place: and if they might only see with their own eyes the wondrous work at length accomplished, which had slowly grown beneath their hands and the hands of their fathers, and, perhaps, grandfathers before them,—then, indeed, their highest ambition was accomplished. These poor men were very spendthrifts in their love of the Beautiful.

Much of this feeling doubtless was due to the prevailing influence of the church and religious or superstitious motives. But even after making a liberal allowance on this score, a great deal remains which is only explicable on the supposition of a general enthusiasm for noble architecture. The religious bodies themselves had little to gain by the mere decoration of their edifices: they, at least, must have been sincere in their masonic seal; for had their churches been as hideous as meeting-houses in modern manufactoring towns, or as contemptible as genteel chapels of ease in fashionable watering-places, their own condition would have remained. They ministered in no way to their personal luxury or love of ease in adorning buildings destined for no private or secular use. Neither could the laity have been animated by selfish motives alone:—the hope of absolution, indulgence and easy exemption from penance, could not have sufficed alone. The unceasing force of spirit externalization of dynasties, its continuance for centuries in succession, and its universality among all grades and classes, sufficiently show that not external inducements alone, but internal feelings also, must have been in operation. The internal feelings which influenced these votaries of art were chiefly:—a strong love of home, an honest ambition for the honour of their birth-places, and a food desire to raise up something in their familiar haunts which might draw the wayfarer and stranger out of their road, to marvel at its exceeding beauty and excellence.

Accordingly, their architecture was of home-growth and contemporary

—It was essentially their own. These men were neither cosmopolitans nor archæologists: they sought neither for exotic impostations nor for ramshackle antiquities—had no craving for things removed by either time or distance—read too little to care for the one, travelled too little to attain the other.

As a long while now since their beautiful architecture fell into decay, and was succeeded by a strange fantastic style—the mingled production of many ages and climates. This medley, as strange as it was ever seen in an old curiosity shop, which grew fashionable in England only after architecture became the exclusive luxury of the rich, has been lauded in all the set phrases of the dilettanti, from the reign of Queen Elizabeth to that of Queen Victorias. It has, therefore, been a most happy chance for the Fine Arts, that this confusion of antagonistic principles, exhibited during that long period, in the public edifices of England, has at last been checked, and in that offering designs for so vast and important an edifice as the New Palace of Westminster, the competing architects were restricted to two styles which, whatever their imperfections, possessed in a great degree those essential elements of architectural truth—indigenous growth and the subservience of decoration to construction.

The style actually adopted by Mr. Barry—the Perpendicular—is, of the two styles to which the designs were restricted, the one which most fully satisfies the tests in question. It is not only English, but exclusively English. The change of architecture, after the Decorated period, took in this country a form altogether different to that exhibited in the contemporary change of foreign architecture; so that it is all but absolutely true that the Perpendicular style is not to be found out of England. Again, the style was a faithful one—It involved none of the absurdities arising from the incongruous combination of arches and horizontal architraves. All exomium of the new building, should therefore, as it seems to us, commence from this point—that it is developed on a grand scale, for the first time in modern public edifices, the principle of architectural truth. Columns, arches, piers, and buttresses are employed not merely to be looked at, but to contribute each its due share to the support of the building. It is true that this principle has some exceptions. Large iron girders are employed in the construction; and though all attempts to apply modern mechanical skill to the legitimate purposes of art tend to the benefit of art itself, yet it must be confessed that the consistent adaptation to an ancient English style of mechanical appliances so entirely unknown to our ancestors as were cast iron girders, involves considerable difficulties. Among the few exceptions to our commendation of the constructive faithfulness of the architecture of the New Palace must be mentioned certain arch-heads formed by single stones. These stones are to all intents and uses, and to cut them into the shape of arches is to destroy the eye by an affection of forms without purpose.

The interior of the House of Lords corresponds well to the character of the external architecture. We find the same rich profusion of elaborate details, the same multitude of rectangular panels, the same minute and careful study of the decorations. The old architects deemed the composition of their buildings the first point for consideration to which the elaboration of minor parts was to be kept subordinate: but the visitor to the House of Lords must not expect any of that massive, bold combination of simple parts by which the older architects produced effect, even with restricted means. Everything here is rich, graceful, and delicate. The severest of critics could not discern one offence against good taste. But there are no towering columns, dark vaulted roofs, piers that seem to have been reared by giants, and broad deep masses of shadow, such as are found in the adjacent ancient building.

The drawing herewith shown is the first of a series, which we propose to give illustrative of the new Houses. It is merely an outline, and must not be considered as giving any adequate idea of the effect of decoration—for every little detail there shown is filled up with carvings and other enrichments, which we shall hereafter give in detail. A work so large as the House of Lords, so profusely and so minutely decorated, cannot be reproduced drawing which is less than the size of the original; for there is certainly not a square foot of surface, which has not been placed under the hand of the decorator. Our engraving has, by the great kindness of Mr. Barry, been made partly from our own admeasurements and partly from drawings, and we shall endeavour to give a record of this valuable work, which may be received as authentic.

The House of Lords is a double cube of 46 feet, that is to say, 90 feet in length, and 45 feet in breadth and height. It may be considered as consisting of three parts—the southern or throne end, the northern or bar end,
and the middle or larger portion, in which are the woollas, clerks’ tables and seats of the peers.

The House is lighted by twelve windows, six on the west and six on the east; the latter side is the one shown in our drawing. At each end of the House are three archways of the same dimensions as the windows. At the throne and these arches are filled up as to receive fresco paintings; at the north and they are recessed for galleries.

We shall confine ourselves at present chiefly to the description of the sides. It will be seen that the side forms three tiers, the two lower of which are of oak panelling, and are divided by a projecting gallery. The lower tier is divided into twenty-four compartments or divisions, three under each window, and one under each pier. This lower tier is formed into panels, four high, with a coved panel or canopy under the gallery. The three lower ranges of panels are of the “napkin” style, with V.R., an oak leaf, and crown interwoven in the corners of the folds of the drapery. The fourth range has an ogee arch, crockets, and finials, the arch being divided by quatrefoils and tracery, with a flower ornament at the bottom. The compartments are divided by a pillar bearing a bust. The busts form a series of the English kings. Between the busts is an inscription, in Tudor characters of “God save the Queen” in openworked letters. Above this and below the canopy is a pierced brattishing of trefoils. The canopy is supported by moulded ribs, springing from the pilasters. Each panel of the canopy bears the emblazoned arms of one of the Lords Chancellor of England. The series begins with Adam, Bishop of St. David’s, in 1377, and extends to Lord Cottingham, the present Chancellor. The arms of the sovereigns, also richly emblazoned, serve to mark each reign, and to form a chronological division.

The front of the canopy is moulded, having a trellis in the lower moulding. The pediments are carved, and bear a lion’s head, above which is the brass railing of the gallery. The lower part of the brashwork consists of roses intertwining. The rest of the brashwork is chiselled twisted. The knobs are enamelled in colour and gilt, and serve to relieve and set off the brasswork.

The gallery only contains one row of seats, intended for peersesses, and is entered by a number of small concealed doors in the panelling under the windows.

The upper tier of panelling is very rich indeed. It is divided on a different plan from the lower panelling, as will be seen from our plate. The upper panels are filled with labels bearing “God save the Queen,” upon a ground of vine leaves and grapes in relief. The pillars dividing the panelling are slight and are elegantly carved. They support a cornice decorated with paterae and embattled. Above this again is a brattishing of trefoils, interspersed with foliages corresponding to the pillars below.

The windows are each of eight lights, divided by mullions and transoms, and the upper range of lights subdivided and filled in with quarterfoil tracery. The windows are filled with stained glass. On the splay of the jambs the inscription “Vivat Regina” is painted many times, the words being separated by quatrefoils, alternately blue and red.

Between the windows are niches with canopies, in which are to be placed statues of the Barons who signed the Great Charter. The pediment is supported by an angel bearing a shield, on which is emblazoned the arms of the Baron. The interior of the niche is diapered, but the canopy, pillars, &c., are gilt. Above the niches spring the spandrals, to support the arches ribs of the windows and the ceiling, being filled in with quatrefoil tracery, richly gilt. On the fascia around the House is inscribed repeatedly the motto, “Dieu et mon droit.”

**Chromatotype.**—The most interesting process of photography appears to be that of the Chromatotype, discovered by Mr. Robert Hunt. It consists in washing good letter paper with the following solution:—Bi-chromate of potash, 10 grs.; sulphate of copper, 20 grs.; distilled water, 1 oz. Papers prepared with this are of a pale yellow colour; they may be kept for any length of time without injury, and are always ready for use. For copying botanical specimens of engravings nothing can be more beautiful. After the paper has been exposed to the influence of sunshine, with the object to be copied superimposed, it is washed over in the dark with a solution of nitrate of silver of moderate strength. As soon as this is done a very vivid positive picture makes its appearance; and all the fixing these photograpic pictures require is well washing in pure water.

**Review.**


The progress of ornamental design in this country has created its own circumstances; it has now its own artists, its own societies, and its own literature. Whereas, when we began our labours in this Journal, it was difficult for a gentleman to get his house decorated—and then only under foreign superintendence and with foreign assistance; in consequence of which, very few persons of competent means gave any encouragement to decoration: now, as in the case of the Baron de Goldsmid’s mansion in the Regent’s Park, the most admirable designs can be executed by English aid alone. We are convinced that had the High Dutch party been allowed to have their own way, and to surrender the decorations of the Palace of Parliament to Cornelius and the Mannich people, the present progress of the arts in England would have never taken place; and we feel gratified that we were among the earliest to oppose the attempt, and to claim a fair trial for Englishmen on their own ground. We do not regret that we then exerted ourselves, and we may say confidently that every effort that has been made of late years to forward the cause of art, has been fairly met, and that there is every encouragement for future exertion.

Mr. Leith is an artist at Edinburgh, connected with the Board of Trustees for Manufactures in Scotland, and he has been led to bring forward a cheap collection of drawings suitable for tradesmen, with the view of spreading a better knowledge of style and purer elements of taste. In this first number there is, among the examples, some excellent iron work, particularly perforated railing. The carved stand, which is called Flemish, does not seem to us to have any impress of style. An Italian study of angels, from a drawing made by Guido Reni, after an earlier master, is admirable. There is an Elizabethan vignette. We know that a work of this kind is wanted, and we think that Mr. Leith is likely to prove successful. We shall therefore watch its progress attentively.


A table for the calculation of earthworks, of sufficient generality to include all cases—and at the same time of easy application—has long been a great desideratum among engineers. The two tables which have been hitherto employed are those of Bidder and Macneill; the great objection to the former is the number and labour of the operations required, and to the latter that they are not sufficiently comprehensive. Neither of these objections apply to Mr. Bashforth’s system, which is very simple and easily applied—and moreover has this advantage, that it includes the case of sidelong cuttings. The tables, with the scale for proportional parts, are not much more bulky than those of Mr. Bidder: the mode of using them we now proceed to describe.

Suppose two cross sections, a chain apart, to be made through a railway cutting; and first suppose that the slope on either side is unity, and the heights of the opposite banks equal at the same section, but uniformly decreasing from end to end. If now we suppose the inclined planes to be produced, they will meet in a straight line below the formation level; and the figure included between the two vertical planes of the sections a chain apart, an inclined plane through the summit of the banks, and the inclined planes of the banks, will be a portion of a pyramid. If, moreover, a and b be the vertical depths of the line where the planes of the banks or slopes meet below the summit of the cutting at the two sections, the volume of the portion of the pyramid will be 

\[
\frac{22}{27} \left\{ a^2 + ab + b^2 \right\} \text{ cubic yards.}
\]

If, now, the slope, instead of being 1, had been n, the volume would have been 

\[
\frac{22}{27} \left\{ a^2 + ab + b^2 \right\} \text{ cubic yards; and if the distance between the terminal sections had been d chains, instead of one chain, the above quantity must have been multiplied by d. In order to find a and b, suppose a and d' the heights of the portion of}
\]
entering at the two ends measured from the formation level; \( e \) the breadth of the formation level; and \( r \) the slope; then

\[
\frac{e}{2r} + \frac{a}{r} = a; \quad \frac{e}{2r} + \frac{b}{r} = b.
\]

But the quantity of earthwork is equal to the volume of the above frustum of a pyramid, minus that portion which lies below the formation level; and this latter portion is a prism, bounded by two triangles at the ends, the areas of which are, for a slope \( a (b - a) \); consequently, if \( L \) were the length of chains of such a prism, its cubic contents would be \( \frac{22}{9} L (b - a)^2 \); and for a slope \( \frac{22r}{9} L (b - a)^2 \).

The quantity of earthwork taken for \( L \) distances, a chain apart, and a slope \( r \) would be

\[
r \times \frac{22}{9} (a^2 + ab + b^2) = \frac{22r}{9} L (b - a)^2.
\]

In Mr. Bashforth's tables, \( \frac{22}{9} (a^2 + ab + b^2) \) is tabulated for all integer values of \( a \) and \( b \), from \( a = 0 \) to \( a = 66 \), and \( b = 0 \) to \( b = 65 \); and a scale of proportional parts is added, to extend the calculation to decimal parts of a foot.

**Example for Equal Distances.**

To show how to use the tables, we will take out the following example, working it first by Mr. Bashforth's, and then by Mr. Bidder's method:

Heights from formation level at distances a chain apart, 30, 40, 25, 33; breadth of formation level, 80 feet; slope, \( 1\frac{1}{2} \) in 1.

**MR. BASHFORTH'S METHOD.**

To find the quantity to be added to each of the heights, divide half the base by the slope: then \( 14 \times \frac{1}{2} = 7 \). Adding this quantity to the heights, and taking the corresponding figures from Mr. Bashforth's table, we have the following scheme:

<table>
<thead>
<tr>
<th>Heights</th>
<th>Tabular Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>30, 40</td>
<td>3015</td>
</tr>
<tr>
<td>40, 25</td>
<td>2625</td>
</tr>
<tr>
<td>25, 33</td>
<td>2250</td>
</tr>
</tbody>
</table>

Subtract \( \frac{7}{9} \times (a) \times (b) \) from the additional height \( (S) \) 

\[
\begin{align*}
24033 & \text{cubic yards. (Ans.)} \\
11678 & \text{the slope} \\
12145 &
\end{align*}
\]

**MR. BIDDER'S METHOD.**

If we take the sections at unequal distances, the difference between Mr. Bashforth's method and Mr. Bidder's is more apparent. In both, the tabular numbers have to be multiplied by the distances; but as there are only tabular numbers in Bidder's table for every distance, the number of multiplications is doubled.

Let the sections be taken at distances 3, 24, 2, 1, chains, respectively. Let the heights be 40, 30, 20, 15, and 10. The slope \( 1\frac{1}{2} \) to 1; the base 25 feet.

**MR. BASHFORTH'S METHOD.**

The addition to the heights is half \( 25 - 1\frac{1}{2} = 10 \). Making the addition, taking the numbers from the table, and multiplying by the corresponding distances, we have:

<table>
<thead>
<tr>
<th>Heights</th>
<th>Tabular Numbers</th>
<th>Distances</th>
<th>Products.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50, 40</td>
<td>4970</td>
<td>3</td>
<td>14910</td>
</tr>
<tr>
<td>40, 30</td>
<td>3015</td>
<td>24</td>
<td>7537</td>
</tr>
<tr>
<td>30, 25</td>
<td>1554</td>
<td>2</td>
<td>3708</td>
</tr>
<tr>
<td>25, 20</td>
<td>1243</td>
<td>1</td>
<td>1243</td>
</tr>
</tbody>
</table>

Subtract \( \frac{7}{9} \times (10) \times (\sqrt{5}) \) ... 2077

**MR. BIDDER'S METHOD.**

<table>
<thead>
<tr>
<th>Heights</th>
<th>Tabular Numbers</th>
<th>Distances</th>
<th>Products.</th>
</tr>
</thead>
<tbody>
<tr>
<td>40, 30</td>
<td>3015</td>
<td>3</td>
<td>9045</td>
</tr>
<tr>
<td>30, 20</td>
<td>1548</td>
<td>24</td>
<td>3870</td>
</tr>
<tr>
<td>20, 15</td>
<td>754</td>
<td>2</td>
<td>1508</td>
</tr>
<tr>
<td>15, 10</td>
<td>387</td>
<td>1</td>
<td>367</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
5257 & \text{the slope} \\
25 & \text{(base)} \\
& \text{14810} \\
13142 & \text{18512} \\
& \text{13142}
\end{align*}
\]

Total cub. yds. 31654 (Ans.)

Macnoll's method does not, like the above, give a general table for all slopes and bases and any combination of them, but a number of special tables of particular slopes combined with particular bases. This method not being general, it would require not a volume, but a library, to contain tables of all combinations of slopes and bases which occur in railway practice. The cases above taken (for example) are altogether omitted in Macnoll's tables. But wherever these tables do apply, the arithmetical operations are nearly the same as Mr. Bashforth's; and consist in multiplying the tabular numbers by the distances, and adding the results.

The great value of Mr. Bashforth's tables is the scale of proportional parts; for the mode of using this, and likewise for the calculation of earthwork in sidelong cuttings, we refer the reader to the next number of the Journal: we cannot, however, dismiss the subject even temporarily, without expressing our conviction that Mr. Bashforth's tables are by far the most simple and generally useful of any that have yet appeared:—such we know is the opinion entertained by many who have for years past been engaged in the computation of earthworks, and, consequently, are best qualified to appreciate the value of tabular modes of shortening the labour of calculation.


The work of M. Legoueske treats of every subject relating to borings for underground works, and although there has been no lack of detached papers on this head, the work before us comprehends the whole of the facts and reasoning hitherto known. After having briefly sketched the history of the subject, the author proceeds to the geographical portion of the doctrine, and first defines what is to be called a geological basin. He describes, then, the aspect of secondary and tertiary basins in different countries, and examines the most favourable localities for the boring of artesian wells, the strata of fossil fuel, rock salt, mineral waters, &c.

After these preliminaries, our author enters on the description of the different systems, and the different applications of sounding; the explanatory apparatus for the study of the ground; the driving of piles, and placing of poles for telegraphic lines; mooring stones, and foundations for suspension bridges; submarine boring for the removal of shoals and reefs, and the improvement of bridges; horizontal boring, and other mining operations—ventilation, and absorbing pits for the draining or absorption of tidal waters; in fine, on artesian wells and the search for underground water.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

After having dilated on the different modes and systems of boring, the work passes to the description of the different boring apparatus—as instruments for clearing and emptying, correcting apparatus, instruments for boring horizontally, or for boring in the angles of walls, &c. The author then details several contrivances for tubes and repairing damages, and inserts a journal of a boring operation, indicating the general principles of the work through different formations; the accidents which might have intervened, and the remedies resorted to to repair and prevent them. A recapitulation of the results hitherto obtained by boring, and what may be accomplished, follows, and the author concludes this chapter by the description of some instruments which are indispensable for ascertaining the extent and quality of work performed in any given time. The means for obviating the decrease in the flow of artesian wells, as well as absorbing pits suffering under stoppages, are then given. The work concludes by fixing attention on the especial laws of geology and mechanics, which it is indispensable for the borer to know, and for securing the highest results in the works in which boring is now used. The plates form a very useful and interesting accessory to this deserving work.


This is the first part of a new issue of Peter Nicholson's work, with additional plates, and many promised improvements. The work seems likely to be what it is styled, "comprehensive and useful"; but we hope that the reducency of Mr. Nicholson's style will be carefully avoided, and that unexecuted designs (such as the verandah by Mr. Arundale) will not be published. Mr. Nicholson's practical plates are very good, but his descriptions of them are apt to run to too great a length.

Post Office Railway Directory for 1847.

With the growth of railway kings, directors, and members of parliament, the necessity is becoming desirable to know who they are—which is, we suppose, the reason for the present work, which gives an alphabetical list and biography of all these functionaries. Thus we have sketches of the Stephensons, Brunel, Locke, Hudson, &c., and as the book ministers to public curiosity, it will in all probability be a standard. We notice a list of railway engineers and mechanical engineers, with the appointments they hold.


Mr. Donaldson has published a small work, which consists of two parts—a collection of maxims, and a lecture on the character of architects. It is a work remarkable enough to deter us from reviewing it at the late period at which we have received it.

THE DEE BRIDGE FAILURE.

Considerable interest has been caused among the profession through the failure of a cast iron girder bridge over the River Dee, near Chester, which took place on the 24th May last; and in consequence of the accident involving the death of some individuals, a coroner's inquest has been held, which lasted several days. It was not our intention to give the whole of the evidence, as much of it was extraneous; but we shall select those portions which immediately apply to the construction and failure, and then offer some remarks of our own, together with a wood-engraving of the girder, showing the fractures, and a section.

Mr. Thomas Alfred Yarrow, who was selected by the coroner and jury to examine the bridge, said,—I have been a civil engineer for the last 12 years. I have held the appointment of bridge-master for Chester for some time, and have no connection at present with any railway. I have made an examination of the railway bridge over the Dee, and I now read my report of the inspection report.

Upon examining the bridge, I found that the masonry and ironwork, with the exception of that part of each which has fallen, were in an apparently sound state. The principle of the bridge is that of securing a proper central metal resting upon stonework and abutments, which are parallel to the course of the river, but make to the railway above. Each girder consists of three pieces, having vertical flanges, with bolts at the joints, and, in addition to being bolted to the full depth of the girder, each joint is surmounted by a segmental piece, to receive which, notches have been cast in the upper surface of the girder. The tension necessary to cast these notches can only be provided by the horizontal tension between them; they consist of separate bars of wrought iron, which are secured to each other laterally by clips. The portion of the bridge which has fallen consists of one outside girder on the Saltney side of the river, the other outside girder, the end platform, end abutment, and one part of the string course, constituting part of the string course, and acting as a bed for the girder on the Saltney abutment have fallen, and also the corner stone at the acute angle of the river pier upon which the broken girder rested. The girder, as stated before, was a cant girder, having the end of the Saltney abutment, and one in its centre. Having presumed this short description of the construction of the bridge, and its present appearance, I may proceed to state what I have observed of the probable cause of the accident, and which have enabled me to arrive at a confident conclusion as to the cause of the accident. My attention was in the first instance directed to an examination of the fractured ends of the girder, for the purpose of determining whether any additional tension had been put upon them, and the appearance of the broken surface led me to conclude that the castings had been sound, and the tension bars, as far as they have yet been recovered from the water, are unbroken.

From calculations which I have made of the strength of the girders, taken from an actual measurement of the section at the point of fracture, I find that, independent of any additional strength which may be obtained from the tension bars, the girders alone are capable of sustaining a much greater tension than could be placed under any ordinary circumstances upon them. The breaking weight of each girder I calculate at 74 tons, supposing the weight to be concentrated over one point, and of both girders 148 tons. But it is an admitted principle that a beam will carry twice the weight of a string, if the load be concentrated over one point. We can therefore conclude, that twice the above weight, 146, 906 tons, is the breaking weight of one bay or opening of the bridge for one line of rails. The weight of girders and platform is, at a rough calculation, 1,000 tons, which must be deducted from the above quantity; we have therefore 366, 900, equal 306 tons as the breaking weight; and this is altogether without reference to the tension bars.

From the above facts, I concluded that the accident did not arise from the weight of the girders; and I may well direct the attention of railway directors and engineers to the state of the masonry and to a consideration of its sustaining power. Having carefully examined all the displaced stones and their respective beds, I found that one, previously named as forming the acute angle of the river pier, and upon which the end girder rested, was totally inadequate, in its form and bearing surface, to its important situation. This stone had sustained nearly three-quarters of that portion of the flange of the girder which rested upon the pier. The area of its lower surface is 24 ft. 6 in., of which 18 ft. 6 in. only was bedded on the pier, leaving 13 ft. to overhang as a corbel. The stone was not connected by cramps or ties with the adjoining masonry of the pier. The railway over the whole bridge is curved. The broken girder supporting the bridge on that side was being put in the lowest position; the girders forming the inside radius of the curve, I consider that this lateral force, acting during the passage of each train, must have so far loosened the important masonry as to cause a displacement of the girder and its consequent fracture."

Mr. Robert Board, superintendent of the Mawsley Iron Works.—The girders of the Chester railway bridge over the Dee were manufactured at those works. They were tested before sent to the railway. Each girder was placed side by side and tested by 50 tons of iron being put on them in the centre. We took the deflection on every five tons, but have not got the particulars of those deflections. The ordinary pressure on the girders passing over them would not exceed 50 tons. After the girders had been tested we found a flaw in one of them: it was a mere honey-cake; and it was rectified before it was sent away. I have since examined the girder, and found that the accident had not resulted from the flaw. The fractures were in the bound metal, at appearance the string course of the girder. There are many railway bridges of the same kind. On the Trent Valley line there are eight of the kind. It is not opened to the public as yet, but on the Blackwall railway there are several that have had heavy trains passing over them for years. The people on board of any of them giving way. Had been several times to view the bridge when trains were passing over it, and found the deflection very trivial, not much more than an inch.

For General Sir Charles William Pallet.—I was the Government Inspector-General of Railways when the Chester and Holyhead Railway was opened. I surveyed the bridge over the river Dee on October 29th, and reported it as safe. I compared the plans with the actual building, and found them as I deemed them to correspond well. The iron girder bridge, of three openings or spans of 98 feet each; wrought iron tension rods are used to strengthen it. I always was of opinion, and am so still, that these tension rods are not of great use, because I consider that the expansion of wrought iron is very small. Although they are not very great; but that iron girders being very massive and the tension bars thin and of small dimensions, the sun may act on the wrought iron rods very considerably and less on the cast iron girders; and supposing them to be adjusted for a moderate temperature, the intensities of hot weather may destroy their proper proportion and do away with the benefit of
the tension. I may here state that wrought iron, when acted upon, will elongate considerably without breaking, but cast iron will not without breaking. There have been a number of bridges of this description erected on railways in various parts of England, both before and after I held the appointment of resident engineer. But I am not aware that there has been a single instance of the exception of this one, ever failed. They were not quite of the same extent, but I will allude to a cast iron girder bridge at York, over the river Ouse, of the York andScarborough Railway, which has two openings of 70 feet span, and one of 85 feet span. Of the large bridge in the engine and goods shed, increased to a large extent by the laying down of 28 tons of ballast on the platform just previous to the accident. The witnesses then handed in a lettered report which he had made to the Directors, respectively. The fire had stopped, and the broken off part of the girder, by Mr. E. Stephenson, as having been produced by a lateral blow, was, in his opinion, caused after the girder had fallen, and that the fracture which caused the bridge to give way was that in the centre. He considered that there was the stretch between the abutments.

Mr. Roberton then read the following report which he had made to the Directors of the Shrewsbury and Chester Railway:

"I minutely examined the Dee bridge on the Chester and Holyhead Railway on the occurrence of the accident, and have since examined repeatedly the points which bear upon the accident. I have caused drawings to be prepared and a model, showing the details of the structure and the fragments of the beam, in so far as now discovered; and to these I would refer you, instead of attempting to give a written description of the same. (The model was placed before the committee.) To me it appeared that the fall of the centre, from the position of the fallen portion, and of the middle tension-rod, which was compressed and broken by the strain arising from the rolling weight of the engine and tender, and the vibratory motion of the structure itself, increased to a large extent the friction on the other side of the bridge, which would probably have caused the beam to give way in the position of the bridge, and would have been the cause of the accident. This compression is remarkably evident by the bulging out of the metal at the point of the parting at the top of the web, or vertical portion of the girder."

I am of opinion that the cause of the girder's forming an angle on the opposite face of the beam, and an undue strain, by compression, on the top flange; but, assuming that they did not weaken it, and applying the formula, as given by Eaton Hodgkinson, F.R.S., to the girder—by one formula, the breaking weight is equal to 87 tons; by the other, the breaking weight is equal to 75 tons.

Now, it has been an established rule in practice, that one-third or one-fourth of the breaking weight is the safe working weight to which a girder should be subjected, and the larger the size, the smaller ought to be the strain. The formula (therefore, 59.25 tons), it follows that the safe weight to which one of the girders ought to be subjected is 84 tons, and the two girders 57 tons. The weight of the timber, platform, beams, rails, chairs, etc., exclusive of the girder, according to an approximate calculation made by Mr. Whillet, is such that a uniform weight is diffused over the beam, is equivalent to one-half that weight suspended at the centre, this becomes equal to a weight suspended at the centre of 8 tons 13 cwt. The equivalent weight of an engine and tender of 33 tons 10 cwt. 2 quarters, suspended at the centre of the beam, I estimate at 32 tons—making a strain of 41 tons 10 cwt. against 57 tons—the safe working strain to which the bridge ought to be subjected. However, on the afternoon of the accident, immediately previous to the explosion of the engine, the strain was approximately that of 12 tons 19 cwt. The weight of the structure, and the strain of 8 tons, with the additional strain, by the laying on of 5 inches of broken red sandstone ballast, amounting to weight over the bridge of 28 tons, which is equivalent to a weight suspended at the centre of 12 tons 19 cwt. There is, therefore, a total of 44 tons against the safe strain of 87 tons formerly stated; and the last addition appears to me to be the immediate cause of the accident. In these calculations, however, it is assumed that everything is at rest, and that the forces applied are not greater than those acting on the girder. There is a vibratory movement of the whole structure to a large extent; and there is, besides, a progressive movement of the engine and tender, which, with a heavy long-boiler engine, with outside cylinder, is considerable.

The weight of the structure, and of the train in motion, will be about 164 tons. The strain for the strain for the bridge ought to be subjected. However, on the afternoon of the accident, immediately previous to the explosion of the engine, the strain was approximately that of 12 tons 19 cwt. The weight of the structure, and the strain of 8 tons, with the additional strain, by the laying on of 5 inches of broken red sandstone ballast, amounting to weight over the bridge of 28 tons, which is equivalent to a weight suspended at the centre of 12 tons 19 cwt. There is, therefore, a total of 44 tons against the safe strain of 87 tons formerly stated; and the last addition appears to me to be the immediate cause of the accident. In these calculations, however, it is assumed that everything is at rest, and that the forces applied are not greater than those acting on the girder. There is a vibratory movement of the whole structure to a large extent; and there is, besides, a progressive movement of the engine and tender, which, with a heavy long-boiler engine, with outside cylinder, is considerable.

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lead me to the conclusion, that the girder broke in the middle from its weakness to resist the strain, increased by the laying on of the ballast.

"The opinions of Mr. Stephenson and Mr. Locke, founded on the alleged facts as to the paint on the tender, the broken carriage-wheel, and the snips in the plates, appeal to the ground already stated on those particulars, which can all be disproved.

"Chester, June 15, 1847.

Captain Symonds, R.E., and Mr. Walker, who were retained by Government to examine into the cause of the accident, presented to the inquest a very lengthened report, the following are extracts from it:—

"That the bridge was of sufficient strength if the cast iron and wrought iron be assumed to be of equal proportion of the strain.

"That there is great difficulty in insuring the joint action, and that if this is a part of the principle of the bridge, we do not approve of it.

"That neither the wrought nor the cast iron, taken separately, was sufficient for perfect stability; but that, to have sufficient strength for girders alone should have been of sufficient strength to carry the whole weight, with an ample allowance for the various circumstances (some of them peculiar to this bridge) which we have explained.

"That, with the exception of the beams at the top flanges, the castings are of good quality. That the wrought iron is also of good quality.

"That the stonework of the piers and abutments is good; and in no way contributed to the failure.

"We now come to the question, what was the immediate cause of the accident, and had carried as great or greater loads before, the suggestion that there was something peculiar in this case, as the end of a rail having projected from the straight line and been struck by the engine, or the tender having got off the line and struck the girder laterally, is not improbable. The engineers who were engaged by the Railway Company considered that the breaking of one leaf of the wrought iron that was next the tender, the piece that was struck out of the girder, and the damage to the abutment wall, are all proof of the fact that the accident was caused by the tender having got off the line, and broken the girder by a heavy lateral blow. We refer to the evidence of Mr. Robert Stephenson, Mr. Locke, Mr. Vignoles, and Mr. Gooch, who were also of opinion that the strength of the girders was sufficient. As to this latter point, we have stated that the principles upon which the conclusion could have been arrived at, and our own opinion. As to the tender or the carriage immediately behind it having got off the railway and damaged the abutment walls, there is no doubt; and if the tender struck the middle of the girder, when the latter was only a fracture and not a fracture consequence. This is on the presumption of the tender having got off the line from some other cause than the breaking of the girder.

"Our own decided opinion, formed from the statement we have made to the strength of the girder, and from the position in which the broken pieces were found, the two halves being each in a straight line, or nearly so, but at an angle with one another, is that the first fracture took place in the centre of the girder, and not at the end which rested on the abutment.

"In corroboration of this last view, the iron bars, from the broken parts of the bridge, immediately before the accident, by the ballast spread over it, and the fact that when a weight, partly permanent and partly passing, but which together formed a considerable portion of the breaking weight of the girder, in the ordinary operation of casting, we suffer injury, as their strength becomes reduced; and if, when this has taken place, the momentum of the passing weight is increased by an irregularity of the rails, or in the motion of the engine, to which the best made rails can have no resistance, the whole structure is likely to be torn asunder. The probability of this having been so in the present case, and the fact of the tender having been on the line, and having been drawn up with great violence, so as to break the end piece of the girder by the blow, are to be weighed against each other in assigning the cause of the accident.

"Having reference to other cases, it is proper to state that Mr. Robert Stephenson stated in his evidence that he had erected a number of bridges on the same principle as this, and that this was the first failure. We have not visited these bridges; but they are at least as safe as the Chester bridge, but that the dimensions of the parts are proportionately less; and it may perhaps be argued from the above numerous examples, and the opinions of the eminent engineers opposed by this one failure, that we are mistaken in considering the weakness of the girder to be the cause of the failure in the present case, and unnecessarily cautious in the objection we entertained, and have expressed, as to the principle of this bridge and its security; but, as we entertain these opinions very decidedly, it is our duty (by no means an agreeable one) to express them.

The Verdict of the Jury.

After an hour's deliberation, the foreman, Sir E. Walker, returned the following as the unanimous verdict of the jury:—

"We find that George Robinson, John Maxwell, and Charles Nevitt, were actually killing on the evening of the 24th of May last, in the parish of St. Mary-on-the-Hill, in the city of Chester, by being precipitated along with a train of carriages on the bank or bed of the river Dee, from the breakage of one of the 12 cast iron girders constituting the railways-bridge over that river.

"We find also that Isaac Prewis died on the 30th of May from injuries he received at the same time and place, and from the like cause; and we find that Thomas Anderson came by his death on the 24th of May last, in the parish aforesaid, by being accidentally thrown from the tender on to the rails.

"We are further unanimously of opinion, that the aforesaid girder did not break from any lateral blow of the engine, tender, carriage, or van, or from any fault or defect in the masonry of the piers or abutments; but from its being made of a strength insufficient to bear the pressure of quick trains passing over it.

"We feel that the 11 remaining girders, having been cast from the same pattern and of the same strength, are equally weak, and consequently equally dangerous for quick or passenger trains as was the broken one.

"We consider we should not be doing our duty towards the public if we were not to point out expressly to the attention of the Railway Company to take off the bridge of so brittle and treacherous a metal as cast iron alone, even though trussed with wrought iron rods, is safe for quick or passenger trains; and we have evidence before us, that there are upwards of 100 bridges similar in principle and form to the late one over the river Dee, either in use or in the course of being constructed, on various lines of railway. We consider all these unsafe, more or less, in proportion to the span; still, all unsafe.

"We therefore call upon her Majesty's Government to institute such an inquiry into the merits or demerits of these bridges, as shall either condemn the principle, or establish their safety to such a degree, that passenger may rest fully satisfied there is no danger, although such bridges may deflect from $1\frac{2}{3}$ to 6 inches.

"The Coroner stated that that portion which related to the death of the deceased persons only be taken as their verdict. Their recommendations, however, he would forward to the Railway Department of her Majesty's Government; and no doubt the press would give them due publicity.

"The bridge crosses the Dee river at an angle of about 45°, and is constructed with three spans—skewed to the same angle—of 98 feet each in the clear; each span being supported by four trussed girders, 109 feet long, one on each side, and two in the middle, making the two roadways independent of each other; on the inside of the bottom flange of each pair of girders, shoes are cast, having a dovetailed socket, into which wrought iron cross ties are fitted, to secure the girders from springing outwards at the bottom. Between these, and resting upon the same flange, are strong timber bearers or joists, upon which a flooring of four-inch planks is laid; on this the longitudinal sleepers are fitted, carrying the rails and check-rails, the latter being continued 26 feet beyond the span of the bridge each way.

"The train passing over the bridge at the time of the accident consisted of the engine and tender, following which the carriages were arranged—1st. One first-class; 2nd. One second class (with break and guard-box); 3rd. One second; 4th. Luggage van; 5th. Second-class.

"Each girder is in three lengths of cast iron, bolted together at the joints, making 13 feet in length, 9 inches in breadth, that addition in the depth, and surrounded over the face by a connecting scarfing, 13 feet long, and 2 feet high. The clear span of the bridge is 98 feet, and the bearing 5 ft. 6 in. at each end.

"The width of the top flange is 7 inches, and thickness 1 inch on the edge; thickness of the web $\frac{3}{8}$ inches; width of lower flange 2 feet by $\frac{1}{2}$ inches thick. The top section, including the molding on the underside, contains 14 square inches; the lower flange and molding 66 square inches, and the web 80 inches: making in all 160 square inches. On each side of the girder there are four wrought iron tension bars, 6 in. by $\frac{1}{4}$ in., the collected section of the eight bars (two on each side) contains 60 inches. The bars are put together in lengths, as usual for suspension bridges; and at the joints of the cast-iron beam, a wrought iron bolt passes through the eight thicknesses of wrought iron bars and the cast iron girder. To this cross-bolt are suspended two other bolts, which pass through the cast iron dovetailed plate, under the joints, and secured on the underside with screws and nuts, to bring the plate up taut to the flange; and the ends of the suspension bars at the abutment are secured to a cast iron raising piece by cross keys.

"It will thus be seen that the girder consists, in section, of a cast iron girder (similar in form to fig. B) and eight thicknesses of wrought iron suspension bars; these wrought iron bars, from the flat angle at which they are set and secured to the cast iron girder itself, are to be a very poor safeguard against the breakage of the cast iron. In fact, on account of the tension bars being inclined at such a small angle, that a displacement of the particles of the cast iron girder, quite sufficient for fracture, would have produced scarcely any extension of the wrought iron bars, and, therefore, hardly called into play any resisting force from their section: the tension-rods, in short, were of about as much service to the girder as a piece of yank-thread passed from end to end. The scarfing
pieces being placed over the joint, also appear to be injudiciously arranged, and are not so good as when an increased depth is given to the casting at the joints, as adopted in some other bridges.

The annexed wood-engraving (fig. 1) is an elevation of a portion of the broken girder; part of one of the lengths, which was not broken, is cut short for want of space. The abutment end of the girder is that portion which laid on the Salteyne abutment, and had a bearing of 5 ft. 6 in. on the masonry. There are two fractures—one in the length nearest to the Salteyne abutment, and which was of considerable extent, 2 ft. 8 in. wide at the bottom, the fracture running along the web, just on the top of the lower flange, and then upwards in a slanting direction on one side and perpendicular the other side. Fig. 2 is a section of the iron at this fracture, which shows two bolt holes at the top, made for fixing on an eagle ornament, and doubtless considerably weakened the girder, as at these bolt holes the flange was found to be completely crushed. From the appearance of this fracture, upon the whole, we are inclined to assign it as the part that first broke. The other fracture is nearer in the centre of the middle length of the girder, and takes a diagonal direction across the girder upwards, to the extent of 4 feet horizontally.

From experiments that have been made since the accident, the deflection of the girders under different loads is from 1 to 8 inches—the greater the velocity of the train the greater is the deflection: this shows that we must not fix the proportions of a girder at three times the breaking weight; but considerably more must be allowed—it ought to be at least four, if not five, times.

The question that suggests itself, from the failing of this bridge, for consideration among engineers, is whether a girder, containing the same quantity of metal of wrought and cast iron together, 140 square inches in the section, could not be better arranged than the one before us, so as to form the requisites of crossing over a road or river without interfering with the headway below. From the best consideration that we have bestowed upon the subject, we are induced to adopt a girder of the proportions and form shown in the annexed engravings, figs. 4 and 5. The flanges at the joints

![Fig. 4 and 5. Elevation and Plan of Proposed Girder.](image)

...to be wide, and of the form shown in fig. 3, and the surfaces placed; the connecting bolts to be of as large a diameter as the metal flange will allow, the lower bolts being at least 9 inches diameter; particular attention must be paid to the fixing of these bolts, and the keying of them, to prevent the nuts loosening by vibration.

According to Hodgkinson's formula\(^a\) \(W = \frac{2.166 \times d \times d}{l}\), the breaking weight of the Dee Bridge girder is 60 tons—that is supposing the tension bars to be of no service; whereas, the breaking weight of our proposed girder is 110 tons, and contains four tons less metal than the Dee Bridge trussed girder. The weight of 110 tons is, as near as can be, the strength required for the Dee Bridge span of 96 feet, which will be equal to 220 tons for a pair of girders: taking a fourth of this weight as the safe strain, it will give 85 tons. The calculated strain upon the girder at the time of the accident was 84 tons.

It is the joints of these girders that require the especial attention of the engineer, as we shall next proceed to show.

\(^a\) W weight in tons, \(a\) the area of the lower flanges in square inches, \(d\) the total depth of the girder in inches, and \(l\) the length in feet in clear of the bearings.
The cause of the fracture we believe to be, that the girder was jointed, and this consideration was not given to that circumstance in assigning their relative proportions to the flanges. As the effect of a joint is one that practical men are apt to overlook, we propose to examine the subject in detail—excluding as much as possible symbolical language, in order that our reasoning may clearly be apprehended. It is well known that there are usually three distinct divisions of a girder, consisting of the upper and lower flanges and the web: the vertical and transverse section of such an arrangement would resemble somewhat an H laid on its back—but this. The reason of this mode of construction will be better understood when we have determined the nature and amount of the strains and thrusts experienced by the several parts of a loaded girder.

Let A B D C be a vertical section of a girder, resting on the points A and B, and loaded with the weight w at Q. Let e Q = a; e D = b; c D, the section of the upper flange; c B, of the web; and A B, of the lower flange. Let R = reaction at A; R' = reaction at B; w' = weight of the girder, which is supposed symmetrical and uniform throughout its length.

Then we shall have these equations, when there is equilibrium—

\[ w + \frac{w}{2} = R; \quad w-(l-a) + \frac{w}{2} = R'. \]

Let us now suppose a vertical section to be made through some point, M, of the girder. Let \( e M = h; c = e; A a = d. \)

Consider now the equilibrium of the part \( e N : e K \) is kept at rest by the reaction \( R' \) at \( A \), by its own weight \( w'h \), and by vertical and horizontal forces arising from its connection with \( M B \); let \( Y \) be the vertical force; \( t; t' \) acting at \( m \) and \( m' \) in the directions indicated by the arrows, the horizontal forces. Let \( Ns = s; Nm = s'. \)

Then we have for the equilibrium of \( e N \)

\[ R + Y = w + w'h \]

also, taking moments about \( A, \)

\[ Y + t + \frac{w}{2} = w + w'h + t's'. \]

Now, \( t = t'; R = \frac{w(l-a) + \frac{w}{2}'}{l}; \]

\[ w + w'h - R = \frac{w}{2} + \frac{w'(3h-l)}{2l}. \]

Substituting this value of \( Y, \) we find

\[ (x' - x) = \frac{w}{2} + \left[ (a, b, l, w, w') \right]; \]

and this is known, and depends simply on the weight of the beam and its load, and not on the shape of the beam—that is the only condition to that effect being, that the beam shall be longitudinally uniform.

We find, then, that at the upper part of the beam there is a thrust, and at the lower part a tension. Consequently, at the upper part the particles of the beam are in a state of compression, and at the lower in a state of extension. Therefore, between \( M \) and \( N \) there is some point where the particles are neither extended nor compressed. Let \( o \) be this point: \( o \) is said to be a point in the neutral axis. If, now, the beam were laminated—that is, composed of parallel laminae, incapable of sliding over each other, and which obeyed Hooke’s law—the amount of the forces arising from the extension and compression of the particles in \( M N, \) would vary as their distances from \( o. \) This is the law usually assumed for materials of even a crystalline texture; at all events, the probabilities are, that even if the tension and compression do not in all cases vary directly as the distance from \( o—\)they vary as some higher power of the distance: according to either supposition, it is clear that the particles near \( o \) are not so effective in supporting \( w \) and \( w', \) as those farther from it; and, consequently, we see the reason why the greater part of the substance of the girder is distributed at the greatest available distance from \( o, \) in the form of flanges.

In the case of a cast iron girder like that of the Dee Bridge, it is not necessary to make the upper flange as thick as the lower one, because cast iron exerts a much greater force for compression than it does for extension to the same amount, and bears a much greater crushing than yielding strain. Suppose now \( M N \) to be a joint, and the connection to be effected by means of bolts let through perfectly tight; then the case is the girder that breaks the question immediately supposes, how would that effect the thrust and strain on the upper and lower flanges? Before we consider this question, it will be advisable to show that in the molecular connection, first noticed, \( x' - x \) is either very nearly a maximum; and, therefore, \( y \) either or very nearly a minimum—for \( y(x' - x) \) is a constant, as we proved.

In the first place, taking the usual law—and supposing the girder not flanged, but uniform, \( x' - x \) would be \( \frac{2}{3}; \) but when we consider the flanges, the resultants of the strains and thrusts will be thrown much nearer to \( M \) and \( N \) respectively—and with the ordinary proportions observed for the flanges and web, \( x' - x \) would not be less than \( \frac{4}{3}, \) \( c, \) or \( \frac{4}{3} M N \)

—and it is difficult to conceive any mode of connection at \( M N \) which would make it greater. We cannot, then, suppose that \( y \) can be increased; let us, therefore, suppose that \( y \) is the same for all modes of connection.

If, instead of the ordinary law, we had assumed any other law for the amount and variation of the thrusts and strains, involving a higher power of the distance from \( o \) than the first, (for instance that adopted by Mr. Hodgkinson) \( x' - x \) would on such a supposition be still more increased. On the whole, we may fairly suppose \( y \) to be constant—certainly not capable of being diminished by any mode of connection; for, although \( y \) remains constant, its distribution, both above and below \( o, \) will materially depend on the nature of the joint. Suppose, for instance, a single bolt at \( N; \) then this bolt will sustain all the tension—and all the particles about \( N \) will be exposed to an enormous resisting strain. Again, if, as in practice, when the joint is bolted from \( M \) to \( N, \) the lip gives and is slightly deflected, and the bolts work loose, then, in order to make up the value of \( y, \) more bolts than those between \( o \) and \( N \) may be in a state of tension, and less of the girder than from \( o \) to \( M \) in a state of compression; consequently, since the area which sustains the thrust is diminished, the thrust per square inch will be increased. Also, if some of the bolts work lower than others, the bolts which work tightest will be in the highest state of tension. Some of these causes of imperfect action may be presumed always to exist; and the only way we know of compensating for their effect, is very much to increase the vertical breadth of the girder at the joint. This, however, was not done in the girders of the Dee Bridge.

To all this reasoning, it may be objected that the girder did not break at the joint. Our reply is, that the strains arising from a bad joint are transmitted to a great distance through the substance of the girder—and even at the weakest, there may be sufficient friction to resist them. It is not enough to build bridges calculated to endure two or three times the greatest statical strains they can be subjected to—especially when those strains are to be supported by cast iron girders. The continual vibration to which iron is liable, tends to weaken the cohesion of its particles: the alternate expansion occasioned by heat and cold has the same effect.

Lastly, it must never be forgotten that the vibration of a train increases enormously the tendency to fracture, by bringing into play dynamical strains, the amount of which is beyond calculation; and that iron bridges are especially adapted to transmit such vibrations.

**Artificial Wells in Volcanic Formations.**—The first attempts of this kind in Naples were made, some years ago, near the Campo Santo, by the Societé Industrielle; they, however, yielded but a small quantity of water, at a depth of 89 or 90 feet. This led to the great undertaking in the Royal Gardens, which, however, is not likely to yield any favourable result. The deeper the boring proceeds, the harder is the appearance of the strata of volcanic tuffo—and the only advantage derived in the perfect knowledge of the geological stratification of the terrain of Naples, on which the architect, M. Canziani (who superintends the work) read a paper at the meeting of Italian scientists, in 1845, The supply of water for the metropolis (especially near the Portelli and Vomero) is constantly on the decrease, government will be obliged to erect new aqueducts at an enormous expense, and to convey fresh water from Monte Taburno, or the sources of the Sarno—or even so far as the Tiferno and Trebbini mountains, need the only advantage derived in the perfect knowledge of the geological stratification of the terrain near Naples does not contain a sufficient quantity of drinkable water for its increasing population—even if it be not the case, that the quantity of water is yearly decreasing, for reasons not yet properly ascertained.
HISTORY OF ARCHITECTURE IN GREAT BRITAIN.
A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By JAMES ELMS.

"Epitomes are helpful to the memory, and of good private use."

SIR HENRY WOTTON.

(Continued from page 170.)

It has been already mentioned that Inigo Jones had improved his taste by studying the works of Palladio and other eminent Italian architects, in Italy. It is not unlikely that he had met Sir Henry Wotton at Venice, as this tasteful connoisseur and elegant illustrator of the Vitruvian art was then ambassador from James I. to the Doge. James's brother-in-law, Christian IV., King of Denmark, who had heard of Inigo's reputation from that city of lakes and palaces, introduced him to the British monarch, who immediately appointed him his architect.

Jones's style, after his return from Italy, bears marks of much improvement in taste and purity, as may be seen in the works he executed before his visit to that fostering country of the arts, and those which he designed after his return. This eminent architect visited Italy twice, and enjoyed the friendship and patronage of the celebrated Earl of Pembroke, and other tasteful nobility of the period.

Among his works not already mentioned, are additions to Lord Pembroke's seat at Wilton, the porch of which had been designed by Holbein. Jones's personal additions to this edifice are apparent, particularly the triumphal arch and its equestrian statues, that has been lately cited as an authority, among others, in the controversy about Matthew Wyatt's colossal statue of the Duke of Wellington, in Piccadilly. Also, the quadrangle of St. John's College, Oxford, another proof of his want of feeling for the beauties of Gothic architecture, as is the Chapel Royal, St. James's; Coleshill, in Berkshire; Cobham Hall, in Kent; and the Grange, in Hampshire.

Before concluding that portion of our notice that terminates with Inigo Jones, we must revert to some of those lesser known artists who flourished between the great days of the Tudor style and the expulsion of arts from England by the rough-shod founders and supporters of the Commonwealth.

Whatever may have been the intentions of James I. as to the erection of a splendid palace for himself and his successors to the crowns of the two kingdoms, which had been first united in his person, he had strong objections to his example being copied by his nobles. Fearing that if they made their establishments in the metropolis too large and expensive, it might rob the provinces of much of their grandeur, and the country people of their natural protectors, the wealthy aristocracy of their respective counties; he therefore issued edicts against the enlargement of the metropolis, and confirmed the royal will of his predecessor, Elizabeth, that no further mansions or noble residences should be erected but upon ancient foundations. Lord Bacon informs us, that King James was wont to be very earnest with the country gentlemen to abandon London for their country seats; and that he would sometimes say to them; "Gentlemen, at London you are like ships in a sea, which show like nothing; but in your country villages, you are like ships in a river, which look like great things."

Although James attempted to drive his opulent subjects from the metropolis to their country residences, few of our monarchs had a greater number or more splendid palaces in London than the successor of Elizabeth, from whom he probably inherited this dread of palatial rivalry by his nobles in the metropolis. That powerful queen, who was one of the most absolute monarchs in our history, issued several proclamations, rigidly forbidding the increase of new buildings in London. James did not consent himself with merely reproving and exhorting his nobles and magnates, but issued several proclamations to the same purport.

In 1605, when he had been but two years upon the throne, he issued the first of these mandates, which forbade all manner of building within the city, and a circuit of one mile thereof. Among its commands was the statutory one to a wooden metropolis, that all persons henceforward should build their external walls and windows either of brick or stone. The classical reading of the king, who delighted to be compared in wisdom to Solomon, and in the patronage of literature and art to Augustus, probably wished to vie with the Roman emperor in the boast of having found his metropolis of wood, and leaving it of marble (stone). The reason given in this proclamation for building with brick and stone is, "as well for decency, as by reason all great and well-grown woods were much spent and wasted, so that timber for shipping became scarce." James always shewed a predilection for the establishment of a powerful navy, both mercantile and warlike, as his founding the corporation of the Tower of London, the cultivation of the royal woods and forests, and this proclamation, testify. This edict produced as little effect as those of his predecessor; he, therefore, issued another, with more stringent penalties, dated October 10, 1607, and on the 16th of the same month, some offenders against it were seized in the Star-chamber, for building contrary to its tenor. By another edict of the same nature, issued in 1614, the commissioners are required to proceed with all possible strictness against every offender of this kind. This had somehow more effect, particularly as to the mode of building with stone and brick; and from this period may be dated the reformation of the architecture of London, which is so much indebted both to the architect and his royal patron.

The first house of note that was erected in conformity with this proclamation, was one in the Strand, built for Colonel Cecil; after that, one near Drapers' Hall, Throgmorton street, in the city, is celebrated; another, built for an opulent goldsmith, in Cheapside, opposite to Saddlers' Hall; and one that was built for a leather-seller, in St. Paul's Churchyard, near the north gate to the cathedral, not being in conformity with the king's regulations—being built of timber—was ordered to be taken down, and rebuilt according thereto.

Among the principal mansions of this period, are Hatfield, in Hertfordshire, the seat of the Marquis of Salisbury, and Berleigh, near Stamford, in Lincolnshire, the seat of the Marquis of Exeter, both built in the reign of Queen Elizabeth; and being still in existence, with very little alteration from their original design, are fine specimens of the mixed pictorial style of the Elizabethan period.

These were enlarged and improved, in a similar style, Theobald's, near Cheshunt, in Hertfordshire, originally the seat of Elizabeth's great prime minister, Cecil, Lord Burleigh, who often entertained his royalmistress within its walls. It was a favourite residence of King James, and was the scene of his last moments. It afterwards became the abode of Richard Cromwell, who retired thither after his resignation of the protectorate of England. He passed the remainder of his days in this once royal residence, in peaceful retirement.

Of the principal reformers of taste among the literary men and nobles of the period, the great lord-chancellor Bacon stands in the foremost rank; and his opinions on architecture and gardening are decisive of the character of those arts, which he so much improved, in his days. His maxim, that houses are built to live in, and not to look on, should never be forgotten by the domestic architect; and his description of a palace, in opposition to such huge buildings as the Vatican, the Escurial, and some others, which, he pitifully observes, have scarce a fair room in them, is characteristic of the best style of this period, which Inigo Jones, Sir Henry Wotton, and the elegant-minded lord-keeper had so much improved.

That the taste of Jones was influenced by his association in literature and art, with Pembroke, Bacon, Wotton, Ben Jonson, and other eminent Englishmen, as well as with the literati and connoisseurs of Italy, is proved not only by the purer style of his mature age, but by the unvarnished design for the royal palace, which bears marks of being arranged in the study of the artist, assisted by noble minds, rather than the work of a builder's office, traced by the mechanical hands of architectural draughtsmen.

Bacon's description of what elements an architect should compose a royal palace, with its accouterial gardens, terraces, and courts; royal state, dwelling, and necessary apartments, together with the personal survey that Jones had made, accompanied by men with congenial minds, of the palaces and royal residences of Venice, Florence, Rome, and other parts of Italy, had a powerful effect upon all his designs, and particularly upon that of his unexecuted palace.

The limited space which the pages of this Journal allows to this notice, will not permit the quoting of Bacon's admirable description of a royal palace—not designed for his poetical Commonwealth of Britania, but evidently for the encouragement of his royal master to commence a palace, which, in two or three reigns, might surpass all the other royal residences in Europe.

Upwards of twenty years ago, the author of this sketch gave Bacon's description entirely in the introduction to his Memoirs of Sir Christopher Wren, and said—"This ideal palace would be an excellent task to try the abilities of a young architect to design on paper, and would make an
The brilliant galaxy of philosophy, poetry, and art, which illumined the hemisphere of the Stuarts, with Bacon, Ben Jonson, Davenant, Rubens, and Jones as stars of the first magnitude, set, amidst the clouds and tempests that convulsed the nation, from the first attack upon the monarchy till the Restoration; when elegance again dawned upon the people in the times of the second Charles, which will form the next epoch of this sketch.

Amidst the stars of lesser magnitude that shone among the contemporaries and immediate predecessors of Jones, were Girolamo da Tresino, who, like Holbein, practised both painting and architecture—the latter, as an artist, and not as a builder; Richard Lea, an Englishman, somewhat later; and another, named John Thynne, who built Somerset-house, in the Strand, in 1567, in a mixed style of Italian and Gothic architecture. John Shute, an English painter and architect, who flourished in the reign of Queen Elizabeth, was sent by the Duke of Northumberland, his noble patron, to study the art under the best masters in Italy. He published, in 1563, a folio volume of the principles of architecture, as developed in the most celebrated monuments of antiquity. Mileiza, in his lives of architects, mentions an Englishman, of the name of Stickleys, who flourished about 1596, as an excellent architect. Robert Adams, who practised architecture and engineering, was superintendent of the royal buildings to Queen Elizabeth, and wrote a description of the river Thames, and of the best method of fortifying it against an enemy. In the same period, Soriished Theodore Havens, an architect, sculptor, and painter, who affected grandeur on a small scale, and was rich in familiar elegance. He designed Caius College, Cambridge, a fair specimen of the architecture of the age—pedantic, eccentric, affected, and trifling. This college was founded by Dr. Caius, physician to Queens Mary and Elizabeth; and three of its gates are of curious, if not of elegant, designs, being among the first constructed after the Italian manner in England. The first is inscribed "HOMILITAS," and, as the Gate of Humility, is of low proportions; the second, which is lofty, and embellished with a portico and emblematical figure, is dedicated to Virtus, and is inscribed "VIARUM IN CAELO PAVIT SAPIENTIA," and conducts to Caius Court and the public schools; and the third, which is inscribed "HONIOR," is called the Gate of Honour, is of still larger dimensions, and decorated with the various orders of Roman architecture, overlaid with ornaments, in the style of the ecclesiastical monuments of the period.

About the same time, Rudolph Simmons built Emanuel and Sidney Sussex Colleges, Cambridge, and rebuilt the greater part of Trinity College, in the same University.

Bernard James, a painter-architect of the Flemish school, also flourished in the reign of James; he was a disciple of Distelring, a celebrated architect of the same country, who wrote much on his art. James executed, during his residence in England, the splendid mansion of Andley End, in Suffolk, and a great part of Northingham-house, London; but the extraordinary and original façade was designed by Gerard Christmas.

Among the other architects of this period whose names have reached us, are John Smithson, who died in 1649, and who, under the patronage of the Duke of Newcastle, travelled into Italy to improve himself in his art, and to acquire a knowledge of good design. The mansion-house at Welbeck, and the castle at Bolsover, were of his execution. Stephen Harrison must have been an architect of some reputation, as he was employed to design and execute the triumphal arches and other architectural pageantaries, erected in London, on the accession of James I. to the throne of Great Britain.

The political struggles that convulsed the reign of Charles I., which began with such flattering prospects for the arts, and which was the epoch of good taste in architecture, has been, I may say, not noticed. The rulers of the Commonwealth, instead of patronising arts and artists, not only discouraged the living, but destroyed the works of the dead. The destruction of some of the most elegant productions of painting, sculpture, and architecture, by the iconoclasts of the Commonwealth, will ever remain a stigma on the administration of Cromwell: but the reign of Charles II. was favourable to architecture, as much by the dreadful fire which consumed the metropolis, as by the innate love of magnificence and art which distinguished the king and his court.

(To be continued.)

[In the first part of this sketch, in our last Number, page 108, col. 2, line 11 from bottom, for "Tortugiano," read "Torregioano."
ON THE CONSTRUCTION OF ARCHES.

A paper "On the existence (practically) of the line of equal Horizontal Thrust in Arches, and the mode of determining it by Geometrical Construction." By William Henry Barlow, M. Inst. C.E. (Read at the Institution of Civil Engineers. (With an Engraving, Plate XI.)

The supposition of the existence of a certain curve or line, in which the pressure is transmitted throughout the vousoirs of an arch, is not of recent origin. The theory of equilibration, called the Catenary, of which an account is given by David Gregory (Phil. Trans. 1697), is founded on this basis; but throughout the investigation, it has been assumed necessary to make the line in which the pressure is transmitted, coincide precisely with the form of the intrados of the arch; a condition which is necessary to stability, only when the arch is infinitely thin.

In the theory promulgated by La Hire and Attwood, familiarly known as the wedge theory, or that in which each vousoir is supposed to act as a wedge, it is considered necessary that the pressure should be transmitted, so that the direction in which it acts at each joint, should be at right angles to the surface of contact, which condition is only necessary to stability, when no friction exists between the surfaces of contact of the vousoirs.

But when the thickness of the arch and the friction at the surfaces of contact of the vousoirs, are both included in the investigation, it has been shown by Professor Moseley, in his able and elegant exposition on this subject, that the two conditions above mentioned, become modified, and that in an arch of uncutted vousoirs, the actual requirements to establish stability are,—

First, That the line in which the pressure is transmitted (which he has named the line of resistance), should fall within the thickness of the arch at every joint.

Secondly, That the direction of the pressure, at each joint, should be within certain limits, depending on the friction of the materials employed.

Coulomb, the first writer on this subject, who based his assumptions on data consistent with practice (Mémoires des savans étrangers, 1773), considered, with Moseley, that there were two causes of rupture; the first, arising from the turning over of certain parts of one vousoir on the edges of another; and the second, from the slipping or sliding of the vousoirs on each other; and although the mode of investigation pursued was totally different, yet the results present a complete accordance with those since arrived at by Professor Moseley, so far as they embrace the same elements of discussion. This remark applies also to the catenary and the wedge theories; for if the thickness of the arch be considered to be infinitely small, the line of resistance becomes the catenary, and if the thickness be retained and the friction omitted, the line of resistance is analogous with the line of pressure determined by Wobwell in the wedge theory. Although the investigations of Moseley leave little to be done in elucidating the conditions of stability in arches mathematically, yet the deductions have not received that attention from engineers which their importance deserves; chiefly from the absence of any decided practical exhibition of their correctness and utility, and also from the investigation being surrounded by too much mathematical difficulty, to admit of ready application.

The analogy before-mentioned, as existing between the line of resistance: the catenary, and the line of pressure of the wedge theory, arises from one governing principle, which is general in these curves, and constitutes the essential element of equilibration when the only force acting is gravity, namely, that the horizontal forces in any part of the curve are equal to each other; by which it must be understood, that not only must the horizontal forces, at any part of the curve, be opposed by a horizontal force of equal amount in the opposite direction, but that the horizontal force is equal throughout the curve. This essential element of any curve of equilibration, though probably known, has not been pointed out; its mathematical correctness is self-evident, and of its existence practically, as applied to the line in which the pressure is transmitted through the vousoirs of an arch, the following experiments give satisfactory evidence:—

In an arch composed of numerous vousoirs, let their surfaces of contact, instead of being planes, be made curves, as in fig. 1. If the original form of the arch be such that the line of resistance passes through the points of contact, no motion will arise among the vousoirs, on removing the centre; but if the arch be a segment of a circle, or any other form which does not coincide with the line of resistance, the vousoirs will take up a new position, the curved surfaces of the vousoirs rolling on each other, to a certain limit, when they come to rest, and if disturbed from this position (unless the disturbing force be sufficient to produce actual rupture), they will return to it.

![Fig. 1.](image)

In this experiment it is obvious, that the pressure must be transmitted through the points of contact; and it affords a practical proof, that this line is the curve of equal horizontal thrust; for if in any vousoir a, the horizontal force at b, was not equal to that at c, motion must ensue, and as this condition is the same in all the vousoirs, it follows, that the horizontal force is equal throughout. The experiment admits of further application, by loading the arch so as to vary the form of the curve in which the pressure is transmitted, while it of necessity retains the element of equal horizontal thrust; and it will be found, that the limit of stability is when the point of contact of any two vousoirs falls at their outer or inner extremities; thereby establishing practically, that the line of resistance, or curve of equal horizontal thrust, must be contained within the thickness at every joint.

The second condition necessary to stability, namely, that the direction of the pressure, at each joint, should be within the limiting angle of friction, is almost always of necessity fulfilled in the forms of arches and with the materials usually employed in practice; this part of the inquiry will therefore be confined to the first condition.

Now the property of equal horizontal thrust, enables a geometrical construction of the curve to be readily obtained in any given form of arch, if two points in the curve be given, and by assuming those two points, it can be ascertained by a tentative process, if any given arch does, or does not, contain the curve.

Proceeding in this manner it is found, that in a semicircular arch, the thickness must be one-ninth of the radius to contain the curve, a result which is completely borne out in practice; for though apparently unnoticed, a semicircular arch cannot be made to stand without foreign support, unless the thickness be greater than one-ninth of the radius.

In like manner, in any other form of arch which does not precisely coincide with the curve of equal horizontal thrust, there is a certain minimum thickness, or depth of vousoir, necessary to obtain stability.

Among various other experiments, made to test the accuracy of the theory, it will be sufficient to give the following. The curve of equal horizontal thrust, when drawn on the elevation of a semicircular arch, of which the thickness is one-ninth of the radius, touches the intrados at 35° above the springing, and the extrados at the crowns; and practically, an arch of these dimensions yields, by the crowns descending, and the haunches going outwards, the points of rupture, or rotation, being precisely those where the curve touches the intrados and extrados.

![Fig. 2.](image)

* It is necessary that the radius of curvature of the vousoirs be made within certain limits, depending on the depth of the vousoirs and the radius of the arch; if too much curvature be given, the arch will fail, before the points of contact can take up such a position, as to coincide with the line of resistance.
The condition, that the curve must lie within the thickness at every joint was also tested in the following manner. A semicircular arch, of which the thickness was one ninth of the radius, was constructed in four pieces, having the joints e and f, fig. 2, at the points of contact of the curve of equal horizontal thrust with the intrados and extrados. A similar arch was also made in six pieces, having the joints at a, b, d, c, where the curve lies within the thickness. In the first case, yielding took place, by the crown descending and the branches going out, and in the second, though composed of a greater number of pieces, perfect stability was obtained.

Fig. 3.

Lastly, it being obvious, that these conditions, if correct, must apply to any form of structure whose stability depended on equilibrium; the curve of equal horizontal thrust was ascertained, in a series of rectangular trusses, as in fig. 3, and it was found, that when they were placed inclined to each other at an angle of $45^\circ$, the thickness must be 1404 of the length to contain the curve, and that the point of contact was $3335$ of the length, from the upper extremity; also, that whether the inclination was greater or less than $45^\circ$, the curve fell within the thickness. Then taking two rectangular pieces of wood of this form, and dividing them where the curve touches the extradosal line at $c$, they will yield by the apex going upwards, when placed at $45^\circ$; but when the angle of inclination is made greater or less than $45^\circ$ as in fig. 4, stability is obtained; and at the inclination of $45^\circ$, if the divisions be made at $c$ and $d$, instead of at $c$, fig. 2, although composed of a greater number of pieces, stability is also obtained.

Before leaving this part of the subject, it may not be out of place to mention another experiment, which exhibited the analogy between the catenary and the curve of horizontal thrust.---On a vertical plane surface, an inverted semicircular arch was drawn, and divided into eighteen voussoirs of equal dimensions. Through the centre of gravity of each voussoir, a vertical line was drawn, as in fig. 5. From two pins, fixed at $p$ and $p'$, a strong fine silk cord was hung, and eighteen pieces of chain, of equal weight, were attached to it, representing the equal weights of the voussoirs. This species of catenary was then adjusted, so that each of the chains hung opposite the vertical lines, and the apex fell just within the thickness of the arch as shown on the figure. The similarity of the curve thus produced, to that of the curve of equal horizontal thrust, was immediately apparent.

Next, one of the pins at $p$ was withdrawn, and the cord was lengthened and attached to another pin at $P$, so as to retain the part $p'c$ in its original position. The line $Pp$ thus represented the resultant of all the forces acting at $p$, and completing the triangle $Pap$; $Pp$ the weight or vertical force, was to $Pa$ the horizontal force as 276 to 1, which result was found to accord perfectly with that exhibited in a brick arch which was subse-

Fig. 4.

Having now, it is presumed, given sufficient practical evidence of the existence of the line of equal horizontal thrust, it only remains to notice, in this part of the subject, that as well as the position of the point of rupture being denoted by it, the direction in which yielding will take place, may also be known. That is to say, it will be outwards, when the curve of equal horizontal thrust touches the intrados, and inwards when it touches the extrados, and before actual rupture, the approach of the curve to either extremity of the voussoirs, indicates the tendency to yield.

Numerous other experiments, of which it is unnecessary to give the details, have shown, that the conditions of equilibrium are the same for the arch and the abutment as for the arch itself; in fact, that the arch and the abutment, when together, may be considered as an arch.

"On the Geometrical Construction of the Curve of equal Horizontal Thrust."

The two half arches being assumed to be symmetrical, the apex of the curve will be in a vertical line equidistant from the springings, and for the present purpose, it will be sufficient to assume one of the two points (supposed to be given), to be in this line. The construction of the curve then resolves itself into two problems.

Fig. 5.

1st. To find a third point in the curve, at any joint between the two points given.

2nd. To find a third point in the curve, at any joint beyond the two points given.
The first of these constructions, is that which is more particularly applicable, in determining whether a given form of arch contains the curve; for by taking each joint separately, the whole curve is obtained. The second is that which is employed, in determining whether a given abutment is of sufficient thickness to contain the curve.

**Problem I.**—Let $a$ and $b$, fig. 6, be two points in the curve of equal horizontal thrust in the arch $A B$; required to find the point at which the curve intersects the joint $e q$. Let $G$ be the centre of gravity of the half arch $A B$, and $g$ that of the portion $e q B$. Through $b$ draw the horizontal line $c m$, and the vertical line $b l$; also through $G$ and $g$, draw the vertical lines $G h$ and $g k$, intersecting $c m$ in $h$ and $k$; join $a h$, and produce it to $l$; from $k$ set off $k n$, equal to $a h$, and through $n$ draw the vertical line $n m$, making $m n$ to $l b$ as the weight of the portion $e q B$, is to the weight of the half arch $A B$; join $m k$ and produce it until it intersects $e q$; $p$, the point of intersection, will be the point required.

**Problem II.**—Let $a b$, fig. 7, be two points in the curve of equal horizontal thrust, is the arch $A B$; required to find the point at which the curve intersects the joint $e q$, being the base of the abutment. Let $G$ be the centre of gravity for the half arch $A B$, and $g$ that of the arch and abutment taken together. Through $b$, draw the horizontal line $b r$, and the vertical line $b l$; also through $G$ and $g$, draw the vertical lines $G h$ and $g k$, intersecting $b r$ in $h$ and $k$; join $a h$ and produce it to $l$, from $k$ set off $k n$, equal to $a h$, and through $n$ draw the vertical line $n m$, making $m n$ to $l b$ as the weight of the arch and abutment is to the weight of the arch $A B$; join $m k$, and produce it, until it intersects $e q$; $p$, the point of intersection, will be the point required.

It is unnecessary to accompany these constructions with a demonstration, as it is evident, from the nature of the construction in either case, that the horizontal thrust of the portion $A B$, at the points $a$ and $b$, is equal to that of $e q B$, at the points $p$ and $b$.—For a loaded arch the construction remains the same; the centre of gravity of the arch and load being taken, instead of that of the arch only.

These constructions point out, not only the form of the curve of equal horizontal thrust in any given arch, but also the direction and amount of pressure at any joint. For as the perpendiculars of the several triangles represent the weights of the several parts, so the hypothenuse of the several triangles represent the resultant pressures at any joint. From this it appears, that the actual pressure, tending to crush the material of which the arch is made, decreases towards the crown of the arch.

Figs. 8, 9, 10, 11, and 12 (Plate XI.), are drawings to scale, of ordinary forms of arches, showing the minimum thickness that will contain the curve of equal horizontal thrust, and that this is the least thickness capable of standing practically, may be readily tested by models; due allowances being made, on account of the joints not being able to be worked with mathematical exactness. From these diagrams it appears, that the arches which differ most in form from their curves of equal horizontal thrust, are semicircles and semi-ellipses, and that in these forms, there is a tendency for the crown to descend, and the haunches to go outwards. Hence the utility and the general adoption of solid backing and squinch walls in these forms of arches. The pointed arch has a tendency to go up in the crown.

Figs. 13 and 14 show the variations produced in the curve of horizontal thrust, by the addition of the filling in, up to the level of the roadway. Evidently, only one line, or curve of equal horizontal thrust, has been spoke of; but if the thickness of an arch be more than sufficient to contain this curve, it is obvious, from the nature of the construction, that more than one such curve will be contained in it, and if the theory advanced is correct, the arch ought to be capable of being supported in any one of these curves.

The truth of this position was practically tested by the model represented in fig. 15, which consisted of an arch composed of six voussoirs, separated at each joint by four small pieces of wood, each of which could be withdrawn by hand. A curve of equal horizontal thrust was then carefully drawn upon the profile of the arch, as represented in the figure by the line $a b c$, and it was found that, provided the separating pieces were left in at the points where this curved line intersected the surfaces of the voussoirs, the whole of the remaining pieces might be removed, without producing rupture of the arch; in the same manner it could be supported in the curves $a d$ or $g h k$, or in any curve of equal horizontal thrust, which was contained within the depth of the voussoirs; but that if the separating pieces were so placed, that a curve of equal horizontal thrust could not pass through every one of them, the stability of the arch could not be maintained. Of these curves there are two limits, namely, that in which the ratio of the versed sine to the chord at the springing is the greatest, and that in which it is the least. These two curves are represented in fig. 16 (Plate XI.), and are both determinable by the same process.

The first points out the curve, in which the pressure is transmitted through the voussoirs to the abutment, and is identical with that called by Moseley, "the line of resistance."

The other points out the curve, in which a pressure from without would be transmitted from the springing through the arch; such as would arise from the thrust of a second arch. This line may be called, for the sake of distinction, "the line of impression." The one curve, in short, is derived or generated by the pressure the arch exerts; the other which it is capable of resisting. In different forms and constructions of arches, the amounts of these forces vary very greatly, and it becomes a consideration of importance, where arches of different sizes are abutted against each other.

In the flat arch, fig. 17, the line of impression is a straight line, and therefore, equilibrium could not be destroyed by outward horizontal pressure, until the material yielded by crushing; while by increasing the depth of the voussoirs, the thrust exerted on the abutments may be diminished and rendered comparatively small.

From this, a knowledge of a property in arches, is arrived at, which
though felt, and to a certain degree acted upon, has not hitherto admitted of a clear explanation.

The annexed diagrams, figs. 18 and 19, exhibit forms of arches, supposed to be loaded with a material of equal weight with the arch, and show the abutments necessary to sustain them. In these, it will be observed that the division between the arch and the abutment is not made where the arch, as called, commences. The point of division adopted, has not been chosen on account of the result as to the required thickness of abutment being materially affected by it; but as being the place at which rupture would cease, if the abutments yielded. In fact, the effective part of an arch is only so much of it as would not stand unless the arch were entire. So much of the arch as lies below this point, would stand of itself, and is practically a part of the pier or abutment, curved out for the arch to spring from. This point of division also permits a reader means of computing the thickness of abutments; as with the exception of the small projection at the springing, the weight of which may be omitted, the abutment is a rectangle, when the roadway is horizontal.

In this manner the following formula is derived, for ascertaining the thickness of the abutments necessary to support a given arch; the height of the abutment being given.

![Fig. 18.](image1)

![Fig. 19.](image2)

The centre of gravity—assuming $p$ and $p'$ to be two points of application of the pressure, or points in the curve of equal horizontal thrust in the arch—let $p' = d$, $h' = a$, $p = m$, $x = m$, $AD = a$, $w =$ weight or area of arch and backing, and $x = DC$ the width of abutment sought; then, assuming equal areas to produce equal weights, $x \cdot a$ will be the weight of the abutment; and when $x$ is such, that the curve of equal horizontal thrust will meet the base of the abutment at the exterior point $D$, we have

$$a^2 \frac{x^2}{3} + \frac{w \cdot (x + a)}{m} = \frac{w \cdot d}{a},$$

or

$$x = \frac{w}{a} \pm \sqrt{\left(\frac{d}{a} - \frac{m}{a} \right) \cdot \frac{w \cdot d}{a} + \left(\frac{w}{a}\right)^2}.$$

Also to find the thickness of abutment when any given additional load is placed on the arch, let $B$ be the load, expressed in terms of the area of the arch and backing, and $s$ its horizontal distance from the point $p'$; then

$$x = \frac{w}{a} \pm \sqrt{\left(\frac{B}{a} + \frac{w \cdot d}{a} - \frac{w \cdot m}{a}\right) \cdot \frac{w \cdot d}{a} + \left(\frac{w}{a}\right)^2}.$$

In like manner, when the arch and abutment are given, we can find the extreme load which may be placed on the half arch.

Referring again to fig. 20, let $GK$ be a vertical line passing through the centre of gravity of the arch and abutment, and $p' = H$, $DK = D$, $S =$ horizontal distance of load from the back of the abutment, and $W =$ weight or area of arch and pier; then using the same letters as before for the other dimensions—

$$\frac{WD}{H} + \frac{BS}{H} = \frac{wd}{a} + \frac{Bs}{a}$$

or

$$B = \frac{Awd}{H} + \frac{H}{a}.$$

In these cases, the two half arches are assumed to be loaded alike; hence, when the load is at the crown, the result must be doubled, to give the entire load. As regards the positions of the assumed points $p$, $p'$, it is sufficient, in an arch of large dimensions, to take them in the centre of the thickness. Though the extreme limit, theoretically, in an arch turned in one ring of voussoirs, is when the points $p$, $p'$ are in the line of resistance.

In offering the foregoing as a practical outline of the laws which govern the equilibrium of arches, it must be observed, that the most simple conditions consistent with practice, have been assumed as data, and so far as these conditions can be fulfilled, there is no doubt that the principles here set forth will be fully borne out in actual execution. How much further the inquiry might be carried with advantage, it is difficult to say; but there appears to be much connected with the unequal loading of arches, which has not hitherto been the subject of investigation.

Moseley has introduced in his researches, the effect of the adhesion of cements; but he has accompanied it with the remark, that "that structure (being of large dimensions) which would not stand without cement, would assuredly be a perilous one," a remark which applies very properly to arches of masonry; but in brick arches, turned in numerous rings, the adhesion of the cement undoubtedly becomes an element, materially affecting the stability of the structure. Upon such subjects, and upon the varying conditions in which arches are placed, it is in vain to attempt to bring theory to bear. They are considerations which must and ought, at all times, to be left to the skill and judgment of the engineer.

In practice, an arch will exert more pressure and resist less than theory would denote; because the conditions of unyielding materials and mathematical adjustment of the joints, are incompatible with practice. Even in arches of the hardest stone, and with the best workmanship, the lines of resistance and impression must not be brought too near the extremities of the voussoirs; and in brick arches, particularly those turned in separate rings, a much greater latitude must be allowed. It must be evident, however, that it is desirable to form brick arches as much as possible in one bonded mass, using the best cement.

In abutments, a still greater variety of considerations will arise. To render this part of the subject tangible by theory, the abutment must be assumed as standing alone, the foundations being perfect, and the point of rupture being at the base of the abutment. In practice, they are rarely, if ever, without earth behind them, adding more or less to their support. Some cases, such as in arches under embankments, the force acting to push in the abutment, exceeds the horizontal thrust of the arch, and a tendency has been frequently exhibited in arches so situated, to rise in the crown.

The foundations, the wing walls, the spandril walls, the backing, the nature of the materials employed, and many other practical considerations,
CONSTRUCTION OF SEA WOLLS.

A Protest against the Decision of the Members of the Harbour of Refuge Commission present at the Sitting of the 15th January 1845; and Dissert from their Report, on the part of Lieutenant General LORD DOUGLAS, one of the Commissioners of the Harbour of Refuge (Sir John Sibbald, abridged). The enemies referred to will be given in the next month's Journal.

Attaching the greatest importance to the attainment of certainty in the mode of forming, and of durability in that of executing the extensive works about to be undertaken for the proposed Harbour of Refuge in the Firth of Forth, I consider it incumbent upon me to express my marked opinion, in opposition to plans which, in my judgment, are founded on modes of construction not resting upon any proved principle, and untried upon any sufficient scale to warrant their present adoption; which an unwise precaution, and consequence, and consequently uncertain in their ultimate result. Such plans are, in my opinion, unfit for the attainment of the great national object which we have in view; and which it is my anxious wish to see undertaken in such a manner and by such means as to render the proposed work a lasting monument to the wisdom of the present age, and a lasting ornament to the public roadsteads and anchorage, to be productive of aid to the most important commercial operations in the Channel.

Mr. Alan Stevenson states, that to build an upright wall in seven or eight fathoms of water, is a proposition novel in theory, and never, as far as I am aware, proved in practice, on a scale to warrant its adoption; and being of opinion that the depth of water be not exceeded, and that the magnitude and moment, arising with an upright face, from the depth of 48 feet at low water, would be far less capable of resisting the violence of seas, and especially of broken seas, (exposed as it must, moreover, be to the unmitting action of strong tides and currents) than a sloping breakwater formed in a manner similar to that which has been successfully completed in the harbour of Forth (which is produced in the manner of a pyramid) (Annex B.D.), as well as similar to others (Delaware Breakwater, Annex L.), I conceive, therefore, and in my judgment, that the change of mode of construction, and to the employment of any artificial or inferior material, as a substitute for stone, from mere considerations of pecuniary economy. The latter should I think have no place in a great national undertaking of this kind, and if the method proposed with this view would, in the end, prove by far the most expensive.

In the more recent minutes and proceedings of this Commission, I find no one confess, practically, their views and opinions (which I brought before the Commission in July 1844), and I perceive that even the highest acknowledged scientific authorities who adhere or incline to the theory of the upright wall, speak cautiously, diffidently, doubtingly, or maintain the small capability of artificial walls to resist the actions of waves and seas in all cases and under all circumstances. Some of these maintain that waves in a breaking state do act percussively; that a sloping breakwater is therefore best able to resist the action of seas in that state, and that consequently there should be a sloping breakwater in one part of the proposed harbour of refuge, and a perpendicular wall in others; whilst other high authorities, who incline to the upright wall, admit that this is merely matter of opinion, quite speculative and experimental as respects breakwater, and that there the situation of the coast and the nature of the water would be perfectly secure. Now in my judgment, nothing purely theoretical can remove the strong objections which have been so forcibly ad

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1 See Observation on Kilbruck Pier, built in only 6 feet 6 inches depth of water.
2 The application of the theory of the resistance and impact of solids is no doubt attended with great difficulties and anomalies in this as in many other cases connected with natural philosophy; but whatever results have been derived, either from theory or observation, they all agree in this, that the horizontal impulsion of a fluid on any resisting body is increased, in direct ratio of the tangent of the inclination of the surface (A B) to the direction (B C) of the motion impinging on it. The fundamental theory is, that this varies as (sin B) (cos B) the perpendicular projection of the height of the breakwater on it, and in the same proportion as the angle of inclination. If the height of the breakwater be increased, the same angle being maintained, and a perpendicular impetus then be as (sin B) (cos B), and the horizontal impulsion is much less.
3 In this case, not only is the force of the several particles diminished in proportion to (cos B), but the number of particles which impinge on the plane varies as sin B.

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On the best form for the profile of a "breakwater" on a natural or artificial foundation (concrete) to which I had always objected, as deficient in tenacity, and incapable of resisting mechanical action of water. An opinion of the efficiency of this material was, however, strongly supported by the reference made in the preceding report to the success of a breakwater of concrete for the completion of the breakwater in Cherbourg Bay, which was described as a successful experiment, and one deserving of being adopted by us, as precedent; but the contrary of both was soon evident; for within the period to which, happily, the proceedings of the Commission were thus extended, an important failure occurred in the works at that place; and the employment of concrete, as a substitute for stone in this climate, has been abandoned by all British authorities.

Mr. George Bentall, in a successful experiment with the adoption of blocks of concrete as an artificial stone, which he thought would fail, s. posed of this proposition; and it will not be conducive to the public inte

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2 Mr. George Bentall, Annex (C). See also his plan, No. 2, of the Report; his model being 101 feet 4 inches in length, Q. 420 to 446.
3 Mr. C. O. Smith, Annex (D). See also his Report and plans, No. 6, and recent examination, Q. 210, to 293, 284, and 289; and letter to the Chairman, Appendix, No. 11, Second Report.---

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Poulton,侧重于理论，而非实验数据，强调了水下结构的稳定性，提出了一个关于斜坡的理论，认为这种结构在抵抗海浪冲击和沉降方面具有优势。他进一步说明，这种设计可以有效减小海浪的力量，并且在不同的水深条件下都能保持稳定。
The recommendation of a majority of the Commission in favour of the upright wall was stated in the Report, to have been made on a summary, without consideration of the details which determined the plan. The Commissioners freely admit that standing remarkably well in the breakwater at Algiers, the whole mass of the breakwater has settled bodily, not from the effects of gales of wind, but from defects in the material (which time will further show); there is no doubt that the work is subjected to a long sea and tide, and will be built in a sandy soil, and will be in contact with the concrete will not guarantee the lines from solution. Nor can that work, under any circumstances, be cited as an example for our imitation on the coasts of Great Britain. There are no tides in the Mediterranean; there is an absence of the drying and consolidating influence of the ocean; and the work is not, which is not the case in more northern regions.

It may be, that the form of the work at Algiers is not that of an upright wall, for its base has a slope of 45 degrees; the work, therefore, cannot be added as an example in favour of that form of construction.

In support of my dissent from the adoption of the upright wall, I appeal to the debate which took place at the Institution of Civil Engineers, in April 1842, on Colonel Jones's "Observations upon the Sections of Breakwaters as heretofore constructed, with Suggestions as to some modifications of their Forms." This debate may be taken as a very fair exposition of the opinions of practical engineers on the principle of the upright wall.

The president, Mr. Walker, took an important part in that discussion. He said it was evident that if the material was solid, and any portion being displaced, is only carried down elsewhere. Although strictly speaking it may not be wanted, it must nevertheless assist in consolidating the mass, and the vacant spaces can easily be filled up. In the same way, he continued, it was evident that if the material of the breakwater (a perpendicular wall) would suffer more severely, and probably would have fallen entirely. He therefore considered that in all the case of a breakwater, which was exposed to a breaking sea, the Chief Engineer would stand at a disadvantage.

Mr. Palmer, vice-president, observed that the form suggested by Colonel Jones for the bases of breakwaters, did not appear sufficiently justified by observed facts; that the idea was entirely of a speculative character, and was contrary to the laws of nature, which should be the engineer's chief guide; and he attributed the failure alluded to by Colonel Jones, in the harbours of Ardglass, Portrush, &c., more to defects in workmanship, than to the form of the structure. General Pasley said he believed that a perpendicular wall, constructed of large ashlars, well cemented, would assume the character of a rock, and all the prejudicial action of the receding wave would be avoided.

Mr. Ball differed entirely from Colonel Jones, and adopted the opinion of breakwaters with vertical or nearly vertical faces, because any disturbance of the foot, however slight, must have a tendency to overthrow the wall.

Mr. George Rennie deprecated in strong terms the upright wall, and stated that the late Mr. Thomas Telford had abandoned that mode of construction.

Mr. Vignoles only agreed to a certain extent, to the form proposed by Colonel Jones, and recommended a combination of a slope below with a vertical above.

Mr. Gordon was in favour of the slope; and stated that a sloping breakwater, composed of pierre perdre, with a sloping face, had withstood the surf at Madras.

Mr. C. Wall added, long slopes of sand, at an inclination of 10 to 1, thatched with straw, resist the waves of the ocean on the coast of Holland.

Thus we have in this discussion, a majority of speakers of seven to two, in favour of the slope; and of the minority, one was for a combination of the slope with a vertical wall above. Even Colonel Jones suggested this modification. See p. 125, vol. 2, Proceedings of Institution of Civil Engineers. Plan No. 5, proposed by him for Dover Bay, was of this description.

It is object to Kilrush Pier being added as a test of the principle of the upright wall sufficient to warrant its adoption in the construction of a harbour of refuge in Dover Bay. Kilrush is a small tidal harbour on the coast of County Clare, consisting of a small basin of sea-water, and of a depth of water, at low tide. The foundations were laid without difficulty by the diving-bell, with large masses of stone, which were easily and quickly deposited. The area of the section of the wall is considerably greater than that of the principle of the brick piers, which were built in consequence of the sloping profile as originally proposed having failed, Col. Jones expressly says "that the old work stood remarkably well." There is nothing in this, therefore, either practically certain, or sufficient to justify the practice of the plan, because if not to have been put in, and it likewise appears that the damage which these piers may have sustained might easily be repaired; but certainly no such errors would be committed in any new work of this description, far less in that great national work now under consideration.


The Harbour of refuge in Dover Bay were submitted to the Commission; and

2. With reference to the opinions of those persons who have been requested to give their advice up to this important question.

The following is a list of the engineers whose plans for constructing a harbour of refuge in Dover Bay were submitted in to the Commission:


1. Mr. Walker, civil engineer, is somewhat inconsistently adduced in the Report as an advocate, in principle, for the construction of a nearly upright wall. The principle of the Commission's report, is to build these walls in immense vessels, or as he calls them, "utensils" (caissons), three or four hundred feet long and seventy feet wide, containing two or three thousand tons of ready-made breakwaters, to be towed by steam tugs and stranded in Dover Bay! But we have Mr. Walker's authority, from what he said at the meeting of the Institution of Civil Engineers, on April 13, 1843, that his reason for proposing nearly upright walls in this case, was to avoid the extravagant width which must be given to these huge utensils, if the walls have any considerable slope; for, at the discussion to which I refer, Mr. Walker stated, that in situations exposed, like that of the Plymouth Breakwater, to a heavier sea than that which rolls into the harbor for Bay, has always been employed; and that a perpendicular wall has been constructed in Plymouth Sound, instead of a sloping breakwater, it would, in the storm which assailed it, have suffered more severely than it did, and probably would have been entirely overthrown.

The dangerous instability of works executed in deep water, by a system of caissons, such as that proposed by Mr. Walker, is very generally acknowledged, and is sufficiently proved by the perils state in which Westminster Bridge now stands, from the expedients by which it has been attempted to remedy the defects of its original construction. These expedients consist in forming a cofferdam about each pier, pumping out the water, and then driving rows of sheet piling into the blue clay, so as to form a girt around the base of the original caisson, and thus prevent the materials of the natural bed of the river from being undermined by the current, or squeezed out by the weight of the bridge, into the gradually deepening water-courses. But it does seem very strange, that the Commissioners should have overlooked the advantage of the method employed in the construction of the original bridge, giving a greater head to the water, and by the very process of removing the water from the base of the structure, would prevent the water from taking place in Westminster Bridge, the method employed in the construction of that work should be proposed for adoption, on an immense scale, in the formation of a harbour of refuge in Dover Bay.

5. Captain Denison is for a vertical wall formed of hexagonal prisms of concrete (proposed by Monseur Emy, in 1811, but never adopted), 10 feet long, and about 23 tons weight, to be manufactured at Dangereuse, and dragged by steam tugs to Dover Bay, by being suspended to rafts formed of two cylindrical pontoons, and there sunk by mechanical means. The water would be supplied from the bottom to about low-water mark, with a superstructure of granite.

4. Sir John Rennie, afterdeprecated in strong terms all systems of caissons, and some other expedients, particularly the adoption of upright walls; and after on entertaining the opinion that it could be attended to, any mode of construction which is not recognised as certain of success, proposes the adoption of the principle observed in the breakwater at Plymouth. This he considers as having completely succeeded, and therefore he conceives that it fully justifies the adoption of the like mode of construction for the proposed harbour of refuge in Dover Bay.

5. Colonel Jones is in favour of a combination, of a sloping breakwater, up to low-water mark, with an upright wall of stone erected on it.

6. Mr. Cubitt, after having been a little taken with the theory of the upright wall, and having since bestowed upon this subject the most careful consideration, comes to the conclusion that any attempt to erect an upright wall in Dover Bay would be an undertaking of great difficulty, and that the best practice in such a case would be to construct a series of masses of stone, to form a sloping breakwater, as at Plymouth, with stone brought from the Channel Islands, or from Portland.

7. Mr. Vignoles's plan is for a sloping breakwater, by depositing cubical blocks of concrete up to about low-water mark, and upon this to erect a vertical wall.

8. Mr. Rendel is next adduced as an advocate for the upright wall. Now, with great respect, but with no permission from any eminent engineer, it is of importance to review in detail his several expedients before the Harbour of Refuge Commission, previous to his conversion to, or adoption of, the new theory, and to advert to the circumstances with respect to material, which induced him now to recommend a wall of that form.
my two or three feet of low water; above that, he proposed to construct perpendicular walls, as recommended by Colonel Jones; observing that if the stones were deposited in this manner, and allowed to form their own slope, it would in most situations be the most economical plan.

He stated that if he had an unlimited command of materials, he would construct the walls in this manner, by laying them in their natural mass, and when he had brought his foundations up to that point (nearly low-water mark) at which the sea would begin to attack them, he would attack the sea, by building with a class of materials that would be its master; adding, that he thought an upright wall in this case might be desirable for a superstructure.

In Mr. Rendel's examination before the Commission, in November 1843, his attention was expressly called to his former observations on these points, and to all that was said respecting the opinion expressed in that evidence; and also stated that he did not know of any instance in which a breakwater with an upright face, of the magnitude now contemplated, had been constructed in the manner proposed. He added, that the upright face of the material used was an experimental measure. Mr. Rendel's reasons for adopting the upright wall, in the project which he now proposes, are founded purely on considerations of economy in money and time. He observed, that where there is an abundance of masses of stone, fit for constructing breakwaters, he would form them of rubble stone up to low-water mark, with sloping faces, in the manner in which he had just finished a design of Holyhead harbour; but in order to avoid the expense of bringing stone to Dover, he proposed to adopt, as substitutes for stone, rectangular blocks of brick, set in cement, ten feet long, five wide, and three thick, and with these to build a perfectly upright wall in Dover Bay, by means of powerful machines and the use of the diving-bell. On a former occasion, he had referred to the advantages of this arrangement, particularly in the use of the diving-bell. This proposition, therefore, resolves itself into the question, whether such a project would be economical.

Mr. Rendel admits that if the execution of the work by means of brick blocks were pressed on so rapidly as to render it necessary to import into Dover bricks, or materials with which to make them, a great part of the economical advantage would disappear. He also acknowledges that 'the advantages of that mode of construction in the upright wall, are sufficient to overcome the common sloping-sided breakwaters, is a mere question of economy in money and time.' He has further admitted, that if he had unlimited command of materials at Dover, he would adopt the usual mode hitherto observed in the construction of breakwaters.

He states further, that the expense of providing brick blocks made of the materials that he recommends as indispensable in the construction of such a work, would be greater than that at which gravel might be procured from the Channel Islands.

From this and other calculations it appears, that 'the mode of constructing breakwaters hitherto observed, with materials of the best description, is preferable, in an economical sense, to that proposed by Mr. Rendel, and this being so that he would renounce it. We have this reliance on Mr. Rendel's discretion and judgment, that he would guard himself against assuming anything where experience, the only safe guide, can be referred to; and, in a great national work like this, would not propose any vague, fangled notions that have nothing but their ingenuity to recommend them.'

If then the question, whether the theory of the upright wall, or the established practice of the slopewas to be determined by the opinions of a majority of the Commissioners, as to which he is not acquainted, he states, that he hopes to bring evidence before the Commission from other sources, that the upright wall is the most economical.

With every respect, then, for the theoretical opinion of this high authority, I cannot consider that it would justify the Government in sanctioning the mode of construction recommended by a majority of the Commissioners; it is not to be inferred that this is contrary to the deduction of science, and that, if the difficulties of constructing such a wall in deep water could be overcome, it would be incapable of resisting the action of the sea where waves assume that shape, and possess that percussive power, which Mr. Airy admits.

2. Professor Barlow has most usefully applied mathematical investigation to practical purposes, and knows well the difference between theoretical views and practical effects upon a proposition of this description. In his letter of 9th January, 1843, he says, 'It is not necessary for me to say any more, or to employ any arguments which have been adduced as advising the construction of the upright wall; 1. Professor Airy; 2. Professor Barlow; 3. Major-general Sir John Burgoyne; 4. Sir Henry De Lisle, in Beche; 5. Mr. Hayley; 6. Major-general Pasley; 7. Captain Veitch; 8. M. Reibel; 9. Mr. Gras; 10. Mr. Bremer. Professor Airy's opinion in matters of science is unquestionably entitled to the weight of scientific authority; he has, in the publication of his second work, with the greatest attention and profit the Astronomer Royal's tract, in which the phenomena of tides and waves are investigated by a refined analysis on what is called the 'wave theory.' It is evident that this is what is contained in the papers of the past year, and that the rising and falling of the surface of the sea depend on the horizontal movements taking place alternately in the same and in contrary directions; that these displacements are represented by a periodic function, that is not to be depended on, as an inexhaustible ocean. The circular or elliptical movement of the particles is shown to take place only when a wave is transmitted along a channel of uniform breadth and depth; and the fact, that, as the depth of water becomes less, waves become shorter, and less in number, is accounted for, in accordance with what may be deduced from the theoretical expressions of the displacements. It follows from this, that, as a sea-wave advances into water gradually becoming shallower, it assumes a crested shape, the upper part of the wave rising to the top of the base, the wave breaks, and a surf is created. Reference is made in this article to the special treatises on sea-waves by M. Reibel in 'Cours de Physique,' and Breemer.

When Mr. Airy was Professor of Natural Philosophy at Cambridge, he explained, with success, that waves in a fluid at rest, such as we may cause to arise by throwing a stone into a pond, or the ordinary waves in a close lake, are more or less superficial undulations, and that in reality no current, or onward motion of the fluid, appears to take place. I well remember, also, that he invented an ingenious machine by which he illustrated the wave theory. What he afterwards wrote to this effect, that to express the true extent, in a pond or a small lake, it is totally inapplicable to the sea, and the open sea, in Dover Bay, where an immense body of water is in constant motion, by tides rising and falling fifteen or twenty feet in the course of two and a half hours, is inapplicable to be further illustrated by heavy gales, which drive in rolling seas in succession with rapid onward motion, and therefore producing percussive force in the direction of the wind, just as a smooth bow entering here Professor Airy's theory of waves in deep open seas, but not competent for illustrating it to the practical effect of waves in gales of wind on erotions in the sea, of a limited depth, it will be seen, that instead of his theory (that the upright wall is the most economical) he contemplates another, and when this eminent authority allows that waves in a breaking or broken state do percussively and powerfully as hydraulic rams, and not by hydrostatic pressure. How then can that hydraulic action cease and become merely hydrosstatic pressure unless it has first exerted a force of impact upon the wall which arrests its motion? Even if the wall should stand after having received the shock, the concussion must be more severe upon an upright wall, in the ratio above mentioned, than that which would take place on a sloping wall of equal height.

The question of construction, then, resolves itself into this: In what depths of water do waves assume that form and acquire that percussive force? Where, according to this, should the slope cease and the upright wall begin? The professor says, practical opinion, that of the pilots, can best determine this.

Those whom I have questioned on that subject say, that this will be found to take place, in heavy gales of south-west and south-westerly winds, throughout the whole of the Dover Bay.

However this may be, it is clear from the Astronomer Royal's deductions from his own theory, that there should be a sloping breakwater in the shallower parts of the space to be enclosed, and an upright wall in the deeper parts of the same.

But with respect to the practical question, Professor Airy states, in reply to question 596, whatever theory may say, "that building an upright wall in the open sea, in seven fathoms water, is so far an experimental measure that such a wall it is to be regarded as a poor experiment."

With every respect, then, for the theoretical opinion of this high authority, I cannot consider that it would justify the Government in sanctioning the mode of construction recommended by a majority of the Commissioners; it is not to be inferred that this is contrary to the deduction of science, and that, if the difficulties of constructing such a wall in deep water could be overcome, it would be incapable of resisting the action of the sea where waves assume that shape, and possess that percussive power, which Mr. Airy admits.

3. Professor Barlow has most usefully applied mathematical investigation to practical purposes, and knows well the difference between theoretical views and practical effects upon a proposition of this description. In his letter of 9th January, 1843, he says, 'It is not necessary for me to say anything else than that the wave theory is a matter of science, and is not to be depended on, as an inexhaustible ocean. The circular or elliptical movement of the particles is shown to take place only when a wave is transmitted along a channel of uniform breadth and depth; and the fact, that, as the depth of water becomes less, waves become shorter, and less in number, is accounted for, in accordance with what may be deduced from the theoretical expressions of the displacements. It follows from this, that, as a sea-wave advances into water gradually becoming shallower, it assumes a crested shape, the upper part of the wave rising to the top of the base, the wave breaks, and a surf is created. Reference is made in this article to the special treatises on sea-waves by M. Reibel in 'Cours de Physique,' and Breemer.

When Mr. Airy was Professor of Natural Philosophy at Cambridge, he
much of their force caught by the receding of the previous wave, so as rarely to strike with much force against the wall itself.

"There can be no doubt but that a slope could be given to a breakwater that would be very secure.

"The shores, even of sand, are in many parts secured against the whole force of the North Sea by a surface coating of mere clay and straw, but then the inclination is exceedingly gentle quite to deep water, not more, I apprehend, than 1 in 16 or 1 in 24. As the material is considerably heavy, it is to be presumed that this slope may be increased."

4. Sir Henry De la Beche is adduced as an advocate for the upright wall. Now the theory of the upright wall rests entirely upon the assumption that it has a progressive, or rather accumulative force, in acting upon ejections in the sea, or on coasts, cliffs, or breakers. But Sir H. De la Beche expressly states, that seas in heavy gales of wind are urged onwards in the direction of the winds which raise them, and he speaks of a breakwater as a progressive force from the weight and velocity of the water thrown forward; and the following extracts from his very able work, "How to Observe Geology," show that he has been erroneously cited, or that he expressed himself in an unguarded manner, when he asserted that upright walls resembling cliffs are more capable of resisting the percussive effects of waves and seas than slopes.

"In the very able work which this eminent geologist published, he delivers the following rules as the result of what he had observed and ascertained with respect to the action of the sea:—

"Properly to estimate the effects of this power, the observer should be present on some exposed coast, such as that of the western part of Ireland, the Land's End, Cornwall, or among the western islands of Scotland, during a gale. We then find the percussive and erosive power of the ocean increased by the breakers, and the percussive power of the waves when it strikes the coast. The blow is sometimes so heavy that the rock will seem to tremble beneath his feet. He will generally find in such situations that though the rocks are swept and covered into a thousand fantastic shapes, they are still hard rocks, for no others could continue long to resist the almost incessant action of such an abrading force. Having witnessed such a scene, he will be better able to appreciate the effects, even though the waves be far inferior in size, upon the softer rocks of other coasts."

"The observer should carefully remark the direction of the prevalent winds, and the proportion of those which send the greatest waves, or seas as they are termed, on shore, in order that he may duly appreciate the loss of coast sustained in those directions where the force of the breakers is greatest and most incessant.

"It must not, however, be forgotten that coasts where breakers reach the shore, which are frequently protected by beaches or cliffs, and that therefore they are removed from the abrading power of the waves, during all the time that they break on the protecting beaches, a time which varies with the varying state of the tides, and the state of the weather generally."

"Other encroachments are made by the fall of masses of cliff undermined by the waves, the percussive power of the rock not being equal to its weight, or the action of gravity downwardly. If a rock be even sufficiently cleft, it will be as accessible to excavation without failure, as to admit of considerable excavation without failure, when the time must come, if the breakers continue to work on in the same direction, when the weight of the superincumbent mass would be such that it must fall."

Where, however, a great mass of cliff does fall, in the manner noticed above, the observer should direct his attention to its conserving influence. To appreciate this, he will consider the hardness of the rock, the position into which it has fallen, and its new power of breaking the waves farther from the coast. If the mass of fallen rock be stratified, much will depend upon the face presented to the breakers; for if it fall so that the plane of the beds remains sloping seaward, it will act as a well-cemented wall erected to defend the cliff; but if the beds should be exposed vertically and the fall, the future destruction of the mass would be far more rapid, and its conserving influence consequently less."  

5. No one knows better than I do the ability, the zeal, and the intelligence which Mr. Hartley has displayed in the construction of the Liver- port hydraulic works, and the River Mersey; but in stating his evidence, as that of a practical man, is in favour of the upright wall in the open sea at Dover Bay, I think it best to let him speak for himself.

"Question. You say you prefer an upright wall to any other form for a breakwater, do you know any certain instance of the practicability or otherwise of the wall which has stood the test of time in such an exposed situation, and on such a monstrous scale as Dover Harbours may require?—

"Answer. I do not.

"What is the matter of opinion?—That is all.

"This perfectly upright wall in Dover Bay is seven fathoms water in an experimental measure you admit?—Quite so as respects myself.

"With respect to the time that it would take to make a breakwater, is that to be measured by any known amount upon the difficulties of making a wall at Dover?—No, it is only founded upon a supposition of what the sea is in general, and supposing I was to attempt to it myself, and having nothing else to do; but it is a vague sort of idea.

"You were on the occasion of the local inquiry?—No, not sufficiently; I have been there two or three times.

"Have you ever built a wall yourself in such deep water as that?—No, never."

6. My gallant and highly esteemed friend, Major-general Pasley, gives the following account of his conversion to, or adoption of, the theory of the upright wall:—"For many years I paid no attention to this subject, but thought that the long flat slope adopted at Plymouth Breakwater must be the best form for resisting the sea, not only from the reputation of the eminent engineer and naval officers by whom this construction was proposed, but also from the circumstance of its having been approved and carried into execution by order of the Government of that day. But in the year 1848, when this question was publicly discussed at one of the meetings of the Institution of Civil Engineers, at which I was present, after a paper of Lieutenant-colonel Jones, R.E., had been read, in which he gave the preference to upright walls, as being much more secure than breakwaters or flat slopes, and stated his reasons for this opinion, the arguments in favour of the former appeared to me so preponderate. I have since given the subject much attention, and have made inquiries and observations, which have confirmed me in this impression."

7. Captain Vetch is the next authority cited in favour of the upright wall, or crushing wall, of which the formation is derived from theory and practical observation. The account of the extraordinary difficulties of constructing a harbour of refuge in Dover Bay, he thought that the best mode of executing such a work was by the system of caissons which he proposed. With respect to the combination of a slope with an upright or nearly upright face for the superstructure, he Captain Vetch, said it would be highly advantageous; that it would obviate a great many objections to the present condition of the Plymouth Breakwater; it would prevent the waves breaking over, and would give security of protection on the breakwater itself. The works now going on at Cherbourg, which had been erroneously considered to be an abandonment of the slope in favour of the upright wall, is only a combination of both; this he thinks a great improvement, and adds, that such a breakwater at Dover would be very superior to one entirely sloping. Captain Vetch recommends brick in cement for face work, and suggests blocks of brick firmly agglutinated into mass by means of a cheap flux between the joints; the mass of brick blocks being subjected to the required heat by means of fires or otherwise.

8. M. M. Reibell is the next authority adduced in support of the upright wall; and a sketch, of which the annexed is a copy, is inserted in the Proceedings of the Commission to sustain, as it would appear, the proposition of the upright wall, which it is inferred the French engineers as a body, approve, and would adopt, if the breakwater in Cherbourg Bay were to be commenced de novo.

Captain Washington, in his report on the breakwater at Cherbourg, states, that "M. Reibell, the present engineer, is decidedly in favour of an upright wall, and recommends the form shown in the annexed sketch as the best for opposing the shock of the waves."

9. Mr. Brunel is next adduced as having given his opinion in favour of an upright wall for the construction of breakwaters. But Mr. Brunel was not examined before the Commission, and the only opinion which he has given upon this subject is that his name is in the annexed extract of a letter from Mr. Brunel, addressed to the Chairman, dated 10th June 1844:—"Upon one point upon which I understand the Commissioners to have sought an opinion, I have no hesitation in expressing my concurrence in those which I am told have already been expressed in favour of vertical sea-walls, in lieu of slopes, where the nature of the material to be used, and other circumstances, admit of such a plan being efficiently and economically carried out."

The Queensland Dredger is next adduced as an authority in favour of the upright wall.

With the greatest possible respect for all these able and eminent men, I must say, that I do not find any thing in what they have adduced that can, in any just or competent way influence me against the opinion which they recommend; it does not rest upon any proved principle, is untried upon any sufficient scale to justify its adoption in a great national undertaking, and all agree in designating it experimental.
and in total failure; and when to this I shall have added what I have yet to say upon the subject of Cherbourg, Plymouth, and Delaware breakwaters, works actually constructed on the principles which the new theory would advantageously add to the old, I venture to think that the enlarged and enlightened engineer of France, I trust I shall be considered to have made a good case in support of this dissent.

There is no part of the Report of the 28th January 1846 from which I more desire to dissent than that which relates to Cherbourg Breakwater as a failure, and as a "test which may serve as a warning to those who may have to decide upon the construction of such works in this country," that they avoid entirely the principles upon which that work has been constructed.

In the Annex (M.) is a brief historical account of Cherbourg Breakwater from the commencement, together with an extract of the Report of the Commission of the Institute of France, of which Proisy and Charles Duparc were members. They state that from the time the breakwater was first projected, a careful inspection of that work, and after having investigated the whole process of its execution throughout, reported that the failures which had taken place arose, not from its having a sloping face, but that the slopes were not long enough to resist the action of the waves; that no constant degree of slope is calculated to resist the different actions of the sea at different depths; that these actions reduced gradually the masses of stone forming the original dyke, to a profile having different degrees of slope, and that this necessarily diminished the height of the work at different times. They added that the whole mass was thus, at length, brought into a state of the most perfect stability; and all this was verified by the United States Commission.

The first great lesson really taught by the work in Cherbourg Bay, as a warning what to avoid, is that the system of caissoning should not be adopted; the next lesson is to avoid the use of small stones deposited a pierre parde; the third lesson is, not to construct the sea-face of breakwaters in one piece from the bottom to the top of the slope, but to form it of two slopes, and to make the slope far longer than that which was originally designed for the work. The result of this extensive experiment demonstrates first, how insufficient and incompetent mere theory and speculation are, to determine with precision the foundations which should be given to a work exposed to the violent efforts of the sea.

We find that the mass of materials originally deposited in Cherbourg Bay, was heaped up so as to form a too steep a slope, and that the agency of tempestuous waves has disposed of them by reduction to a form which secures their permanent stability:

- That the part of a breakwater which is above the highest level of spring tides, is so strong that the action of waves (which must have lost by their ascent a portion of their momentum as they arrive there), that it may be more steep than the part below.

- We learn also that the part of the breakwater between low water and high water, spring tide level, is exposed to the greatest violence of the waves during the whole of the rise and fall of tides; and that there the slope should be longest, or the inclination of the face to the horizon should be the least.

Captain Washington states, in his report on the breakwater at Cherbourg, "that the long slope of ten to one, formed by the action of the waves, from low-water mark upwards, has not varied, not even in the gales of 1825, 1834, and 1846, the most memorable on record." There cannot be better evidence of the stability of the breakwater.

That the part of the breakwater for a certain distance below the lowest spring tide, is exposed only to the shock of waves towards the termination of the fall and the commencement of the rise of tide; that there the slope may be steeper or greater; while at the lowest part of all, or that which remains permanently submerged, the slope may be more steep, or have the greatest inclination to the horizon.

With respect to the magnitude of materials, we find that small stones have not sufficient stability to withstand even a moderate action of waves. That stones of from one and a half to two tons weight, are sufficient to resist the effects of a moderate sea.

That blocks considerably larger are required to withstand violent seas. That when small materials are used, it is indispensable to cover them with blocks of large dimensions.

That very large blocks should be placed towards the top of the work, to compensate by their weight the loss of stability caused by the total immersion of the lower part, and the weight of their weight in water, as is equal to the weight of water displaced.

The last fact to be noticed respecting the work at Cherbourg constitutes a very decided warning against the use of blocks of concrete, which was proposed in this Report; for the application of this material on a large scale has entirely failed; the blocks of concrete having broken to pieces.

The imperfections of the original project being corrected, the breakwater at Cherbourg was now proceeding rapidly to completion; and far from being a warning that those who have to decide upon the construction of a Harbour of Refuge in Dover Bay, or elsewhere, should avoid the principles and reject the lessons which have been observed in its construction, it deserves, in the most forcible manner, that the theory of the upright wall should be rejected, and that in its place should be adopted the well-tried slope, or rather a combination of different slopes; while a nearly upright wall may serve for a facing of a parapet like that which crowns the work at the French port.

Now, persons who read curiously that part of the Report to which I have referred, may imagine that the old dyke at Cherbourg had been taken down, and that the vertical wall which has recently been built, is raised from the natural bed of the sea, to the exclusion of the slope; whereas it is, in fact, merely a parapet with a nearly vertical face placed on the original breakwater, to prevent the waves from rushing over the terre-plein, after their force had been expended or greatly diminished, in ascending the long slope or glacie in its front.

That great work now stands in the form of combination of the slope with the upright face for the superstructure; a profile which Rendel, Bennie, Cubitt, Vetch, Stuart, Colonel Harry Jones, Vigneau, and others recommended, but which Professor Airy says, speaking of an entire breakwater so formed, is, theoretically, without doubt the worst of all.

That there may be no mistake upon this important matter in reference to Cherbourg Breakwater, unquestionably the greatest piece of hydraulic architecture that has ever been executed, I annex a profile, shewing a combination of the long slope with the vertical parapet and its fore-slope of stones; and I add the reasons which induced the French engineers 14 years ago to recommend such a superstructure. This profile is drawn from a bar of the completion of the breakwater, by Mons. Duparc, director of hydraulic works at Cherbourg, and sanctioned without modifications by the Minister of Marine in April 1832, on the advice of a special commission, to which that proposition had been referred; but so far from pulling down the ancient dyke, as stated in the Report, it was raised from the level to which it had been reduced from not having slope enough, by depositing large blocks of rough stone up to the height of low-water spring tides; and on it there was laid a mass of concrete, about 3 feet thick, on which a wall or parapet is built to the height of 15 feet above high-water spring tides. The exterior side of this quay or wall, is protected by a fore-shore of great blocks of stone, extending in a slope of 120 feet to the depth of 21 feet below low-water mark. The object of these blocks is stated by Mr. Virle to have been two-fold; the inclined surface of this fore-slope makes, with the face of the wall, a re-entering angle of the foundation, and as the sea rises, and the time of high water approaches, the slope in front produces the effect of an ordinary beach in turning and throwing up the waves, which would otherwise break against the wall with extreme violence at the moment of their maximum of intensity.

Lient.-General Sir Howard Douglas concludes by giving his dissent to the statement made by the Commissioners in their Report, "that they do not approve fully of any of the plans sent in."
RENAISSANCE DECORATIONS.

An Account of the Palace of Blois and Palace of Chambord, France, especially as to the Decorations. By JOHN GREGORY CLACE. Read at the Royal Institution of British Architects, May 31.

Having been much interested during an excursus made to Touraine, in the autumn of last year, by visits to Blois, Chambord, Chenonceaux, Amboise, and other monuments of the Renaissance style of architecture, which abound in that district of France, I am induced to lay before you a description of what I saw at the two former of those places, Blois and Chambord.

The town of Blois, on the river Loire, is of very considerable antiquity, and contains many objects highly interesting to the lover of modern architecture. It is, on one of which is the cathedral, on the other the palace or castle.

The Castle of Blois is supposed to stand on the site of a Roman camp. Mention is made of it in history about the ninth century. I do not attempt to detail to you its various possessors, but merely observe, that in the year 1292 it first came to the De Chatillon, who are supposed to have built parts of the castle. Froissart, who was chaplain to Guich de Chatillon, Count de Blois, says, that it was "grand and strong, and one of the handsomest to France." By this Count Guy it was sold, as indignantly mentioned by Froissart, to Louis d'Orleans, brother to King Charles VI., who took possession in 1397. The Orleans retained the property till their descendant became King of France under the title of Louis XII.; it then remained crown property till Louis XIII. bestowed it on his brother, Gaston d'Orleans, at whose death it seems to have reverted to the crown, and at the Revolution to have become public property. Viewed as you ascend from the town, the Chateau rises from a mass of masonry, on which is an imposing base of solid masonry, giving the idea of a fortress of considerable strength. Passing the west front of the building, you arrive at the Place des Jesuites, when the eye is struck with the magnificent north front of the quarter erected by Francis I. This front is entirely of stone; partly in two, and partly in three stories. The windows are in arched recesses, relieved with deep colouring, producing a rich and powerful effect; between the windows are pilasters, and where these are double they are separated by niches and deep recesses. Picturesque bays also project in various parts of this façade. A large circular tower marks the old tour des vassellières, or the donjon, considered one of the oldest parts of the building. The roof is separated from the entablature by a series of columns, thus forming an open gallery, and from the pedestals of these columns project tremendous gargules. To my mind the effect of this front is truly beautiful, and a successful example of the introduction of colour to architectural exterior. Part of the building was erected by the architect Mansard, by direction of Gaston d'Orleans, in the reign of Louis XIII., in a style of art seen to great disadvantage beside the beautiful front I have attempted to describe.

Leaving the Place we approach the east front of the exterior, constructed by Louis XII. It is of brick, with ornamental stone dressings. It rises from a mass of masonry, on which is a poor base of solid masonry, giving the idea of a castle. I sketched one window, and also—the principal object—the canopied recess that formerly contained the equestrian statue of King Louis XII. This recess, surmounted by its canopy, is of stone beautifully wrought. I have ventured to restore, in the drawing, the colonnetts to the back-ground, powdered with gold feuille dorée, and to replace the statue as it existed previous to the Revolution, from a drawing in a manuscript by Feuillen. On the fascia under the statue was formerly placed an inscription in Latin, which may be thus translated:

"Where by the grace of God Louis was born.
Here, with a noble heart, he assumed the royal sceptre.
Happily the day announced the coming of so great a monarch.
France could not have found a king more worthy of her."

That statue and the inscription are alike removed, and on the same fascia is now written "Caserne d'Infanterie." The palace of Louis XII., "the father of brave people," is now a barracks.

Under this canopy is an archway, forming the principal entrance to the interior court of the palace. This court consists of a irregular square, the four sides of which are in as many styles of architecture. On the south, the Gothic of the fifteenth century; on the east, the elaborately ornamented Gothic of Louis XII.; on the north, the elegant Renaissance of Francis I.; and on the west, the French-Italian style of Mansard; all these, full of irregularities, produce an ensemble picturesque and charming to the eyes of all, and most interesting to the lover of art.

The side building of the south, looking towards the interior court, was altered and partly rebuilt by the old Dukes of Orleans. It is of

an upstanding style of domestic Gothic, the outer walls being of brick, the windows and dressings of stone. In this quarter, in addition to various apartments, is the old chapel of St. Csalis, which dates from a much earlier period; a view of it can be seen in Androuet Duchesne.

The east side of the court is the building erected by Louis XII.; it is of red brick, with window dressings, string courses, and enrichments of stone richly carved; above, rises a high roof formerly created with gilt metal work, from which project dormers in stained beautiful tints. The whole roof contains a sort of cloister; the stone pillars being disordered with trellis work, in which were formerly feuille dorée and cornices. This quarter contains the chapel of King Louis XII., which, though now under one universal coat of whitewash and all in the occupation of soldiers, were formerly fitted with regal splendour.

Here, in the year 1549, King Louis XII. received in this building the Archduke Philip of Austria, and a chronicler of the period gives a most complete and interesting description of the palace as it then appeared. The east front was then just finished, its network of stone shown in all its brightest freshness on its bright brick ground; the carvings were seen in all their perfection; a profusion of feuille dorée and cornices, sculptured or painted, were spread over the building; gold, purple, and azure dazzled the eye in every direction, even up to the roof, whose crestings and enrichments were also gilt; over every door was seen the royal badge of the porcupine spreading out its quills, and the arms of France; the majority of the statues that decorated the palace were bronzed with heraldic shields, paintings, and devices; the joists of the ceilings (for they were unplaned then) glittered with gilding and elegant decoration; furniture, carved with the utmost delicacy of finish; beds, covered in the richest stuffs, embroidered in gold and silks of all colours; these ornamented the apartments. And if we recall the salutary thought of Francis I., in the midst of all that was gay and joyful there was painted, as was usual then, the celebrated dance, Macabres, on the walls under the piazza or colonnade.

The king was proud of his palace, and royal dignity did he receive his visitor. Our chronicler, after describing with much interest the magnificence of the decoration, the grandeur and pomp of the court, and the ceremonials of introduction to the king and queen, continues his description of the apartments of the palace.

"The Grand Hall, by which the archduke and duchess entered, was of great size, and hung with a tapestry of the Destruction of Troy; on each side was a further room, and on the front a chapel at the end of the hall. The room where the king dined, and where the archduke was, was hung with a tapestry of a battle. Over the chimney was a grand mantle of cloth of gold, creped very rich. The chamber of young Madame Claude was next to the king's, and was hung with a tapestry of pastori, all small, with inscriptions, which was very fine. To the right of this from four to six beds came the chamber of the archduke, hung with a cloth of gold and silver, and in the middle of the room were strange beasts and birds, with figures from foreign countries; and in a side room was a bed, all dressed out with cloth of gold, and above the bed a canopy of crimson damask. In the lodgings of the archduke there was a gallery, hung with tapestry of the deeds of the Trojans; after that a grand chamber, hung with tapestry of the actions of Alexander the Great, and a mantle over the chimney, of cloth of gold, creped. From one of this room hung two chandeliers, marvellously large, of silver, made crossings, for placing on each four flambeaux, which chandeliers hung by great chains of silver. At the end of this room was the chimney, with the archduke's and the gentleman's seat, which was hung with cloth of gold, wove with black and red. Here were two beds, of which the one in which they slept was of stuff embroidered in gold, and curtains of the same, lined with white damask; and above this bed was a canopy, the top of cloth of gold, the curtain of safety, yellow and red.

"The other bed was furnished in the same manner, and on each corner were overlaid with cloth of gold, and inside them sheets of linen from Holland. All around the beds, and on the buffet were carpets of cloth of gold. In the corner by the bed was a gilt chair, admirably wrought by Italians, of which the seat, &c., was covered with cloth of gold, and the back and arms with a stuff of gold and silver. Before the chimney was another chair, also covered with cloth of gold, and there was carpet of the same stuff under it; also, there were many rich coverlets in the room to sit upon."

And thus goes our chronicler, describing every room: one hung with crimson velvet embroidered with E's and A's, crowned; another with crimson embroidered with cords and the arms of Burgundy,

July,
of its ornaments; the stair door-frame is decorated, and has over it the salamander in flames, the badge of Francis I. The ceiling here, as in most of the rooms in this building, is formed of beams, which are, in fact, the floor-joists of the room above; the effect of these, in conjunction with the lightness of the other parts, is by no means unpleasant. I made a sketch of the decorations lately executed on this ceiling, in which the initials, arms, and badges are mingled, with forcible contrasts of colour; whether the precise pattern is a restoration or not, I had no means of discovering; but there are many old examples of this mode of ornamenting the ceilings still remaining at Chenonceaux, Fontainebleau, and other places; and in Venice, almost all the older palaces have the ceilings decorated in this way, with arabesques and isolated ornaments of great variety and beauty. The walls of this chamber are now bare, so they are all, in fact; nothing now remains of the splendid that dazzled the eyes, or the works of art that delighted the mind, during the time of Francis I. We pass from this rich and variegated ap- solute alike—each has suffered the distressing calamine of whitewash—not a vestige of furniture, not a hanging remains. The chimney-pieces alone attest the magnificence and beauty with which the remain-der must have been ornamented. I anticipated the pleasure of sketching these, which possess a rich fund of renaissance art, but a custodian abruptly prohibited my making further drawings; and I was thus prevented taking many details in the interior that might have proved interesting. The state-rooms seem to have been situated on this court-side of the building; and on the other, looking towards the river, were the large bedrooms of the princesses and of the queen; amongst the others the petit appartement. In this the walls are covered by carved panellings, the details of which are executed with much spirit and taste.

Again mounting the open staircase, we reach the floor above, the disposition of the rooms on which is exactly similar to the one we have left. These were the apartments occupied by King Henry II. You enter first the Salle des Gardes, which served also as a council chamber; from hence you pass into the king's bed-room, a very spacious apartment looking towards the Place des Jaunes. Here oc-curred the tragedy of the murder of the celebrated Duc de Guise. The cabinet of the king is next this chamber; it is a small room, which still retains some traces of decoration. On the ceiling are to be distinguished slight remains of colouring, and arabesque ornament in fresco may still be seen on the linings of the window recess. On the left of the bed-chamber you enter a sort of passage which leads to the old Tour des Oubliettes or Donjon, of which so many horrors are retailed; at present nothing but bare walls of considerable thick-ness are to be seen.

Above this second floor are a range of rooms in the roof, but these contain no ornamental or interesting feature of any kind except that a most extensive view of the adjoining country is to be obtained from the windows, which look outside them.

Of the west front I have little to say; it is that erected by Gaston d'Orleans, in the time of Louis XIII. As a structure away from this middle age remains, it would probably be admired, but here it is thoroughly out of place. It stands on the site of a part of the ancient château erected by the old Dukes of Orleans.

Before leaving the Château I must not omit to call attention to an old tower, used subsequently as an observatory and astrological study by Catherine de Medici.}

THE PALACE OF CHAMBORD.

Crossing the Loire, you pass along a sandy road through a district of vineyards, till you enter a forest, in the midst of which, and at about four leagues from Blois, lies the celebrated Château de Chambord. It is difficult to describe the effect it first creates upon the mind—it looks so perfectly unlike any thing one has ever seen before. Below the great round towers are small structures that might pass for the strong fortress of ancient date. Above—the wildest confusion and profusion of the most fantastic, the most beautiful, and the ugliest forms, all mingled together, and produce an architectural scene that cannot be imagined.

The building is immense, and has an appearance of extreme grand- ness, stateliness, and solidity.

Androuet Du Cerceau says, "All this edifice is admirable, by reason of its great massiveness, and presents an effect wondrously superb on account of the immensity of work in it." It is said to have been begun to be built by Francis I after his return from Spain, in the year 1517, and that nearly 5,000 workmen were employed on it for many years.

The centre building is in the form of a square, having at the angles four great round towers about 60 feet in diameter. This centre square building is enclosed, as it were, within an exterior court, having at its angles round towers also. Of these, the two in a line with the prin-
principal building nearly resemble those of the centre, with which they are connected by a continuation of the front; and the two towers at the other extremities are smaller, and connected with an insignificant range of buildings for stables, offices, &c., and which, though built by Mansard, in the time of Gaston d'Orléans, are a complete eye-sore compared with the more ancient building.

I believe it is unknown who was the architect of Chambord. Prima- tiocio has been mentioned, and it seems to me likely to have been designed by an artist accustomed to flights of the imagination, rather than by an architect who would have studied greater appropriateness in his forms.

Though it is not so stated in any account that I am aware of, I cannot help fancying that the round towers must be the remnants of some older building, so completely does the plan resemble the inclosed strong-hold, the old maison-forte of the earlier middle ages.

Three ranges of pilasters of almost regular intervals, girt the external face of the principal building, which is partly relieved with open galleries; above these is an entablature, showing the same kind of machicolation and shell-work as in the building of Francis, at Blois; and above the cornice is a balustrade, which girt the platform on the roof. Towards the interior of the court, the architecture possesses more variety, and at the two angles is an open staircase of beautiful design, resembling the one at Blois.

But the roof is the glory of Chambord. The whole top of the building is one grand terrace, paved like a marble court.

Immensely pointed roofs, more than 50 feet high, rise above the towers, and are ornamented with magnificent dormers and gables, intermingled with elegant chimney shafts and towers, decorated with niches and flanked with columns in most beautiful proportion.

Elevated above all the rest is the grand central staircase of the building (of the interior of which I will speak presently). This, as it rises above the platform, is supplied by columns supporting a gallery, from which spring eight grand flying buttresses, ornamented with gigantic salamanders and supporting the cupola, which terminates in the remains of the famous fleur-de-lis, which gave the name to this crowning glory the "Tour de la Fleur-de-Lis."

To the public views to examine, in some degree, the appearance of this wonderful work; but no drawing can convey the full effect of this labyrinth of palaces, seen at different points of view, as you wander about this magnificent platform.

The various towers and chimney shafts are of most elegant proportion; but the details, though of beautiful design, are rarely executed with the finish of the work at Blois, which they much resemble.

The caps of the pilasters, and the corbels at their base, are of infinite variety. On the gable and the buttress of the central tower, may be remarked dark lozenge and circles, and also a sort of fluting. To these I beg to prefix the date, for the notion that time is a great beautifier is undeniable, they are in fact nothing but pieces of slate nailed on the surface.

The interior arrangement of the château is extremely peculiar. On each floor one vast apartment stretches in the form of a cross, from back to front, and from side to side, of the building; and in the centre of the building there is another vast apartment, rising through every floor, and forming the highest object in the roof above.

In each of the four angles left by the cross is a separate suite of apartments, including also others within the angle towers, and from two of these, again, there is a communication by another suite of rooms with the two outer towers on the same side. The larger cross-shaped chambers are called Salles des Gardes; but I cannot think that rooms of such magnitude, communicating with every quarter of the château, could ever all of them have been intended as guard chambers. I rather imagine, considering that Chambord was erected by Francis I. as a hunting palace, that it was arranged on this singular plan as a place where the king might be laid sault to the rest of the castle and its pleasures.

Their ceilings are vaulted and divided into panellings, filled with the initial F. and the royal salamander in flames alternately. In one of these curious chambers, where scenes of state and ceremony have often occurred, Molière's play of the "Bourgeois Gentilhomme" was represented for the first time, before Louis XIV.

The grand staircase is wonderful—wonderful for the effect it produces and the beauty of its proportion and its ornaments, rather than for any peculiar difficulty of construction. Its construction may be thus described:—the outer diameter of the staircase is, I suppose, about 10 feet; between these two circles the stair wind up in a double spiral, commencing at opposite points, so that parties entering at each, in ascending, see each other repeatedly through openings, but do not meet till they arrive at the various floors. The exterior of the staircase is decorated, and the interior wall is also highly ornamented with a variety of beautiful niches. The salamander in flames and the initial F. are also introduced, the latter surrounded with a frame of ordures—remains of the Cordilliers to which the king's mother belonged. Of the terminus of the staircase there was one—occurrence not yet spoken of.

Of the four hundred and forty chambers which this mighty château is said to contain, there is not one that has escaped the distressing evil of whitewash, and few of them retain any ornament indicating their former use or recalling their former grandeur. I sketched a ceiling of a small vaulted room, said to have been the study in which the poet wrote his "Les Contes des Saisons" and a part of a plaster ceiling of a smaller chamber.

Yet, what must the chambers have been at the time of the royal Francis, who so loved to surround himself with objects of art—what thousands of works produced under his fostering care still remain to us! Who can doubt that the rooms, so wretched now, were one blaze of splendour then? That, besides the paintings of Primaticcio, and the tapestries of Jean Cousin, who were engaged there for years, there were assembled there the choicest works of the greatest masters—groups in marble by the rarest Italian hands; bronze statues of Venus, Apollo, Venus, &c., and the choicest portraits in gold and silver; delicate carvings in ivory; enamels, by Leonard de Limoges; glances from Venice. Fancy that the walls were hung with the richest tapestry, or leather, or brocade—that the ceilings were painted in blue, and gold and gold with glitter and glitter. A taste for art, which is the most beautiful art; which is the most beautiful art of nature; and which is the most beautiful art of the world.

I have said that in the midst of his brilliant court, dazzling the eye with the richness of the costume and the beauty of the ladies—and the mind will indeed conceive a scene at Chambord, in vivid contrast to now what meets the view.

ON THE INDUCTION OF ATMOSPHERIC ELECTRICITY ON THE WIRES OF THE ELECTRIC TELEGRAPH.

By Professor Joseph Henry.

(Continued from page 177.)

4. Powerful electrical currents are produced in the wires of the telegraph by every flash of lightning which takes place within many miles of the line, by the action of dynamic induction; which differs from the action just described, in being the result of the influence of the electric current in the conductor. The effect of this induction, which is the most fruitful source of disturbance, will be best illustrated by an account of some experiments of my own, presented to the Society in 1845. A copper wire was suspended by silk strings around the ceiling of an upper room, so as to form a parallel conductor of about six feet in length. An already apteratic current of electricity was sent through one produced a current in the other, though the two were separated to the distance of 300 feet; and from all the experiments, it was concluded that the distance might be indefinitely increased, provided the wires were strengthened in a corresponding ratio.

That the same effect is produced by the repulsive action of the electrical discharge in the heavens, is shown by the following modification of the foregoing arrangement. One of the wires was removed, and the other so lengthened that one end could be passed into my study, and thence through a cellar window into an adjacent well. With every flash of lightning which took place in the heavens, within at least a circle of the thirty miles around Princeton, needles were magnetised in the study by the induced current developed in the wire. The same effect was produced by soldering a wire to the metallic roof of the house, and passing it down into the well; at every flash of lightning a series of currents in alternate directions was produced in the wire.
I was also led, from these results, to infer that induced currents must traverse the line of a railroad, and this I found to be the case. Sparks we see at the breaks in the continuity of the rail, with every flash of a distant thunderstorm. Similar effects, but in a greater degree, must be produced on the wire of the telegraph by every discharge in the heavens; and the phenomena which I witnessed on the 19th of June in the telegraph office in Philadelphia, I am sure, of this kind. In the midst of the brrry of the transmission of the conformational intelligence from Washington and Philadelphia to New York, the apparatus began to work irregularly. The operator at each end of the line announced at the same time a storm at Washington, and another at Jersey City. The portion of the circuit of the telegraph which entered the building, and was connected with one pole of the galvanic battery, happened then to be at a less than two feet from the wire which served to form the connexion of the other pole with the earth. Across this space, at an interval of every few minutes, a series of sparks in rapid succession, was observed to pass; and when one of the storms arrived so near Philadelphia that the lightning could be seen, each series of sparks was found to be simultaneous with a flash in the heavens. Now we cannot suppose for a moment that the wire was actually struck at the time each flash took place; and indeed it was observed that the sparks were produced when the cloud and flash were at the distance of several miles to the east of the line of the wire. The inevitable conclusion is, that all the exhibition of electrical phenomena in the telegraph line during the afternoon was purely the effect of induction, or the mere disturbance of the natural electricity of the wire at a distance, without any transfer of the fluid from the cloud to the apparatus.

The discharge between the two portions of the wire continued for more than an hour, when the effect became more powerful, and persisted until the operator requested the safety of the building, connected the long wire with the city gas-pipes, and thus transmitted the current silently to the ground. I was surprised at the quantity and intensity of the current; it is well known, that to affect a common galvanometer with ordinary electricity, requires the discharge of a large battery; but such was the quantity of the induced current exhibited on this occasion, that the needle of an ordinary vertical galvanometer, with a short wire, and apparently of little sensibility, was moved several degrees.

The proximity of the spark was also, as might have been expected, very great. When a small break was made in the circuit, and the parts joined by the fore-finger and thumb, the discharge transmitted through the hand affected the whole arm up to the shoulder. I was informed by the superintendent, that on another occasion a spark passed over the surface of the spoil of wire, surrounding the legs of the horse-shoe magnet at right angles to the spires; and such was its intensity and durability, that the operator was not able to completely stamp out the spark, or cut it down at points in the same straight line as if they had been cut in two by a sharp knife.

The effects of the powerful discharges from the clouds may be prevented in a great degree, by erecting at intervals along the line, and at a proper distance, metal poles, connected with the earth at the lower end, and terminating above at the distance of about half an inch from the wire of the telegraph. By this arrangement the insulation of the conductor will not be interfered with, while the greater portion of the charge will be drawn off. I think the precaution of great importance at places where the line crosses a river, and is supported on high poles; also in the vicinity of the office of the telegraph, where a discharge, falling on the wire near the station, might send a current into the house of sufficient quantity to produce serious accidents. The fate of Professor Richman, of St. Peterborough, should be recollected, who was killed by a flash from a small wire, which entered his house from an elevated pole while he was experimenting on atmospheric electricity.

The danger, however, which has been apprehended from the electricity leaving the wire and discharging itself into a person on the road, is, I think, very small; electricity of sufficient intensity to strike a person at the distance of eight or ten feet from the wire, would, in preference, be conducted down the nearest pole. It will, however, in all cases be most prudent to keep at a proper distance from the wire during the existence of a thunder-storm in the neighbourhood.

It may be mentioned as an interesting fact, derived from two independent sources of information, the flash of electricity have been observed, but designed by the claws of the wire of the telegraph. They had in all probability been instantaneously killed, either by a direct discharge, or an induced current from a distant cloud, while they were resting on the wire.

Though accidents to the operators, from the direct discharge, may be prevented by the method before mentioned, yet the effect on the mass cannot be entirely obviated; the residual current which escapes the discharge along the perpendicular wires, must neutralise for a moment the current of the battery, and produce irregularity of action in the apparatus.

The No. 3 wire, or discharge from the cloud on the wire is, comparatively, not a frequent occurrence, while the dynamic inductive influence must be a source of constant disturbance during the season of thunderstorms; and no other method presents itself to my mind at this time for obviating the effect, but that of increasing the size of the battery, and diminishing the sensibility of the magnet, so that at least the smaller induced currents may not be felt by the machine. It must be recollected that the inductive influence takes place at a distance through all bodies, conductors and non-conductors; and hence no coating that be put upon the wire will prevent the formation of induced currents.

I think it not improbable, since the earth has been made to act the part of the return conductor, that some means will be discovered for insulating the single wire beneath the surface of the earth; the difficulty in effecting this is by no means as great as that of insulating two wires, and preventing the current striking across from one to the other. A wire buried in the earth would be protected in most cases from the effect of a direct discharge; but the inductive influence would still be exerted, though perhaps in a less degree.

The wires of the telegraph are too small and too few in number to affect, as some have supposed, the electrical condition of the atmosphere of the earth, and thus produce the change in the climate, and thus producing a less changeable state of the weather. The feeble currents of electricity which must be constantly passing along the wires, in a long line, may, however, with proper study, be the means of discovering many interesting facts relative to the electrical state of the air over different regions.

REGISTER OF NEW PATENTS.

WAGON COVERS AND WRAPPERS.

Henry Henson, of Hampstead, in the county of Middlesex, gentleman, for "a new fabric, suitable for goods' wrappers, wagon-covers, and other like purposes; and certain processes employed in the manufacture of the same."—Granted November 5, 1848; Enrolled May 5, 1847.

This invention relates to the manufacture of two descriptions of fabrics; one suitable for covering wagons, coaches, or other vehicles, and the other for covering houses, or for covering goods and other materials when exposed to the weather, and for similar purposes. The base of the first fabric is hempen thread; with which is interwoven, when the fabric is being made in the loom, copper wires, or galvanized iron wires covered with thread (but uncovered may be used, if preferred), or the dress of the fabric being to be made as required, or the dress which shall not be liable to be rent or torn. The wires or strips of case may be inserted at one to six inches apart, according to the strength required, and the thickness of the wires or strips; and they may form part of either the warp or weft. For ordinary fabrics, No. 28 wire will be found suitable, and inserted in two inches apart. The fabric is immersed in a vat, filled with tanning liquor, of 12 cwt. of good oak bark to one hundred gallon of liquor; the fabric must be so proportioned to the quantity of the liquor, that for every yard there shall be about two gallons of tanning liquor, and to remain in the liquor for about fifty hours, and kept at a temperature of 150°; it is then removed from the vat, and dried by exposure to the air, or to drying by immersion in a vat, filled with tanning liquor, at a tempera-
of a spatula or brush; the first composition being forced into and through the fabric, and the second laid on evenly and smoothly.

The second description of fabric is made by pasting, cementing, or otherwise uniting a sheet of paper to a sheet of calico or similar textile fabric, which has been previously waterproofed and japanned.

MANUFACTURE OF GAS.

George Lowe, of Finsbury-circus, Middlesex, engineer, for "Improvements in the manufacture of and in burning gas, and in the manufacture of fuel."—Granted Oct. 8, 1846; Enrolled April 8, 1847.

The improvements relate, first, in preparing peat in combination with resin, pitch, oil, fat, or other hydro-carbonaceous matter, and in making gas thereof; secondly, in an apparatus for purifying gas; thirdly, in making gas from coal and other matters, by introducing steam, highly heated, into the retorts used; fourthly, in improvements in Argand gas-burners, whereby the gallery or apparatus carrying the chimney is made to rise and fall on a screw, so as to adjust the admission of the air to the flame; and, fifthly, in manufacturing fuel from peat, by causing dry blocks of peat to be saturated with pitch or other hydro-carbonaceous matters.

The first part of the invention is for saturating blocks of peat with resin, pitch, oil, fat, or other hydro-carbonaceous matters. The peat is cut into blocks, and well dried, and then saturated by boiling it in a square cast iron boiler, about 88 inches deep, with 8 inches of the top; then melted pitch, resin, tar, or combinations thereof, or other cheap hydro-carbonaceous matter, in a highly-heated state, is allowed to flow into the boiler, and heat is then applied; by such means, the hydro-carbonaceous matter penetrates the blocks, and causes them to be well saturated; the time of such process depending on the character of the peat and the sizes of the dry blocks, but generally about an hour is sufficient. When the blocks are saturated, the remainder of the fluid matter is allowed to run off, and the blocks are removed, and a fresh quantity put into the boiler, and the saturated blocks are placed on edge or open shelves to drain, and afterwards made into gas, by being placed into retorts, in the same manner as coal. The patentee prefers to saturate the dry blocks of peat by placing them within a vessel, such as is now used for saturated wood by the aid of vacuum and pressure. When using tar as the hydro-carbonaceous matter, it is advantageous to combine therewith from five to ten per cent of quicklime in the state of powder.

The second improvement relates to an apparatus for purifying gas. The annexed engraving is a section of the apparatus, made in two compartments, weak ammoniacal liquor to be used in the lower one, and water or water acidulated with sulphurous or muriatic acid in the other. These two compartments are each nearly filled with lumps of coke, as has before been done in constructing what is called the scrubber; and the improvements consist of the means of distributing the purifying fluid used. a is a tank of water or other purifying liquid; b, a tank for weak ammoniacal liquid; b', c, are two perforated pipes on axis, the perforations on either side of the axis of each pipe being on opposite sides, so that the fluid of flow in streams will cause the tubes to revolve on their axes and distribute the fluid equally on the coke; the gas rising upwards from its pipe of introduction at d, passes off, partially purified from ammonium, by the pipes; and it is the use of revolving pipes, b', c, which constitutes the novelty of this arrangement of apparatus.

The third part of the invention consists in applying steam, highly heated (after passing through the boiler or generator), into the retorts used when making gas from coal, prepared peat, or other matter rich in carbon. Steam from a steam-boiler or vessel passes through pipes highly heated, in a like manner to that commonly resorted to for obtaining hot blast in the manufacture of iron, which highly-heated steam is conducted by a pipe into any part of a gas-retort most distant from where the gas passes off from the retort. The steam is generated under a pressure about that of the gas, and it flows into the retort freely at the commencement of gas making, after charging the retort, and it is stopped after the most carbonaceous matters have been driven off from the coal or other matter used.

The fourth part of the invention consists of treating blocks of dry peat in the same manner as that described under the first part of the invention for gas making.

STEAM HAMMER.

John Condie, of Glasgow, engineer, for "Improvements in machinery used in manufacturing malleable iron."—Granted Oct. 16, 1846; Enrolled April 15, 1847.

The improvements relate, first, to the arranging or constructing steam hammers, that the steam cylinders have the hammer faces applied thereto and move therewith; and, secondly, to the introduction of malleable iron tubes into anvils and hammer and squeezer faces.

Fig. 1 is a front elevation of the hammer and steam apparatus; fig. 2 a vertical section, taken at right angles to fig. 1; and fig. 3 a plan of the cylinder. The steam is admitted through the valve a and tube b, which serves the piston rod, into the steam cylinder c, and presses on the piston d (which is fixed) and the cylinder top, and raises the cylinder, which is made moveable, together with the hammer e, attached thereto, until the steam valve a closes, and cuts off the supply of steam, and at the same time opens the outlet port f, to allow the steam to escape from the cylinder through the pipe g into the atmosphere; consequently, the hammer will then fall by its weight, and when the steam is again admitted the same operation is repeated. Near the bottom of the cylinder, there is a port, a, to allow the air under the piston to escape while the cylinder and hammer are being raised, and also the air to return when the hammer is falling. When the hammer is required to strike with more force than its weight alone, the throttle valve is fully opened, which causes the air port a to pass the piston and compress the air under the latter, by which additional recoil will be given to the fall of the hammer.

The cylinder is guided by guides r, working in grooves attached to the vertical framing k.

The hammer may also be worked without the air port a, at the bottom of the cylinder; in such case, the cylinder is made longer, and the air under the piston is compressed, as the hammer is raised, until its density is about half that of the steam. When the steam is
allowed to escape by this plan, the compressed air gives additional force to the blow of the hammer.

FIGURED SURFACES.

ARTHUR MILLWARD, of Birmingham, in the county of Warwick, gentleman, for certain Improvements in producing figured surfaces and in relief!—Granted October 15, 1845; Enrolled April 16, 1846.

This invention is divided into eight parts; it consists, firstly, in the following method of producing sunken designs on metallic surfaces:—

The design is painted, drawn, or otherwise depicted on the metallic surface to be ornamented, or it is imprinted thereon by stencilling or transferring; a thin coat of gold, silver, copper, or other metal is deposited by voltaic electricity or other means on all parts of the surface, except those parts covered by the design; and, thirdly, when the plate is removed from the decomposing or eroding process, the parts of the plate left unprotected are subjected to the decomposing process. A similar effect may be produced by at once stopping out all the parts but those required to be matted or deadened, and submitting the plate to the decomposing or eroding process.

The last part of the invention relates to the production of engraved surfaces, sunken and in relief, from which impressions may be taken on paper, cloth, or other suitable material, by the ordinary modes of printing or embossing. If the design is to be sunken, it is painted or otherwise depicted on a plate or metallic surface; a thin coat of metallic plate is next deposited by the decomposing or eroding process, and the parts of the plate thus left uncovered are decomposed or eroded to the required depth. When the design is required to be in relief, the plate first receives a coat of any suitable metal; the design is then painted thereon; and those portions of the metallic plate which are not covered by the design are decomposed, leaving the design standing out in strong and clear relief.

The patentee claims, Firstly—producing of sunken figured surfaces by the combination of painting, drawing, transferring, stencilling, or otherwise depicting the required design on a metallic plate, followed by processes of decomposing or eroding under the action of voltaic electricity, as above described. Secondly—producing of sunken figured surfaces by the employment of a combination of metallic precipitates or deposits with the direct action of voltaic electricity, as above described. Thirdly—the producing of figured surfaces in relief by the combination of metallic deposits with painting, drawing, transferring, stencilling, or other known processes of decomposing objects, and with or without the addition of the process of line-indenting or engraving, as above described. Fourthly—the producing of figured surfaces in relief by the combination of the processes of sunning and scraping out with the metallic deposits, and the direct action of voltaic electricity, or acid or alkaline or other saline solution, as above described. Fifthly, and Sixthly,—the producing of pierced work by all or any of the processes described under the fifth and sixth heads of this invention. Seventieth—process of marring or deadening plain and figured surfaces, above described. Eighthly—the production of figured surfaces, sunken or in relief, for the purpose of printing from or embossing, by the processes described under the last head of the invention.

SHEET METAL AND PAINT.

BARRY PORTER, of Rhode'swell-road, Limehouse, for Improvements in the manufacture of sheet metal for sheathing and other purposes, in preventing the corrosion of metal, and in preserving wood and other materials.—Granted Nov. 9, 1845; Enrolled May 6, 1847.

This invention consists, first, of a mode of manufacturing lead into sheets for various purposes, composed of a mode of manufacturing copper into sheets, and in combining metals to be afterwards rolled into sheets for sheathing and for other purposes; and, thirdly, of manufacturing composition or paints for preventing corrosion of metal and for preserving wood and other materials.

First, for manufacturing lead into sheets, there is to be added to the lead, when in a melted state, a quantity of regulars of antimony, in the proportion of from one to two parts in weight to 100 parts of lead; the same is to be well stirred and the impurities skimmed off, when the mixture may be poured out and rolled into sheets in the same manner as lead.

The second part of the invention is the manufacturing copper into sheets. When the copper is in the refining furnace and just before it is to be run out according to the ordinary process, there is added a quantity of regulars of antimony in the proportion of 1 lb. to about 300 lb. of copper; and at the same time about 2 lb. to 3 lb. of salined soda, heated to such a degree as to be just previous to melting, and after stirring the whole of this mass together and skimming the surface, it may be run out into the moulds; and in the other yellow metal (Mont's patent metal). Take one part of copper and four or five parts of yellow metal, and pour them into a mould of cast or wrought iron coated with clay and sand; and heat the same to a red heat, when
the whole mass will be in a fit state for rolling. Instead of yellow metal, brass may be employed. And the same process may be employed on lead and tin; the last being first poured out, and then the tin, the proportion being four or five parts of lead and one of tin, or tin and lead combined. This sheet metal will be very suitable for water cisterns, &c.

The third part of the invention is for preventing the corrosion of metals, and preserving wood and other materials by combining metals together, and then applying a ready paint on the surfaces of the metal or wood, which paint consists of regulus of antimony and copper, mixed together in the proportion of one part of antimony to two or three of copper; to be well mixed and melted together, and run out into water, and afterwards dried by a gentle heat. Then about two parts of oxide of copper is added, and the whole ground together and melted together during several hours, sufficient to make a thick pasty state. A solution, composed of tar and naphtha in equal parts, is then made, and mixed with the metallic compositions, in sufficient quantity to bring the composition into a suitable state to be employed as a paint.

By preparing two pots in which zinc or lead is employed, antimony in the proportion of 14 part of antimony to 1 part of zinc or lead is to be used; and when tin is used, the proportion is two of antimony to one of tin. These materials are to be first melted together, then poured into water, and ground as before described, leaving out the oxide of copper, and when ground they may be brought into the proportions before named, and then employed as a paint, by mixing with either a sufficient quantity of oil and the setting ingredients, or they may be mixed with the naphtha and tar as before described.

Another composition for the same purpose is prepared as follows:

Take 30 lb. of tar, 50 lb. of pitch, 20 lb. of dried soot, and 4 lb. of tallow or sperm oil, and melt the whole together, adding naphtha to it in the proper quantity; as bringing it into the suitable consistency required for the purposes to which it is to be applied.

Another part of the invention for the prevention of the corrosion of metals, is by immersing sheets of copper or zinc, and also copper and zinc nails, in a solution of muratic acid and other materials in the following proportions: Take about 60 lb. of muratic acid of commerce, 50 lb. of copper, and 20 lb. of zinc; and this regulus of antimony, and mix the whole together, and place the sheets or nails therein, and allow them to remain for two or three days—the solution being at a temperature not less than 70° Fahr.

SCHINKEL'S REMARKS ON ART, ART-CULTURE, AND ART-LIFE.

By Dr. G. F. WAGEN.*

Having been called upon by many artists and art-friends to publish my discourse, uttered on this year's anniversary of Schinkel's birthday, I have undertaken my task the more eagerly, as his remarks possess not only a subjective value, derived as they are from such a man, but may also have a great and real weight for art público, who earnestly desire to strengthen themselves in sentiment and activity.

That gloomy—yet, after all, solitary and free feeling, of celebrating the memory of a noble mind, which that unavoidable transition to higher existence (called, perhaps improperly, death) has deprived us of,—pervades, I am sure, the breath of this solemn meeting. A nature so rich as that of Schinkel, presents always new aspects for consideration. I intend, therefore, to fix attention to some observations, which have been found amply the property of the departed—albeit many cherished leaves; still, most fit to show his character as an artist in a very fair light. I hardly think it necessary to observe, that some slight inaccuracies of diction must not be taken into account; as, in the first place, the handling of the pen may not be considered beyond the province of the forming and original [Künstler]. What these remarks may want in this respect, a certain touch of genius will greatly compensate.

Amongst one of the most distinguishing qualities of Schinkel, by which his great exertion in art has been caused—is his great moral strength, his healthful and spirited vivacity, his rigid, unruffled tendency to progress; on which account, nothing so much as from him as the reposing on one's laurels, the so much wanted isthmus của dignitaries. How much he knew that he knew, and with what masterly powers he discharged all duties on that account, his own words will best illustrate. "The conditions of a perfect existence (Zustände) are real liveliness and stirringness; phlegma, be it bodily or mindly, is a sinful situation for him who lives in a civilised nation—an animal for the philosophers. And thus it was, I think, with my master, who tasted the spending of noble forces, and in which appears the highest tendency of man—a noble sacrifice of noble powers—imparts true interest and edification. Wherever it is seen that a master has taken things too easily, that he has not arrived after something extraordinary and novel, but has abandoned it all in the choice. He is—what is called—very indolent, even if he succeeded in displaying all known form-beauties—he will not over-come, it appears to me, the ennui of the beholder; and such works, however superior in many respects to those of inferior minds, are nevertheless unworthy of him who, as a technical as well as an art world, we are only then really living when something novel is created; and whenever we go too softly on trodden paths, our exertions become ambiguous, as we then have perfect knowledge of what is to be done—do, therefore, something new already; otherwise it will be something second-hand, as it were, a mere repetition. This, surely, is already a half-dead vitality." Wherever we are yet uncertain, but feel the impulse towards, and the presentiment of, something beautiful, which is to be produced—therefore, where there is life, we seek and live vividly. From these reflections I will be explained the often apprehensive, anxious, and even humble temerity of the greatest talents on earth—compared with the bouncing, over-bearing, and self-sufficient contentment of the successful and purse-proud cobbler and handcraft artisans. These forcible expressions of Schinkel are not only most characteristic of the whole art-mind of the departed—but, perhaps, never before has that trepidation and hesitation, those pangs of perturbation, felt in the holy privacy of the man of genius purposes, and his aim is infinitly more attained by approximation—been so truly and consciously expressed as here. If it has been repeatedly remarked, that one of the chief characteristics of Schinkel's art-genius consisted in the combination of the manifold and most present practical creations, together with the unrelated study of the general and eternal laws of art—telos—thereby the follow on principle must be a comprehensive work of the great artist, and will show how early he felt what others never do.

I perceived, when I began my architectural apprenticeship, a great treasure of forms, which, for scores of centuries past, have guided nations in the various phases of their understanding, and culture of the buildings and structures. But I saw, at the same time, that our use of this treasure was arbitrary, and that what produced a most pleasant effect in its primitive usage, was quite inappropriate in its present application to structures of this age. Especially clear became the conviction to me, that in the arbitrary form-giving—the real cause of want of character and style in so many of our modern structures is to be sought for. It became a vital question with me to arrive at the bottom of these anomalies, and to the deeper penetration on this topic, the high comprehensiveness it appeared to me. At first I fell into the error of pure, fundamental abstraction, and developed the whole idea of any given structure from its nearest trivial object and scope, and the three laws of condition, following this course, dry and stiff without anything in freedom, and excluding the two grand elements of architecture—the historical and poetical. I further inquired in how far the mere rational principle be sufficient for fixing the mere mechanical and trivial basis of an edifice, and how much there is required of the influence of the historical and poetical to elevate it to the conception of an art-work. It became clear to me, that I had arrived at that point in architecture, where the real element of art is to be placed, which, in every other respect we put aside, but a trade with a scientific basis—a way of working and comprehensiveness it appeared to me. In this stage of thought, here, in any other art, the dogmas of a doctrine became difficult to be uttered, and were perhaps reducible to a culture of feeling and intuition—qualities on which the mind is, in architecture, a very wide circle, and require to be much and most varied developed, if their products are to yield great results.

It appears to me necessary to ascertain properly the different spheres in which the feelings and intuition of the architect are to be developed, which will also enable us properly to survey the extent of this art-branch.

We have, therefore, to consider, first, what are the desiderata of our time in architecture; secondly, a retrospect on previous periods will show what has been thus used for similar purposes, and at last that (considered in perfection) may be useful and adequate now. Next, the modifications of approved expedients are to be properly weighed. It is, however, chiefly necessary, that (fourth) we inquire how imagination has to act in the assimilations, and adaptation of these expedients—how, even without producing, it is to be treated in form and essence. This, however, is to be done thus, that it may still possess some historical basis, and that the conception of the new may arise without taking away the impression of an architectural style—by which the truest feelings of art and something primary, even ingenious, will arise in the beholder.

From this it is to be seen what general path Schinkel has traced out for a society of genius. But for complete success, he has pointed to several abstract intuitions—form the principles according to which the artist has to act, to be deduced. These intuitions are the hidden point of crystallisation (punctum solis) of every mind destined for, or tending after, greatness. *

* It may be said, that such remarks are unprofitable, as we cannot attain profit by them, in the sense of a gain; but in another, every one may reach as high as he can. "It is undoubtedly superiority to know one's own inferiority," and to wisely co-ordinate ourselves to our powers. The young men who are ever inquired after art and must be conceived, would, be, and pretending. [Dr. Wagen.]

* May appear still more disagreeing than the previous remarks. Our dependancy, however, would not make things different from what they are. It is once in a hundred years or so, that great talents arise, it be in architecture, or otherwise. Fine, like other things, will be left at times, but never driven. [Dr. Wagen.]
of the other hand, a most detailed study of the architectural forms of all times and ages, had brought Schinkel to the idea, that the intuition of true principles of art-style had never started so clearly, harmoniously, and safely as with the Greek schools. This, together with the idea of making himself a real architect, had formed a completely new, and the most intimate sympathy. And thus, in another of his fragments, he says—"The real study, especially an assiduous exercise of imagination on the terrain of classic art, will alone bring harmony in the processes of understanding, which belong to the arts of expression. But it was in many other respects that Grecian antiquity attracted him so forcibly. It was one of the most vivid ideas of Schinkel, to think that the "highest and most general signification (Be-deutung) of fine art was the elevation in the conception and cultivating of men by the beautiful." But this, certainly, has never and nowhere come into practice so extensively—so nowhere been so extensively restored to—as wherever Heilicic existence has taken root in the world. And thence Schinkel, speaking of Hercules and Pompeii, says, "No town, not even the most pleasant where no house was without art; every one was so far cultivated, as to surround himself with art-culture, from which thought, ideas, precept spoke to him—and thence was developed an immense treasure and great depth of thought about himself, which, perhaps, constitutes the very principle of culture (cultur substantia)."—Nay it may be said, that Schinkel's whole life and his tendency in art, were so much identified with the noblest ideas which Heilícic civilization presented—as well as with its various forms of pure and beatific humanity, that both cannot be better expressed by the Greek term, Kallokagathia, which means the innermost (natural) combination of the beautiful and good.

Notwithstanding this enthusiasm for Grecian art, Schinkel, in his capacity and practical sense, the absence of which is so ruinous, with a tendency to the waste of our times, which is evidenced in many of his splendid buildings. Alas, this made him not un-susceptible of the particular grandeur and the wonderful mystery of Gothic architecture, as his restorations of Cologne Cathedral, several of his oil paintings, etc.—nay, even some of his exquisite designs of churches, fully demonstrate.

It cannot be doubted, in fine, that to a mind like that of Schinkel, the immense disparity of the public taste in our times, and those of Grecian antiquity, should have been apparent to him. He was able to elevate himself in the contemplation of art-works, especially buildings, to the standard of general culture or general civilization. In the main, they find only that beautiful and praiseworthy, which is desirable in their own individual climate—i.e., every day work, with a certain degree of completion and nicety, is all they ever require. The novel, grand, and uncommon hardly ever pleases the great mass; and if it does not suit their most obvious convenience, it will meet with most opposition and obloquy." Ushapy house has the genius and the force to serve such paltry purposes; into which, however, nearly the whole of our architectural and structural endeavours are now endeavouring.

J. L. —

1 We think that some of these sayings ought to be inscribed in brass and marbles on some of our public buildings.—[Wagener.]  
2 The components of the German word, "Cultur," are very difficult to be rendered in English.—[Thom.]  

PROCEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

June 3.—Amerob Poynker, Esq. V.P. in the chair.

A communication was read from A. H. Latard, Esq., relative to further Discoveries made by him at Nimroud; particularly as to the fact of the employment of the most Assyrians in the embellishment of their architecture and sculpture; describing the mode of construction adopted, and stating that it had been satisfactorily ascertained that the buildings recently brought to light are of various epochs, and expressing an opinion that many of these were obliged to serve such paltry purposes; into which, however, nearly the whole of our architectural and structural endeavours are now endeavouring.

On the Geometric System applied by the Medieval Architects to the Proportions of their Ecclesiastical Structures." By R. D. Chantrell, Esq.

The chief object of the paper was to prove that in all the medieval structures a general principle of the most perfect and beautiful proportion pervades the whole, and that the system recognized by the modern architect in order to produce the same successful results. That some general principle of composition had been adopted by the medieval architects is an opinion that has been entertained by various individuals for many years past; and attempts have been made by Mr. Rick, Essex, Brown, and others to develop it. Their endeavours have been attended with various degrees of success; but according to the author of the paper no one but himself has succeeded in discovering the true principle capable of uniform application. Mr. Chantrell exhibited a number of plans and other diagrams in elucidation of his theory; and without which it would be impracticable to convey an adequate idea of the system.

On the Effect of Steam on the Repeated Action of Steam." By Mr. J. M. Hippert, Grad. Inst. C.B.

The object of the paper was to deduce a more exact formula than those now in use for the dynamical effect developed by steam in expanding from one pressure to another. The usual method of computing this effect neglects the influence of the variation of temperature, which always accompanies the change of density, and which has been shown to modify considerably the corresponding pressure. M. de Pambourg, however, has, by combining Guy Lussac's formula for the relation between temperature and density under uniform pressure, with that of Boyle for the relation between density and pressure, from the uniform transformation of a gas subject to uniform pressure, and temperature, from which any two being given, the third may be deduced. What was further done in Mr. Hippert's paper, was to combine this formula with that of Mr. Scott Russell, expressing the relation between the pressure and temperature, and by this means to eliminate the latter, and obtain a formula containing only the pressure and density. From this formula another was easily obtained, showing the total dynamical action developed during expansion from pressure to another, and the results were given in a tabular form, exhibiting—

1. The pressure in lbs. per square inch.  
2. The relative volume, or ratio of the volume of steam, to that of the water which produced it.  
3. The dynamical effect before expansion, or the number of lbs. raised one inch by the evaporation of each cubic inch of water.  
4. The dynamical effect during expansion, or the number of lbs. raised one inch by the steam produced from one cubic inch of water in expanding from a pressure of 100 lbs. per square inch to the corresponding particular pressure. The dynamical effect in expanding from any one pressure to any other, must
be clearly expressed by the difference of the corresponding numbers in this column.

Part of the remainder of the paper was devoted to showing that the performance of engines could not possibly be expected to be the result of so-called as above, it should not fall far short of the case in engines of good construction. In conclusion, a simple method was suggested of ascertaining the magnitude of all the forces in action during the working of an engine, and finally, at the point of a perfect vacuum, it would be at a minimum (indeed stationary, were air perfectly elastic), because at that point the expansion would be infinite, but the pressure only finite—viz.: 90 miles of mercury. Experiments made, notably those of Mr. Brunel, with the South Devon Railway atmospheric apparatus, confirmed the theory. The line traced by an indicator apparatus was shown to accord very closely with one traced by this theory, whilst it was widely at variance with the result of the ordinary theory.

[We must caution our readers against placing any confidence in the new law of the motion of elastic fluids, enunciated by Mr. Froude, which seems to be directly opposed to the fundamental laws of dynamics. If we suppose any number of particles acted on by external impressed moving forces, all in the same direction, the motion of the centre of gravity of the particles in that direction will be the same as the motion of the centre of gravity of a solid body of which the mass is equal to the sum of the masses of all the particles, and the moving force the sum of the moving forces acting on all the particles; and this law is true whatever be the nature of the connection between the particles or the mutual internal forces which they exert on each other. In the case of the motion of particles of fluid from an orifice—if the pressure at the orifice is constant, we can see no reason why a fluid discharged in a given time should follow the same laws, whether the fluid be elastic or inelastic. Absurdities of elasticity or non-elasticity involving merely the internal or molecular connexions of the discharged particles. We wish, instead of the brief and not very intelligible abstract inserted above, we had been favoured with Mr. Froude's unabridged analysis. If his views be correctly reported, it seems to us that he has confounded mass with volume; at all events, his results lead to an evident absurdity—viz.: that air were perfectly elastic (as indeed it is very nearly), and the vacuum in a air-pump were perfect, on opening the cock of the receiver no air would flow in. We think that if Mr. Froude repeats his experiments with well constructed air-pump, he will be convinced of the mistake. Let him take as an example, a mercurial gauge, and having opened the cock, note the times of the mercury rising from 0 to 5 inches, 5 to 10 inches, 10 to 15 inches, respectively;—why our ear at once detects the absurdity. Who has not noticed how the hissing of the air, as it rushes through a small orifice into a vacuum, changes from a shrill to a hoarse note? There is no doubt that the law of theory is not fulfilled in practice, but that is owing to the friction— or rather resistance—arising from the particles of air striking with enormous velocity, against the inequalities of the small tube. Whether it is possible—at least in the present state of the art—to make the pressure at the orifice and at the same time reduce the difficulty holds in the case of inelastic fluids— for the motion of which, we refer the reader to a paper in the Journal for April; one or two errors which escaped us at the time, will be found corrected in the Number for June. For the "back pressure," we recommend our readers to turn to the Count de Pambour's valuable work on the steam engine.—[Enron.]

June 29.—"An Account of the Plans that have been Proposed for Connecting the Atlantic and Pacific Oceans by a Navigable Canal." By Mr. Joseph Glynn, M. Inst. C. E.

The author took a review of these projects from the time of Cortes, who proposed to cross the Isthmus of Tehuantepec by joining the waters of the River Coatzococues, which flows into the Gulf of Mexico, with those of the River Chichapa, flowing into the Pacific, by the Bay of Tehuantepec; a plan that was finally abandoned. Later, Don Juan de Onate, with the assistance of Signor Moro, surveyed the country from sea to sea, and showed that the chain of mountains is there broken for about 35 miles, giving place to an elevated plain or table land, called the Mesa de Tarras, about 200 miles, or 056 feet above the ocean. The survey was made by the direction of Don Blas de San Martin Ayme, who professed to grant many important privileges to the promoters. The Isthmus of Nicaragua was next examined, and after that the course of the River St. John to the lake, which is a little more than 15 miles distant from the Atlantic Ocean. The distance and the levels were accurately taken by Mr. Bailey, an officer in the Royal Marines, by desire of General Mariano, President of the Central American Republic. The ridge of hills intervening between the lakes and the ocean, and the uncertainty of the waters in the River Stuart, alternately swollen by the rains, or dried up by the heat of a tropical sun,
the volcanic character of the country, and the unhealthy nature of the climate on this river, from which Lord Nelson's expedition suffered so much, render the execution of such an undertaking at this place very improbable. The Isthmus of Panama presents fewer obstacles than any other point—50 to 30 miles, and the country is traversed for nearly the whole width by the great river of Chagres and its tributaries, which are interlaced, as it were, with the streams flowing to the Pacific. The chain of mountains here sinks into extensive savannahs, interspersed with a few hills, and small elevations, seldom exceeding 200 feet in height. The country was surveyed in 1828, at the instance of General Bolivar, by Mr. Lloyd, an English officer, who also took the levels, and determined the difference between the two courses to be about 7 ft. of the sea level, making it the highest. Mr. Lloyd's valuable papers, deposited with the Royal Society, and the Royal Geographical Society, were exhibited to illustrate the paper. A survey of the River Chagres was also made by order of the Admiralty, during which Captain Rouse, of the Manxman, lost his life. The maps, plans, sections, and other valuable information deposited with these societies, seem to have created but little interest in England; but they have been diligently examined, and extracts and copies taken by foreigners, who have had free access to them. They are all published by French; and M. Guizot lately sent M. Napoleon Garrella, as engi- neer-in-chief, with a numerous staff of assistants, to make a further survey, and ascertain the practicability of making a canal. This survey has fully confirmed the opinion that the progress of shipbuilding and the growth of engineers and contractors of the present day could not encounter and overcome without much difficulty or expense; the difficulties being more of a political character, and to be dealt with by statesmen rather than by engineers.

The meeting was very fully attended, and an interesting discussion ensued, in which his Royal Highness Prince Louis Napoleon took an active part. He had evidently studied the subject carefully on the spot, and traced the history of the plan of a canal, which had been recommended as preferable on account of the local facilities, the salubrity of the climate, the already populated character of the country, and the advantages of the two lakes, which, at small expense, may be converted into harbours. His Royal Highness appeared at the meeting, as far as a ship canal was concerned; but it was agreed that for quick transit by railway, the lines traced by Mr. Lloyd over the Isthmus of Panama might be adopted.

CONVERSATIONS.—The President, Sir John Rennie, gave his two convos- nações on May 29th and June 5th. The latter of these was one of the best conversations of the season, forming a grand union of the men most eminent in science, literature, and art. Additional rooms were thrown open for a small fee, and the personal attention of himself and Mr. Charles Manby, the Secretary to the Institution, to the hospitable entertainment of the guests, made the meetings particularly pleasing. The leading feature in the model-rooms was a grand collection, illustrative of the progress of naval architecture, from the time of the Firth's to the last productions of the Surveyor-General's office.

Next to them came a series, showing what has been done in electric telegraphs and clocks. A mass of electric telegraph lines gave singular evidence of the extension of the art, the latest having been constructed by a recognized body of public service. It is a curious tribe of the age, to note the Times, in a number, complain of the mismanagement of the Railway telegraph, by which they were deprived of their accustomed racing news. The visitors were almost numb with the number of beautiful models for a shipping marine, the most prominent. The Grand Duke Constantine of Russia, being unable to attend in the evening, went with his suite to a private view of the models.

Count D'Orsay contributed some statues of the Emperor of the Russian, Daniel O'Connell, the Duke of Wellington, etc., which were deservedly admired. Paintings and sketches by Landseer, Oliver, Buss, Wood, Scanlan, Digby, Wyatt, Rossetti, and Ward; enamel paint- ings, so good that some of them were purchased by M. Rennie, Ackerman's collection, were profusely scattered throughout the rooms. Taylor, Williams, and Jordan, had some excellent specimens of machine carvings; and Mr. Rogers some delicate examples of cast carving, as seen in the Arts and Crafts Exhibition.

A series of models from the Admiralty exhibited the construction of a 50-gun ship at various epochs. Other models illustrated the most approved forms of bows, sterns, and midship section; and the general lines of the vessels composing the experimental armor were contrasted by a series of uniform models. The wave principle was illustrated by models from Mr. Scott Russell and Dr. Phipps; and the progress of the steam navy was exemplified by models of vessels and engines, constructed by Messrs. Ramage, Gardner, and M'Cullagh. Mr. M'Cullagh, Mr. Rennie, Woodroffe, Hays, and Munday, Models of Brunel's block machinery, and Hurwood's patent scuttle, were appropriately introduced.

All the various systems of electrical telegraphs were represented, and at work; the electric telegraph, the submarine electric telegraph, the electric's single-wire telegraph—the Electric Telegraph Company's system, as used at the Admiralty—Brett and Little's apparatus, and Brett's writing telegraph, in which, by depressing a series of keys, corresponding letters are brought into contact with a continuous strip of paper, and the communi- cation is printed at any number of miles direct.

Mr. Cowper contributed a series of models of the old French and other telegraphs, in order to form a contrast with the present instantaneous methods of communication.

There was a series of models of bridges of all kinds, amongst which we remark a model of Mr. Greathead's corrugated cast iron, erected by Mr. Barlow on the Tun- bridge Railway.

The wrought-iron tube bridge, by Mr. R. Stephenson, at Conway, beautifully shown, on various scales, by Saller's elegant card-board models.

A cast-iron girder bridge, by Mr. Borthwick, of the same construction as that over the Dee, at Chester.

The drops for landing coal vessels at the Butte Dock, Cardiff, by Mr. Borthwick, appeared to be an ingenious modification of the system used in the north.

Stephenson's long boiler locomotive, Bessemer's axles, Dunn's turn- tables, Stevens's railway signals, and Clarke and Varley's new atmos- pheric railway tube, formed an interesting series of railway models.

Cochrane's machine for sawing out carved timbers of all forms, without waste, was worked, and was universally admired. It was stated that these efficient machines were now being introduced into the royal dock- yards.

Little's new printing machine, by which the number of sheets now dispensed, great as the quantity seems, can be doubled, was also at work, and excited much attention.

A revolving disc, made by Tompson, in 1870, and presented by Charles I. to the Duchess of Cleveland, was exhibited by Mr. Vallumly.

M. Praget contributed some extraordinary specimens of gold electro- deposit for ornamental work for clock cases, etc. It appeared from the specimen that this introduction would make a great diminution in the price of this kind of work.

A collection of fossils, from the Oxford clay, at Towbridge, made by Dr. Mantell, during the excavations on the line of the Wills, Somerset, and Mr. Mantell's new machine for the separation of the bones, as did as two casts of impressions of the feet of some unknown species of animal, found in the new red sandstone in the United States, and recently transmitted to Dr. Mantell.

A revolving disc, made by Mr. Fondec, for rendering uniform the circular revolution, under considerable variation of the maintaining power.

Ottis' American Excavator, which was worked on the Eastern Counties Railway, by Mr. Hyde, and that of Messrs. Barber, Brothers, invented by Colman and Hunt, and in competition for dredging the port of Toulon, were placed with Prideaux's Excavator.

A model of the Somerset-bridge, of 110 feet span, by Mr. Brunel, on the line of the Bristol and Exeter Railway, an example of the strength and simplicity which may be attained by well-constructed cast-iron bridges.

Fuller and Dérécque's application of thick rings of vulcanised India rubber, alternating with metal discs, to form buffer springs for railway carriages.

Davison's system of cleansing casks, as used at Truns and Hanbury's, and other breweries.

SOCIETY OF ARTS, LONDON.

At the Annual Meeting, which took place on Thursday, June 10, in their Great Room in the Adelphi,—H.R.H. Prince Albert, as President of the Society, sitting the chair, the floor being crowded by a crowded and enthusiastic meeting, the President ordered the honours which had been awarded to authors of important works or inventions in arts, mechanics, and manufactures submitted to the Society during the past year—and many of them exhibited at their last Exposition. The list of medals, &c., awarded on the occasion is as follows:

The GOLD MEDAL to Messrs. Davidson and Smyth, for their method of applying Currents of Heat to Air to Seasoning Timber and to the various Manufactures—Messrs. Davidson and Smyth, for their invention of a process for seasoning timber. To Mr. Thomas Dayman, for his new process of Silvering Glass with pure Silver—and John Everett Millais, for his process of Glassing with Silver.

The GOLD 1858 MEDAL, to Messrs. Richardson and Co., for their specimens of Rorrer-colours on Glass—Thomas Brown Jordan, for his Machine for Carving Wood, and his new machine for Carving Wood; and decorative purposes—Mr. Henry Granger, for the best specimens of White Earthware—Messrs. H. Minton and Co., for the best specimens of Stoneware—The same, for the best specimen of Green Colour on Glass—the same, for the best specimen of Green Colour on Porcelain.

The Large SILVER MEDAL and 101. 10s., to Messrs. D. Pearce and C. Worrell, for their design and model of a Lamp-Pillar—Mr. Charles Meigh, for a model of a Lamp orna- mented in relief—and Mr. P. Abate, for a means of Preventing the Emission of Noxious Vapours from Sewers. The same Medal and 101. 10s., to Mr. John Stoddard, for his design for a Roller Window Blind—Mr. Daniel Pearce, for his design for Printing on China—Mr. John Philip, for his design for an Earthware Mug ornamented in relief—Mr. Seckley, for his design for a Geometrical Stamped Mug—and Mr. J. Austin, for an Original Composition, and specimen of Stained Glass. The same Medal and 101. 10s., to Mr. G. J. Gom, for his Composition of Art for Carving and Design, for his Block Printing in Pattem—Mr. Edward Keys, for his model of a Mug ornamented in relief— Captain Carter, for his method of Stamping a Number of Mugs at a Time—Messrs. McWeth and Finny, for their Block Printing in Pattem—Mr. C. J. Varley, for an Apparatus for facilitating the use of tools for Stamping Mugs—Mr. John Lewis, for his Composition of Art for Carving and Design—Mr. George Cross, Oxford—Mr. W. Ford, for his Original Model of a Figure of Nebuchadnezzar—Mr. J. Austin, for his Original Figure of a Woman from the Bust, and his Original Figure of a Man from the Bust—Mr. Mabel of a Figure of Mercury—Mr. Waterhouse, for his Portable Level—Mr. J. Walker, for his Model for a Sewer Trap—Mr. Chadley, for his Plan for Preventing the Emission of Noxious Vapours from Sewers—Mr. H. Burrell, for a Cabinet and an Original Model of the Figure of Hercules—and Master Alexander Stanesby, for a Chalk Drawing of Apollo from the round.
THE DECORATIONS OF COVENT GARDEN THEATRE.

Mr. Leaues* reads a paper at the Decorative Art Society on the Decorations of Covent Garden Theatre, 1847, considered in their relation to art. Alluding to the practical difficulties to be overcome in so brief a period, he said, that he did not write about some of the most striking and some of the most excellent, but those on which he was informed. The material was so varied and of such a nature as to be very difficult to work into a regular and harmonious whole. The material thus disposed of was to be seen at the exhibition, and was described as being composed of the refuse part of flax, held together by a bituminous matter, and pressed into sheets into inorganic moulds, producing thereby a base-releve surface at rather less expense, and of greater lightness, than paper, mache and similar substances. The author considered this material a useful auxiliart in decoration; but in the present case, the distance at which it is placed from the point of view, together with the indiscriminate colouring and an excess of carved gilt, confirm the interest which under favourable circumstances, it is supposed to possess. Mr. Leaues complained of the gloomy and heavy tone of red and shadow pervading the boxes—the divisions being covered with crimson and maroon figured paper, with a crimson carpet on the floor, crimson curtains and valances; while the light impinging over a smoothly stuffed cushion in front covered with crimson silk, diffuses a red glare by no means favourable to the appreciation of colour elsewhere. The arrangement of the curtains and valances was said to be meagre; and it was assumed that the whole had been intended to offer a quiet effect, with a reliance on the value of the silk for imparting respectability. The ground on which crimson had probably been selected for these purposes were diversed.

If as a background to a picturesque development of the audience, it was said that it totally failed—and if with reference to the effect of the general interior decoration, the one word which could condense all the processes in one—the effect of the horizontal stripes in white and heavy-toned red in harmonious colour, placed moreover without apparent vertical support. The carved fronts to the boxes were not considered equal in respect to form and finish, and the general effect of carved paper was found to be as well as usually gilt, but an excess of carved gilt being nothing to relieve. It was argued that gilt ought to be burned only in a very slight proportion when placed on a white or a light coloured ground; and that the burning of this case completely confused the delicate warm-releve forms of the frames. The ceiling, it was observed, is an agreeable repute to the eye in the circular range of graduated green with the full-toned browns prevailing in the marginal decorations. The general effect of the clothing throughout the embellishments is influenced in a remarkable manner by the crimson boxes in which the spectator is placed; and this, it was argued, constitutes the key-note to which other parts refer but little accordance. It was suggested that a charming effect might be obtained by the application of different colours for the curtains of the respective tiers—alternating divisions in the boxes ought to be a neutral colour, and by the character, treatment, and propriety of selection in various details of the embellishments on the box fronts were described and commented upon. It was said that forms of ornament prevailing at almost every period had been applied—ancient Greek, Roman, Renaissance, Louis XIV, Louis XVI, and modern French combination, had each its own charm, but that the new order was not to be condemned. In the movement arrangement, the attributes whose aspects they were; while the ceiling itself, which it was stated is almost the only portion partaking of artistic manipulation, owes its merit to examples of Le Brun. The introduction of new materials in base-releve ground, and sometimes ingenious arrangements in the boxes, the ingle, whereby the alleged subjects appear in abundance, were considered to mark the loss of skill between the artists of that and those of the present period.

We do not by any means concur with Mr. Leaues in his sweeping conclusions. We cannot see how the lining of the box can serve as the key-note to other decorations, and it has never produced that effect on us. We likewise differ from him as to the effect of the crimson as a background to the audience, for we agree with those who hold that it ad

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THE STEAM JET FOR VENTILATING.

Professor Paraday, in a former lecture delivered at the Royal Institution on Mr. Barry's method of ventilating and ventilating the new House of Lords, it was noticed that the most effectual means for securing a continuance of steam of high pressure steam in the ventilating shaft of that building. At a recent meeting Mr. Paraday explained the physical conditions of such a steam-jet, and the relations of the vapour discharged from it to the surrounding air.

More than forty years ago, Dr. Young (Nat. Phil., vol. II., p. 334) had shown that wherever an elastic fluid was forced from a jet with but small velocity, the steam proceeded for some inches without observable dissipation, and then directed into the air, but that when the pressure on this was increased, the apex of the cone approached the orifice of the jet; but whatever might be the amount of this pressure, the form of the cone continued the same. Mr. Paraday proceeded to notice the lines of motion of the particles constituting this cone of vapour. The rings of smoke produced by the combustion of bubbles of phosphorescent hydrogen on the surface of water were exhibited. The revolution of each of these hollow rings on the axis of the cylinder which forms it was pointed out, as was their gradual expansion when rising into the air and it was shown that each of these enlarging rings might be viewed as a magnified element of the cone of steam issuing from the jet. In the same class of effects Mr. Paraday placed the rotating clouds of smoke which are seen issuing from the chimneys of steam-boats, &c. The force of which the parts of the surrounding cone of steam produced by a powerful jet were drawn towards it, is shown by various striking experiments. Hollow balls of 1 and 2 inches diameter were blown drawn into the cone, and sustained floating in the line of its axis, even when, by an arrangement of the apparatus shown, the jet was brought 35° out of the perpendicular. The jet was 18 inches long and 1 inch diameter, having one extremity plunged into water and the other end drawn into a capillary jet was visibly exhausted of its contained air (the water being drawn up from the lower end of the tube) and the capillary jet was placed within the in-draught of air occasioned by the cone of steam. In closing this part of his subject, Mr. Paraday explained the use which has been made of a cylindrical or conical jacket to include this steam-cone, and thus to increase the draught-power of the jet. In the arrangement adopted by Mr. Paraday for ventilating the Houses of Lords, this jacket is the ventilating-shaft itself; so that there can be no room for the entrance of air to form a downward current in the shaft. This mode of moving air has been adopted in lead-work and other manufactories, for the purpose of washing and condensing the steam, and for the removal of the condensed water. Noticing the coolness of the high-pressure steam, even near the orifice of the jet, as being due to the quantity of cold air rushing towards it and diminishing its temperature, Mr. Paraday connected with this and the other phenomena the experiment of M. Clement and Dison. It is shown that when steam, under high pressure, is allowed to escape from an orifice pierced in a plate, and a flat disc is brought close to this plate, the plate and disc are made to adhere together. In this case, the elastic force of the steam issuing from the jet, and which tends to separate the plate and disc, diminishes rapidly in its course from the centre to the edges of the disc. At the same time, the radial currents by their in-draught, as before illustrated, bring the two plates together with a power which is so much greater than the former that the surfaces adhere. Mr. Paraday finished by noticing the danger of conical safety-valves in high-pressure boilers, when the lateral expansion of the conical surface is large in proportion to the sectional area of the steam passage.

TIRES OF RAILWAY WHEELS.

The following remarks have been communicated by a correspondent (" X. Y. Z."), to the Railway Record. "It was given in evidence, at an important meeting held to decide upon the fatal result of an accident occurred on the Great Western Railway, that the fracture of the steel tire of the driving-wheels of some of their locomotives was by no means an unusual occurrence, and that even those made in baso-releve ground, and when the ingle, whereby the alleged subjects appear in abundance, were considered to mark the loss of skill between the artists of that and those of the present period. These steel tires are inserted into the iron wheel; and being let in hot, it appears to be assumed that the sludge hammers of the forgers will cause the two metals—steel and iron—to properly welded together. Now this I venture to dispute; on the contrary, I am convinced like a real cementation of the two metals will be effected. If this assumption

*Mr. Leaues
be correct, it necessarily follows that the iron felloes of the wheel will be surrounded by a distinct steel hoop. Now, the transverse section and body of hoop is very small, compared with that of the felloes, or iron rim, of the wheel—consequently, under the enormous pressure of a Great Western locomotive, the steel hoop will have a tendency to roll out longitudinally more than the iron rim of the wheel; and, so rolling out or stretching, it must either fracture the felloes, or the iron rim itself, if it is let into its dovetailed bed very tightly; or, if there is any looseness in the former, the hoop will roll out vertically, not having the same diameter as the felloes of the wheels. If this latter be the result, we know that the wheel and the steel tire cannot, without a jerking back of the tire, make the same number of revolutions in any given distance. A tire so enlarged, on an iron wheel, will, when the wheel is in revolution with a heavy load upon it, be rolled down tight into its bed at all points behind that of its contact with the rail; and, at all points before that, it will be thrown partly up and forward out of its bed, by so much as it is larger in diameter than the felloes of the wheel. But when, from any cause, the steam is not increased in the engine, or at some portion of its bed where the steel rim fits tighter—which kind of slipping of the larger outer rim on the smaller inner one, can no longer be maintained, the outer, that is the steel rim, must snap, and its fractured pieces frequently fly through great force. It is stated that these tires sometimes snap when the engine is not in motion. Here the laws of expansion and contraction, probably, come into action. Supposing a steel tire not to have been rolled out, as previously assumed, in running; then, when the engine comes to a state of rest, the wheel will begin to discharge into the atmosphere the extra amount of heat it has acquired during its rapid journey; and, though the contractive forces of iron and steel are, in like conditions, nearly the same, yet, the tire being the outside, will cool faster, and contract at first more than the body of the wheel; and it will be likely enough to snap, particularly if the hardness of the steel is considered. The converse of all this even might account for the flying off of those tires when running, without supposing there were any roll out of the metal under the enormous load of the engine, with all its hammering on the rails. Now, if the cementation of the steel tire and the iron felloes of the wheel were perfect, the risk of all such accidents would seem to be obliterated; and this occasions me to mention, that I some time back observed, on a patent that had been laid by an ingenious gentleman—I think of the name of Sanderson—for welding a steel plate, of sufficient thickness, on an iron bloom, and then rolling out into bars. In fact, it seemed to me that this was a plan for plating iron with steel, precisely on a similar method with that of plating copper with nickel, as long practised in the well-known Sheffield plated ware. I have not been in the way of learning whether this patent has been successfully worked out; but it appears to me it might be well worth the while of any railway company using steel tires to inquire."

**Notes of the Month.**

Avignon and Marseilles Railway.—A serious disaster has occurred on the new line of railway between Avignon and Marseilles, which was just ready to be opened. The viaduct which carried the railway over the river Neuvière, one of the principal watercourses of the country, and which was the subject of this event had not reached Paris, but it appears that no lives have been lost. The damage to the company will amount from two to three millions of francs.

Crimpic Viaduct.—This magnificent viaduct will, when completed, form one of the most wonderful of the achievements of railway construction in the kingdom. Its massive towering piers are now all reared, and its lofty expansive arches, stretching their wide concavities across the deep glen, will shortly be brought to a close. Those of our readers who may be unacquainted with this structure, may feel somewhat interested by a brief description of its situation, and an accurate admeasurement of its gigantic form. Its situation is about a mile to the south-east of Harrrogate; it is intended to convey the Harrogate and Church Fenton line of railway over the large and wide valley of the Crimple Valley. The viaduct consists of 25 arches, each of 22 ft. span, and the loftiest is 180 ft. in height. The piers on which they rest, 39 in number, are about 30 ft. each in thickness at the base, and are composed of immense blocks of hard granite. The top of each pier, immediately beneath the springing, is 8 ft., and the quoins 4 ft. in thickness. The abutments are thickly flanked, and joined by lofty embankments. The line at the south end is carried through a long deep tunnel; while at the opposite extremity it proceeds along a deep rocky cutting. The whole of this ground is rocky. Between the first and second buttresses at the south end runs the line of the Leeds and Thirsk Railway, which is carried along the mountain side a considerable distance, and afterwards thrown across the valley by another viaduct, which, however, is diminutive compared with this noble and vast structure. The part of the valley over which the monster viaduct is thrown, is a beautiful and romantic little defile between two high rocky mountains, whose steep and rugged sides are covered with a profusion of heath, brushwood, and other kinds of vegetation, indigenous to the mountain soil.—*Harrods Herald.*

The Exhibition of Oil Paintings at Westminster Hall, must be looked upon as satisfactory on the whole, while the awards of the Commissioners can scarcely be impugned. The works are 150 in number. The 1901 prizes are given to Mr. Armitage, for his Battle of Meaux, a most spirited work; to Mr. F. R. Pickersgill, for the Burial of Harold; and to Mr. G. F. Watts, for his Sketch of Alfred insetting the English to meet the Danes at Sea. The 1901 prizes are given to Messrs. John Cross, P. F. Poole, and J. Noel Paton. The 2001 prizes are given to Messrs. J. E. Lauder, Charles Lucy, and J. C. Horsey. Among the remaining meritorious works are those of Mr. S. Gambartetella, Mr. Wm. Cave Thomas, Mr. Sadler, Mr. Crowley, and Mr. Branning. The most definite is in the choice of subjects, showing the want of liberal education on the part of the artists; it was not so in the middle ages; but now the artist thinks he need only study with his pencil, that he can learn enough by his own observations, without having recourse to the study of others. The paintings of "art-cultus" and artistic teaching had better look to this.

The Opening of Hartlepool West Harbour and Docks, situate near the village of Hartlepool, about a mile and a half to the south of Hartlepool, and consists of an inner and outer sea-port, having two male and two female docks, made of about eight acres of water, and has substantially built quay walls on every side, and in cases of danger is calculated to afford a conveneient place of shelter and security for a large number of vessels. The harbour comprises two thousand acres of water and two bold piers jetting into the sea, the whole built in the most solid and substantial manner. Vessels can always be afloat in the dock with twenty-three feet of water, if required. A graving dock has also been commenced.
LIST OF NEW PATENTS.

GRANTED FROM MAY 23 TO JUNE 24, 1847.

Six Months allowed for Enrolment, unless otherwise expressly provided.

Henry John Nocoll, of 114, Regent-street, Middlesex, tailor, for "Improvements in garments, and in pockets, bags, caskets, &c., especially those of May 29."

William Bridges Adams, of Old Ford, in the county of Middlesex, engineer, and Robert Richardson, late of Mannheim, in the county of Hesse, now of Hackney, in the county of Middlesex, for "certain improvements in the construction of bridges," May 29.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for "a new and useful mode of forming or manufacturing more than one-third of the machinery, preparations, or other solid or liquid preparations." (A communication.) May 31.

Henry Leaver, of Great Portland-street, W. Middle-end, Middlesex, for "Improvements in dyeing and straining silk, and in starching plait." May 31.


Christian Schlae, late of Frankfort on the Main, but now of Manchester, for "certain improvements in machinery or apparatus for converting steam, which said improvements are also applicable to similar purposes," May 31.

Alfred Stevens, of 5, Queen’s Terrace, Saint John’s Wood, Middlesex, chemist, for "a new or improved preparation or preparations of certain substances for making various objects," May 31.

Pierre Arnaud Le Comte de Fontaines Demesse, for "certain improvements in the manufacture of silk," May 31.

Alfred Stevens, of 5, Queen’s Terrace, Saint John’s Wood, Middlesex, chemist, for "a new or improved preparation or preparations of certain substances for making various objects," May 31.

Francis Bernard Bakker, of No. Royal, Kouterloër, Brussels, in the kingdom of Belgium, for "a process of increasing the quantity of cream procured from milk, and preserving milk," May 30.

William Hors, of Leog-acres, Middlesex, coach-maker, George Brandon, of Battersea, and Andrew Smith, of Mill Hill, Middlesex, engineers, for "Improvements in wheel-carriages." May 30.

Joseph George Jenings, of Great Charlotte-street, Blackfriars, for "Improvements in water-pumps and in the constructions of pipes." May 30.

Christopher Nicholas, of York-road, Surrey, gentleman, for "Improvements in the manufacture of woven fabrics, and in giving elasticity to certain articles of fabrics." June 3.

Charles Larrard, of Leominster, machinist, for "Improvements in machinery for cutting wood for the manufacture of bobbins and other articles." June 8.

Henry Cox, of No. 2, Chappel-place, Battersea, Surrey, for "Improvements in the preserving and preparing of wood, bricks, tiles, and other substances." June 10.

Bony Askell, of Rotherhithe, in the county of Surrey, printer, and Abraham Solomon, of the city of London, merchant, for "certain improvements in the manufacture of charcoal and other fuel." June 10.

William Darling, of Glasgow, Scotland, iron-founder, for "improvements in moulding, and in the manufacture of certain articles of cast iron." June 12.

Charles Richards, of New York, engineer, for "Improvements in the construction of locomotive cars, to be used upon rail or other ways, which improvements are also applicable to carriages used upon railways." June 12.

James Johnson, of Bradley, in the county of Stafford, iron founder and boiler maker, for "Improvements in the manufacture of rivets, railway, or other pipes, bars, nails, pins, and spikes." June 12.

John Mervor, of Oakham, and John Greenwood, of Church, both in the county of Leicestershire, for "Improvements in the manufacture of sawing, and washing wool and woollen fabrics and other substances." June 12.

George Edmund Doolothorne, of Lewes, in the county of York, for "Improvements in weaving and spinning wool and flax, and in treating wool previously to spinning, and heckling flax." June 12.

James Richards, of Brackenbury, in the county of York, gentleman, for "Certain improvements in the restraint of mines." June 12.

Richard Roberts, of Manchester, engineer, for "Improvements in machinery for preparing and spinning cotton, and other fibrous substances." June 16.

James Hogg, of the county of Stafford, for "Improvements in the manufacture of glass, (A communication.)" June 16.

James Hogg, of the county of Stafford, for "Improvements in machinery or apparatus for stretching, drying, and finishing fabrics with or without the aid of steam engines or other machinery." June 16.

Frederick Theodore Philippe, of Beilfield Hall, in the county of Lancaster, calico printer, for "certain improvements in machinery or apparatus for preparing cotton," June 16.

James Hogg, of Oldham, in the county of Lancaster, for "certain improvements in machinery or apparatus, to be used in the preparation and spinning of cotton, wool, and other fibrous substances." June 16.

Henry Pooley, of Liverpool, iron founder, for "certain improvements in weighing machines." June 16.

James Hill, of Staley Bridge, in the county of Chester, cotton spinner, for "Improvements in or applicable to certain machines for preparing, spinning, and doubling cotton, wool, or other fibrous substances." June 16.


Frederick Henry, of Biddesdole, in the county of Stafford, woolen manufacturer, and Mary Henry, of the same place, for "certain improvements in making woolen goods worn by men on both sides." June 16.

Francis Hinde Rice, of Newfound World, and Madegon, for "Improvements in machinery or apparatus for preparing corn, seeds, plants, and trees, and in fertilizing land." June 19.

William Vickers, of Smalley, steel manufacturers, for "Improvements in the manufacture of iron." June 19.

Thomas Russell Clement, of Adam-street, Adelphi, engineer, for "Improvements in locomotive engines." June 19.

James Robertson, of Great Howard street, Liverpool, for "Improvements in the manufacture of casts and other wooden vessels, and in machinery for cutting wood for such and other purposes." June 19.

John Macintosh, of Stafford-square, Middlesex, for "Improvements in engines to be worked by steam or other suitable fluid, and improvements in propelling carriages and machinery by water, steam, or other fluid." June 22.

James Scotter and William Frederick Hammond, of the Spread Eagle Works, Limehouse, engineers, for "certain improvements in the steam engine, and in machinery for propelling." June 22.

John Obadiah Newell Batters, of Brighton, gas engineer, for "certain improved methods of producing, or apparatus for converting natural gas," June 22.

Henry Mapple, William Brown, and James Lodge Mapple, of Chibbs Hill, Hendon, for "Improvements in communicating intelligence by means of electricity, and in apparatus relating thereto, part of which is also applicable to other like purposes." June 28.

John Richard Watson, of Finchley, Middlesex, gentleman, for "an improved instrument for registers of scales at sea." June 28.
OBITUARY.—We have to record the death of the late Vice-President of the Royal Institute of Architecture, Mr. John Nicoll, which occurred on Wednesday, the 16th of May. Mr. Nicoll was born in Edinburgh, and was educated at the University of Glasgow. He was a member of the Royal Institute of Architects, and was also a member of the Royal Society of Scotland. He was a man of great ability, and was highly respected by his colleagues. He was a great lover of art, and was much engaged in the decoration of public buildings. He was also a great lover of nature, and was much engaged in the work of landscape gardening. He was a man of great kindness, and was much admired for his generosity. He will be greatly missed by his many friends.
THE NEW PALACE AT WESTMINSTER.

(Charles Barry, Esq., Architect.)

We this month, agreeably to our promise, give a second view of the interior of the House of Lords; it is a transverse section, or view of the north end, showing the Reporters and Strangers' Gallery. The archway under the centre of the gallery is the principal entrance to the House, and the side arches enclose two small waiting rooms or lobbies. The arches above the Gallery, and the centre one below, are filled in with cloth curtains. The front of the Galleries and the enclosure to the Lobbies below are of wainscots, and the arches above of stone. The faces of the spandrils and ribs are elaborately gilt, similar to the side elevation. The Plate is drawn to the same scale as the one in last month's Journal.

The following is Mr. Barry's report of the state of the works on June 10, 1847:

The carcase works of the portion of the building towards New Palace Yard are entirely completed.

The Victoria Tower is about 200 feet high; the carving of the stone groins within it is completed, and the scaffolding is removed.

The Clock Tower is also about 200 feet high. Framed scaffolding and hoisting apparatus have been prepared, and are now being fixed for the upper portions of those towers, which are not yet contracted for.

The stone groin over the Central Hall is now being turned, and is far advanced to completion.

St. Stephen's Hall is in part carried up to its full height for the roof, and the remainder is, upon an average, within about 10 feet of the same level.

The Commons' public lobby, and the central masses of the building above the corridors and public staircase, are, upon an average, within about 10 feet of their full height.

The House of Commons' ceiling, beams, and capping, and the stone screens at the north and south ends of the house, are completed. The fittings and finishings of the house are not yet ordered, as no decision is yet come to respecting Dr. Reid's plans for warming and ventilating this portion of the building.

The House of Lords, the royal ante-chamber, and the house or public lobby, with all their warming and ventilating arrangements and apparatus, are (with the exception of a portion of the stained glass, the fresco paintings, statues, and other works of art) completed; and those portions of the building were occupied for the first time immediately after the Easter recess of the present year.

The fittings of the Old House of Lords were removed during the Easter recess; the house converted into a gallery of approach from the House of Commons, and other communications made between the temporary and the new buildings.

The fittings and finishings of the libraries and refreshment rooms are near completion. A considerable extent of joiners' work in ceilings is prepared; much of it is fixed, and other finishings are executed in other portions of the building.

Ten new committee rooms in the river front have been temporarily fitted up for use since Easter.

There are at present 1,776 men engaged upon the works of the New Palace, of whom 708 are employed at the building, 147 at the quarries, 228 at the government works at Thames-bank upon the joiners' fittings and wood carvings, and 198 upon miscellaneous works both at the building and elsewhere.

ABuilders' Benevolent Institution is about being established for the relief of decayed masters in the building business, and also for the relief of workmen in the employ of a subscriber, who may meet with an accident; it is also proposed to establish Alms-houses when an adequate sum can be raised.

Candidus's Note-Book.

FASCICULUS LXXI.

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

I. "Why work we not as our forefathers wrought," is a question that was put by Mr. Scott as the motto to his design for the Army and Navy Club-house. Nor doubt it is one which he considers unanswerable; yet the design itself furnished a tolerably conclusive reply, as did likewise one or two others which appeared in similar architectural masquerade, having assumed the costume of medievalism. Clubs and Club-houses, however, are institutions belonging exclusively to modern civilization and refinement. In former times, there was nothing whatever analogous to them, unless it were convents, monasteries, or living in common, and the exclusion of the society of the other sex, being one great characteristic of both. Yet there all resemblance ends; modern conventism being of quite a different stamp from that which was in vogue among our "forefathers." Everything has been metamorphosed—either greatly reformed or else greatly perverted. The Coffee-room has taken place of the Refectory, and the epicurean centre has put the morgue days of the "good old times" to flight. Are the latter, then, to be now restored? or are we to return to mediævalism only by halves? If we are to be rustic in our buildings, why not also in our dress, in our speech, in our amusements? Why do we not dine as our forefathers dined? And we might go on adding question of the kind to question, till we asked: why are we not our veritable forefathers themselves? Sentimental archaism is one of the fashions of the day, and one whose very extravagance will sooner or later bring it into contempt, when it will be put on the same shelf with biblicomania and other exploded follies. Like biblicomania itself, archaism is—although it does not absolutely exclude them—quite independent of any knowledge of, or taste for, the intrinsic aesthetic value of the class of productions it concerns itself with. The one prides itself upon estimating buildings as the other does books—by merely extrinsic circumstances, instead of judging of them by their architectural or literary worth. The building may be rubbly, the book may be—rubblish also; but if the one can be proved to be of the date of the Conquest, the other be a black-letter edition—perhaps an unique copy in the original binding—your archaismiac and your biblicomania fall into ecstasies, that is, provided there be anybody present to witness them, such raptures being themselves far too valuable to be acted in private. Your archaismiac will, perhaps, be able to tell you the date of every part of a cathedral, and the names of all the respective bishops or other founders, together with many other, no doubt, highly curious, yet altogether extrinsic, matters; but ask him for a critical elucidation of individual and aggregate beauties, and he stares at you with contempt, if not with horror—probably the latter, for he feels very uncomfortable in your company. You seem to expect something like reasoning new from him; while he demands the unqualified admiration of implicit faith from you.—Go to! you are a heretic!

II. Among the designs for the same building, namely, the Army and Navy Club-house, was another Gothic one that was an absolute bargain; for, although it showed a lofty structure, bristling with pinnacles, and crowded with canopied niches and their statues, and the whole was to be executed in real stone, the estimate was neither more nor less than the exact £30,000; which rigorously prescribed sum was conscientiously adhered to by nearly every one of the competitors, notwithstanding the prodigious difference of the designs themselves, in regard to a great variety of circumstances affecting cost. But, alas! even such a contract bargain as the design alluded to, did not tempt the gentlemen of the Army and Navy Club. Perhaps they rather looked at that and the other Gothic designs with contempt, as silly at-temps to make them make monkeys of themselves, by aping the architecture of monkery and monkish times. Let us not mock our forefathers, by substituting mere mummery for art.

III. We have outgrown medieval architecture. It is a garb which, besides that it ill accords with the rest of our social costume, would require to be enlarged—to be both greatly lengthened and widened, in order to fit the modern ideas of our constitution. Its size is not small enough, as being of the true clerical cut and "cloth." But for ordinary purposes, and all sorts of purposes,—that is not to be thought of seriously. Nevertheless, it is stated that the Carlisle Theatre, which was last year burnt down, is to be rebuilt in the Gothic style—at least, some such idea is enter-
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[...]

tained, and Heideloff has been specially invited to furnish designs in that style. Still, complimentary as this looks to Gothic architecture, it may fairly be questioned whether the compliment will not be resented rather as an insult, by the staunch advocates for a mediævalism. To apply such a style to a theatre will be deemed by them little less than a degradation of it. One inevitable scandal will be, that Precedent must be rudely shoved aside, and such biographies have since then (at least) been unceremoniously thrust out of the kind in all the realms of the middle ages. Innovations, and very extensive ones, there must be, in order to accommodate the building to its express purpose. The idea is not, indeed, quite new to the Germans, a private court theatre having been built some few years ago, by Oetmer, in a sort of Gothic—but of such sort, as would certainly scandalise our Pagnis and our Williens. Whether Heideloff will acquit himself of the difficult task imposed upon him, more much satisfyingly, may be doubted, since the very fact which is alleged as peculiarly qualifying him for it, must in a great measure disqualify him also; because if he has all along devoted himself exclusively to the study of Gothic architecture and art, he must come quite unprepared to such a very special subject as a theatre, which is, moreover, one that demands ability of a particular kind. His designs for Gothic furniture do not promise much for his power of invention—that species of invention which consists in re-combining forms and details into novel applications of them, and adding others to them where necessary, conceived in the same spirit and treated with the same gusto.

IV. Although in his lately published lecture on the "Education and Character of the Architect," Professor Donaldson earnestly recommends the study of biography, and especially commends Milizia's "Lives," he seems to think that no further dose of biography is now wanted. At least, he has expressed no desire to see some one undertake a continuation of that work, bringing it down to the present time. Such a continuation of it ought to be as fully as interesting as Milizia's work, which, to say the truth, hardly pretends to be a readable book, though useful enough as one of mere reference. To say the truth again, there is very little that answers to the idea of biography in it, most of the lives being very jejune notices of the individuals themselves, with a dry enumeration of their principal buildings. The subject has not been sufficiently great in any of them, though it must be confessed that materials for them exist in many instances very scantily, owing to their not having been collected while they were within reach. Still there is very much lying scattered about, which requires only to be searched out and put together. It will, perhaps, be said that in the two last generations of architects who have gone off the stage, there were few who distinguished themselves either by great works or great talent. Still, there were many of celebrity, whether that celebrity was merited or not, and several of great ability also,—persons quite as worthy of a niche in biography, as are a very great many of those recorded, and merely recorded, by Milizia. It is in one case the better if they are incompletely or not at all be spoken of, because in that case there is room for biographical narrative and critical remark. Something more attractive and instructive also than such mere skeletons, as many of the notices in Milizia are, is highly desirable;—something sufficiently readable to impress itself on the memory;—something analogous in plan to "Johnson's Lives of the Poets." Properly written, the biographies of architects, or indeed any artists, might be made to comprise a great deal of valuable preceptive comment, illustrating and illustrated by the buildings themselves that are spoken of; and even where they must be spoken of with censure, art and good taste are benefited by the exposure of mistakes and errors. It is almost as necessary to know what we ought to avoid as what we ought to imitate; otherwise we have only one-half of the experience necessary for our guidance, and are in danger of running aground on the very same shoals that others have been wrecked upon, merely because the mistakes, to say dishonest, lenity of biography and criticism has not pointedly marked out for our warning, those concealed dangers.

V. Not long ago a volume made its appearance, which promised beforehand to be an unusually complete piece of architectural biography, the whole of it being devoted to the life of James Gandon. As the subject of it could possess no interest for the general public, it was almost to be expected that it would contain a great deal that would be particularly interesting to architectural readers. Instead of which, it has no interest at all for any one: as a biography it is a nullity, there being nothing in the history of the man himself but what might have been related in a couple of pages. His was not a life replete with incident like that of Benvenuto Cellini; neither is it made a vehicle for bringing us acquainted, except here and there merely nominal, with other individuals who were of particular note. The anecdotes with which the book is decked out, are all of the most trivial description; and the notices of contemporary artists—nearly all of them, by the by, painters—are as dull as they are meagre, or rather are so meagre as to be almost of necessity very dry and dull also. The only one of whom we are allowed to obtain more than a mere glimpse, is Paul Sandby, who exhibits himself as a humoursist, in which character he possesses us not a little in his favour in one or two very lively and pleasant letters—the only fragment founds the volume. As to Gandon himself, he might just as well have been any thing else—a builder or contractor, for instance—as what he was; and the book might still have been just what it is now. That he was an architect seems to have been all but entirely forgotten by his biographer. Though he did not erect many structures, those which he did were important ones; accordingly they ought to have been made the subject of full description and discussion: or if his works do not deserve it, but are as uninteresting as his own life, why should his biography have been attempted at all? As at rate, one work there is of which he would have afforded ample matter for notice, namely, the two supplementary volumes to the "Vitruvius Britannicus," for upon them might very properly have been founded a review of the state of architecture in this country during the period they illustrate. As it is, the "Life" of Gandon fully verifies the proverb, that "God sends meat and the devil sends cooks."

VI. Allan Cunningham's "Lives of British Architects," are just what they were intended, a few popular and pleasingly written biographies of the kind, derived from accessible sources, interspersed with superficial, and some of them erroneous, remarks, that may pass for very respectable second-hand criticism. With him, Vanbrugh the architect is eclipsed by Vanbrugh the dramatist. Allan contented himself with what he could find at hand and shaped out for him, without looking about for more rare material. James Wyatt is excluded, although he was most undeservedly of extraordinary genius in his time, and also in some measure makes epoch in his profession by having been one of the first to practise revived Gothic architecture to any extent. Notwithstanding, too, that he himself was a Scotchman, and not deficient in nationality, Allan gave us no biography either of Sir William Bruce, or Robert Adam—and the omission of the latter is remarkable enough.

VII. If we turn to the continent, we shall there discover many important names that are now become available for architectural biography,—such for instance as Perse, Cignola, Piermarini, Schinkel, and quite recently, Friedrich Girtzner. Of these, with the exception of the last, various memoirs, and some of them of considerable length, and critical as well as biographical, are to be met with in foreign publications; as are likewise those of a great many other French, Italian, and German architects. Most of them are as well written, as Milizia's "Lives;" some of them incomparably better. As to Mrs. Creasy's translation of the latter, it is charitable to suppose that she was learning Italian at the time, and turned the book into English, for there are passages in it of which it is impossible to discover the meaning at all without referring to the original. Milizia required not a lady translator, but one thoroughly conversant with architecture, and capable of officiating as his annotator also.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."

Sir Henry Wotton.

(Continued from page 210.)

The great epoch of modern architecture in England is that of Wren, and was created by the fire that reduced the city of London to a mass of ruins. Wren was fortunate in falling upon such an opportunity, and London was fortunate in finding such an able builder as Wren, who was a singular combination of the greatest powers of the human mind. He was a scholar, a poet, an artist, an astronomer, a mathematician, an engineer, an architect, and a profound philosopher. Nothing was too difficult for his aspiring and powerful mind. He was born when Charles I. was in the zenith of his power, having then sat on the throne of Great Britain, as its second monarch, about seven years. How that monarch patronised architecture and the other arts of design is before recorded. Wren began his public career at a very early age; but, unlike the generality of precocious youths, retained his intellect unimpaired and his body vigorous to a Neotorian age.
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He left Westminster school and was entered a gentleman-commoner of Wadham College, Oxford, at the early age of nineteen. Although so young, he obtained the notice and friendship of the greatest men then resident in that university. The great mathematician, Oughtred, then a Fellow of Wadham, records his talents in his "Clavis Mathematicae," and Dr. John Wilkins, the then warden of his college, introduced him as a pro\-digy of science, to the Elector Palatine Prince Charles, who was on a visit to that distinguished seat and seminary of learning. He had previously known this illustrious Prince when on a visit to his father's house, the Denesery at Windsor, and took this opportunity of presenting some scientific inventions by the desire of Dr. Wilkins, and recorded them in a letter* to His Serene Highness. As a scholar, he was commanded by Sir Charles Scarborough to translate Oughtred's "Geometrical Dialling" into Latin, for the use of the learned men of Europe; and this when he was only in his 13th year. In the same year he invented and received a patent for an instrument for writing with two pens; and it is recorded as a singular coincidence that Sir William Petty, the founder of the noble family of Lansdowne, invented a similar machine in France, and obtained a patent in England in the same year with his youthful contemporaries. He was at the same period engaged by Dr. Sir Charles Scarborough as his demonstrating assistant in his lectures on anatomy, of which appointment he was so proud, that he communicated it to his father in a letter of elegant Latin. He also signalled himself as an astronomer, a scholar, and a poet, by a series of Latin metrical stanzas, proposing a reformation of the ancient fables of the signs of the zodiac; an algebraical treatise on the Julian period; and a Latin treatise on spherical trigonometry.

Few men of any time have exhibited a more expansive mind than Wren: like Michael Angelo he seemed too great to be contained, or too minute for its investigation. At one time sweeping the heavens with "Galileo's tube," tracing the motions of planets and comets through empyreal space; at another seeking the properties of insects and animals with the microscopic lens; occupied in his study by storing his vast mind by the treasures of ancient lore; giving to the learned his discourses in Latin, worthy of the Augustan age; improving machinery for tillage, the measurement of time, registration of changes in the atmosphere, and other useful projects. In fact, his mind was never unemployed; he studied for science directs, by day and by night, and of so much could it be more truly said, nulla satis sine littera.

Whilst Wren was pursuing his course of studies and investigations with indefatigable industry, giving to the world useful discoveries at an age when others were studying their elements, a circumstance occurred that gave a powerful direction to Wren's mind. In 1648, Wren's 16th year, Pope Innocent X. announced to the world, that St. Peter's, the great cathedral of Catholic Europe, was then completed, under the supervision of the illustriousBernini. This great event was the enquiring topic of the day, and induced Wren, among others, to the examination of its claims to celebrity, by comparing it with the great works of the ancients and their architectural law-giver, Vitruvius, which was then a sealed book but to the learned. This new study enabled Wren, in after days, to complete our Protestant cathedral of St. Paul by himself, whilst that of St. Peter's occupied the talents of twenty architects, from Bramante to Bernini, including Raffaello and the mighty Buonarotti, who raised, as he had promised, the Pantheon into the air. Nineteen popes, from Julius II. to Innocent X., aided by forced contributions from the whole Christian world, raised the one: a single people, in three short reigns, by one architect, a single diocesan Protestant bishop, from no funds but those voluntarily given by the people, accomplished the other.

Wren's society and advice was sought by all the illustrious in birth and mind. His reputation was not merely British, it was European. At one time, he is sought by Helvicos to illustrate his chronological tables by an algebraical calculation of the Julian period; at another, invited by the illustrious Boyle to examine the hypothesis of Des Cartes on the pressure of the atmosphere, which indisputably gives to Wren the invention of the barometer; again, Dr. Willis desires his assistance in dissecting and preparing a treatise on the anatomy of the brain. Immersed in the numerous engagements consequent on being elected Fellow of All Souls, Oxford, and the preparation of an inaugural discourse on being appointed professor of astronomy in Gresham College, he found time to solve Pascal's problem, and to propose another, originally proposed by Kepler, and privately answered by himself, and was the only solution ever given to it. Hundreds of such instances, in every branch of science, occur in his biography, from an investigation into the motions of the satellites of Jupiter, and as Savilian professor in Oxford to report on the constellation Taurus, to an earnest solicitation of his friend John Evelyn,* on the education of his son, to which Wren applied himself with as much sincerity and zeal as he did to the questions of the most learned in Europe, and to the king's command to make a globe of the moon. Sought for both in Oxford and in London, his presence at one causing regrets for his absence at another; filling with unexampled earnestness and zeal the astronomical chair of the university and the Academie des sciences, descending to them upon the starry heavens, and entertaining the members of the newly formed Royal Society by microscopic disquisitions upon the smallest insects, and with ever-recurring novelties in mechanics, he still found time to cultivate the arts of design, and the still more abstruse science of chemistry, which he studied with other learned contemporaries under the celebrated Rosicrucian philosopher, Peter Stibael, of Strasburgh, who was invited to Oxford and courteously entertained by the illustrious Robert Boyle, one of the closest and perhaps the most distinguished of Wren's friends.

At this period of Wren's life, his 26th year, which was marked by the restoration of monarchy in the person of the profligate and ungrateful Charles II., 1660, whilst he was filling the rich storehouse of his mind from every available source, had it been directed to any distinct object, whether in literature, philosophy, science, or art, he would have been eminent in either. From the circumstance of there being at that time no architect in England, but the neglected and almost forgotten Inigo Jones, he was consulted as a man of general knowledge upon all the little architectural projects of the day. Cromwell was a patron of the liberal arts, Wren, most likely, would have been his architect and surveyor-general, for it is related that Mr. Clapworthy, who married Oliver Cromwell's favourite daughter, who had more influence over her father than any other human being, was well acquainted with Wren. Clapworthy, who was a mild, retiring man, fond of mathematics and the studies of the closet, had a great love for the society of the youthful philosopher, and frequently introduced him to his own domestic circle, where the stern Protector occasionally paid visits to indulge in society with his favourite daughter. It happened at one of those visits that Cromwell came into the room as they sat at dinner, and without any ceremony, as was his usual way in his own family, he took his place. After a little time, fixing his eyes on Mr. Wren, he said, "Your uncle has been long confined in the Tower." "He has been so, sir," replied Wren; "but he bears his afflictions with great patience and resignation."

*Cromwell—"He may come out if he will." Wren—"Will your highness permit me to tell him this from your own mouth?"

*Cromwell—"Yes, you may."

As soon as Wren could retire with propriety, he hastened with no little joy to the Tower, and informed his uncle of all the particulars of this interview with Cromwell. After which the bishop replied, with warm indignation, that it was not the first time he had received the like intimation from that miscreant; but he disclaimed the terms proposed for his enlargement, which were a mean acknowledgment of his favour, and an abject submission to his detestable tyranny; that he was determined to tax the Lord's leisure, and owe his deliverance, which was not far off, to him only.

That Cromwell did patronise Wren is clear, from a letter written by the latter to his friend, Dr. John Wilkins, wherein he states that his diplographic instrument, for which he had recently received a patent, had been "commended to the then great, now greatest person in the nation, " (Oliver Cromwell).

In 1660, Wren may be said to have commenced his architectural career, and to have fixed upon his future profession. He had completed his academic honours by receiving from his university the well-won degree of doctor of civil law. The king (Charles II.), who had acquired, both from his father and his sojourn abroad, a great love for the arts, finding on his return to the throne of his ancestors, how much the royal palaces, the cathedral of St. Paul, and other sacred edifices, had been dilapidated and desecrated by the military hordes of the Commonwealth, had determined on their restoration. Sir John Denham, author of "Cowper's Hill," who is more recorded for his poetry and polite learning than for any knowledge of architecture, had been appointed, in reversion, to the office of surveyor-general of his majesty's works, in reward for his loyal services, to which he had now nominally succeeded by the death of Inigo Jones during the interregnum. The fame of Wren had reached the ears of the king, who propos-

*Author of the well-known Parallel of Architecture.
*Hines' Life of Wren, Appendix No. 2.
its illustrious architect, whom the Quarterly Review* calls "the pride and honour of English art," to the rank of an equally bold and original imitator, as Milton is of Homer and of Virgil; exhibiting in all its parts the most indubitable marks of real genius—"that quality, without which," says Dr. Johnson, "judgment is cold, and knowledge is inert; that energy, which collects, combines, amplifies, and animates."

* For October, 1822. (To be continued.)

GLANCE AT SOME OF THE ATTRIBUTES OF ARCHITECTURE.

By Frederick Law. No. II.

"Greek art had its infancy, but the Greeks rocked the cradle, and Love taught her to speak."—Pope.

Simplicity, &c. —We cannot arrive at conclusions respecting the first principles of art, without making the human mind, as being the source of all beauty, the groundwork of our investigations. All the qualities that contribute, or are essential, to artistic beauty, will be found to make up the requirements of a perfect mind; and among these qualities, that which bears a very striking analogy to it, is simplicity.

Simplicity and unity of composition may be compared to that power of generalization which selects from dissimilar objects, parts of a like nature or property, and then includes them under one genus or kind. It was a principle of the Greeks, which was founded on the idea they formed of perfect nature, "to combine into one grand expression of feeling a whole series of ideas, and by excluding everything heterogeneous, to combine all homogeneous elements into a perfect and harmonious unity" (Schlegel). Amidst, therefore, the many and varied elements of an art, whose general object is to make a strong impression on the senses, no matter that is irrelevant must be allowed—that nothing would produce confusion; so that the eye may repose upon it without the least distraction: the various ingredients being so balanced and regulated, that not one of them shall act prejudicially to the rest by any undue proportion; but that each combine, to the utmost of its power, in such perfect union and co-operation, as to conduct towards but one end, and announce in its effect the one great controlling mind that directed and presided over it. This is so necessary, that even where the style of architecture is elaborate and intricate, it must still preserve a marked unity and consistency of purpose, for without it we may not be enabled to see and embrace clearly the complication and web of the whole. In simplicity, a degree of variety and contrast must be joined to it, lest it should be too monotonous and betray a poverty of imagination; variety also, uncomposed and without some simplicity and consistency in its parts, would withdraw the attention from it on account of the appearance of confusion.

Those ancient temples, which in their plan and general forms were parallelograms, and offered a most striking similarity and uniformity of parts, suggested to the spectator ideas of infinity, notwithstanding their extreme regularity. But the gratification which the mind receives from objects, depends upon the nature of the exercise they afford to the visual faculty; and circular forms, in consequence of bringing all the muscles that move the eye into play, exciting an equal share of labour, are found to yield more delightful sensations than those produced by objects bounded only by straight lines. Now, a knowledge of the effect of geometrical figures was known to the Greeks; and we have a fine instance of their appreciation of the circle, in the Choregic monume of Lysicrates. In this rotunda temple, as in many others, we may notice that the figures in succession in the bas-reliefs on the frieze, seem to the eye to have no limitation, but as it advances and one portion appears, another disappears; so that although the whole is most simple and uniform in itself, and may be easily embraced at a glance, yet at the same time it seems endless and infinite. This beautiful idea was imitated by the Romans, but its elegance and grace was lost in vastness of dimensions; for grandeur emanated from them as beauty did from the Greeks, and proofs of their mastery

control over the arch and vault, which they were ever ambitious to display, remain to us in their Aqueducts, in their Pantheon, and Castle of St. Angelo. So the classical mind of Bramante, soaring and expanding itself in the contemplation of circles, in conceiving a design for St. Peter's, suggested "for the navies, an adaptation of the arrangement of the great arches in the ancient edifices called the Temple of Peace; and for the conjunction of the four navies, the construction and form of the Pantheon;" thus uniting and harmonising in one stupendous structure the proportions of two of the grandest edifices of antiquity.

Simplicity is the leading characteristic of Grecian architecture. The form of their temples was the simplest, although in its details the most elegant, and in its dimensions the grandest, that could be conceived—gracing the sites on which they were erected; for there seemed to exist among the architects a sort of anxiety lest they should in the smallest degree disfigure nature. The orators and philosophers of the day beheld in them the image and reflection of sincerity and truth; and the aspiring columns, no less than the graceful superstructure, were channels for conducting minds habitually soaring, to the contemplation of supernatural beauty. At the glorious epoch of the Pantheon, the porticoes being the favourite places of resort, a building would scarcely have been tolerated that was not stamped with that calm reposè, that dignified simplicity, which most assimilated with the feelings of the Athenians. Hence the sentence of expression which breathed from their temples, which led the thoughts upward, and was eloquent not only with the authoritative voice of the senate, but with the stern wisdom yet mild tranquillity of the deity to whom it was consecrated. The presiding goddess of Athens was the muse that aided them, the fount whence they drew their inspiration.

The Greeks prided themselves upon the invention and perfection of their columns, and since they made them perform such an important part in their edifices, they took care to set off their contours and proportions to the best possible advantage. With what success they did so, we have proofs in the impressions conveyed to us by some of the porticoes of their temples—as that of Minerva, where the utmost relief and effect are given to these features, by the majestic shade which is swung into its interlaminations. Here, it may be remarked, the chiaroscuro is not broken up and minute, but the light and shade of the structure presents breadth and simple masses.

The most cherished objects which the sculptor could commemorate on their temples were the deeds of conquerors and heroes; but then there was demanded on his part a high command of talent, that such things should be worthily represented; and that, by a scientific and beautiful execution, by force of expression and simplicity of character, they should be at the same time a powerful auxiliary to the architecture. Viewing sculpture in the days of Phidias, we cannot but be struck with its admirable harmony to the grand and simple character of the temple. The high embellishment and importance which it received from the introduction of sculpture, is particularly observable at that epoch; and it is by an attentive examination of the boldly and decided execution of the ancient reliefs, so adapted in their effects of chiaroscuro to their elevated positions, that we can appreciate the excellency of the principles which regulated their introduction into the buildings—principles often inculcated and taught by the philosophers, and founded on a profound knowledge of optics and perspective.

In the materials and means employed, as well as in the forms they selected, we see how wisely they sought and secured simplicity; they adopted just so much as the peculiar nature of circumstances prompted, and no more; they produced the greatest strength with the fewest materials—the greatest effect with the simplest means; they brought out the most beautiful features into the strongest relief; they mingled the stile cum studio; the elongation of lines and the relation of spaces satisfied the mathematician,—the delivery of the curve delighted the poet; the uniformity and succession of parts, the huge masses of the surfaces, the long unbroken continuation of the members, all tended to produce sublimity and breadth of manner; the ornamental portions softened the aspect, and prevented too great a degree of austerity; yet, in the sculpture there was no artificial refinement,* no laborious minuteness, but it contributed to the stateliness of the pile; and even when the Greeks thought it necessary, under their glowing sky, to heighten the effect of the whole by the addi-

* Lectures on Dramatic Art and Literature.

* The Seven Marbles.
tion of pigments, still its moral grandeur rose paramount to all the brilliancy of colour. Owing to the searching and penetrating light which shone around it, anything that was defective would be immediately manifest—the beauties more strongly developed; so the utmost ingenuity of the artist was taxed to combine greatness with caution, effectiveness with economy: if the colouring, for instance, were over-warm and not judiciously applied, a glaring contrast might be produced; equal care was necessary, also, lest it should be too cold, amidst the variegated and luxuriant scenery by which it was surrounded. On the same principle, nothing unessential or superfluous was to obtrude itself in the ornamental portions: what took the lead in these were the sculptured figures, that represented various actions, and gave the most animation to the marble—on the execution and arrangement of which, mature consideration was to be bestowed, a conspicuous situation being given to the principal: to conclude all, the building, by its pyramidal termination, was brought to an exquisite climax.

This supremacy of grandeur over the desire for the exhibition of ornament—this mastery of simplicity over every inferior feeling, convinces us of the high taste and refinement of the Greeks. They attempted, but indeed were able, to achieve the sublime. They knew that art could only possess the efficient cause of the sublime, in proportion to the manifestation of skill and main energy. They knew that a departure from simplicity would be a fatal blow to art: and hence it was that the legislature watched over the interest with a vigilance enforced upon the necessity of preserving in all their works the marble—the principal source of grandeur. And there is in simplicity of architecture, especially in that so deservedly called "Classic," an attraction which calls forth a dignified calmness, yet a tenderness of soul, and steals upon its sympathies as does the pure and unsophisticated nature of a beautiful child. Hence the dominion of the architecture of the Greeks over our feelings—for the evidence of what is truly good or beautiful, is recognised by the soul as something most congenial to it; and that unity of design, that conformity of character, in Greek architecture, corresponds in its nature to that of a well-regulated mind—

THE BRITISH MUSEUM.

No. I.

The opening of the new hall of the British Museum is a fitting time for beginning a set of papers on its contents in this Journal, in which we have often given notices relating to it. The collections in the British Museum are more the result of the exertions of the public than of the government, and unless the exertions of the government be kept up by the voice of the public they will be slackened. Great as it has been already done, yet measured by what is wanted and what is to be done, it is but little. As the public get a better knowledge of the Museum, and make a better use of it, so they prepare themselves for the requirement of something more. We fear, however, that the worth of the Museum is not yet sufficiently felt to be enjoyed; and while we cannot but say, that even in its most trifling uses its worth is great.

By some, the Museum is looked upon as a great plaything or play-house for the people. Be it so; we should be willing to take the matter on that footing, for it is no mean thing to furnish pastime for a people. Among the chief duties of a government, are to provide for the amusement of the people; and if men who are hard-worked in their several callings, can have a day's pleasure in a Museum, and can give to them new thoughts, which shall fill their minds in many days of toil, this is a great thing. Discontent is one of the greatest evils, and to withstand, even where bodily evil, hunger, and want are not felt. The gloomy sway of the Independents broke down mostly from this cause; and the people hastily changed a good government for a bad one at the Restoration, because they were desponded and disheartened by the want of their accustomed pleasures. The playhouse, the bear-garden, and the fair were closed, the fiddler and the ballad-singer were put down, holidays were forbidden, and although plenty resided at home, and glory crowned our arms abroad, the people were sullen and unhappy. In times of want, workmen are ever open to be led astray by mob orators and agitators, to whom, when in full work, they will not listen. As it is with one, so it is with many; when the mind is heavy and the heart faints, the man himself gives way to a trilling sorrow, and sinks from bad to worse; whereas, if the mind be kept in order, he would overcome every hardship. More or less, the same thing is to be seen at all times, and we feel sure that we are always doing good when we are yielding pleasure to the old or to the young. Happy feelings are the mainspring of good deeds.

As it has been acknowledged by the greatest statesmen, that it is desirable to find pastime for the people, so it should be given usefully. The bloody shows of gladiators, or the beastly games of the bear-garden or the prize-ring, will give pleasure to those who are called enlightened Romans or enlightened Englishmen; the gambling cock or quail fight or horse race may prove still more exciting, but no one good feeling is awakened or strengthened, and no bad one weakened or quelled. The love of the good, the true, the great, and the beautiful is that which should always be kept before the people, from their childhood to their death, in all outward forms and shapes. It should never be thought that education is the time of schooling in boyhood, but it should be remembered that its rightful meaning of "bringing up" a man, it is being carried on at all times, in all places, and by all means. The eye, the ear, the tongue, the taste, the smell are always on the watch learning something,—and if not good, they are learning something bad, which when not bad or undone, are shown slowly and unknown, and fetters are welded which chain the mind in the doing of good or evil. If mankind are to be thoughtful and careful in their deeds and thoughts, it is becoming that in everything we should keep sight of goodness, of truth, of beauty, and of greatness, for the Almighty maker of all has done this in everything, from the smallest being, hardly seen by Ehrenberg under the most powerful microscope, to the great bulk of the mastodon or the most dreaded beast which ever walked the earth. If mankind are not to be taught to think, at least, we should take all means of giving them right habits.

Whatever may be the feeling as to the forms of worship to be taught in common schools, however much quarrelling and bickering there may be about these—whereby the children of England run the chance of losing their schooling altogether—there can only be one feeling as to the right and duty of the government to look after the public bringing up of the people, by training them to proper thoughts, whoever there may be the means of doing so. No one, we believe, has ever thought otherwise than that the great mind of the Greeks, their love of freedom and of learning, was kept up as much by their care for the beautiful in their buildings and public works, as by any other means. Those lovely temples, those carvings which have never yet been outdone; those shapes, which seem already to have a soul, and want only breath to live, were but the outward showing of what the minds of the people held within, of those great feelings of which even the lowest Athenian slave must have had his share.

If we are to have great public buildings and great architects, we must have an enlightened people, a people who love art for its own sake. In Athens, lowly as were the dwellings, every public building was beautiful, and was so because no other dare be opened to them. Public buildings are always those which are the best for showing the skill and cunning of the builder, where there is the most money to be laid out, the best place to be had, and the most care to be taken in keeping up what is once built. In London, not to say in England, so far from our public buildings being always handsome, they are often far from it; and what a single rich man can do not bear nor lay out his wealth upon, many thousands of the people are made to bear. It is a mere chance whether Wren or Dance be the architect, whether he be Barry or Soane. We should never see workhouses set up for public buildings, and barns for churches, if the people were brought up to think rightly. The taste of a people may wander upon matters of detail or of style, but it is always right as to what is great or beautiful. York Minster, St. Paul's, and Westminster Palace will always be liked by the people, although they may never be able to give a reason for their liking.

It is acknowledged that we have made a great step in weaning the people from cockpits, bear-gardens, and prize-fights, that we have lessened their love for low and bloody sports,—and we feel a kind of pride that we have done so much. We may be no less proud that we have given them a greater love of gardens, paintings, and museums, which, while we look upon only as a harmless change, must indeed work greatly upon the minds
of the people. The lessening of drunkenness and idleness, the milder bearing of the people, the falling off of street fights, the greater cleanliness and neatness, if they lead to better health, are of still greater worth, as they lead to better minds. If we teach a workman to like the museum better than the alehouse, we teach him something more; by awakening his thought we do so to what is only rare, we awaken his mind; in his own calling and the thinking workman must be a better workman than the unthinking workman. There are, however, many callings in which the workman has to deal with shape and colour, and if his thoughts are in any way trained to see and feel what is beautiful, he has earned something which to him is of the highest worth.

That the people of England are not brought up to have a right feeling of the beautiful and great in works of art, is seen painfully, not only in our public buildings and in our shows of paintings, but also in our workshops. Whether this has been looked into, there has been but one answer by men of skill and knowledge, whether English or foreigners, and that is—that the English people and English workmen have less taste than those abroad. This is the pain whereby carelessness of a natural and moral law is made known, and those who judge by the purse are punished in the purse. The price we pay for foreign silks, satins, ribbons, lace, clocks, watches, castings, jewellery, paper hangings, made flowers, and other wares bought of the French, Flemings, Swiss, Italians, and Prussians is so great, as to be a wonder to those who reckon it up, and bethink themselves that the glass producer and the glass grinder is the greatest in the world, the heart of trade, and the mistress of every craft whereby wealth can be made. We pay down in hard money a heavy fine for our want of learning; but this is not the only loss to which we are open, for we further lose the supply of foreign markets, which, if we tried in the right way, we could master, as we do all things that we once try. This is a money reason, and a weighted one for a love of art.

We cannot foster the love of the beautiful and great in art, without fostering the love of the true and the good. It does not follow that a painting, a carving, or a building shall be all truth and nothing more, but there must be something which shall strike the mind as true; and though with this it will take in which is untrue or false, yet without some truth is mixed up, it will not take in any share of truth. In a building, this seeming of truth may belong to the look, as, if a prison were built as a playhouse it would not be liked, neither would a playhouse if built as a church; so, too, if a building were so made, that it seemed unsteady or topping, there would be a want of truth about it which would strike any man. In a play or in a painting, it is acknowledged that there should be this truthfulness, which when once given in the leading parts, the looker-on is willing to take the stage or the canvas as the rest of the scene of the events, and to overlook the want of solidity in the colours, or the smallness of the drawing—say, to go in despite of his own knowledge that the painter is Jack Robinson, and believe him to be Alexander or Henry the Fifth. It is, perhaps, a failing of mankind, that a small share of truth is often enough for them, and that having that, they do not look further; but as in works of art they are trained to look for the true, so is the love of truth upon which a high price is set; and when opening, and his mind awakened, it cannot be otherwise than that he should get a greater love of truth, and that it should follow him in his life.

The truthful in art is its groundwork, and carelessness as to this is a begetting sin of our artists, and therefore they do not carry the people along with them. The painter makes a show of bright colour, and thick as does enough; the architect puts in good stone and good mortar, and then prides himself that he has done all. "To kalon kai to propon,"—the handsome and the fitting—was the good rule of the Greeks in art; so like wise we say "good and beautiful"—and, indeed, in a few words, they teach the whole sum of art. With a better trained people, we should have better drilled artists, for these latter would no longer dare to set themselves against all right laws, and waste their own powers and our means. The new school of art must be made from without, and not from within; it must, as with the Greeks, not depend upon the few of the artists, but upon the firm will of the many. Although Pericles took the lead, the Athenians never forsook the path in which he had led them, and the whole commonwealth took its way onward. On the other hand, single lovers of the arts die, and the arts die with them. The wealth of the Philip's gifted Spain with paintings, but not with painters; Charles the First died before he had awakened a love for art in England; but if Lewis of Bavaria dies, the school of Munich will live in despite of churlish followers. Lewis has not merely bought paintings, but he has raised up a school of artists, who are already sought throughout Europe.

Where the love of the beautiful is strengthened, the mind likewise is strengthened, for it takes a healthy action instead of an unhealthy one. Discontent is one of the worst signs of a low state of being, as is seen in Ireland, where what is good and useful is altogether lost sight of in brooding over fanciful ills. A healthy mind is ever ready to draw the good from everything: an unhealthy one to draw the most evil. So in criticism this may be true; while the older, the higher, and better taught critic is ready to find whatever is good, the younger and worse trained critic thinks he does best if he can hit upon a blot—which moreover he is sure to be able to do in any one of man's works. These must always be faulty from their very beginning: we know this, and it needs small skill to show it; but every one is not well enough trained to find a beauty and to feel it. How often is it found that an old and great painter will find a beauty in the work of a young painter, who gives him no praise, is not enough for any end of public teaching. The greater our knowledge, the greater our pleasures; it is not, as is thought by some, that the round of our pleasures is heaped in by our greater knowledge, but that the more we know, the better our feelings are trained, the greater love do we get for what is good and right, and the less we care for what is bad and wrong.

The kind of schooling which has been most used by enlightened people in olden times and in new times, has been such as to open the minds of youth to the great principles we have named. The teaching of Homer was given to the Greeks and Romans, and of the Classics among ourselves. We should give better answers to a libeller, free, and easy way of training, than does the drier way of mathematical study, which there are many people who now uphold. In schooling, what is taught is less to be looked at than how the mind is trained, for the man of hereafter will not be made by a faultless knowledge of English grammar or an exact and correct way of reckoning, but by those powers of mind which will enable him to do his part among his fellow men. Public training should be in agreement with that of the schools—the man should be able to follow up what he began as a child; or if, as a child, his training has been careless, there is the more need that it should afterwards be in a right way.

We have thought it right to stand up for the British Museum, as a school for the people, inasmuch as the matter is little understood, and many able men are very careless about what so far from being a trifle is a thing of very great earnest. In whatever light we look at the matter, if we choose to think, we are always brought back to the same point—that the public training of the people in the right way is of the highest need, and that a museum, well laid out, is among the best schools and best means of doing this. Indeed, we have no fear in saying that every pound laid out in the British Museum has been already brought back by what we have earned in our workshops, to say nothing of the very great good which is done to the minds of its hundreds of thousands of yearly visitors.

It is pleasing to see that the part of the Museum given to olden art is now large and well provided; but it is not laid out as if those at the head of it had a clear sight of what it ought to be. To gather bit by bit works of art is one thing, and the laying out of them another. The more the Museum is made useful, the more its worth will be felt, and the more will be done to make it greater and better. Although the Museum holds the works of many people, it neither gives any full view of the works of one people, nor of the way in which art has grown and been followed up. It is wanting as a whole, and the feeling made is that it is a gathering of bits of wreck, worthless to their former owners, and of which the now owners do not know how to make use. This is not to be said of all to the same length; but it is to be said, much more than one. Although the Greek rooms hold the Phigalides and Elgin marbles, and have many later works of worth, they give, even to the scholar, but a small knowledge of what Greece and Greek art are; they rather want the book to help them out, instead of helping the book out. There is an earnest, it is true, of the will to do and of what may be done; but we want a great deal more. When a working man has seen all the marbles of the Parthenon, he has no better thought of the Greeks than he had before. The Egyptian rooms, which are much better off, will teach him much more as to the Egyptians. The letting in of some casts from the Parthenon, of the casts from the Elgin marbles, and of the models of the Parthenon, have opened the way for more. We would have the Greek rooms laid out with casts from other museums of the works which are missing here; there should be models of such temples as can safely be laid down; likewise models of tombs. In the Greek rooms we would place the vases, bronzes, and coins. Why these are put away we do not understand.
RAILWAY LIFT BRIDGE.

(With an Engraving, Plate XIII.)

J. U. RASTICK, Esq., Engineer.

This Bridge is in course of construction over the Surrey Canal, on the Brighton branch railway from New Cross to the river Thames; it is constructed of timber, consisting of four inverted trussed girders, which carry the rails, the ends of the girders bear upon sills supported by piling of whole timbers, 12 x 12 inches. The platform is lifted bodily by six wire ropes, which pass over single grooved pulleys, supported by iron standards, and then descend and pass round doubly-grooved pulleys; the ends of the ropes are attached to six iron balance-weights, of two tons each. The lower pulleys are keyed on to iron shafts, which are turned by the wheel gear at the end, when it is desired to raise the Bridge.

The clear water-way is 31 feet, and the head-way, when the platform is lifted, 12 feet; the platform is 31 feet long by 23 feet wide.

GERMAN ARCHITECTURAL WORKS.


We may put these three publications together as affording materials for considerably enlarging the sphere of architectural study, and directing it towards edifices and works of art belonging to the medieval period, which have hitherto been scarcely noticed, much less illustrated, either by the pencil or by historical comment and description. This is especially the case with regard to the first work on the list, viz.: Ruhm's "Brick Architecture of Italy," though some of the examples are from Bologna, Ferrara, and other places usually visited by travellers, artists, and students. Yet, pre-occupied by the fame of the remains of classical architecture on the one hand, and by that of the modern standards of the art on the other, such visitors seem to have no eyes except for the Pantheon and St. Peter's, and for the buildings of Sansovino, Palladio, and other accredited masters. Surrendering themselves entirely to their "Guide-book," they suffer their attention to be absorbed by, and their inquiry limited to, its directions. Next to seeing all that is there pointed out, it seems to be with them a merit to see nothing further. They do not even give themselves the chance of stumbling upon anything which their purblind and one-eyed "Guide" is unable to discern for them.

Even Woods himself is exceedingly unsatisfactory indeed in regard to some of the places and buildings he visited, for his visits seem to have been made en couvreur, and his notices of them—Ferrara and Pavia, for instance—are more provokingly tantalizing than complete silence would have been; or if they do not tantalize, it is because they mislead, by leaving it to be supposed that they really contain nothing at all worth an architect's attention. He does not even so much as hint at Brick Architecture in the North of Italy as constituting a peculiar style of ornamentation. Something, on the contrary, although in itself but very little, may be found in the 29th chapter of Hope's "Historical Essay of Architecture," in a note to which it is said: "In the plains of Lombardy, where stone is rare, clay has in buildings of importance, been moulded into forms so exquisite as to have been raised into a material of value and dignity. In the ancient churches of Pavia, &c., it presents itself in all the delicate tracery of the middle ages; in the Great Hospital, Campo Santo, and Castiglione Palace, at Milan, it exhibits the arabesque, medallions, and scroll-work of the cinque-cento style. On this side the Alps, clay has never received forms quite so elaborate, &c. &c." This alone sufficiently recommends, or ought to recommend, Ruhm's work, which

* Most strange to say, Woods dismisses this extraordinary architectural monument as once, by merely assuring us that "it possesses little interest as an object of architecture"!—although it is an edifice of most singular character.
THE CIVIL ENGINEER AD ARCHITECTS JOURNAL.

[AUGUST,

as far as we are aware, is the first publication that presents us with specimens of brickwork as it was formerly practised in Italy.

Did we previously doubt it, we should be convinced by these examples that brickwork, combined with moulded bricks and terra-cotta ornaments, is susceptible of a high degree of embellishment, and readily affords great variety of combinations. But we are prejudiced against it by the slovenly coarseness of our modern bricks, which are only used for ordinary buildings, or else intended to be concealed by stucco facing. Thanks to acts of parliament, which have prescribed their size and shape, ours are, as Hope observes, the coarsest and most unsightly bricks used in any country; yet why parliament should interfere with the fashion of bricks, more than with any other fashion, it puzzles us to make out. Such interference has certainly been so mischievous, that unless the interest now affected for the advancement of art be all make-believe and sham, such injurious restrictions ought at once to be repealed.

The frontispiece, or engraved title-page, of Bongie's work exhibits the portal of the church of Sta. Caterina at Bologna, a composition of such remarkable elegance and delicacy, that it is astonishing it should have escaped the notice of those who professedly go in quest of architectural studies. The next plate gives us two admirably profiled cornices at Ferrara and Faenza, also the part of a window and highly enriched string-course from a house at the latter-place; somewhat similar decoration to which, we are informed by the author, has been adopted in the restoration of the Klosterkirche at Berlin. A house at Bologna has furnished the subject of the two following plates, and although it cannot be affirmed that the building itself is by any means a model, the windows and some of the other details afford valuable hints. It is to be regretted, however, that the principal cornices and their friezes are not shown at large like some of the other parts, for if we may judge by what can be made out in the perspective view of the building, they are of particularly rich and elaborate design. The other plates show a variety of other cornices, wherein the mere arrangement of bricks of nearly the usual shape is made to produce very bold and effective mouldings for such purpose. Hardly need we add that Rauge's work deserves to meet with extensive encouragement in this country, as one of real practicalutility, and calculated to improve the character of brick buildings.

Osten's work, on the contrary, is more of an archaeological and historical nature, in which respect it is a highly welcome contribution to the history of architecture in Lombardy and the North of Italy, from the 7th to the 14th century. It promises to go far towards filling up what is now a hiatus in the architect's library,—towards serving as a bridge across the chasm which separates the classic from the medieval period of the art. Lombardic architecture has of late years obtained attention; yet, owing to the want of adequate notices and illustrations, those who have spoken of it have not been able to enter into the subject so fully as they otherwise might and would have done. We do not know whether Osten intends to give only unclassified monuments, but even should any that have been before represented here be introduced, they will be more satisfactorily explained than hitherto. The principal monuments contained in the two first Livres ou Deux of the work are the cathedral of S. Ervâo, at Casale, Monteferrato; the baptistery of S. Pietro, at Asti, and the church of S. Andrea, at Verceil, of some of which is any mention at all made by either Seroux d'Aigincourt, or Wielbaker, Hope, or Woods. Both the churches are interesting, that at Verceil more especially; it is being, we are told, the work of an English architect, named Brigantine.—at least one whom the founder, Cardinal Guaia Blochieri, brought over from England, where that prelate had resided for several years. The edifice is further remarkable for having been completed within the short space of about two years, it being begun in 1219, and finished, together with the buildings of the adjoining convent, in 1222. It is accordingly uniform in idea, though it at the same time exhibits the combination of two different styles, for while the exterior is decidedly Lombardic, and the windows are very small semicircular-bordered openings, the pillars, arches, and vaulting of the nave are expressly in the Pointed style, and some of the arches are unusually acute. The general dimensions of the plan are about 233 by 108 English feet, and 131 across the transept. The other church, viz.: that at Casale, which was begun in 741, by King Liutprond, and consecrated as a cathedral in 1107, by Pope Paschal II., forms externally a parallelogram of 170 feet by 104; but although the external form is so simple, the internal plan is very remarkable, the church itself, notwithstanding its moderate dimensions, being divided into five compartments or aisles, and preceded by an atrium or Galilee; of which latter two sections are given, but not even one, unluckily, of the body of the church itself. The baptistery at Asti is a polygon of 24 sides—accordingly may be classed with roundness. It is 53 feet in its external, and 46 in its internal, diameter, and 40 high to the summit in the centre of the plan; although to the edge of the sloping hemi-epistyle roof over the surrounding side, or whatever else it may be called, the height is only 17 feet. Strikingly piquant, the architectural character of the structure arises almost entirely out of plan, and its successive forms, independently of, and in this instance quite without, decoration; wherefore, were we to term current among architects, we should apply it to this building as a very appropriate epithet for it,—one that goes far towards expressing a prominent aesthetic quality in it. The edifice itself, indeed, belongs to a class now extinct; nevertheless, ideas available for other purposes than the original one, may be derived from it. Were our architects occasionally to turn to such studies as the example at Asti, and the Abbatoire's Barn at Glastonbury, they would not give us such fantastic monstruosities as they now frequently do when called upon to design buildings for industrial or economical purposes, for which a medieval style is desiderated.

The third publication on our list, is of quite a different character from the other two, it being devoted to specimens of furniture and articles of wîrû, both of the middle-age period, and that of the Cinque-cento and Renaissance. Most tastefully executed both as to drawing and colouring, it will form a very suitable companion work to H. Shaw's "Encyclopedia of Ornament," with which it agrees also in size,—at least the difference of size is so very slight, as perhaps to be disregarded. Two books of this kind, side each other on the same shelf. To many of our readers this, we presume, will be sufficient information as to the general nature and character of this collection of "Kunstwerken." Having as yet only the first leaf or part before us, we cannot say which class of subjects will predominate, but the specimens themselves, selected from public and private collections at Vienna, Berlin, Dresden, Gotha, Cassel, Darmstadt, and other places in Germany, will be new to this country, and will extend our acquaintance with medieval art and taste. That the latter approaches the taste of our modern fashionable pseudo-medievalism in furniture, is tolerably evident from an oak cabinet here represented, which unites extreme simplicity of general form with elaborate ornamental design. If we compare this with modern productions calling themselves designs for "Gothic furniture"—and we may mention those of Heidelberg, both because he is a German artist of considerable repute, and because some of them have been not only shown, but exhibited in the Art-Union,—the latter appear truly coarse and barbarous extravagancies, devoid of a single principle of either design or composition. To say the truth, some of Herr Heidelberg's chairs are so preposterously absurd, that their clumsiness, inconvenience, and uncomfornatobleness, if not their ugliness, must deter any one from adopting them. Neither do we say that even such a specimen of furniture as the cabinet above-mentioned, is now suitable as an export model for us; for even the choicest and most genuine relics of the kind require considerable modification, and ought to be revised by the best patterns, but as studies; and as a collection of original studies, these "Kunstwerken" promise to become a most valuable addition to the information we already possess; too scanty, perhaps, in itself—relative to "industrial art" during the middle ages.

OF LOGARITHMS.

By OLIVER BRUM.

SIA.—Having known for years the readiness with which you publish any thing interesting in art or science even when it is not in strict accordance with the averted objects of your excellent Journal, I take the liberty of sending you a few remarks on the construction of logarithms. Indeed, I know of no other periodical open to mathematical communications, particularly when the subjects require woodcuts to illustrate, or symbolical language to investigate.

Logarithms is as powerful an agent in calculation as steam is in machines; with this truth before us, it is strange that few know their proper use or how they are computed,—and fewer still, from the great labour attending the operations by any known method, attempt the calculation of these very important numbers. Since the days of Napier and Briggs, logarithmoechay, in a practical point of view, has received but little improvement, while logarithmic formulae have been cultivated with great success, and advantageously employed to abridge many analytical inquiries in different parts of mathematics. However, it is also true, that some analysts have restored
much time and labour in search of a simple and direct mode of calculating logarithms, and though wholly unsuccessful, or very nearly so, as respecting the obtainable object of the inquiry, they have been rewarded by the discovery of those interesting and momentous formulae which constitute what is at present termed "The Theory of Logarithms." It is also worthy of remark, that Briggs, Halley, Sharp, Vlacq, and others, who brought the doctrine of logarithms to perfection, were not averse to arithmetical calculations; but our modern mathematicians depend by far too much on purely algebraical expressions, foreign translations, and merely hocus pocus operations on operational symbols.

In an inquiry on logarithms, it is usual to put \( N = \text{a given number}, \ a = \text{the base of any system}, \text{and } M = \text{the modulus of the system. Substituting } 1 + s \text{ for } N, \text{&c., we have}
\[ \log (1 + s) = M (a - 1) s + \frac{1}{2} M (a - 1)^2 s^2 + \frac{1}{3} M (a - 1)^3 s^3 + \text{&c.} \]

for the fundamental expression, from which several other formulae are derived, hitherto used in the computation of logarithms. But the above series is only useful when \( s \) is a very small fraction; while the majority of those deduced from it are only available in the case of determining logarithms from the combinations of others. The value of \( M \), in the above series, cost Mr. Briggs 54 successive extractions of the square root, and 54 multiplications; and although many ingenious contrivances have been devised to abridge the labour of these extractions, the process is at best very tedious.

Lagrange converted the above series into

\[ \log s = r M \left( \frac{s^2}{2} \right) - \frac{r^2 M (s - 1)}{3} \]

by substituting \( s^2 \) for \( 1 + s \); \( r \) being entirely arbitrary. This formula can be rendered as convergent as we please, and therefore the value of \( r \) can be so assumed, that the logarithm of any number, \( s \), can be determined to a limited extent, by using only the first term of the series, viz. from the equation

\[ \log s = r M (s - 1) \]

This method, undoubtedly, is always applicable to the direct computation of a logarithm; yet it is the same in effect as that proposed by Briggs, and is equally laborious, on account of the great number of extractions generally required.

It is, perhaps, unnecessary to dwell at any great length on the difficulties attending the computation of logarithms by a direct process, independently of other logarithms; however, we cannot conclude these remarks without giving a remarkable expression, deduced by Professor Wallace, of Edinburgh.

The form is this—

\[ \log s = \log a + \frac{a - 1}{a} (s - 1) + \frac{a - 1}{a^2} (s - 1)^2 \]

in which \( m \) and \( n \) are any numbers chosen at pleasure; \( s \), always some value between 0 and 1; and \( a \), the given base of the system. This expression leaves the base unrestricted, involves no infinite quantity, and is said by some to be "of great analytical elegance";—yet, it is purely algebraical, and as to its practical utility in the actual determination of a logarithm, it is just as much use as any other intelligible hieroglyphics.

Perhaps you will allow me to state a fact, which you have tested"—i.e. that I have discovered a method by which the logarithm of any number, to almost any extent, may be calculated, independently of other logarithms, in a few minutes. Mathematicians and the curious will, I have no doubt, be obliged to you for publishing the following results. It is well known that when the diameter of a circle is one, the circumference is

\[ 3 \times 1415926535897932384626433832795028841791793238511 \]

of 50 places of decimals. Now, I find the logarithm of this number to be

\[ +96714892644335953159285290290987355176732436446 \]

to 50 places. For the information of the general reader, it may be necessary to mention, that the logarithm of a number consisting of so many places of figures, has not been before computed to anything near this extent; for, by any of the known methods, such a calculation is almost impossible. From the above result, the logarithm of the area of a circle, when the diameter is unity, may be readily deduced, and is found to be

\[ 1.9629888136517146392970498841128201115995614562 \]

correct to the last figure.

With equal facility, we obtain the logarithm of the contents of a sphere, when the diameter is unity, to be

\[ 1.76999652310490921245014000211293583538557072764 \]

\( M = +34329440193029182765112201161650568229429070058056666 \]

July, 1847.

OLIVER BRYNE.

WARRER'S LONG RANGE.

For the following calculations of the dimensions of the balloons which would be required for the purposes of Mr. Warner's Long Range, we are indebted to the courtesy of Sir Howard Douglas, whose scientific researches have so greatly tended to disabuse the public mind of errors respecting the reusability of an old project for aeronautical warfare.

It has been already explained that Mr. Warner's apparatus consists of a balloon, from which, when it has attained a proper altitude and position, heavy shot or shells are to be let fall, being detached from the car by self-acting mechanism; these missiles derive their destructive effects from the velocity acquired by the action of gravity during their descent, or from the disruptive force of an explosive composition contained in them.

First of all, let it be required to determine the greatest possible velocity which the shot will acquire.

Falling bodies are acted on by two vertical forces during their descent—the accelerating force of gravity, and the retarding force of the resistance of the air. The former of these forces is constant at all velocities; the latter increases very rapidly with the velocity, and may be assumed to vary as the square of \( t \); consequently, the resistance of the progress of the ball becomes greater and greater, till at last it just counterbalances the action of gravity: In this stage of the descent, the velocity is said to have acquired its "terminal value," beyond which further acceleration is impossible. When once, therefore, a falling body has acquired its terminal velocity, it is no longer accelerated, but continues its descent with precisely the same uniform velocity (unless new forces are brought into operation), till it reach the earth.

Now it appears from numerous experiments, that the terminal velocity of a 12-lb. shot, filled with lead, (that is, the greatest velocity which the shot can acquire by descent) is 419-6 feet in a second; and to acquire such a velocity the ball must fall from a height of not less than 2749-2 feet. These results may be safely relied on, as they express the mean of a vast number of experiments. The terminal velocities of solid shots of various sizes differ considerably. As the solid contents of spheres vary as the cubes of their radii, and their surfaces only as the squares of their radii, it follows that the larger the shot the heavier will it be in proportion to the surface exposed to the air's resistance, and therefore the greater will be the terminal velocity; for shells filled with an explosive composition the terminal velocity is less than for solid shells of equal size, the former being lighter in proportion to the surface exposed to the resistance of the air.

If the resistance be taken to vary as the square of the velocity conjointly (the surface varying as the square, and the weight as the cube, of the radius), it may be easily shown that the terminal velocity varies as the cube of the radius. Hence, \( v = 178.5d/3 \) is a general expression for the terminal velocity of a ball of \( d \) diameter, the constant 178 being determined by numerous experiments.

The doctrine of terminal velocities is beautifully illustrated in the descent of the parachute, which, after it has attained a certain velocity, will, if properly constructed, continue to descend uniformly, without any further acceleration. Another admirable illustration is afforded by falling rain, which, unless retarded by the air, would be so much accelerated as to destroy vegetation.

The idea of defence of fortified places by "vertical fire"—that is, by shot discharged so as to fall nearly vertically on the heads of the besiegers—was promulgated by the celebrated mathematician, M. Carnot, who, however, totally overlooked the resistance of the air, and supposed the shot to describe parabolas. In a Reply* to his theories, it was shown theoretically, that the retardation of shot descending vertically would render them all but inoperative; and the theory was confirmed by actual experiments, undertaken by the author for the especial purpose of testing its accuracy. The following extract details the nature and results of these experiments:

* The present volume contains a number of errors, and is published at the instigation of the Rev. Dr. Walling. London: printed for T. Egerton, bookseller to the Ordnance, Military Library Whitehall. 1813.
A cobble mortar was placed 108 yards from six new dam tents laid on the ground, and two new washmill tents spread out near them, to estimate by the impression made on them the force with which the wheels would fall.

The first round was with the usual tin case, containing 93 four ounce-balls, with a charge of one ounce of powder, elevation 45°. The case went bodily about 150 yards without breaking.

 Loose bolls were then put in over a wooden bottom. After a number of rounds with the above charge and elevation, with different numbers of fourounce balls, it was ascertained that the cobble would throw 42 of them 100 yards, and that the spread was, on an average, about 10 or 12 yards. It was not very easy to hit the targets and cloths, although they covered a surface of 774 square feet; but, in one instance, 22 balls left their mark. The indentation on the surface of the deal was so small that it could not well be measured; it certainly was not more than an inch deep. A ball thrown with force from the hand appeared to make an equal impression. Those which struck the washmill tent did not penetrate, but merely indented the ground underneath. The penetration of the balls into the ground (which was of the softest nature of meadow) was, on an average, 2 inches; but the balls thrown by hand did not penetrate so far.

The mortar was then elevated to 75°, and with two charges of powder and 42 balls made nearly the range as before; but the spread was increased to about 40 yards, so that it was difficult to hit the surface aimed at. Several balls did, however, at length fall on the targets and washmill tents. The impression on the former was something increased, but still so trifling as hardly to be measured; the balls did not go through the cloth, and the penetration on the meadow was only increased to about three inches.

Secondly, to determine the dimensions of the balloons necessary to raise the weights proposed by Mr. Warner. By a well-known principle of pneumatics, the weight of the balloon and its appendages, when floating in the air in equilibrium, is equal to the weight of the air displaced. Now the density of hydrogen gas when prepared in large quantities for the purpose of inflation is about 3, or a cubic foot weighs 3 oz. In order to ascertain the density of the air, the diminution of barometric pressure due to the altitude must be taken into account; and if the balloon be supposed to have attained the average altitude of 2500 feet, the density of the air may be taken as 1.09, or a cubic foot of air weighs 1.09 oz.

Assume the balloon to be spherical, and call its radius $r$. Its solid content is $\frac{4}{3} \pi r^3$. The weight of that volume of gas is $2 \times 4.1877 \times r^3$. The weight of that volume of air is $1.09 \times 4.1877 \times r^3$. The weight of 100 shells of 500 lb. each is 500,000 oz. The weight of silk, netting, car, &c., taken for an approximate determination of the size of the balloon, is 75,931 oz.

Now, as has been stated, the total weight raised is taken as a comparison of that volume of air equal to the capacity of the balloon, &c. Hence, neglecting the space occupied by the car and appendages, we have the equation

$$1.09 \times 4.1877 \times r^3 = 2 \times 4.1877 \times r^3 - 500,000 + 75,931$$

Whence may be obtained the following results:

$$4.1877 \times r^3 = 981,945 \quad \text{(volume)}$$

$$r = \sqrt[3]{612.6} \quad \text{(radius)}$$

$$4 \pi r^2 = 47,866 \quad \text{(surface)}$$

In other words, the capacity of the balloon and the quantity of gas which would be required to inflate it would be one million cubic feet, the quantity of silk required in its construction would be forty-eight thousand square feet, and its diameter (double the radius) one hundred and twenty-three feet.

If instead of ascertaining the dimensions of the balloon at an altitude of 2500 feet, its dimensions necessary for raising the given weight just off the ground be calculated, the results will not be materially altered. In this case, the density of the air must be taken at 1.2 (instead of 1.09), and the diameter of the balloon will be found to be 119 feet instead of 123 feet. The following table shows the dimensions of the balloon necessary for sustaining the several specified loads, and the cost of the silk required in its construction.

<table>
<thead>
<tr>
<th>Weight of load</th>
<th>Diameter of balloon in feet</th>
<th>Cubic feet of gas content</th>
<th>Surf. of balloon in square yards</th>
<th>Quantity of material</th>
<th>Cost of silk in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 lb.</td>
<td>33-0</td>
<td>18,816</td>
<td>380</td>
<td>570</td>
<td>500</td>
</tr>
<tr>
<td>40 lb.</td>
<td>40-4</td>
<td>33,510</td>
<td>569</td>
<td>884</td>
<td>450</td>
</tr>
<tr>
<td>100 lb.</td>
<td>45-8</td>
<td>56,893</td>
<td>751</td>
<td>1097</td>
<td>587</td>
</tr>
<tr>
<td>200 lb.</td>
<td>55-2</td>
<td>77,821</td>
<td>1010</td>
<td>1315</td>
<td>613</td>
</tr>
<tr>
<td>100 lb.</td>
<td>63-1</td>
<td>77,821</td>
<td>1010</td>
<td>1315</td>
<td>613</td>
</tr>
<tr>
<td>500 lb.</td>
<td>123</td>
<td>974,349</td>
<td>2598</td>
<td>3748</td>
<td>3,200</td>
</tr>
</tbody>
</table>

* The silk of which balloons are made is of the best quality, and only 24 inches wide so that a corresponding increase must be made.
intended to prevent the channel c e from becoming obstructed. a is a channel or pipe, communicating with the chamber H, and the lower level, through the valve-gate e. w is a man-hole in the leaf d, for the purpose of getting at the small valve-gates i, s, for repairs and other purposes. b & k, shows the water-way communicating with the reservoir and the level below.

Fig. 2 is a longitudinal section of the plan, represented in fig. 1.

Fig. 2 is a cross section of the same.
The plan represents the wicket-gate as closed, and the lock, as well as the chamber H, full of water. When it is desired to empty the lock, the valve-gate e, communicating with the lower level, through the channel a, is opened; at the same time, the valve-gate i (which is connected with the same), communicating with the lock-chamber, through the pipe c e, is closed; the water is thus discharged from the chamber H, and the pressure of the water acting on the larger leaf d, forces the gate or smaller leaf s open. The water contained in the lock-chamber is then discharged through the passage b k.

EXPLOSION OF A LOCOMOTIVE ENGINE IN THE UNITED STATES.
The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred the examination into the causes of the explosion of the locomotive engine "Neversink," upon the Reading railroad, United States, on the evening of the 14th January last, reported:-

That they have collected all the evidence bearing upon the subject which they could obtain, and have visited Reading for the purpose of examining the wreck of the engine, and they desire in this place to return their acknowledgments to the officers of the Reading Railroad Company, and especially to Mr. G. A. Nicolls, the superintendent, for their very great courtesy and kindness to the committee, in facilitating in every possible manner, their examinations, and putting them in possession of all information having a bearing upon the object of their research. The following is the result of their inquiries:

The engine Neversink was originally built by Baldwin, and sent upon the road in April 1846. It then weighed 104 tons, and had six wheels, two of which were driven. The engine was thoroughly renewed and rebuilt by the Reading Railroad Company at their Reading depot, in April 1846, and was changed to an engine of 19 tons, on six wheels, all connected drivers.

In rebuilding it, four plates in length at the fire-box end of the cylindrical part of the boiler were retained, and 14 sheets in length were added at the front end of the boiler. The new iron was five-sixteenths of an inch in thickness, the old one-fourth of an inch.
The vertical part of the boiler was 51 inches in diameter; the fire-box was 39 inches long, 37 inches wide, and 44 inches high; the crown was stayed with wrought iron bridge bars, and was so strong that it received no damage from the explosion. The horizontal portion of the boiler was 41½ inches in diameter, and 11 ft. 6 in. in length between the tube-sheets. The smoke-box was 2 ft. 3 in. in depth; making a total length of boiler of 18 feet. There were 128 wrought iron tubes, two inches in internal diameter and one-eighth of an inch thick in the wall; they had copper ends at the fire-box tube sheets.

There were but one safety-valve, 2½ inches in diameter, placed upon the dome; there were four gauge-cocks, the lower one of which was 8 inches above the crown-sheet, and the upper one about 14 inches above the lower. The highest tube was 14 inches below the crown of the fire-box, and 114 inches below the top of the cylindrical part of the boiler. The fire surface, reduced to fire-box surface, amounted to 309 square feet. The cylinders were 13½ inches by 20. The driving wheels 46 inches in diameter.

It was a favourite engine upon the road, and had run, previous to the alteration, in April, 1846, 19,850 miles. Afterwards . . . 71,010 miles. Afterwards . . . 18,041

Total 58,051 miles.

Upon their examination, the committee found the horizontal part of the boiler almost completely destroyed. In this part of the boiler
the explosion had manifestly originated, commencing in the older iron which remained in the hinder part of the boiler. The tubes were, for the most part, still fast in the tube-heets, but they were bent outwards at the point of the explosion, and some of them, which had passed through the boiler, was collapsed, but not broken. The outer shell of the boiler had been torn into fragments, and the rents had extended to the vertical part, the upper portion of which had been entirely torn away, so as to expose the fire-box, which was sound, but slightly injured. The engine was not destroyed, and the extent of it was slight. The boiler, however, having exploded, had been removed, and the quality of the iron appeared to the committee to be uniformly good.

There was, therefore, nothing about the engine to indicate that the accident had occurred from defects in workmanship or material, nor, indeed, were there any circumstances pointing to an explosion, except the idea of a defectively built boiler.

The evaporative power of these heavy engines is necessarily very great. Mr. Nicoll assured the committee that the Neversink was capable of drawing a train of 88 cars, weighing, loaded, 71 tons each, (equal to 637 tons) at a speed of 12 miles per hour, (1056 feet per minute.) Allowing the traction to be 71 pounds per ton, (as experiments upon this road show it to be,) this is equivalent to 163 horse power—requiring an evaporation of 2-55 cubic feet of water per minute.

Now, by the peculiar construction of these engines, rendered necessary by the restricted space allowable for the boiler, when the water-level stood two inches above the lower cock, the steam was confined exclusively to the hemispherical dome above the fire-box, the cubic content of which is rather less than 24 cubic feet, (23-66 cubic feet.) The cubic content of each cylinder (18-7 X 20) is 1-657 (1) cubic feet, and the two cylinders and dome, or the ratio of the cylindrical content is 8-314 to 24, or more than one-eighth. When the water-level is at the upper gauge-cock, the steam room is nine cubic feet, and the ratio about one-third. Now, the most recent (and apparently the best) authority upon the high pressure engines declares, after nearly 30 years of practical experience, that the safety valve should be at a minimum 20 times as great as the space to be filled with steam in the cylinder. If it can be made greater, consistently with the other arrangements of the boiler, so much the better. This is, of course, inapplicable to locomotive engines.

The safety, therefore, that these engines will throw water from the safety-valve, and from the gauge-cocks, when the actual water-level is dangerously low—and that, in the words of Mr. Kirk, they are ticklish in carrying their water, must be evident. The foaming in one of these engines must be incessant, and the danger of priming very great. The gauge-cocks, which, under the most favourable circumstances, are but indifferent indicators of the water-level, become, in this case, useless, and the engine driver must rely upon his experience of the engine and trust to incessant watchfulness alone, if he would avoid an accident.

A very remarkable fact about this explosion is, that the steam pipe passing through the upper part of the boiler, from the throttle valve to the cylinders, was collapsed and unbroken, as is well seen in the accompanying Daguerreotype portrait of the engine, taken after the explosion by Mr. David Monday, of Reading, and kindly lent by him to the committee. It is, indeed, possible that this may have been produced, during the explosion, by the sudden bending upwards of the tube, otherwise it would seem to indicate that the engine was throttled at the time of the explosion; an expedient which may have been resorted to for the purpose of avoiding the dampness of the steam, or to check the speed of the engine; but the fearful danger of it will be seen when it is considered that, if the steam was shut off but one-fourth, (the water being above the lower gauge-cock,) the pressure in the boiler would double itself in about one minute.

It seems useless to speculate upon the immediate cause of this terrible accident, since the death of all upon the engine has removed the direct testimony of the circumstances under which it occurred. But, ever, it appears that the engine was under a very heavy pressure of steam, and scarcely less certain that the safety valve was (accidently or otherwise) fastened down. Mr. Nicoll and Mr. Kirk both testify to the competency of the engine driver, who was in charge, and every one bears witness to his character for sobriety. That he may have been influenced, as to the amount of water in the boiler, from the character of the engine, although it is difficult to imagine how an experienced hand could have neglected the indications given by the increased pressure, as shown by the rapid running of the train and the sharpness of the exhaust.

Upon the whole, it is probable that the committee will probably consider the possibility of the explosion of the Neversink occurred in this way:—

That the engine was running under a heavy pressure of steam, and that, owing to the defective indications of the gauge-cocks, the water in the boiler was permitted to get below the upper tubes, which thus became unduly heated; that the rapidly increasing pressure (assisted, perhaps, by an injudicious partial closing of the throttle valve) caused the starting of one or more of the tubes from the forward tube-heet, and this sudden relief of the pressure caused a foaming in the boiler, by which the water was thrown over the heated tubes, and being thus rapidly evaporated, caused an instantaneous increase of tension, which the additional openings were incompetent to relieve, and thus produced the explosion. The scale of the boiler intended to prevent the collision of the coals, and intended only as a plausible suggestion, and by no means as a confident affirmation of the cause of the explosion.

But whatever hypothesis may be adopted to explain this unfortunate accident, its investigation has forcibly called the attention of the committee to several matters which they believe to be of sufficient practical importance to deserve the attention of the Institute.

First. The necessity of providing all steam engines with a second safety-valve, of large dimensions, regulated to the maximum pressure which the engine is intended to bear, and placed beyond the control of the engine-man. It is true that this will entail upon the owners the trouble of frequent examination to maintain the efficiency of such a valve, but this trouble will be more than compensated by the increased safety which will be procured by its use.

Secondly. The uncertainty of the ordinary gauge-cocks, as indicators of the water-level under the most favourable circumstances, and the deceptive character of their indications upon the modern locomotive engines, where the amount of work to be done and the restricted space which can be allowed to the boiler, necessarily confines the water and steam room, and renders the evaporation more tumultuous than in the larger boilers of stationary engines.

Thirdly. The committee would suggest the inquiry whether it is not feasible and advisable so to construct the locomotive engine that explosions, if they occur at all, shall take place in such a manner as to be less destructive to human life than they at present are. One of the great misadventures of a large boiler, when first introduced into use, was this very diminished liability to do injury, by allowing a tabular flow, of comparatively small size, to collapse, in place of the large cylinders, by which the boiler was at once emptied of its content.

**REVIEWS.**


These tables are for the purpose of estimating the contents in cubic yards of the earthwork of railways: they are calculated, by the ordinary prismatic formula, for a central width of 93 feet at slopes of 1, 3, and 2, to 1, 14, and 8, heights from 0 to 60 feet, at intervals of half-foot.

The advantages of the tables are, that there is no necessity for a second calculation, as at one glance the cubic contents of a chain in length are seen by merely looking for the corresponding heights of the respective ends of each chain's length in the table,—the heights of one end being given at the bottom of the table, and the other height on the side, and at the intersection of the two lines the cubic contents are given. Thus, for a cutting 5 chains in length, of the respective heights of 348, 190, 1365, 756, and 151—total, 3700 cubic yards.

We believe these tables are the only ones that offer such a facility of calculation; consequently, we strongly recommend them to the profession.

We must observe that there is another table, by which the contents, for any other width, from 23 to 43 feet, may be found; for this purpose, it will be requisite to have two inspections, but no multiplications.


Professor Donaldson has laid the groundwork for an excellent book; but in the present edition the Maxims are too concise, and are not carried out sufficiently to render them of much service to the student. Many of the topics are insipid explanations, and a reasoning to prove that what is set forth is true; we feel assured that Mr. Donaldson, if he can devote the time to the work, will be enabled to enlarge it in such a manner as to make it a valuable work of
reference, not only to the student, but also to the experienced architect.

With regard to the Lecture which is appended to the present work, we can only say, at the present time, that it is a good summary to a course of lectures, but there are some portions of it with which we cannot agree—our reasons for differing must be deferred to another opportunity.


We gave a short account of this instrument in the Journal for December last (Vol. IX. p. 389). The object of the present work is to show how the instrument may be used: it is extremely simple, and is highly satisfactory. It will be found of great service to the travelling student in taking sketches of buildings and other objects.

The Tradesman's Book of Ornamental Designs.—The second part of this work fully sustains its character for utility: the design for an iron gate is exceedingly good.

REGISTRATION OF NEW PATENTS.

RAILWAY AXLES AND SIGNALS.

Thomas Waterhouse, of Edgeley, near Stockport, cotton manufacturer, for "Mechanical Improvements applicable to railway engines and tenders, and railway carriages of various kinds."—Granted March 10; Enrolled Sept. 10, 1847.

The object of the improvements is, firstly, to facilitate the passage of railway engines and carriages round curves, by allowing each wheel to move independently of its fellow. This is effected by forming one of each pair of wheels with a long nave equal to one-half the diameter of the wheel to which it is applied, which is bored to fit the axle, and to work against a shoulder on the same; it is to be kept in contact with the shoulder by a washer, secured to the axle, outside the nave by a key; the other wheel is fixed to the opposite end of the axle. Another method is to divide the axle at the centre into two parts, and its bearings to the lower framing of the carriage, for the purpose of supporting the inner ends of the two parts of the axle; by which means the wheels are permitted to rotate independently of each other.

The second improvement is for an apparatus for sounding signals by means of compressed air; consisting of a force-pump for compressing air into a receiver beneath the carriage, from which it can be admitted, by the guard or attendant, into a railway whistle or other instrument for sounding signals.

DRESSING LACE AND FABRICS.

John Kelly, Jun., of Nottingham, dyer and lace-dresser, for "Improvements in dressing or finishing lace and other fabrics."—Granted December 14, 1846; Enrolled June 14, 1847.

This invention relates to a dressing for lace and other fabrics, which when made up, will not be liable to absorb moisture from the atmosphere, but will preserve their shape when heated or damp.

6 lb. of shellac is to be dissolved with 1 lb. of borax in 3 gallons of hot water, or the shellac may be dissolved by other alkalis, and in different proportions to the before-mentioned. The solution of shellac may be used alone, or, when thought desirable to give a greater degree of stiffness, it may be mixed with starch, gelatine, glue, or other stiffening material, dissolved by the ordinary methods, and then stirred into the solution of shellac while the latter is at a boiling heat: the quantity of stiffening material added will vary according to the stiffness required; the addition of 1 lb. of glue to a solution containing 1 lb. of shellac has been found to answer well. The solution is applied by dipping the fabric therein, or spreading it upon the fabric; the stiffening is proceeded with in the ordinary manner.

GAS METERS.

Thomas Edge, of Great Peter-street, Westminster, for "Improvements in the manufacture of gas-meters."—Granted Dec. 9, 1846; Enrolled June 30, 1847.

This invention relates, firstly, to the manufacturing of gas-meters of plates or sheets of iron, covered with a coating, first of tin, and then a coating of zinc, or with an alloy consisting of tin and other metals, to prevent or retard the destructive effects of the gas. The metals or alloys employed for this purpose are tin and zinc, as being found in practice to be the most desirable and efficient. Any known method for coating plate-iron with these or other metals may be employed. The inventor leaves the manner of piercing or covering of plates or sheets of iron with zinc and tin, or with any alloy of metals, as these processes form no part of his invention when taken separately.

The second part of the invention is for forming the internal parts of the meter of the same or a similar kind of metal, so that no volatile action may be induced between the several parts, by constructing them of an alloy of metals, as being most suitable, and which alloy is made to bear some analogy to the particular coating of the plates or sheets of iron of which the case is constructed; and, in order to present the solid parts, which are liable to be injuriously acted upon by the gas, or that come into contact with the water that becomes impregnated with the gas that passes through the meter, the inventor constructs them of an alloy of metals, consisting principally of zinc and tin, the proportions of which may be varied, or other metals may be added, for the purpose of hardening the alloy. For the above purposes, an alloy consisting of from 80 to 70 parts of zinc to from 20 to 30 parts of tin, will be found to answer the object required.

PIERS AND HARBOURS.

Peter Borrie, of the Crescent, Minories, City, engineer, for "Improvements in the construction of piers and harbours."—Granted Dec. 21, 1846; Enrolled June 21, 1847. (Reported in the Patent Journal.)

This invention relates, first, to the construction of piers, whereby the communication is maintained between the approach and the vessel, without the intervention of stairs, at all times of the tide. It consists of a combination of a permanent way, a floating pier, and a platform connecting the two, which is hinged at one end to the permanent way, and at the other rests on the barge or vessel, which rises and falls with the tide. For light traffic this erection is constructed almost entirely of wood; the permanent way, which in the drawing is represented as being curved, but which may be formed according to the nature of the approach, is supported on piles driven into the ground; the space between each set of piles leaving a clear water-way.

The roadway, which is of peculiar construction, is represented at fig. 1. Beams, c, c, are laid longitudinally and resting on the piles; at their extremities they are slightly curved upwards and strengthened by means of tension-bands, or chains, b; the chain is secured to a cast-iron cap on each end of the beam, and support it at intermediate points by stretchers, c, c, c, c. Now, it will be obvious that the tendency of weight placed on the centre of the arch will be to straighten and, consequently, lengthen the beam, thereby throwing the greater part of the strain on the chain. The barge, or floating part of the pier, is placed between two buttresses formed of piles, one at either end, and by them is guided in its rise or fall with the tide; and it is generally preferable to place this barge parallel to the current, without regard to the position in which it is necessary to connect the roadway; this barge may be constructed of iron, with a wooden deck, or it may be wholly of wood; the inner side of which has a platform, having a greater displacement of water to compensate for the weight thereof, and it is furnished with water-tight bulkheads for additional security and strength. The platform which connects the roadway with the floating barge, is constructed in a similar manner to the permanent roadway, being formed of longitudinal beams, strengthened by tension-rods and stretchers, as before described; one end of these beams is connected by a strong bolt, passing...
through the cast iron caps and corresponding knuckles, fixed to the piles which support the lower end of the permanent way, and thus forming a flange on which it rises and falls; these piles are strengthened sidewise by means of struts, so as to enable the structure to resist the strain consequent thereon; the other end of the platform, which rests on the barges, is furnished with rollers, which traverse rails placed in a recess formed in the side thereof, so as to bring the surface of the platform on a level with the deck. The flooring of this structure is supported from the beams by joists which, with other transverse fastenings, connect the whole firmly together, and it is surrounded by a railing in other similar erections. Piers intended for heavier traffic, are constructed in a manner very similar to the foregoing, but with the several parts of a proportionate strength; but in many cases, where the rise and fall of the tide is too great to admit of the whole of the inclination being thrown on one movable platform, he, therefore, makes use of an intermediate floating barge, protected by buttresses; this arrangement avoids the necessity of having the platform of any extraordinary length, when any great height is to be attained. Instead, also, of the rollers at the end of the platform bearing directly on the floating barge, it rests on a frame which is supported by a strong shaft laid horizontally in the direction of its length; this admits of a rocking motion, and, consequently, prevents any strain from twisting or affecting the permanent pier, to which the other end is affixed. In piers constructed for every description of heavy goods, in place of supporting it on piles, it is erected on a base of solid masonry, supporting cast iron pillars, on the top of which the longitudinal beams are placed, and the whole is finished in a manner proportionately strong for the accommodation of wagons and other vehicles; the platform of this pier also rests on an apparatus, the same as before described, for the purpose of counteracting the rolling of the barge from the action of the waves.

The floating-barge of this pier, supporting it to be erected where it will be subjected to the action of the sea, is constructed with open-ended tubes passing through from side to side, as also from the deck to the bottom; this not only materially strengthens the barge, but allows the sea to break through and thereby partially avoids its effect. Having described the nature of his invention as regards piers, he states that he is aware they have before been erected where the communication has been effected by means of a platform, rising and falling with the tide, but what he claims is the peculiar construction of low-water piers, adapted for all kinds of traffic, and for the accommodation of all classes of vessels in loading or delivering passengers or goods of all kinds, at any state of the tide, without the intervention of stairs between the fixed and floating piers, and which pier forms proper roadways for carriages, carts, wagons, or other vehicles, even of the heaviest description, coming to or going from vessels lying alongside the floating-piers; and when such piers are to be adapted for ferries, the floating-piers may be made of such a height that their decks will be level with the deck of the steamer or other vessel used for the ferry, so that any carriage or vehicle may drive down the pier, and on board such steamer or vessel, without disengaging the horses, and which piers are constructed in the peculiar manner here shown. The second part of this invention relates to the construction of a floating breakwater, for the protection of shipping in harbours, bays, estuaries, or other inlets of the sea. Fig. 2, represents a transverse vertical section of this breakwater, and fig. 3, an elevation of the same; it consists of a cylindrical casing, a, of iron which being rendered water-tight forms the buoyant part on which the whole structure is supported; b, b, is a framework made of iron, attached to the caisson; on this framework a number of planks, c, c, are fixed longitudinally, which as the sea breaks through renders it comparatively smooth on the inside. The caisson a has a number of tubes, d, d, through it, both vertically and horizontally; these tubes allow the sea to break through, and consequently lessen the effect thereon, and likewise tend considerably to strengthen it; at the lower part of the framework a ballast-chamber is placed, which has the requisite quantity dropped through vertical tubes, d, d; several of these breakwaters may be connected together by the joints e, e, according to the entry of the harbour; the whole is secured by the chains s, s, to a suitably anchorage in the position most desirable for obtaining the desired effect. He does not claim the invention of floating breakwaters of iron, or other material; but what he claims is the forming of floating breakwaters in the peculiar manner represented in the drawing, and as hereinbefore described.

RAILWAY WHEELS AND BREAKS.

HENRY GROTON, of Holborn-hill, engineer, for "Improvements in railway wheels and apparatus connected with railway carriages."—
Granted January 16; Enrolled July 16, 1847.

The improvements relate, firstly, to the formation of wheels for railway carriages, to adapt them for running on different gauges. The amended engraving shows the construction of the wheel with two flanges or railway tyres. In place of spokes, the inventor proposes to have two dished plates formed of corrugated iron, which are made by pressing the plate in a mould; the centre to be riveted to the nave and the outer rim to the tyre and a cylinder of sufficient width to receive the two tyres—the distance regulated according to the different gauges. The second improvement is for a railway-break, consisting of a metal band placed between the two tyres, which by a lever is made to press upon the periphery of the wheel between the two flanges.
BARLOW ON ARCHES.

(Continued from page 21.)

Mr. CURTIS, V.P., said he felt the propositions in the paper were so conclusively true that they scarcely afforded an opportunity for remark, much less for discussion. The great mass of the propositions and demonstrations in the paper related to the practice; in most of the treatises on arches, the theory alone was considered; Mr. Barlow had, however, very properly pointed out the possibility of constructing arches of certain forms and dimensions, which could not be done if the rules, so far as I could see, would stand well alone; but that when any pressure was imposed on them, they would fail. These were points of great importance, which should never be lost sight of by the engineer, and demanded not only great attention to the theory, but the results of the influence of the ground employed, the situation, the nature of the foundation and of the backings and numerous other considerations, in order to adapt the arch to the use for which it was intended.

Mr. BOWDIN agreed with the value of the paper. He viewed it more particularly as it related to the construction of arches in mines, where solidity and permanence were of such importance, on account of the unequal pressure to which they were subjected.

Mr. BEANEN had had the advantage of reading the paper, and the remarks of the speakers to the point of its observations, but it was very difficult, as the author's practical experience appeared to have constantly directed his theoretical investigations. He thought, however, that the compressibility and elasticity of materials of construction had not been sufficiently insisted upon. This did not generally obtain enough consideration, yet it was of great importance to the stability of a structure; all materials, even to granite, possessed an amount of elasticity, and it did not suffice to have the line of pressure fail merely within the arch; it must be sufficiently long and extending to allow for any yielding from elasticity, without endangering the building.

Mr. PELLAU observed that the valuable information might be rendered available in the construction of the vaults of furnaces, the duration of which was great and the glass necessary in the glass-making industry. It was desirable, therefore, that the crown of the arch of a glass furnace should be so low as to keep the heat down well, and yet if it was too flat, it was soon destroyed by the impinging action of the flame, or else the expansion of the materials by the heat destroyed its dust. The paper dealt with it, and Mr. Beamish conducted the practical judgment of the workman was alone depended upon for the proper form, and the consequence was, that although a well-built furnace arch might last 14 years, it might not last longer than 14 months.

Mr. INNIS said that the ruins of ancient buildings would afford many instructive instances of the correctness of the principles laid down in the paper. Numerous examples of remains of arches standing without other support than the stones of which they were composed, might, he believed be found, which could corroborate the views of the author, and he recommended such examples as illustrations of the propositions. Mr. STEPHENSON wished to express his conviction of the useful character of the paper, which, he was convinced, would remove many difficulties hitherto felt in examining the subject by the process laid down by Professor Moseley, and though highly philosophical and beautiful, were much too abstruse for the use of the practical man. Any thing which tended to elucidate these formulas, and render the subject more simple and practical, must be received with great interest by the civil engineer, whose labours would be materially facilitated by such clear adaptations of theory to practice. It would appear, that the principal novelty consisted, in describing by a simple process from two given, or assumed, points, a curve of equal horizontal thrust, falling within such points in the voussoirs, as should demonstrate the stability or liability of the structure. There could be no doubt of the value of such a process; but he would suggest to Mr. Barlow the desirability of giving, in somewhat more precise and simple terms, the mathematical demonstration of that which must be universally admitted to be in practice. He would suggest whether Moseley's term of "line of pressure," as contra distinguished to the "line of resistance," did not convey the meaning of the proposition better than the term "cure of horizontal thrust." It was accepted as perfectly true, that, as stated in the paper, the horizontal force at any part of the curve was equal to the vertical horizontal force of equal amount, exerted in an opposite direction, and that the horizontal force or thrust was equal throughout the curve, and hence the equal pressure of the voussoirs could not be laid down, in such a manner as to be practically used.

Mr. BIDDER accorded with Mr. Stephenson in his appreciation of the value of the paper, for he had seldom heard one of greater utility, and he trusted so good an example would be followed in the Institution. The proposition of describing the curve or line of pressure, showed the important propriety of constructing brick arches in separate superposed rings; the line would in almost every instance, travel out of the ring in which it commenced, and in case of fracture, the rings would fall concentrically; but if the arch was well bonded together throughout its entire depth, the line, or curve, would be traced within it, and it would possess the requisite strength. All the best brick arches were now built in that manner with full load. An arch had recently been so built by Messrs. Grisell and Peto over the River Lea, with a span of 87 feet, and a rise of 6 feet; the centres were unusually short, but after the arch was lightened, it stood perfectly, and with very little subsidence. He was tempted to consider as arches constructed of rectangular bricks set in a matrix of cement, as a distinct class, the tenon rods of which were represented by the voussoirs of the arch. Various examples, such as the Maidstone Bridge, were examples of what he meant.

Mr. BIDDER could not agree with Mr. Bidder's comparison, or what he might be permitted to term his amusing theory; on the contrary, he must confess that there was no analogy between a compressed arch and the tenon rod, for the former the main force was pressure, in the latter the force exerted was tension; the abutments of the former had to resist a horizontal thrust, at a given angle, whilst the wing walls, under the other, had to support only the frictional resistance; any tendency to fracture in the arch might come from deflection of the beam or girder, was prevented by the tensile force of the abutments which connected the opposite extremities. If an arch could be considered as a bent trussed girder, it must follow, that it would stand equally well whether the curve was upwards or downwards, which certainly did not accord with his notions of the properties of an arch.

Mr. BIDDER replied that his views were misapprehended; what he contended was, that a brick arch being formed of rectangular pieces, set in a matrix of cement, having great adhesive properties, upon which it in a general way depended, its behaviour was considered as a homogeneous mass, assuming the nature of a curved trussed girder, the resistance of the abutments acting as the tenon rods of a girder. He must still contend for it, and that the bridges of great span and small rise, erected by Mr. Barlow, were excellent examples of the writer's theory, to compress, and the latter by the tension of the tie-rods; the adhesive properties of the materials not being in either case taken into consideration. The arch, per se, should always be considered as composed of separate masses, and not of a single concrete mass; the frictional resistance of the friction between the surfaces. It would be desirable if Mr. Barlow would give a more perfect mathematical formula for describing the curve; the rule which he had given had too much the character of being empirical and being made to fit the position for the sake of argument. It was certain, that the arch and the trussed girder, being supposed to be formed of the same materials, were not supposed to be supported, but by the frictional resistance, and the latter by the tension of the tie-rods; the adhesive properties of the materials not being in either case taken into consideration.

Mr. R. STEPHENSON considered that Mr. Bidder only meant to put forward the position for the sake of argument. It was certain, that the arch and the trussed girder, being supposed to be formed of the same materials, were not supposed to be supported, but by the frictional resistance, and the latter by the tension of the tie-rods; the adhesive properties of the materials not being in either case taken into consideration. The arch, per se, should always be considered as composed of separate masses, and not of a single concrete mass; the frictional resistance of the friction between the surfaces. It would be desirable if Mr. Barlow would give a more perfect mathematical formula for describing the curve; the rule which he had given had too much the character of being empirical and being made to fit the position for the sake of argument. It was certain, that the arch and the trussed girder, being supposed to be formed of the same materials, were not supposed to be supported, but by the frictional resistance, and the latter by the tension of the tie-rods; the adhesive properties of the materials not being in either case taken into consideration.

Mr. W. H. BARLOW was unable to perceive any deficiency in his definition, or in the method by which he ascertained the curve. The line of thrust, as obtained by the construction given in the paper, was practically given in the model. It was not a necessary condition of the line that the "centre line," or other line of "neutral axis," must be straight, but it was necessary that the "line of pressure" should intercept the surfaces of contact at right angles, it was sufficient that the direction of the pressure should meet the surfaces of contact, within the limiting angle of friction. The same condition was exemplified in a column; there the line of pressure was a vertical line, but the surfaces of contact of the stones might be inclined, without occasioning the upper part to slip, provided the inclination was within the angle of friction of the material employed. Moseley's formula, although unretouched, was well established, and was the mathematical knowledge for the general use of practical use. A deep or thick arch contained more than one "line of pressure;" the line of pressure to be dealt with in practical was, in effect, the centre of surface of pressure.

Mr. R. STEPHENSON said, that mathematicians always considered the line of pressure to be at right angles with the supporting surfaces or the abutments. It would appear, from Mr. Barlow's explanation, that his idea of drawing a series of lines at right angles to the surfaces through given points, thus forming what might be termed the polygonal theory, he described a correct curve through the same given points. Mr. Stephenson could not understand how the vousoir could give a line differing from the line of force treated of by mathematicians.

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Mr. W. H. BARLOW said, that Mr. Brunel's "line of neutral axis" expressed more nearly what he understood by the "line of pressure," and that line described by the impinging points of the line of pressure. He thought, that Mr. Bidder's experience, as to arches turned in one entire boid, was stronger than those composed of separate rings, bore out the deductions of the paper. The rings could not contain the horizontal thrust, but when bonded they did so. An arch turned in separate rings depended too much on the adhesive strength of the cement or mortar.

Mr. CURTIS, V.P., said, it appeared to him that the whole question was contained in the proposition demonstrated by the model with curved
also adopted a tentative process. Moseley’s list of resistance touched the arches very closely which would be the point of rupture, and a curve of equal horizontal thrust drawn through these points, though it might not produce the line of resistance with mathematical accuracy, was sufficiently close. Moseley thought the curve very slightly imperfect; in fact he was the only mathematician who had treated the subject consistently with its practical requirements. The difficulty in his mode of investigation was in those arches which did not partake of regular geometric forms, and in those cases Mr. Barlow’s method would be found easy of application.

Mr. Brunel still thought, that Mr. Barlow had scarcely met the objections which had been raised. It was true that in practice some points might be assumed; but it was more satisfactory to have positive rules for finding these points, and assuming the arch the same as to the correctness of the basis of the proposition. In a very large arch, with a small rise, the line of pressure must be confined within very narrow limits, and in such a case a formula giving the points definitively was essential for inspiring confidence.

Mr. W. H. Barlow replied, that the limits which confined the line of resistance, depended on the thickness of the arch and not on the ratio of the rise to the span; the points of rupture in ordinary forms of arches were well known; they were at the extrados in the crown, and the intrados in the arches; there should be less difficulty in finding the line of resistance in these cases. If the mind was as perfectly impressed with the direction of the forces in arches, as in the case of columns, both could be built with equal security.

Mr. G. Swell stated, that in all cases of equal thickness of voussoir throwings, but Mr. Barlow’s method might apply; if the thickness was less the crown, as in the case of an arch with a keystone of limited depth, but of which the voussoirs increased towards the abutments until they came to an extreme length, he did not see where Mr. Barlow could assume his points in the line of resistance.

Mr. W. H. Barlow replied, that in reference to that particular form of arch, it was evident many curves of equal horizontal thrust would be drawn within the thickness, so that it was unnecessary to entertain the question; because, if any one curve of equal horizontal thrust was contained, it proved that the theoretical line of resistance was also contained. It would be observed, on referring to the paper and consulting the drawings and models, that the reliefs were general, and applied to every form of arch and archform structure, loaded or unloaded, and whether of equal thickness or otherwise. The model, with the rectangular voussoirs leaning together at the apex, was selected as an extreme case. He wished to remove an impression, which might have been produced, by his stating that his mode of treating the subject of arches was not mathematical as that of Professor Moseley: he only alluded to the use of geometric construction instead of algebraic formulae; the principle or theory was the same in both cases. The misapprehension as to assuming points in the curve, which Mr. Stephenson alluded to, as not having been sufficiently explained, arose from the modification which was necessary in applying the theory to practice. If perfect hardness of materials and mathematical accuracy of workmanship were attainable, the pressure would be transmitted in the line of resistance; but it was laid down by Moseley, and described by Mr. Swell. On the other hand, if the materials were in the softest state in which it was possible for an arch to sustain itself, the pressure would be transmitted in that curve of equal horizontal thrust, which corresponded most nearly to a line drawn through the centre of the thickness of the arch; because in that state of the arch, the whole available surface of the voussoirs must be acting, to support the insistent pressure; practically, therefore, the pressure would be transmitted in a curve of equal horizontal thrust, somewhere between these two limits. Now, in the case of large brick arches, particularly where the centres were first struck, the state of the arch approached that which had been just mentioned, and it was for that reason he had stated in the paper, that in determining abutments for arches of large dimensions, the points $p, p'$ should be in the centre of the thickness, and making the abutments accordingly, was in effect nothing more than providing abutments of such dimensions as should resist the thrust of the arch, when it was in the most disadvantageous state in which it was possible for it to exist. As the construction with brickwork, or the amount of stability was insufficient to contain the theoretical line of resistance, would possess the same degree of stability as a column placed so far out of perpendicular, that a vertical line drawn through its centre of gravity would just fall at the extremity of its base; but the arch, with abutments so placed as to contain the equal horizontal thrust, which accorded nearest to the centre line of its depth or thickness, would be under the same condition of stability as a column placed perfectly vertical.
CONSTRUCTION OF SEA WALLS.

Opinions of Engineers on the Construction of Sea Walls, referred to in Sir Howard Douglas's Protest, given in last month's Journal.

ANEX (B).—Sir John Rennie on the Mode of Construction of the proposed Harbour.

With regard to the last important consideration, namely, the particular mode of construction, and the cost. Various plans may and have been proposed for this purpose, such as founding the substructure below low water in caissons, and raising a superstructure of perpendicular walls of masonry upon them, carrying out of the timber, or iron, and forming walls of masonry within them, filling the interior space between the walls with chalk or concrete; another plan consists in throwing down masses of masses of chalk on the open sea, and covering them with stone or harder description. None of these, however, appear proper for the purpose, specially for the great outer mole or breakwater; the only similar examples where caissons have been employed, are the memorable cases of Chersones, where the blocks fell, and hollow circular towers, composed of brickwork, masonry, and timber combined, also wooden floating breakwaters, were proposed by General Bentham to be used in the construction of the breakwater at Plymouth, and after being fully discussed, these plans were abandoned as being inapplicable, and, looking to the particular circumstances of Plymouth Sound, the reasons given for the rejection of those plans were unanswerable. In such great and important works, where failure would be attended with such disastrous consequences, none but the most approved construction, that recognised as certain of success should be adopted. This has been amply justified by the result of the mode adopted in the construction of the breakwater at Plymouth, which has completely succeeded in every respect, whether stability, construction, and the costs which the water that under those circumstances, no other system would have answered so well. Much has been said about the damage occasioned by storms disturbing the rubble; the fact is, storms form the principal agent in consolidating the works, and, in the case of Plymouth, the parts of the wall that are unconsolidated by the water, and the failure of the brick masses at Sheerness are sufficient arguments against the adoption of caissons, or other expedients.

If such a work as is now proposed be undertaken, it should be solidly and properly done. The magnitude of such a work would not justify the risk of a failure; and, without entering into the question of the comparative cost and efficiency of different systems, I have no hesitation in pronouncing in favour of sloping stone breakwaters, similar to that of Plymouth; assuming, therefore, the same profile or section for the proposed breakwater as that, from 1,800 to 2,000 square yards, and the same prices which that work costs, the probable amount will be about £25,000, to consolidate the parts that are not consolidated in the vicinity, they must be brought from elsewhere.

ANEX (C).—Mr. George Rennie's Report on the Harbour in Deer Boy, and his Evidence.

With respect to the form and construction of the proposed breakwater. Experience has proved the principles of Cherson, Plymouth, and Kingstown. The decision, whether from the opinion of Mr. Rennie (the only authority that I have) and the failure of the brick masses at Sheerness, are sufficient arguments against the adoption of caissons, or other expedients. If such a work as is now proposed be undertaken, it should be solidly and properly done. The magnitude of such a work would not justify the risk of a failure; and, without entering into the question of the comparative cost and efficiency of different systems, I have no hesitation in pronouncing in favour of sloping stone breakwaters, similar to that of Plymouth; assuming, therefore, the same profile or section for the proposed breakwater as that, from 1,800 to 2,000 square yards, and the same prices which that work costs, the probable amount will be about £25,000, to consolidate the parts that are not consolidated in the vicinity, they must be brought from elsewhere.

ANEX (D).—Mr. William Currie's Plan for the Construction of a Harbour of Refuge in Deer Bay.

The most obvious mode of construction, and possibly after all the best, is that of depositing large masses of rough hard rubble stone in the sea, and in the case of Deer Bay, the only site of Harbour of Refuge of Kingstown and the breakwater at Plymouth were constructed. The simplest is tumbling large stones into the sea, as Plymouth Breakwater and Kingstown Harbour Pier; another mode is building in water with large stones, by means of the diving-bell; another by building caissons, filling them up partially, and floating them into their berths, and sinking them, and completing afterwards, either in or about them.

On the whole, therefore, after a most careful consideration of the subject, my recommendation to their lordships is, to form the harbour at Dover Bay with piers or breakwaters, constructed by depositing the largest blocks of either granite, Portland cap stone, or limestone, or all of them as is the case with this small, or in other words, for the weakest part of the whole, together with all the small stone that may arise in quarrying the rough blocks; and to form the breakwaters with circular heads at each of the entrances 800 feet in diameter, brought up from the bottom with solid foundations of masonry by means of the diving bell after the harbour is enclosed, as is now being done at Kingstown Harbour.

ANEX (E).—Will you have the goodness to state, after such strong expressions in favour of an upright wall, why you now recommend a long slope?—I am, Sir, of opinion that in the case of an upright wall, the height of the base to which the water is able to hunted up the wall, being thus permitted to expend and exhaust itself, which diminishes the effect in the horizontal direction upon the structure; and that if it were not for this, the case of an upright breakwater, the force would act wholly like a ram upon the perpendicular wall, to overthrow it. It would, if we compare it with the friction of water in waves, which I have found by experience to be something like a third of the pressing or horizontal, same result does not hold in the case of a breakwater, where the force of waves would be diminished in the same proportion, only that the friction of those large stones is much greater. I should say that the force by the great angular inclination of those stones would be diminished in the ratio of the square of the angle of slope, and the effect of the breakwater would be diminished in the same proportion. If it is not clear, then, that so far from waves having wholly an up and down motion upon the face of an erection in the sea, so far from having so force in a horizontal direction, they do come upon our breakwater only along the face of the breakwater, against the face, whatever it may be, with a force which varies according to the slope? I am quite of that opinion, and it is further confirmed by the forms which breakwaters take.

The advocates of the upright breakwaters do not dispute the hydraulic fundamental theory, that when fluids in motion act upon a plane, the force of the motion upon the plane diminishes in a high ratio in proportion to the angle of the plane, but they assert that this does not apply to the hydraulic construction which we are considering, because there is only an up and down motion. Do you or do not you consider that the construction of breakwaters, and their proper form, does depend upon hydraulic theory, and that it is impossible to properly estimate the construction of breakwater upon the supposition that it is not governed by those laws, for there is no horizontal motion, but only a vertical pressure?—I think so. I think that the advocates of perpendicular walls are quite wrong, and I have not been deceived.

Do you think it is practicable, or would it not be exceedingly difficult to build an upright wall in the open sea, in seven fathoms water?—I think it would be almost impracticable in deep water; I should be very sorry to undertake such a thing.

Do you think, if undertaken, it would be safe to use any artificial or inferior materials, such as concrete or chalk, in any part of it?—I do not, decidedly.

You know any case in which an upright wall has been built in modern times in such deep water as that in which we propose to erect this breakwater?—I know the case of Sheerness, where the masses were sunk to form an upright quay wall.

Would not the erection of a breakwater, perfectly upright, in the open sea, in Dover Bay, in seven fathoms water, be an experimental measure?—It would.

Under all the circumstances of the case, confusing yourself to the practical question, and especially considering the effect of failure, do you think in the natural roadstead and anchorage of Dover we should be justified in making such an experiment under such circumstances as these?—I do not. Of course I may be a partisan of a particular system, but I give you unbiased judgment.

ANEX (D).—Mr. William Currie's Plan for the Construction of a Harbour of Refuge in Deer Bay.
to a greater height than those which strike a sloping face. Such an opinion is in accordance with the phenomena which characterise almost every part of the coast, where it is found that the angle of the shore breaks down under the force of the waves of the sea exert no percussive energy, when I observe their power in forcing forward a vessel which has neither wind nor tide to help her, or a vessel at anchor, an effect which I have felt in 12 and 16 fathoms water; or when I am on the height to which my spray rises in deep water by striking a vessel at anchor.

That waves driven in by gales of wind are destitute of percussive effect I cannot conceive to be possible.

You refer to the idea that the water would be greatly diminished when they act obliquely on a sloping surface. From the effect of the slope to increase the surface of the wall opposed to a given perpendicular surface of the wave, the energy of the wave will necessarily be decreased in proportion to the amount of the increase of slope, and the force of impact thus diminished in the ratio of the square of the inclination of the surface to the direction of the fluid's motion, must, in order to estimate the tending to displace the wall horizontally, be resolved, first, perpendicularly to the surface, and again in a horizontal direction, as though it were thus finally diminished in the ratio of the cube of the sine of the inclination of the surface of the wall to the direction of the motion. Experiment upon the action of fluids or surfaces confirm the view thus theoretically assumed.

I cannot perceive any material difference, in so far as the result is concerned, between the case of the breaking wave and that of an unbroken wave, moving in my opinion, with the same velocity. The force of a wave which has not encountered an obstacle. Admitting that both have an outward movement (which I take to be the case with all waves which are acted on by the wind), it would appear to me that the direction of the force is a matter of the greatest importance in the determination of different directions, and would thus seem to possess less of a 'ram-like power'.

What do you think of the theory which assumes that waves have no other action than statical pressure upon a perfectly upright wall, although it is permitted that waves in a broken or breaking state have a percussive force, which an upright plane is not so capable of resisting as a slope, according to the well-known hydraulic theorem to which I have alluded?

My opinion of that theory is that it is not sound, and I found my conclusions on observation, and on reasoning, which both conduct me to the same result.

How can the hydraulic action or percussion of the wave, in the direction of its motion, cause when it comes in contact with the wall, and becomes statical acting horizontally, if that which stops that motion, and which consequently, if it resists, resists that impulse? I see no reason, as stated in the last answer, for supposing that the purely vertical or purely statical movement, which the above theory ascribes to all unbroken waves, should not produce, in the process of its neutralization by a vertical wall, effects similar in kind to those produced by its neutralization by an inclined plane. In both cases the undulation is checked; and whether this is done by reflecting the vertical or undulatory motion in one direction or another, seems to me the way to change the measure of the whole shock, which such a concussion and final extirpation of the force seems to imply.

A wave breaking on an upright wall, in a sea in which a perfectly upright wall has been built in the open sea, in a depth of six or eight fathoms—! I never heard of any upright wall being built in any such depth as seven or eight fathoms. It would not such a mode of construction, applied to Dover Bay, be essentially an experimental measure?—Certainly, so far as my experience goes.

Is it in your opinion of the difficulty, facility, or practicability of building an upright wall in the open sea in such a depth of water, and how should you proceed to execute such a work?—I should consider building an upright wall from the bottom in seven or eight fathoms in an easy sea, like that at Dover, as a work of the utmost difficulty, if not indeed wholly impracticable.

Are you prepared, as a practical and experienced engineer, to recommend that such an experimental mode of construction should be tried in such a place, on such a scale, at such a cost, and for such permanent national objects as those to which these proceedings are far from recommending the trial of such a work, I should humbly, but decidedly, disavow the government from such an attempt, which I am sure would end in failure.

What, upon the whole then, is the mode of construction which you would propose for executing this great work, in the most certain, solid, and enduring manner?—Taking into account the forms of the natural shore and the tendency of the sea to work against nothing to warrant a departure, in any material degree, from the existing practice of engineers in the construction of breakwaters.

When you refer to your opinion of the action of the wave upon a perpendicular wall, with a smooth surface, I understand in different cases, I cannot conceive that the unbroken waves caused by wind have less percussive force than when they are broken and diffused; I must conclude that the sudden check of this force, of the superficial bar, would produce a greater single effect than the gradual expenditure of force of a larger size, caused by the succession of successive surfaces presented by a sloping wave. The tendency, therefore, appears to me to be towards a more certain and rapid destruction of the vertical barrier than of the sloping one. The destruction of the sloping

**Annex (E).—Mr. Alan Stevenson's Answers to Questions Proposed to him on the Mode of Construction.**

You are considered to have bestowed much study and observation, and to have, from your own experience, a just estimation of the action of waves on the sea?—I have had considerable experience in the erection of works exposed to the action of the sea, in piers, light-houses, harbours, and breakwaters, and I believe I have enjoyed good opportunities, more especially at the Royal Society, of observing the action of the waves. All my experience, observation, and consideration, lead me to believe that a sloping face is better calculated to resist the action of the waves than a perpendicular one, and the force expended against the perpendicular plane seems by concentration to become more intense, for the seas rise
breakwater may either prove that the slopes were not sufficiently great, or that the breakwater is not complete, because the materials with which a breakwater is to be paved may not only be larger than those which play about on a natural shore, but may have the additional advantage of being carefully assembled and united together. Again, it must be remarked that it is not enough for a breakwater to be placed upon natural beaches, from the following reasons: First, because the choice of their position is too often empirical so far as their stability is concerned, and is primarily and sometimes almost solely determined, with reference to their fitness for the kind of the jetty's or landing wharf. Second, because the noxious effect of jetty's, or landing wharves, is in the nature of a second exterior regard to the risks of injury which they may encounter. And, second, because, from motives of economy, such artificial works, so far as having slopes greater than those of the neighboring beaches, are generally steeper, and as before noticed, are too often deficient in solidity and is the careful protection of their surface by means of pitching. From the general tenor of the answers you have given to Sir Howard Douglas's questions, you are of opinion that the unbroken wave has percussive force like the broken waves, and that of the two, you consider the unbroken wave to have this force in a greater degree than the broken wave: will you be good enough to state how you account, therefore, for those facts that I have large experience of, that an unbroken wave, in its percussive force like a broken wave, and probably in a greater degree, because it has not sustained the same check or retardation. I believe that all waves, except the great tide wave, have an onward motion, because I know of no one case in which a perpetual motion has been observed on ocean waves but the wind, and this agent, it appears to me, must of necessity impress upon the waves some degree of onward motion. From all my experience I have invariably found that the sea broke gently and playfully on all the sloping walls, while it broke with a loud noise on the plumb walls, and raised the spray in some cases to the height of 30 feet and upwards. In striking against this perpendicular face the successive waves make a sound similar to that of a great gun at a distance, carrying sometimes with it the sound of a boat, which, by lengthening or occasionally damage it; though at the distance of 240 yards from the face of the rock. There is no analogy between the case of a pile which permits the sea to pass round it freely, and that of a continuous wall which checks its progress and opposes a front of resistance. The mere circumstance of the in-shore piles being more injured than the outer ones, appears to me not to be of any subject under consideration. As to the circumstance of the piles which were braced being more injured than those which were unbraced, this only proves that from the amount in which the braces were applied, they offered more resistance to the waves, and were not so easily pierced through by them. I have sufficiently shown that it is possible to explain the various circumstances adduced by Colonel Alderson on the view which I have taken of the percussive nature of all waves with which we have to do in the formation of breakwaters. In my own mind I have no doubt that ocean waves are not purely oscillatory, but that all waves have an onward motion, and possess percussive force, and my humble conviction is, that the first attempt on a large scale to the formation of breakwaters, must be based upon this supposition. A vertical wall, will prove a signal failure, and that force will be developed by the collision of the wave with the wall, whose amount will be found to surpass anything which has hitherto been experienced on the face of a sloping breakwater. I cannot look upon the works at Plymouth, Kingsdown, and Cherbourg, each of which I have visited, as any longer merely experimental. Such works, may, on the whole, be considered as satisfactory as the nature of the circumstances will admit. Do you think it impossible to construct a breakwater at Dover in such a manner, and by such methods, as would give it practically a moorish likeness of the same nature as an upright cliff? I have already expressed my belief that the waves have an onward motion, and that this motion would be continued until checked and thrown back by the action of the wall. The wall therefore must reverse the movement and annihilate the force on its outward course, and seems consequently obnoxious to the final effect of the waves. I cannot see how in such a case any part of the water can be considered as at rest, and thus operating as a non-conductor of the force, and the facts adduced to its contrary, which I have myself observed, as to the action of waves against cliffs, seem fully to corroborate my views.

Annex (F)—Mr. William Stuart, Superintendent of the Plymouth Breakwater, on the Mode of Construction.

I have been employed on the breakwater from the commencement of the year 1811; and have held the superintendency only since 1829. The slope, as left by the sea, from low water upwards, was about 5 feet horizontal to 1 foot perpendicular, and in some places rather more. The materials employed were chalk, boulders of slate, and a large quantity of shingle, with a capping of rough squared blocks of granite and limestone, commencing on the exterior, or south side, with a slope of 5 to 1, on the sea side had it; and on the inner, or north side, with a slope of 2 to 1.

What was the object of increasing the breadth at the top?—To add to the stability of the breakwater.

Do you attribute to the damages you have stated in the years alluded to, to the form and shape of the breakwater, and to the want of filling up the interstices?—In the first gales I attributed the damages to the fact that we had not length enough of foresore, or of extension to seaward.

What was the objection you had to the more upright slope?—I was convinced it could not stand; and my belief was afterwards confirmed by the actual failure of a solid part of the breakwater, which had been built on this principle, and the failure of any of its projections, which had never to encounter anything like so severe a test as the breakwater.

Do you think if the breakwater had been constructed in the other form, for instance, if it had been either wholly upright from the bottom of the sea, or upright from about low water mark, that such a breakwater would have had power to resist the force of the sea which large masses of water are able to exert?

Do you think that oblique planes of breakwaters, built in the sea, are better calculated to resist the force of the sea in the direction of motion than any upright work?—I do, decidedly.

I consider that a breakwater, as best able to resist the force of the sea, you further state, from your own experience, you think the slope of 5 to 1 is that which is most likely to remain in a state of stability?—I do.

I would not be by throwing in stones and getting the whole up to low water mark, letting them find their own base in the first instance, with rubble stone, large and small together, and then that would be a protection, and the sea would level down and you could then add it to it.

Was any part of it ever made upright?—Never.

So that the upright building was never tried?—Never.

Annex (G)—Mr. J. M. Rendel, on the Mode of Construction, and Evidence.

To construct a breakwater in seven fathoms water is, I apprehend, a very formidable undertaking, considering the comparative constancy of caissons and machines of that kind are to be resorted to. I doubt very much, if a breakwater is to be constructed in seven fathoms water, whether the only safe plan would not be to deposit in the usual way from the shore (if it is a detached breakwater, or from a railway, if it is a breakwater connected with the shore, and the shore produces suitable materials), a mass of stone up to within, say, two or three feet of low water; and above that to construct perpendicular walls of the kind referred to in Col. Jones's letter of suggestions.

Considerable doubt being entertained as to the slopes, and particularly the sea slope of a breakwater, as least of being damaged by the action of the waves, you are acquainted, or reading Col. Jones's paper upon this important subject, your opinion, which Col. Jones would be very likely to fall into the same error in universally applying perpendicularly-sided breakwaters as other engineers have been of universal employing sloping covers? I am of opinion that these stones were thrown in and allowed to form their own slope, that slope being determined by the nature of the materials up to within two or three feet of low water, and then the breakwater raised upon that with perpendicular sides, it would be the most economical plan in most situations. I should be more disposed, if I had to build one in seven fathoms water, to adopt the plan I referred to; suppose I had an unlimited command of materials, I should first of all begin to deposit those materials to form a rough mass up to within a moderate depth at low water, and then when I had brought my foundations up to that point at which the sea would begin to attack me, I should begin to attack the sea by building with a class of materials that would be its master, think an upright wall in that case might be desirable. In your evidence before the Commission, you add, that in seven fathoms water, you would begin to deposit those materials so as to form a rough mass, with a slope up to about low water mark, and upon that you would superstructure in the shape of an upright wall?—I should do so.

And you recommended this combination of the slope for the substructure with an upright wall for the superstructure?—I should so build if I had such materials at my disposal.

Are you still of that opinion?—I am.

You stated that if you had plenty of materials at your disposal you...
would be disposed to form the breakwater foundations below low-water mark with a slope, and above with an upright wall; was that as matter of economy or as matter of principle?—As matter of economy. It is quite a question of the cost. I have just this design for Howth Harbour; there, on account of the facility of getting rough masses of stone for the breakwaters, I have proposed to form them of rubble-stone up to low-water mark, with sloping sides.

If the construction of this work, with the brick blocks, were pressed so rapidly as to render it necessary that those blocks should be made in remote places to be shipped or otherwise transported to Dover, would not a great part, if not the whole, of the economical advantage of using brick masses instead of stones disappear?—To a certain extent, my lord; but there is no county in England where brick earth more abounds than in Kent. In short, I am quite satisfied that you must have the material without bringing it by vessel; it must be brought by railway.

ON THE ACTION OF WAVES.

Annex (H).—Prof. Airy's Answers to Questions proposed to him on the Action of Waves.

Which form of structure is best adapted to resist the force of the waves, an upright wall or a breakwater with a slope similar to that at Plymouth?—In my judgment, an upright wall.

You have mentioned in a work which I have read with great attention and admiration, on the theory of waves, that the horizontal motion of the particles of water of the bottom wave which reach the bottom is such as to extend to very great depths, and to occasion a sensible disturbance of stones and sand at the bottom, and that waves break over ridges or shoals, to the depth of 500 feet?—Yes; but in these instances the waves are very long.

Without entering on your theory of waves in the open deep sea, and confining my questions to your deductions from that theory, as to the practical effect of waves on erections in the sea, am I correct in saying you assume, that in deep water the motions of the particles are oscillatory, that the rising and falling of the surface of the sea depend on the horizontal movements taking place alternately in the same and contrary directions?—Yes.

That those displacements are represented by a periodical function, the size or course of an angle depending on time?—Yes.

That this circular or elliptical movement of the particles is shown to take place only when a wave is transmitted along a channel of uniform breadth and depth?—Yes.

That as the depth of water becomes less, the waves become shorter?—Yes.

That their force becomes weaker?—Yes.

So that as they proceed into water of less depth, their faces become more and more perpendicular until they break?—Yes.

That waves in a broken state strike erections in the sea, in a manner to act powerfully and percursorily, as hydraulic rams by their momentum?—Yes; when in a broken state they act percursorily, not by the ordinary hydrostatic pressure.

Their mass and velocity give those waves that momentum or percursorial force...?—For that reason, in the shallower parts of the proposed harbour, where the waves come into a depth at which, according to your theory, they would by breaking exert such a force upon the wall, you would recommend a wall of an upright and sloping wall is best able to resist the action of the water in a broken state; and inasmuch as you cannot avoid the breaking of the waves, I should recommend a slope there; but in other parts, where you can avoid the breaking of the waves, I would have a perpendicular wall.

The waves become shorter and sooner as they advance, and, acquiring increasing tendency to break as they come into shallower water, their faces will be nearly vertical, in the state just preceding the broken state. Now, for the reason which you assign for thinking a sloping wall more capable of resisting the impact of a broken wave than an upright wall, do you not think that waves in heavy gales coming in with considerable velocity, and in such a way as to pass along the face of a broken wave, are exposed to the percursorial force due to their weight and velocity, and produce a more serious effect than if that impact were to act against a sloping wall?—It will not strike at all. There will be a great swell up and down again; there will be nothing like horizontal motion.

The wave is proceeding?—It becomes a stationary wave; a combination of a direct and a reflected wave. It goes up and down again without breaking; it is merely an elevation of the surface. I have been in circumstances in which I have had good opportunities of observing that practically, and I know that that is the case.

Then the modification you would propose is, that in the depth of water in which you think the wave would break, you would recommend a slope, and in the other part an upright face?—Yes.

In what depths, practically, would that be? You think you said the pilots can best answer that. You say that inasmuch as a wave does not break against an upright surface, it will exert no percursorial force upon the wall?—No. It will exert the same sort of pressure that there is against a lockgate; that is, a hydrostatic pressure.

Equal to the weight of a column of water, whose base is the surface pressed, and height the depth of the centre of gravity?—Yes.

On the Concorde Face.—The construction would be exposed to less danger, if the section of the wall presented to the sea a hollow curve, like the base of the Eddystone lighthouse; but still there would be the breaking sea and the floating ice against it, and nothing can make square-stone masonry quite secure when it is exposed to this.

BRITISH ASSOCIATION.

The seventeenth meeting took place at Oxford on the 23rd June, when Sir Robert Inglis delivered an elaborate address, which we give in a condensed form.

Sir Robert Inglis's Address.

I begin with Astronomy.—The progress of astronomy during the past year has been distinguished by a discovery the most remarkable, perhaps, ever made as the result of pure intellect exercised before observation,—and determining almost triumphs in the existence and force of a planet; which existence and force were subsequently verified by observation. It had previously been considered as the great trial and triumph of dynamical science to determine the disturbances caused by the mutual action of 'the stars in their courses,' even when their position and their orbits were fully known; but it has been reserved for these days to reverse the process, and to investigate from the discordance actually observed the existence of a planet small in mass but large in orbit, solely by virtue of its creation, exerting this mysterious power. It was reserved for these days to track the path and to measure the force which the great Creator had given to this hitherto unknown orb among the myriads of the air.

I will now show you that there are those events which, if he, had pursued the object then first discovered, would have been well distinguished from the rest of the year, and would have added glory to his own name—did observe what is now fully ascertained to have been the planets observed with more or less accuracy; their orbits to those bright orbs which to mortal eyes for more than 2,000 years have been known to circle our sun, Lalande was observing before Piazzi, Olbers, and Harding had added Ceres, Pallas, Juno, and Vesta to that number, and before these discoveries the planets round the sun had passed the mystical number of seven—since Herschel had confirmed that ancient belief—but that others might also remain to reward the patient labours of others. He had distrusted his own eyes; he had preferred to believe that he had been mistaken, rather than that the existence and force of a new planet had been reserved for the discovery of this latter age. What his eyes saw, but what his judgment failed to discern, and apply this knowledge, has since been ascertained by others.

I will not presume to measure the claims of the two illustrious names of Leverrier and Adams: of him, who, in midnight workings and watchings, discovered the truth in our own country, and of the happily philosopher who was permitted and enabled to be the first, after equal workings and watchings, to proclaim the great reality which his science had prepared and assured him to expect. I will trust myself with only two observations: the one my earnest hope that the rivalry not merely of the illustrious Leverrier and Adams, but of Leverrier and Adams, but of all the two great nations which they represent, France and England, respectively, may always be confined to pursuits in which victory is without, and to studies which enlarge and elevate the mind, and which, if rightly directed, may produce alike glory to God and good to mankind; and the other, my equal hope, that for some (of whom some of whom I trust may now see me) who employ the same scientific training and the same laborious industry which have marked the researches of Leverrier and Adams, there may still remain similar triumphs in the yet unpenetrated regions of space, and that—unlike the greater son of a great father—they may not have to mourn that there are no more worlds to be conquered.

It is a remarkable fact that the seeing of the planet Neptune was expected as suddenly at Berlin by means of one of the star-maps which has proceeded from an association of astronomers chiefly Germans; such maps forming in themselves a sufficient illustration of the value of such Association, and the importance of the subject. Each of the comets which have been of larger apparent dimensions, or which have continued longer within view, have, in consequence, for more than four months or more, been beyond the orbit of Neptune, that is, perhaps, for any one individual—are supplied by the combined exertions of many kindred followers of science.

It is another result of the circulation of these star-maps, that a new visitor, a comet, can hardly be within the range of a telescope for a few hours without his presence being discovered and announced through Europe. These comets which have been of larger apparent dimensions, or which have continued longer within view, have, in consequence, for more than four months or more, been beyond the orbit of Neptune, that is, perhaps, for any one individual—are supplied by the combined exertions of many kindred followers of science.

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derfugal telescope. Its actual operations have been for a time suspended by a cause not less honourable to Lord Rosse in another character. They have been retarded, as far as he himself is concerned, by the more immediate duties, which, as a magistrate, and as a landowner, he owed to his neighbours, his tenantry, and his country, during the late awful visitation which has afflicted Ireland.

**STARS CATALOGUES.**

The Catalogues of Lacaille and of the Histoire Céleste are now before the world; and with the Catalogue of our Association constitute a series of most important gifts conferred on astronomy.

**LUNAR THEOREY.**

The Astronomer Royal has done me the honour and the kindness, by a paper which I have just received from him, to make me the vehicle of communicating to you some important and interesting discoveries of the present year:

"In the lunar theory a very important step has been taken in the course of the present year. When, near the beginning of the present century, a considerable number of the Greenwich lunar observations were reduced by Babinet for the purpose of obtaining elements for the construction of his Lunar Tables, and generally for the comparison of the moon's observed place with Laplace's theory, it was found impossible to reconcile the theoretical with the observed places except by the assumption that some time-varying error affected the epoch of the moon's mean longitude. From the nature of the process by which the errors of the elements are found, the conclusion upon the existence of this peculiar error is less subject to doubt than that upon any other determinate thing; it appears to me, and it is a corresponding influence exerted by the same cause.

So far, the situation has been one entire chapter in the Mécanique Céleste, with the title 'On an inequality of long period by which the moon's mean motion appears to be affected.' Guided by the general analogy of terms producing inequalities of long period, he suggested that the perturbation of the element named as the perturbative influence; it is one to which all the terms in the enormous numerical tables used in the construction of the new tables, and to quote the expression of a distinguished foreigner now present, which he uttered in my own house, when the subject was mentioned, 'It is an exaggeration not to make sure that we are using the very words of the author,' 

"that we could even, if our satellites were incapable of reflecting light, have determined its existence, any, more, have approximated to its eccentricity and period.'

**ANIMAL ELECTRICITY.**

In Physiology, the most remarkable of the discoveries, or rather improvements of previous discoveries of the past year has been made, perhaps, that connected with the labours of the distinguished Tuscan philosopher, Matteucci. I refer in this instance to his experiments on the generation of electric currents by muscular contraction in the living body. This subject he has continued to pursue, and, as the happy coincidences of the rigorous methods of physical experiment with the ordinary course of physiological research, Prof. Matteucci has fully established the important fact of the existence of an electrical current—fieble, indeed, and such as might, by no means be considered as of importance in the deep and the superficial parts of a muscle. Such electric currents pervade every muscle in every species of animal with which has been the subject of experiment; but, although there are visible differences, there are no differences in the qualitative state of these electric currents that continue for a short time; but they cease more speedily in the muscles of the warm-blooded than in those of the cold-blooded animals. The delicate experiments of Matteucci on the torpedo agree with those made by our own Paraday upon the Gymnus electrom, in proving that the shocks communicated by these fishes are due to electric currents generated by peculiar electric organs, which owe their most immediate and peculiar influence to the action of the peculiar organs of the ordinary electricity developed in organic matter or by the artificial apparatus of the laboratory.

**ETHERIZATION.**

This is the subject of the influence of the vapour of ether on the human frame—a discovery of the last year, and one the value of which in diminishing human pain has been experienced in countless instances, in every variety of disease, and especially during the performance of trying and often agonizing operations. Several experiments on the tracts and nerve roots appropriated respectively to the functions of sensation and volition have been resumed and repeated in connection with this new agency on the nervous system. Messrs. Pionues and Lenget have shown that the sensatinoal functions are first affected, and are completely, though temporarily, suspended under the operation of the vapour of ether; then the mental or voluntary influence; and, finally, ether affects the deeper structures.

"It would seem that the stimulus of ether applied so largely or continually as to produce that effect is full of danger—and that such constitution are sometimes unable to rally and recover from it; but that when the influence is allowed to extend no further than to the suspension of sensation, the recovery is as a general rule complete."

**MICROSCOPIC.**

In no department of the science of organized bodies has the progress been greater or more assured than in that which relates to the microscopic structure of the constituent tissues of animal bodies, both in their healthy and sickly states; and the progress is specially marked in this country during the period which has elapsed since the communication to the British Association by Professor Owen of his researches into the intimate structure of recent and fossil teeth.

This year's researches have demonstrated the constancy of well defined and clearly appreciable characters in the dental tissues of each species of animal, (by which characters such species could be determined,
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[AUGUST,

in many instances, by the examination of a fragment of a tooth,) other observers have been stimulated to pursue the same minute inquiries into the diversified structure of the tissues of other organs. Such inquiries, for example, have been most ably and successfully pursued by Dr. Carpenter, in reference to the microscopic structure of recent and fossil shells; and the anatomist, the naturalist, and the paleontologist are alike indebted to the zeal and the skill of that eminent physician. While, in another sense, all are indebted to the British Association for aiding and stimulating his inquiries, and for the illustrations with which the publication of Dr. Carpenter's Report has been accompanied in the Transactions of the Association.

CAPPILARY ATTRACTION.—MOTION OF FLUIDS IN TISSUE.

The hairs of the different mammalian animals offer to the microscopic anatomist a field of observation as richly and remarkably developed as the teeth, which formed the subject of Professor Owen's communication in 1836, and as the external coverings of the testaceous mollusca, which formed the subject of the observations made by Mr. Parker and Mr. Egerton in 1833. The structure of the softer tissues of the animal frame has not been less successfully investigated by microscopic observers. One of the most extraordinary, perhaps, of the recent discoveries by the microscope is that which is due chiefly to Parkinson and Valentine, and which in this country has been well established by Dr. Sharp, relative to the important part in the motion of fluids on internal surfaces, performed by the vibratile action of myriads of extremely minute hair-like processes which are the superficial surface of the body. These movements, for example, raise the mucus of the wind-pipe to the throat and are the cause of gravity. They have been detected in the vessels of the brain, as well as many other parts.

The observations of Sir David Brewster have been carefully confirmed; and many interesting varieties have been noticed in the structure of the crystalline lens of the eyes of different species of animals.

The most brilliant result, perhaps, of microscopic anatomical research has been the establishment of the fact that the most important commercial transactions daily transpire, by its means, between corresponding several hundred miles apart. Of the evidence of this, was afforded me by a communication a few minutes old between a merchant in Toronto and his correspondent in New York, distant about 500 miles. I am anxious to call your attention to the advantages which other classes also may experience from this mode of communication, as I find it in the same Report. When the Hibernia steamer arrived in Boston, in January 1847, with the news of the death of Sir David Brewster, it arrived before the lines of telegraphic communication had been thrown up by insinuative teams of grain almost as quickly as after the arrival of the steamer at Boston, as the news of that arrival could ordinarily have reached them. I may add, that, irrespective of all its advantages to the general community, the system appears to command a steady fair return of interest to the individuals or companies who have invested their capital in its application.

The larger number of the members of this Association have probably already seen in London an exhibition of a Patent Telegraph which prints messages from one pole to another as they are sent or received. It has been well shown to me; and stated that he hoped to carry it into effect on the greatest scale ever yet imagined on the American Continent. Prof. Morse, however, does not acknowledge that this system is susceptible of equal advantages to that of the telegraphic communication; and he conceives that there is an increased risk of derangement in the mechanism employed.

I cannot refer to the extent of the lines of the electric telegraph in America without an expression of regret that in our own country this great discovery has been so inadequately adopted.

In England, indeed, we have learnt the value of the electric telegraph as a measure of police in more than one remarkable case; as a measure of government it is not less important. From the information which I have drawn from America, it is equally useful in commerce; but as a measure almost of social intercourse in the discharge of public business it is not a result of its uses. But if, in the future, I had an opportunity of examining the telegraph in the lobby of the House of Commons and the communications are made to and from distant committee rooms. As a specimen of the information conveyed from the House is the following:

"What is the latest result of the Committee on the Bill?" "Who is speaking?" "How long before the House divides?"
the refuse, usually dry. c. 5000 one can be left on the spot, 8,000 tons of shipping were destroyed for other purposes of commerce between the colony and the mother country; and the saving of cash in England, an object not wholly devoid of interest, is immense.

BRITISH MUSEUM.

Our National Collection may now be compared, not ostentatiously, but thankfully, with those of other countries; remembering, also, that our collections are half a century behind the most civilized nations in this and kindred departments. The museums, in this and kindred departments, the national museums in the British Museum are equal. I believe, to those of any other capital: greatly owing to the talents and labours of the eminent head of that department, Sir Gray,--whom I see here to-day,--and also to my old and able friend, Mr. König, are perhaps superior--in some classes, beyond comparison. Last year, there was added to the palaeontology of the museum the unique specimen of the Holothuria lacunosa, the Cephalopod of Lyell, the Handfish; and much interest is felt in the discovery of what is likely to be, the first in England. The number of visitors, which six years ago was 110,000, was last year above 700,000—and the collections of comparative anatomy in the Manxenian Museum are, as they ought to be, the best in the world.

The following are some of the more interesting papers read in the various Sections of the Association, for which we are indebted to the Athenaeum.

"Report on Geological Theories of Elevation and Earthquakes." By W. Hopkins.

This long-awaited report emphasizes too wide a range to admit of our giving at present a full analysis of the leading principles of volcanoes, both with reference to the fluid volcanic mass and its containing cavity, the author proceeds to the examination of theories of volcanoes. He regards the chemical theory proposed by Sir H. Davy, and the modern theory proposed by M. Bleischoff, as involving mechanical difficulties, and the former as not capable of accounting for the existence of volcanoes which suppose existing volcanoes to owe their origin to the formative fluidity of the earth; the author is led to the conclusion that the theory based on the hypothesis of such fluidity. He examines the evidence afforded in favour of this hypothesis, and concludes that the chemical theory is insufficient to account for the existence of volcanoes, and he reaches the conclusion to which the latter process has already proceeded. Supposing the earth to consist of a fluid central nucleus and a solid envelope, it is concluded that the thickness of the latter is probably not less than one-fourth or one-fifth of the earth's radius. This conclusion is drawn from the observed amount of the process of the earth's pole with that calculated on the hypothesis just stated, respecting the constitution of the earth; but the author also indicated another method by which evidence might be obtained on this point. He showed that if it could be proved by experiment that the temperature of fusion of solid substances is generally increased, even in a small degree, by high pressure, we should have strong reason to believe in the entire solidifiability of the earth; and if, on the contrary, it should appear that high pressure has no such effect, we should have evidence that the internal heat of the earth is not due to its original heat. He considered such experiments necessary for the further advance of this branch of geology.

The second part of the report contains a theoretical investigation and consideration of the nature and properties of the mechanical effects which would result from the action of such forces. The author proposed to consider the subterranean forces as having the nature of an explosion, producing vibrations over a much wider space than that to which the original force was applied. The vibrations comparing themselves to those produced by striking the end of a solid bar— which are of two kinds. The first are similar, but infinitely less in extent to vibrations in air. They are produced by compression, and proceed in the direction of the axis of the bar. The second kind are perpendicular to the axis of the bar, and the elastic forces depend upon their tendency to assume their original shape. The velocity with which vibrations are propagated in the direction of the axis, is much greater than when propagated in any other direction. As in water, sound waves produced in water by blowing a bubble, a wave will be produced by the alternate compression and dilatation of the particles, which will diverge in spheres, equally in all directions, with a constant velocity. In the earth, however, as in water, these waves may be propagated with unequal velocities. The apparent motion of these waves, when they reach the surface, will be different, from their real amount of motion below, depending upon the distance of the place of observation from the point of commencement. The form of the earth's surface, the interior of the earth to be homogeneous, and the vibrations produced by earthquakes to be of the kind described, it becomes a leading point to ascertain, by observation, the position of the focus from which the vibrations originated. By this subject nothing at present is known. The work proposed, stated, that if self-registering instruments of sufficient delicacy were placed at two stations in a country subject to earthquakes, the direction of the vibrations would show immediately the point on the surface from which they originated. The depth beneath the surface might also be calculated, from the difference between the first moment of the waves at the surface and its real movement in the interior, as given by theory; or it might be ascertained by comparing the relative apparent motion of two waves proceeding with unequal velocities, if means were obtained for recognizing the two kinds of the one by instruments of different kind.

Sir H. de la Beuene observed, that if the focus of the earthquake wave near the surface, the problem would become one of great complexity, on account of the many waves in the stratum, and their different composition: but where the earthquakes were several hundred miles below the surface, these inequalities would be of no consequence.

Mr. Mallet enumerated the different kinds of waves which do, or may take place, with every earthquake. When the focal point is inland, there will be the shock-wave, either single or double; the sound waves in the earth; and sound waves in the air, if the original force was accompanied with fracture: if the superficial vibration is sufficient, there will also be the sea-wave. When the focal point is under the sea, as in all great earthquakes, there will be the shock-wave, the sound-wave under the sea, the sound-wave in the air, the great sea-wave, and a smaller, termed the "forced sea-wave"; if, however, there is no fracture, it is supposed that magnetometers were also "seismometers" of a very delicate kind--those at Dublin having indicated from 10 to 20 shocks last year.


The author is introducing his fourth report on this subject observed, that in accordance with the resolution adopted at the last Meeting of the Association; the sets of observations have been extended to the British islands; the extremes of the area embraced being the Orkneys, and Jersey in one direction and Galway and Dover in the other. As instances of the increasing interest manifested on this subject, he remarked that he had observed the shock-waves produced by ships passing with the current using the surface, and that the local movements had been considered to result from the transit of the great November wave. Each of these curves was referred to the same period; namely, from the 2nd to the 17th of November; and the observers invariably reported a regular rise and fall on a course of about one degree indicating a well-marked return of the great symmetrical wave. Mr. Birt, after noticing the remarkable circumstances under which the wave returned last autumn—so remarkable that they had no small tendency to mark the wave in the eastern part of the island—said that in the report by London strictly developed its essential features: the free subordinating waves were well seen, although the inflections were not strong, owing to the small altitude of the wave on its last return, scarcely exceeding half an inch—its whole development occurring above thirty fathoms prevented the bolder cases of the inflections particularly noticed on the occasion of its return in 1842. The author then proceeded to notice the essential features of the currents as obtained from observations at Ramsgate, St. Vigeans near Arbroath, east coast of Scotland, the Orkneys and Western Isles, Applethorpe Mere, Derwent Water, Largs, Limerick, Cornwall, and St. Hélène's, Jersey. Our limits will not permit us to give in detail the resemblances and differences of these curves, exhibiting, as they do, the distribution of pressure around Great Britain and Ireland, which the author traced from the eastward part of the island. These topics will be printed in the forthcoming volume of the Transactions. We may, however, here notice that attention was called to the principle which the author laid down in his report of last year, that the barometric curve, involving a complete rise and fall at any one station, does not represent any reality in nature, but is the effect of two or more systems of waves or currents moving in different directions and crossing each other at various angles. He also pointed out the great extent of oscillation (nearly double) observed in the northwest as compared with the southeastern observations. The great wave commenced on the 2nd of November; at the northern stations it commenced on the 12th; at the south-eastern on the 9th; and it terminated on the 17th. In explaining the difference of pressure as indicating the transit of the greatest wave, the author in the southern stations he found that the observations clearly showed that the barometer passed two maxima, one on the 9th, the other on the 12th; and that the whole extent of the British Isles might be divided into two barometric areas, distinguished in one case by the superiority of the maximum of the 9th, and in the other by the superiority of the maximum of the 12th. A line passing between Arbroath and Newcastle, south of Dumfries, and between Ireland and Wales, separates these areas. North-west of this line we find the maximum of the 12th superior; south-east of it we find the maximum of the 9th. Birt regarded as the central wave forming the crest of the great wave, and the maximum of the 12th be considered as the crest of the first subordinating wave on the posterior slope. The author next proceeded to consider the distribution of pressure in the two areas, from which, in connection with the features of the projected curves, he deduced the following results:--1st. The return of the great symmetrical wave. This occurred in the south-eastern angle of our island under very peculiar circumstances. The area of greatest symmetry is closely in accordance with the results of former discussions, and goes far to confirm the result deduced.
from the examination of Sir John Herschel's hourly observations, "that Brussels is entitled to be considered as a point of comparatively gentle barometric disturbance, * * * and may be regarded as in a certain sense a nodal point, where irregularities are smoothed down and oscillatory movement in general more strongly marked; and, as a point almost free from the influence of winds from Brussels as a centre, especially towards the north-west."

The curve of greatest symmetry was obtained from Ramsagat, the nearest station to Brussels. As we proceed towards the north-west, the symmetry is considerably departed from. We may then compare the appearance of the wave on the posterior slope, by which the maximum of the 12th became superior. This portion of the wave formed a striking contrast to the similar portion in 1845, which was characterized by a considerable depression. It is a little observed that the wave in the opposite direction that of the battery by water during electrolysis be measured, and again when the voltmeter is heated, it is found to decrease. In the first instance, its measure referred to my particular standard, as deduced from a mean of 12 sets is 599-9, temperature 61°. The next by a mean of 13 gives

\[ e = 567 \delta 5 \cdots t = 185^\circ \delta 4 \]

and the third mean of 13

\[ e = 558 \delta 0 \cdots = 301^\circ \delta 4 \]

Applying to these the theory of probable errors, so successfully used in other branches of science, I find it is more than 10,000 to 1 that the difference thus shown is not all error of observation, and an even bet that it is not 5 wrong. The expression of \( e \) is affinity of platinum for oxygen, minus that of hydrogen, or

\[ e = o \cdot p - o \cdot h \].

From this I compute that \( h \) changes 23° for 100°.

This process is confirmed by a different process. The formula for the intensity of zinc and carbon excited by dilute sulphuric acid is

\[ E = o \cdot z - o \cdot c - o \cdot h \].

In Dinielli's cell you substitute \( o \cdot c \) for \( o \cdot h \), and have

\[ E = o \cdot z - 2 o \cdot c \].

In the latter instance, \( E \) undergoes some change by heating the cell to 165°. The metallic affinities therefore do not vary within that range. But in the former \( E \) increases by heat, caused by the diminutive of \( o \cdot h \), and it gives a change 27° for 100°, the mean of all being 25.1. It is curious that if this rate were uniform, the temperature of evaporation by heat would be 236°. In these experiments the conducting power of the electrolyte is greatly increased by heat. The only objection which I see is the diminution of the affinities, which is due to the action of heat in facilitating the escape of gases. An experiment which I made seems to oppose this. If the apparatus be placed under the air-pump, the removal of pressure should show a similar change. This is not the case: when it is reduced to 1 inch of mercury, the measure of \( e \) remains unchanged. I think this a very curious result; it is quite the reverse of what I expected, for I had supposed heat would exalt these affinities up to a certain point, and afterwards that its action would do no change.

But its influence seems here always an antagonist to affinity. How then does heat ever produce the combination? The remark of Davy that hydrogen cannot be made to burn except by contact with a solid heated so as to be luminous, makes me conjecture that light is the agent which causes the molecular change of the three volumes of mixed gases into two of steam.

"On the Precipitate caused in Spring and River Waters by Acetate of Lead." By Prof. CORNWELL.

Nearly all well and river waters are known to yield a white precipitate with acetate of lead. This precipitate is rarely due to any chlorid, as it has too little action in the explanation: and its ready solubility in acetic acid shows that it is not caused by sulphates, unless in so far as it is not dissolved by that acid. The ordinary course I have ascertained to be the presence of carbonate of lime; but the remarkable fact is, that the reaction both of the acetate and of the acetic acid takes place after the water has been boiled and filtered, so that carbonate of lime remains dissolved independently of the presence of carbonate, and the waters referred to yield carbonate of lime when evaporated, after having been boiled and filtered. To ascertain whence this carbonate of lime has proceeded, I passed a current of carbolic acid through lime water, till the precipitate at first formed was dissolved, and then boiled and filtered. To these results it is of the same extent as common waters do. Neither did distilled water which had been left some days in contact with finely powdered marble. I incline to think that the origin of the dissolved carbonate of lime is double decomposition, and that an allotropic change in the Acetic New York; and have found, in all waters yielding the reaction, alkalis united to acids. The common water of the town of St. Andrews contains very little of carbonate of lime after being boiled and filtered. It also contains a trace of carbonate of marl, which is insoluble. The cause, in part, at least, of the reaction referred to, although to a far less extent.

"On the Cause of Evaporation, Rain, Hailstorms, and the Winds of Temperate Regions." By G. A. ROWELL.

Mr. Rowell stated his opinion that amongst the variety of theories given to explain the phenomena of蒸发, it was not one that was least worthy of investigation. The theory of Mr. Hutton on rain may be thought sufficient to account for moderate rains, but totally fails when applied to such heavy rain as that which fell in London, August 1st, last year. Mr. Rowell endeavoured to show that the phenomena of evaporation, clouds, rain, lightning, hail, the
winds of temperate regions, and storms of lower latitudes, may be fairly explained by the hypothesis he submitted; i.e. electricity having no weight and diffusing itself equally over the surface of bodies, the minute particles of water, even in their most condensed state being completely enveloped in their natural coating of electricity, occupy, together with their electricity, nearly the space of an equal weight of air, and are thus rendered sufficiently buoyant to be carried away by the wind; but that when exposed to the least separation of their being thrown up into the air, their capacity for electricity being greatly increased by the lesser extent of surface they are then buoyed up by the air by their electrical coating; that when the rising particle is condensed it becomes surrounded by the contraction of its surface; if on the least fracture of the particle these curdles escape and the particles fall as dew; but if it is condensed when above the electrical attraction of the earth, it is still buoyed up by the electricity and on the escape of the curdles, the particles attract each other and form clouds, and on meeting in the same locality in which the rain falls. He supports his views by referring to the storms of wind which swept over England from the north-west and west, and in some parts there was so heavy a fall of rain that the streets were covered with floating water, and which sometimes fell within the tropics, they would be found sufficient to account for the most tremendous hurricanes:—

<table>
<thead>
<tr>
<th>Place</th>
<th>Date</th>
<th>Depth of Rain in inches</th>
<th>Time</th>
<th>Average Vacuum per sq. mile per second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataskill</td>
<td>July 26, 1810</td>
<td>18 in.</td>
<td>7½ hours</td>
<td>$1,311,968$ cubic ft.</td>
</tr>
<tr>
<td>Genoa</td>
<td>Oct. 25, 1820</td>
<td>30 in.</td>
<td>24</td>
<td>$693,733$</td>
</tr>
<tr>
<td>Joyeuse</td>
<td>Oct. 9, 1837</td>
<td>21 in.</td>
<td>22</td>
<td>$703,027$</td>
</tr>
<tr>
<td>May 26, 1837</td>
<td>42 in.</td>
<td>25</td>
<td>26</td>
<td>$693,733$</td>
</tr>
<tr>
<td>Gibraltar</td>
<td>Nov. 27, 1836</td>
<td>33 in.</td>
<td>26</td>
<td>$703,027$</td>
</tr>
<tr>
<td>Naples</td>
<td>Nov. 22, 1820</td>
<td>37 in.</td>
<td>37 minutes</td>
<td>$800,960$</td>
</tr>
<tr>
<td>Peru</td>
<td>Aug. 5, 1839</td>
<td>30 in.</td>
<td>30</td>
<td>$687,978$</td>
</tr>
</tbody>
</table>

The knowledge which we possess of the tides, looking at the connection of the phenomena over the whole surface of the ocean, is extremely imperfect at present, and not at all likely to be completed in any material degree in any finite time, by the observations which voyagers mainly directed to other objects will supply. The coasts and islands which surround or break the waters of the Pacific, are especially the seats of this ignorance. How soon the time of tide near Cape Horn, may be traced the progress of the tide waves along the western coasts of South and North America. We know the time of tide of the coasts of New Zealand, but cannot connect this fact with the rise and fall of the water on the coasts of the smaller islands in the central and eastern Pacific; we know nothing of the eastern coast of New Holland, but cannot trace the progress of the tide to the Pacific or to the coast of China.—though some observations of Admiral Lütke, made a few years ago, supply a valuable addition to our knowledge on this subject. The course of the tide was among the islands of the Indian Sea is likewise entirely unknown. Observations made by voyagers mainly guided by other purposes appear unlikely to supply this deficiency in our knowledge, for even when made with great care and for several years. They are rarely connected with each other or with neighbouring places. It does not appear that while we are thus left to depend on chance for our tidal knowledge, we shall ever be able to know from observation whether the tides of the Pacific does or does not run in the same time as those of the tides of the east coast of the United States of North America. By means of these observations the general course of the tides in the Pacific, has been determined. If an expedition were sent out on purpose to observe the tides could very soon ascertain a great body of facts of this kind. The observers would, of course, observe the facts of the tides in connection with each other; and would arrange their observations in known points to be by such a mode of proceeding the co-tidal lines for every part of the Pacific and Indian Oceans might probably be drawn (omitting the minor details in the interior of archipelagoes, etc.) in a year, and at two years. The tide observations made, at the request of Dr. Whewell, in 1834, for a fortnight by the coast guard on the coasts of Great Britain and Ireland, gives a general idea of the tides; but it is not complete. A connected observations, and still more those made in June 1835, for a fortnight along the coasts of the whole of Europe and the eastern coast of the United States of North America. By means of these observations the general course of the tides in the Pacific, has been determined. If an expedition were sent out on purpose to make tide observations, it would not be at all necessary to have, as in the instances just mentioned, simultaneous observations along the whole line of sea observed. It would suffice to connect a few places by corresponding observations, in some cases for a fortnight, in others for a few days; then, to connect one of these places with others, and thus proceed through the whole region observed. It appears by the experience of the surveys with such as those employed on the coast guard, under proper directions. On those occasions the necessary apparatus was speedily constructed by the persons employed. It might, however, be useful also to employ, in several English ports. We conceive that the project contemplated by the Association in its recommendations is very desirable; it might be attended by sending out a vessel which should have for the object of its voyage to make tide
observations upon such a connected system. For this purpose, the vessel ought to carry, in addition to a crew sufficient to work her, ten or fifteen men, who, by themselves (in pairs) or under the direction of petty officers, might make observations as required about the sandy bottom of the coast, and of the harbors and bays, as well as about the islands and other objects seen on the coast. The surveying vessel ought to be provided with a launch to be employed in carrying these observers to their stations, visiting them while engaged in their work, or fetching them away when their work was finished. From this it follows that the number of the standard stations ought to be selected at which tide observations should be continued for a longer time, and the observations made in each region should be compared with those at the standard station. The coast line, especially in the case of the eastern coast, is not level, but would point out the direction in which it was desirable to extend the survey, and the special points to be attended to. We, therefore, recommend that applications be made to the Admiralty that they would appropriate to this service an additional vessel.

Mr. Ollier informed the meeting that he had, while at Bombay, conducted a regular series of observations on the progress of the tides; that similar observations had been made in other parts of India, and at Aden at the mouth of the Red Sea; and that the Geographical Society had attended the importance of those observations, and had lately turned their attention to them.

The Astronomer-Royal inquired at what intervals the observations at Bombay were taken?

Mr. Ollier said they were taken by a tide gauge, and were, therefore, continuous.

The Astronomer-Royal said that frequency of taking the observations was most essential. Upon analyzing the observations he had lately supervised round the Irish coast, he was surprised to find that at some places the rise of tides took place in the day; and the constancy of the wavelike of these tides could be distinctly traced to a considerable distance on each side south.

Mr. Ollier said that nothing had been done in the way of analysis or reduction of these observations.

Dr. Warrall pointed out several peculiarities of the tides in the East Indies—particularly dwelling on those at Singapore. He also drew attention to the researches of Admiral Lütke on the north coast of Australia and the Northern Ocean; and begged to ask Prof. Struve whether these were not still continued.

Prof. Struve replied that the researches of Lütke were still continued, particularly along the shores of the White Sea and various parts of the Northern Ocean; and he believed he was almost the only navigator who had followed a large portion of attention on the determination of cotidal lines.

"On English Measures."—The Astronomer Royal stated that it would be interesting to learn that one of the chief objects of their illustrious visitor, Professor Struve, when coming to England, was to make a comparison of the English standards of length with those of Russia. — M. Struve stated that one of the special commands which he had received from his royal master was to make that comparison with minute accuracy. A knowledge of the English and Russian standards of length of that country was exactly equal to seven English feet. — Sir John Herschel said, that although England was at this moment without a Parliament standard of length, yet one would soon be completed, as the commissioners for the same had been appointed. The present was, therefore, a peculiar appropriate time for both countries that the comparison contemplated by Professor Struve should be instituted. — The Astronomer Royal said that the standard now in progress under the superintendence of the commissioners was being done with such extreme accuracy, that he felt convinced that it would not differ from what was intended to represent beyond the minute fraction of the 108,600th part of an inch. He begged to ask Mr. Struve whether the relation he had stated between the English foot and Russian Szwes was strictly or only approximately exact? — M. Struve replied that it was a matter determined by law; and that hence the Russian Szwes had to be varied wherever the English foot was to be used. That being the case, Struve, Captain Herrier's-determinations had been concluded, as well as on other occasions besides the present.

"On some Recent and Remarkable Examples of the Protection-afforded by Metallic Conductors against Heavy Strokes of Lightning."—By Sir W. S. Harris.

The possibility of guarding buildings and other structures against the destructive effects of lightning, has been made a great question in practical science—from the time of Franklin to the present day; and it is of considerable public importance, seeing the damage which occurs to our houses and other edifices from the force of lightning. The question completely under the denomination of induction, observation, and experiment. The general principles which Sir W. S. Harris submitted as detective, were drawn from the inquirie to which he alluded as these:—If we imagine a sheet of metallic wire of very much length, it would certainly be secure from any damage by lightning; and for this simple reason, that what we call lightning is the result of the electrical agency of the atmosphere, penetrating existing matter such as the air, and extricating with explosive force and violence. How, on the contrary, it falls upon comparatively non-existing bodies, such as the metals, given this form of lightning embasement, and the discharge assumes, if the metallic body be sufficiently capacious, the form of a comparatively quiescent current. Our object should be, therefore, to induce the same effect as produced by the wire of the same length; and the general means by which this might be done. So far as possible into that passive or comparatively non-existing state it would have supposing it a mass of metal. This is, in fact, the single and simple condition of such an application, without any reference whatsoever to the wire's material—what is the current conveyed by the wire, what is the current in the air, what is the current in the earth, and how far it is sufficient to serve its purpose. Sir W. S. Harris then referred to some remarkable cases.

"On Ancient Sea Margins."—By Mr. R. Chambers.

The existence of marine detritus containing recent shells at various heights above the present sea-level has long been well known. These deposits are sometimes met with at an elevation of 1,200 or 1,400 feet—and at a still greater height in the form of ridges and terraces, running parallel to the coast, of ancient sea-beaches or terraces, marking periods in which the relative level of land and sea remained stationary. Indications of this kind abound on the coasts of Great Britain, Ireland, and France, and are seen everywhere. The sea-regions are now occupied by water flowing away the coast into hollows and caverns, at others by filling up hollows with sand and shingle, or forming rude platforms at the bases of cliffs. In all these operations the sea advances in areas and the elevation of the coast in the direction of the lakes, the sea having a very small inclination the sea makes little progress, whilst on a bold coast no accumulation remains. The valleys of rivers also afford memorials of the former presence of the sea. Many of these valleys are still occupied by water, and are filled with deposits brought down from distant mountains. The nature of the deposit marking the margin of the ancient sea varies with situation and circumstance, being arenaceous or gravelly, clayey, or alluvial. The author has devoted much attention to the study of marine terraces, and in the valleys of Scotland and England, and measured their elevations above the sea. He finds them most constantly and well marked at certain particular levels, which he has called, for the sake of distinction, after the places where the phenomenon is most distinctly exhibited.

The first level at which indications of the former action of the sea are found is only about 11 feet above high water. The second is from 23 to 40 feet above the sea, and termed by the author the Chichester Beach. The third is from 60 to 100 feet above the sea, and called the St. Andrews Beach, being well marked near that University. The fourth, or Kingstown Beach, is from 90 to 100 feet above the sea, and is seen in only a few places—as for example, near Inverness, and at Kingstown, the near Derreatha to 114 to 115 feet. The fifth, or the Arran Beach, is very generally found at 130 feet above the sea. The sixth, or Bourland Beach, from 150 to 156 feet. The seventh, from 275 to 300 feet; and the eighth, or Verailles Beach 300 feet. Besides these, there are some localities indicating the sea margin at other heights, and marking stationary periods of lesser duration. One of these, at the height of 70 feet, is visible on the shores of the Firths of Tay and Forth; others occur at elevations of 115, 130, 180 feet, and near Peebles there is one at 540 or 607 feet.

The following districts were described by the author as presenting examples of a succession of sea margins at many or all of their levels:—the coast of York and Lancashire, the coasts of the South-West of England, the coast of England, the coast of Devonshire, and the coast of the South of Scotland, and those of Ireland, and of North America. The author considers it probable that this uniformity in the level of the successive margins of the ancient sea will be found to extend also to Norway and perhaps to North America. On the shores of the Altantic and other seas there are few examples of terraces or sea cliffs to form part of only a single line of sea level, one extreme of the sea, and not a distant stationary, whilst the other has been elevated several hundred feet. Mr. Chambers, however, states that the intermediate elevations correspond with the stages of the same sea, and believes they were formed at the same successive periods. Along the shores of the great American
em. Lakes there are also terraces at various elevations, corresponding with the more remarkable elevated beaches in Britain. In conclusion, the author observes that these phenomena cannot be accounted for by the usual theory of distincst and local disturbances, but imply an unceasing elevation of the land (or subsidence of the sea) simultaneously over large areas: and he points to the plains of South America described by Mr. Darwin in proof of the occurrence of such uniform elevations.

Remark.—Mr. Phillips remarked that those who had accepted Mr. Darwin's or Mr. Huxley's views must imagine the form of land by which tracts of land were elevated would believe that the surface of an elevated tract must incline from an axis, or point of greatest elevation. He expressed the opinion that a rounded surface was indicated, and that such a form would be more susceptible of variation as a result of erosion. He cited the examples of the Lake District and the Gloucestershire valleys, which had in reality been produced by the removal of softer beds of horizontal rock, and that as many terraces would be found as there were alternations of hard and soft materials.

Prof. Sedgwick contended that it was extremely improbable that the terraces should be found only along the valley of the Thames and described by Mr. Chambers: much less, that France and Norway and America would be raised the same number of feet at any successive periods. The elevation of the bed of the sea and its conversion into dry land had taken place repeatedly from the earliest to the latest geological periods; and strata were found in every kind of position, incised, vertical and scooted, and seldom horizontal over any wide space.

Sir H. De la Beche observed that, in pursuing this inquiry the author should be careful to distinguish between raised terraces and rafts of raised beaches, in the ordinary way by the question of breakers on a coast. At Bath, there were certainly no indications whatever of the several various levels on the hills.

Prof. Lyell described the elevated beaches. Around the American lakes as being sometimes in the form of hills of sand and sometimes of low cliffs. Allowing for these changes in character, they might, perhaps, be traced for hundreds of miles, and had been seen on the opposite shores of the lakes. With respect to Norway and Sweden, where raised beaches were numerous, it was stated that the northern provinces were still rising as the southern were actually subsiding.

Prof. J. Forbes stated that external form was not sufficient to determine the existence of an elevated sea margin. All instances should be excluded where there was not an actual section to show the nature of the terrace or deposit. Much difficulty would also be experienced in determining the mean level of a well-defined sea beach. The limit of doubt could not be within six feet above or below the line chosen; and so far as Mr. Chambers's sections showed that the sea beach under the height of 200 feet, and three intercalary beaches besides, there was only an interval of about twenty-five feet between each. It became physically impossible to identify detailed terraces where the levels were so ill-defined and the beaches themselves so numerous. If the intervals had been very irregular, the comparison of one series with another would have been much more satisfactory. The terraces on the banks of the Rhone, the Arno, and the Po were found at various levels, and were of different ages. The supply of silt gradually decreased, on account of the constant movement to the eastward, and as all that escaped in that direction was permanently lost, these means were found insufficient, and a system of 'trampling,' with brushwood and timber-piling was adopted. This was found to answer the purposes for a considerable time, but it also, in the course of time, gradually became insufficient; and it was found necessary, at length, after numerous experiments, to adopt a stone facing with an average slope of about eight to one, up to high-water mark, gradually increasing in steepness from the bottom, and terminating in a curve of seven feet radius. The stones, which were laid in a bed of concrete, where they were most affected by the waves, were of different sizes, averaging from eighteen to six inches in depth, the largest being in the middle, where the greatest wear and tear took place, and at which places rows of sheet piling were also driven for additional security.

This plan was adopted by the author after mature deliberation on the subject of the construction of quays in England, and the careful examination of the locality. Part of the wall has now been standing for ten years, and has required a very trifling amount of repair, while the annual expense has been reduced from 10,000l. to 4,000l., with every prospect of a still further reduction in the expense of maintenance, as upwards of two-thirds of the work are now permanently completed.

The last paper was, "On Green Strombium Navigation," by Captain Harris, calling attention to the fact, that in this great maritime nation, naval architecture was neglected as a science, as proved by the experimental squadron and some of the ordinary steam vessels lately built. Neither the public nor science had derived any advantage from these costly experiments, owing to the absence of any information, in a systematic form, that correctly described the relative size, capacity, resistance, power, cost, and speed of ships. The present tonnage and normal horse-power, for all purposes of analogy, being quite fallacious.

The meeting was then adjourned until the second Tuesday in January, 1848.
on Civil Architecture, by Gwilt; and for the best Notes of Papers read at the Meetings during the Session,—A Copy of Hope’s Historical Essay on Architecture.

To Mr. S. J. Nicholls, for his Notes of Papers read at the Meetings during the Session,—A Copy of Millian’s Lives of the Architects, translated by Mrs. Cresey.

A curious Model of a Chinese Chemist’s House and Shop were exhibited to the Meeting, and the several arrangements explained by Professor Donaldson.

In announcing this as the closing Meeting of the Session, the Chairman adverted to the general proceedings of the Institute during the year, and, taking occasion to express the regret generally felt at the recent decease of their highly esteemed Honorary Member, Mr. J. B. Papworth.

It has been arranged to set apart an evening, early in the ensuing Session, for the discussion of the subject proposed in the paper read by Mr. Champness, at the meeting of the 14th of June, on the Geometric System applied by the Medieval Architects to the proportions of their Ecclesiastical Structures, by which time it is hoped that those Members who feel particularly interested in the subject will be prepared to offer their opinions thereon.

A STONE-LIFTER.

Being engaged in the construction of bridges, &c., on the Great Grimsby and Sheffield Junction Railway, and the engineers objecting to Lewis-holes in the face of the coping, Mr. Joshua Oliver, clerk of the works, suggested a plan to obviate the difficulty. The annexed sketch is a representation of the apparatus, which is nothing more than a bar of iron, 3½ inches wide and an inch thick, with a sliding piece and screw; but should it be used for rough stones, the screw may be dispensed with by adding a key to the top of the sliding piece, as shown by the dotted lines.—Beider.

SULPHURIC ACID.

At the College of Chemistry, June 28, a lecture "On the manufacture, properties, and uses of Sulphuric Acid," was delivered by Mr. Henry M’Nab.

After alluding to the great importance of chemistry and its bearings on almost every branch of social industry, the lecturer observed that it may even be classed among the principal elements of civilisation. In illustration of which, he adverted to the influence exerted by sulphuric acid on the manufacture of soap—an article, the consumption of which is not subject to the caprices of taste or fashion, but absolutely essential to cleanliness and comfort. From the year 1829 to 1834 the average importation of barilla into this country amounted to 19,000 tons. Now, however, this barilla is scarce to be met with in the market—nearly the whole of the soda consumed in this country is the manufacture of soap and for other purposes being obtained from common salt through the agency of sulphuric acid; and the united quantity of soda ash and soda crystals annually manufactured is calculated to exceed seven times the largest importation of barilla ever made in one year. This increased consumption of soda is due to the repeal of the salt duty, and to the improvements that have been effected in the manufacture of sulphuric acid.

Mr. Nod proceeded to review the sources and properties of sulphur; and after showing how extensively this elementary substance is diffused throughout the globe and in all the kingdom of nature, he remarked on the imprudent policy of Sicily in granting to a French company, in 1836, a monopoly for the purchase and sale of sulphur—a course which, had it been persevered in, would probably, ere this have entirely, or to a great extent, deprived Sicily of her lucrative article of commerce. During the time this monopoly lasted (only two years) no less than fifteen different patents were taken out for methods of obtaining back the sulphuric acid used in the manufacture of soda. Hundreds of thousands of pounds of sulphuric acid were prepared from pyrites; and a process was indicated for decomposing gypsum. Even at the present time large quantities of hydrochloric acid and vinegar are made from pyrites; and in 1838 the importation of sulphur from Sicily was not one-third of the amount imported in 1836. The lecturer described the various compounds of sulphur with oxygen; illustrating experimentally the properties of sulphuric acid.

He explained the theoretical nature of the reactions which took place by means of diagrams. The leaden vessels employed in some manufactories were stated to be of immense size—upwards of 160 feet long, having a capacity of 500 tons, and being capable of producing 30 tons of acid weekly. The great saving effected by the modern improvement of substituting vessels of platinum for those of glass for the final concentration of the acid, notwithstanding the enormous price of the former, is manifested in a saving of one-third of the price of the platinum used. He explained the scientific laws of the production of acid by sulphuric acid, and by the use of different sorts of acid.

WARMING AND VENTILATION OF THE NEW HOUSE OF PEERS.

We have been requested to give an account of the system adopted by Mr. Barry, for the warming and ventilating the New House of Peers. We cannot do better than give Professor Faraday’s account, read at the Royal Institution:

Mr. Barry’s plan of warming and ventilating the three rooms to which he has applied it (i.e., the royal ante-chamber, the house of peers, and the public lobby), consists in passing a current of air of regulated temperature, to pass beneath the impervious floor of these apartments, and afterwards to rise to a chamber at the top of the building, from whence it is diffused in great abundance, but imperceptibly, throughout the three apartments; and secondly, in drawing off the vitiated air and discharging it with great rapidity into the atmosphere. To accomplish these objects, Mr. Barry has achieved expedients for:

1. Warming the building through an impervious floor, as in the case of a Roman bath.
2. Effecting a system of currents. 3. Providing means of causing ten thousand cubic feet of air per minute to pass through a prescribed course, and with regulated velocity.

The warming is effected by a steam-cockle, supplied from one of Lord Dundonald’s boilers; it is traversed by a quantity of air-tubes firmly fastened into it. The air which passes through the tubes is the source of warmth. This apparatus, with its furnace, is placed beneath the public lobby; and the current of warm air passes beneath its impervious floor, then beneath that of the House of Peers, and lastly, beneath the floor of the royal ante-chamber beyond. With warmth, the air acquires a certain degree of motive power in the rising parts of the passages, which carries it upwards till it reaches the reservoir chambers at the summit of the building; and thence it is made to pass down into the apartments by their walls, and so distributed, without draught, to be breathed by the inmates of those rooms. This gradual diffusion of the air is accomplished by a system of currents. It is caused by the subjecting the air to inequalities of temperature. Descending by the walls of the building, it is cooled by windows, &c., and thus its velocity downwards is increased. Arriving at the level at which it is cooled, it is brought up by means of the chimney, and there it is again heated to the proper temperature, &c., the air again rises in the centre of the room, and passes through the ceiling into a foul-air chamber, which is in connection with a chimney. Through this chimney the air is driven by the third expedient above named; and the motive power is furnished by Bell’s steam-jet [see Journal, last month, page 350] a source of force which has so many philosophical considerations connected with it, that Mr. Faraday expressed it his intention of making it the subject of a future day’s discourse; he therefore limited himself at present, to the simple statement that steam produced under 32 lb. pressure on the square inch, will set in motion 317 times its bulk of air.

In the course of his communication, Mr. Faraday described the arrangement made by Mr. Barry to clear the air, and to regulate its velocity, so as to prevent the possibility of draughts coming on any inmates of the apartments. He showed how the steam-cockle, employed to give warmth in winter, might, by filling it with water from the Artesian well, become a source of coolness in summer. These, and many other important arrangements, were illustrated by sections in relief.
The advantages expected from this mode of ventilation, are, 1. The pre-
vention of local stagnation. 2. The prevention of the stales and discoulour-
ments resulting from smoke, and 3. The avoidance of all encumbrance
and dispersion of dirt and dust of the house by currents occasioned in it,
which, currents if existing, would tend to render the air impure. 4. The avoidance of
fire. 5. Finally, it is probable that all parts of the house were fire-proof.
Mr. Faraday then took occa-

tion to remark that this scheme of ventilation was under a disadvantage
in the present case, as it had to be adapted to buildings which were not plan-
ned with reference to it.

DREDGE'S SUSPENSION BRIDGES IN INDIA.

Major Goodwyn has addressed the following letter to the Editor of the
'Englishman' (Published in India in reply to Mr. Dredge's remarks) —
"Sir, Adverting to a statement which lately appeared in your paper, and
which, with certain comments, has found its way into the 'Star and
Madras Spectator,' relative to the failure of an iron bridge on the taper
chain principle, manufactured by the patentee, Mr. Dredge, sent out by
him, and put up at Jessore, I feel myself bound to offer a few words, as
the measures of the Government have been misrepresented, and the facts
of the case considerably distorted. The span, width of roadway, height
of point of suspension, being necessary data to furnish Mr. Dredge with,
these were sent to him, and these alone, as connected with the required
strength of the iron-work, were sent to him, and he was further particularly instructed to
form the eyes of his links in a peculiar way (which, however, he did not observe). Mr. Dredge, as I before said, required the above data on which
to calculate the strength of his links, and the angles at which his rods were to be placed. Not one of these details was sent from here:
now it is likely he would have adhered to them if they had been, for it
was naturally his interest to protect his patent by every care he could bestow,
and it is sufficiently evident he did attempt it when he made the longitudi-
nal beams 85 per cent. above what he was in the habit of doing, not
as the drawings warranted,' for no drawing went from this country, saving
a tracing of the masonry design, and section of the river, with sandry
queries relative to the retention of the chains in the ground. To prove
that the drawings of the iron-work came out fro, instead of going to Mr.
Dredge, I send you his sheet of plans, which were accomplished by most
eloquent injunctions, all of which were fulfilled, and the bridge was most
correctly put together. It might have been the steadiness of the Hinton engineering
of the pier will be greatly felt by the mail establishments of the Brit-
ish and foreign governments, who have expressed their willingness to enter-
tain the question of an annual grant for its use,—as well as by the contin-
ental steamers, who will thus be enabled to effect a landing of passengers
at low tide, which is a question of great importance to Dover, and enables
it to maintain its hight position as a port of embarkation to the continen-
t.

NOTES OF THE MONTH.

Centre Punch.—It is customary, in moving the "centres" of a piece of
iron intended to be turned, to drive a centre punch into the holes previously
made: first, at an angle, in order to form the metal over to the side re-
quired, and then, to drive it in, perpendicularly, in order to give the hole
the proper shape for the lathe centres. This is frequently repeated, until the
hole is mutilated, or driven so deep as to be objectionable, and is absolutely
awkward on a nice piece of work. There are other modes of moving the
centres, of accurate work, such as the scraper and centre-grind drill, but this
is the mode generally adopted on account of convenience, and has done injury
to much fine machinery. The new plan adopted for this purpose is by applying a vegetable
resin or varnish to carry off the silicious dust before it can reach the mouth or nostrils.

Conversion of Diamonds into Coke.—At the meeting of the British As-
cociation, Dr. Faraday exhibited some diamonds, which he had received from
Mr. B. B. Blight, had, by the action of oxygen, been converted into
coke. In one case, the heat of the flame of oxide of carbon and oxygen
had been used—in another the oxy-hydrogen flame—and in the third the
galvanic arc of flame from a Bunsen battery of 100 pairs. In the last case,
the product was perfectly carbonized, but the formation of the gases,
the fusion and carbonaceous formation were evident. Specimens in which
the character of graphite was taken by the diamond, were also shown.
The electrical character of these diamonds were stated also to have been
changed—the diamond being an insulator, while coke is a conductor. Gibeau,
In his "Young Engineer," suggests that iron girders and similar supports ought never
to be made of cast iron, but of wrought iron, and composed of plate; twisted previously into a rope, and finally moulded into the required forms
The City of Mexico.—Conspicuous above the beauty and magnificence of that great city is the main plaza. In its area, of twelve acres, there is a fountain for each of the eighteen streets opening thereon, and around this area stands the main plaza, a beautiful and impressive structure. The main plaza is surrounded by the main streets, and is the setting for the main business of the city. On every side of this great square, magnificent and costly public buildings are situated. On one side is the grand cathedral, which extends the whole length of the square, and the government palace extends the whole length of another side. The cathedral is erected on the site of the great idol temple of the Aztecs, and the government palace on the ground of the palace of the great Montezuma. The renown of wealth in the cathedral is incredible. The altar is covered with plates of massive gold, and a crown of pearls worth a million dollars. The balsam-wood caskets in which so many of the most valuable jewels are kept are encrusted with gems. We cannot form an idea of the immense wealth of this cathedral. There are about 800 churches in addition to the cathedral, richly ornamented with gold, silver, and precious stones; and it is supposed that the wealth which is exhibited in this manner is no less than to the immense treasures that are kept in the church. The city of Mexico can also boast of a splendid theatre or opera-house, which was erected at an immense cost, and is capable of seating 10,000 persons comfortably. On the western side of the city is another square of 45 acres, with a fountain in the center. It is laid out into pleasant walks, and much frequented in the evening as a promenade. The city of Mexico, like the city of New York, has its fashionable drive—its Third Avenue. We must, however, acknowledge that our Third Avenue cannot be compared to it for beauty and extent. Some street car lines may be seen along the main streets, and some of the most splendid carriages, in innumerable numbers, may be seen every evening. It is not unusual to see 7,000 or 8,000 horsemen and 2,000 carriages on it at the same time.—New York Herald.

Imposed Locomotive Engines.—For some time past considerable attention has been excited among parties connected with locomotive building by the performance of an engine built upon a new principle by Mr. Crompton, civil engineer [see Journal, p. 158], and upon which very extensive experiments have lately been made on the London and Merthi-Western railway. The engine in question has been for a few weeks taking the express, mail, and ordinary trains on that line, and performing its work in such a manner as to effect a saving of from 20 to 30 minutes in a through distance of 39 or 40 miles, was tried last week without a train, for the purpose of testing its rate of speed, and which it was found that within 1 mile per hour. Capt. Coddington, Inspector-general of railways,Capt. Stannard, assistant-inspector, and the patronage, Mr. Crompton, on the engine, it attained the extraordinary speed of 72 miles per hour, on a level, immediately after passing over a steep incline, which was a total abatement of all vibration, and a steadiness of movement perfectly surprising. These great advantages are secured in Mr. Crompton's engine by the central gravity being brought down to its lowest possible point; the boiler, in fact, being, in this machine, within 3 feet 9 inches of the rails, whilst in engines of the old construction it ran, at the very least, 5 inches above their level. The peculiarities of this engine consist in the driving-wheels being placed on the foot-plate of the locomotive, and the boiler itself, by which means the boiler itself can be brought down close to the supporting axles of the engine—and, from the peculiarity of form before mentioned, any strain of driving-wheel may be used without interfering with the position of the other parts of the engine. The advantages secured by this method of building engines is, that no part of the engine overhangs the wheels; its mass is extended beneath the boiler and driving-axle—by which also the distance between the extreme wheels is reduced 3 feet. The engine in question, the Namur, has only 13 feet between them, whilst in ordinary engines the same amount of power would require 16 feet.
BUCKINGHAM PALACE.

(With an Engraving, Plate XIV.)

Although we exhibit the Park front of the new range of building which is being added to the Palace, we are unable to speak as to its exterior, the designs presented to Parliament being unaccompanied by any description or any explanatory Report by the architect himself; notwithstanding that something of the kind, in addition to drawings, might properly enough have been "presented to both Houses of Parliament by command of her Majesty." We therefore, not being so intuitively sagacious in matters of architecture as, it would seem, the two "Houses" are, are greatly at a loss to understand a variety of particulars that ought to be taken into consideration, for we do not get even so much as a single plan to make us acquainted with the general interior arrangements, and thus enable us to judge how far Mr. Blom has been controlled by positive exigencies of accommodation, to the injury of external character,—which latter, if the truth may be spoken, is but ordinary in quality and commonplace in regard to composition. Had it been for what is called a "Terrace," or the side of a square, or any similar range of houses combined into a general architectural façade, the elevation might deserve the epithet "palatial," whereas being for the principal public front of The Palace, it partakes by far too much of "the dwelling-house" physiognomy, undoubtedly of a superior kind. Besides being divided into five markedly distinct portions, that have the look of being separate residences, each with its own entrance, the façade is in one respect, if no other, greatly less dignified than some of our club-houses, the latter not having—at least, not showing externally—any chamber-door, or one of lodging-rooms, over the principal floor; whereas here, there not only is such floor, but it is made quite as important as the other, so that except what distinction it receives from its window-dressings, instead of plainly expressing itself as a lofty state floor, that first-floor is made of no more importance than the one over it. For want of plans, we cannot say whether such is really the case or not, but it does look very much as if, instead of containing a ball-room and other additional state apartments for public entertainments, the new building was intended to consist entirely of offices in its lower part, and in its upper one to afford the same sort of residence and lodging accommodation as has hitherto been provided in the original wings of the palace; and as if the latter—the south one at least—was now to be cleared out and converted into a ball-room, &c., to immediate connection with the present grand staircase. Unless one of the wings is to be entirely re-arranged internally, we do not see how there can be any suitable communication between the present state apartments and any others in the new building. By referring to the plan of Buckingham Palace, as given in the second edition of "The Public Buildings of London," it will be seen that by forming an approach from the grand staircase into the spacious octagon room on that side, converting that octagon into an ante-saloon to a ball-room or other spacious and lofty hall for public entertainments, made to occupy the whole of that wing and what will be added in depth by the new building (making altogether about 250 feet from the octagon), a most important addition might have been made to existing state apartments, in their immediate proximity, but at the same time as to keep the one suite perfectly independent of the other, at the same time allowing them both to be thrown open at once, with direct communication between them whenever the occasion might require it. The arrangement we have pointed out could hardly fail to be productive of an unusual degree of architectural display—of both effect and climax, even were the $200 feet of length from the octagon divided into two halls of entertainment, a larger and smaller one, the former being of course placed last. But we ourselves are new building—not exactly a palace, but a merecastle in the air. We must therefore, content to let what we have been saying pass for mere moon, shine.

Said, perhaps, it may be, that after all, the public need not give themselves any concern whatever about internal arrangement and accommodation; since all that will fall to their share will be external appearance alone. One circumstance will certainly be in favour of the New Building, namely, it being about ten or twelve feet higher, and being advanced so much further it will show itself more conspicuously; at the same time, owing to its forming a single general mass, it will not possess any play of perspective, nor any of that relief and contrast of light and shade which now take place when the sun strikes on one of the wings on its side towards the court while the rest is in shadow. The aspect of the Park front of the Palace is certainly an unfortunate one,* it being such as to render that façade a mass of shadow,—an inconvenience which it has been attempted to keep out of sight in the pictorial perspective view accompanying the two elevations by a device far more ingenious than praise-worthy, the sun being there made to shine upon the building from the north-east, which graphic fiction, besides setting off the east front to itself to full advantage, performs the very good-natured service also of throwing into shadow the south side,—whereas, in reality, the effect will be just the reverse, since the latter, which forms no architectural façade at all, but is, on the contrary, an arbour jamble, will be lit up by the sun, while the Palace will be burred in shadow. Hence the whole truthfulness of a drawing "presented to both Houses of Parliament," in order to enlighten their esthetic optics. For our part, we very much question if any of those noble personages who affixed their signatures to what was presented to them, so much as noticed the fiction palmed upon them.

Having to content with an unavailing aspect, Mr. Blom ought to have exercised his ingenuity by studying how not only to overcome that disadvantage, but elicit some unusual effects. He might have taken a hint from those exceedingly picturesque bits of architecture, the open loggias in the Terrace façade of Somerset place. Something of that kind, admitting a brilliant light through a double range of columns seen in bold relief against the sky (for the buildings in the rear are too much impaired by a dismal naivety to the whole façade. Nor would such arrangement have necessarily destroyed all communication between the rooms on the principal floor, because such communication might have been sufficiently kept up by means of a corridor practised behind the loggia, carried up only so high as not to be visible from the Park. Had there been any opening of the sort through the centre of the new building, it would surely have conduced very much to the cheerfulness of the inner court and the view from the portico and rooms on each side of it in the body of the palace, by admitting a glimpse of the trees in the park, between the columns.† At present, unwellcome as the truth may be, and ungraciously as it may sound, we must say that the architect does not seem to have studied the subject at all; on the contrary, to have taken up with the very first ideas that presented themselves. Most assuredly, he has stolen some from Inigo Jones's designs for Whitehall, but—so not to go out of our own country—has he caught any of that grandeur which stamps those houses? Has he attempted at all, although not faultless in taste, has infinitely more the air of a royal palace than anything we now have, not even Windsor Castle excepted. Had Mr. Blom been compelled to adhere as nearly as possible to the character of what had been before done, that consideration might have mitigated criticism; but for excuse of that kind he has left himself no room whatever, the new building being treated quite differently, yet in such manner as to leave it very questionable whether the difference amounts upon the whole to much improvement;—it most decidedly does not so much as the opportunity afforded. In one respect, there will be even more littleness than before, owing to a low entresol with a series of small windows being here introduced between the ground-floor and first-floor. That entresol, no doubt, supplies a great deal of accommodation for domestics, but in the front of a royal palace, and what is in this case the only public front of it, such extravagance should not be allowed to intrude. In such, convenience ought to give way to dignity, and be provided for elsewhere; just as a sovereign must frequently sacrifice his own comfort and personal indulgence to state, and give an audience when he would much rather take a nap.

* Unfortunately, too, it is that of the Blair front of the Palace of Westminster, and of the new Treasury buildings is just the same; nor, although different, is that of the new Houses of Parliament a Pull-Me-Along. Whole new buildings, as well as old, can sometimes be compared to good picture books in a very bad light. We may perceive what the details are, but they do not produce the intended effect,—not that the light is dim because there is but a small amount of it. The thing it does not do at all times of the day it does not do at all times of the day. Aspect, however, notwithstanding all that is said about it, does not seem to be taken into account at all—not even so much as thought of for a moment in designing a façade. Hence, while we often see enormous fronts fully exposed to the sun, and where ornament would consequently show itself well, we find it on the back of the building, upon the wings of the building, other wings owing to want of requisite light it does not produce any adequate degree of effect.

† We have now before us upon paper three ideas, all widely differing in other respects, but all agreeing in regard to the arrangement of the building. One of them extends the façade as far as the extremity of the present small Doric colonnade, so as to obtain a "corps de logis" north and south, of about 300 feet frontage, and four of these two-masted ships, the buildings now so colonnade on the level of the state floor, entirely open in its upper part, but having the interior rooms filled in, both towards right and left of the façade. The height, by being glazed with brilliant stained glass, the effect of which, with the sun on the opposite side, could not fail to be most splendid. Internally, that part would form a conservatory or winter-garden, into which one of the new state rooms for evening entertainments would open; accordingly, when it is up of an evening, on any such occasion, the audience would be that of a superb illumination, with a series of glowing transparences.
Convenience—no doubt George the Fourth studied his own convenience, and had he inhabited the Palace, might, perhaps, have been perfectly satisfied with it; yet the public would not have been at all better satisfied with the building on that account. And surely, when palaces are built or altered, the public, who provide the money, may very reasonably expect may, rightly demand that the structure shall be made a worthy public ornament, and be, as a work of architecture, of a much higher grade than usual. Extravagance is not to be measured by the ordinary shop-keeping standard of mere cost, because there is far more extravagance in laying out a hundred thousand pounds on things we are afterwards ashamed of, than in expending a million upon what we should have reason to be proud of, as a people. Don't let us have to pay both money and reputation too, as we have so often done hitherto. We do not recollect to have ever seen mentioned what was the approximating estimate for Jones's Whitehall, but enough to have erected two such vast piles has since been flung away—not, indeed, all at once in a lump, but in hundreds of thousands, or so, at a time, in building up, altering, botching up, and in some cases, ennobling again. Could we but ascertain the exact amount of aggregate cost of the quondam Gothic palace at Kew, the Pavilion at Brighton, Carlton House, the present Buckingham Palace, up to the time of the additions now making to it, including some of our government buildings, the total would be most startling; and most grievances, too, would be the reflection that there was never anything at all adequate got in return for it—whereas all is the real grievance.

Whether the public generally will now be satisfied with the Palace, we pretend not to say; we only know that we are not so ourselves,—quite the contrary, for there be improvement at all, it certainly falls very far short indeed of such as there might have been. Instead of extending our remarks at present, we leave our readers to decide how far those which we have made are justified by the elevation itself, in which we think they must be struck, if by nothing else, by the excessive meanness of the state entrance through the centre. That archway is quite dumpy in its proportions, as compared with the other two, and looks all the more so in consequence of the very differently proportioned square-headed passages on its sides. Neither has the architect there provided places for the sentinels, as he might have done, making them both very characteristic and very ornamental features in the building itself, but has left it to the carpenter to put a couple of palace wooden sentry-boxes to the principal entrance to a royal palace.

According to the scale on the drawing, the whole length of the façade is 560 feet; and height to the top of parapet of the wings 77 feet, and of the centre 84 feet, or to the top of the centre ornament, 100 feet.

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXXIII.

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

I. There are some others, it seems, quite as free in opinion, and as audacious in speaking it out, as myself. In an article in the "British Quarterly," entitled "Modern Painters and Architects," the writer says: "If a truly absurd spire is wanted, we must go the length of Fleet-street, where the stone pagoda dedicated to St. Bride's has won the indiscriminate praise of ignorance for a century past. A thing without thought, invention, grace, or any property of mind; but reared as a child does its castles of cards, story above story in monotonous succession—just as many as it will bear." Nor is this all, for it is added in a foot-note below: "Christ's church, Newgate-street, with less monstrosity than St. Bride's, is a still worse specimen of St. Christopher Wren's belfries." The writer has, however, the grace—which I have not—to admit that Bow steeples is "a singularly beautiful specimen" of the kind. For "singularly," read "comparatively beautiful," and the praise becomes just.—After all, a steeple does not constitute an entire church, and whatever their steeples may be, the bodies of Wren's churches are so far from possessing any beauty, as to be absolutely uncomely, and utterly negative as style, although all decidedly partake of one and the same manner. The excuse may be that most of them are in such confined situations, so blocked up by surrounding houses, that very little of the general exteriors can be seen; wherefore to have studied beauty for them would have been study thrown away. The deformity of St. James's, Piccadilly, however, cannot be excused by any such extenuating pleas—and even those who profess to discern such rare beauty and excellence in the interior, are obliged to admit that the exterior is ugly,—not merely a plain, homely structure, for which no architectural pretension is made, but decidedly ugly and a positively disagreeable object. The design is that of a mere builder—or else of a churchwarden.

II. That same master churchwarden reminds me of one thing: speaking of the present "orthodox movement" in church building, it is observed in the article above quoted, that "Ignorant churchwardens no longer go about with their pall of whitewash, beautifying, retrenching, and destroying, according to their notions of taste. Architecture has little that is really valuable, however, to hope for from ecclesiastical movement, beyond the conservation of what already exists. A spirit of reservation that banishes all thought of originality, and all hope of progress, is the utmost that it confers. When it has exhausted its models in the pitiful work of imitative production, what then?—the enfeebled emasculated copyist can only retrograde."—Bravo, "British!" / Your prediction is in a fair way of being speedily verified. Even the very best of our recent Gothic bears that sort of resemblance to genuine productions of Gothic art during the period of its vitality, which wax-work does to life. At the first glance, the resemblance may be deceptive, but at the next we perceive the thing itself to be a mere semblance, devoid of the living breath of art,—a mere puppet skillfully put together to amuse ecclesiastical and antiquarian bigots. Also! for architecture in such hands and under such influences! While unable to comprehend art,—and at the best they are just as matter-of-fact in their ideas as churchwardens, the difference being that their matter-of-fact is of a different and more book-learned kind,—such protectors befriended architecture just as the man in the fable did the horse when it applied to him for assistance, namely, by clapping a saddle on its back and putting a bridle into its mouth. Thus far shall thou go, say they to architecture, and no further, this way and no other, for it is this way which we know; for it has been formed for us by "our forefathers," and we have duly mapped it out by studying chronicles and precedents. Were we to suffer you to get off from the beaten road, we should of a certainty lose ourselves at once, and what few wits we have would desert us entirely.

III. I must be allowed to help myself to another slice of the "British." The writer reproaches the "Oxford divine!" as he calls Mr. Parker, for his total exclusion of Elizabethan architecture from his otherwise ample "Glossary," observing that such exclusions "are a sample of the very partial views that still prevail on all the great principles referring to art. The Elizabethan, forsooth, is no style at all, but a mere corruption of the ortho-}

Precious words those last: if architecture has now become incapable of accommodating itself to the ideas, the habits, and the wants of our times, it must be regarded as efforts; or if it does not so merely because it is not permitted, it must be regarded as enslaved,—degraded to the servile and humiliating office of building according to pattern. "But so little is this idea of adaptation of style to purpose understood,—" I am not quoting from the "British,"—"that within the brief period of a dozen years, we have seen this same Elizabethan style proposed by a carefully-selected committee of taste, as one of the two alone fit for the halls of legislature, and rejected in the best architectural glossary that exists, as no style at all! It is characteristic of the class which the latter may be considered as representing, that it is not the architecture alone of the 13th and 14th centuries which they thus exclusively seek to restore. They are the same reformers who aim at the improvement of the people in the 19th century, by the revival of the maypole, and the manners of the good old times; a spirit that has no onward nor upward gaze; whose golden age lies in the past, and not in the future." Good old times, with a vengeance, were those same times of "our forefathers"—to make use of a casting expression—times not deficient in examples of heroic virtue, but also marked by the most atrocious crimes,—times of spiritual, if not of intellectual darkness,—times whose stunted piety was composed of arro-
giant tyrannical priestcraft on the one hand, and of the most grovelling and besotted superstition on the other.

IV. When he was paying a tribute to the artistic talent of Vanbrugh—an architect gifted, if not with taste, with real concepive power, and that in a prosaic age,—Reynolds might very properly have thrown out a compliment to Hawksmoor, and quoted the campaspe of St. George’s, Bloomsbury, as a most strikingly happy composition,—one on which the eye of a painter cannot but rest with delight. Happy as it is in itself, that masterly production has been made a martyr.—not to criticism, but to stupid ridicule, —to the prosing imbecility of such old women as Ralph, and the schoolboy pretence of such clever codecombs as Master Horace.—Criticism forsooth!—why criticism rejects such grovelling, feeble-wit stuff, and leaves it to Pech and the penny-a-liners. Had he possessed aught of critical faculty, it would have enabled Walpole to perceive how beautifully the statue pees upon, how admirably it completes, and how essential it is to the artistic completion of the ensemble. It is not an historic statue, elevated to such a height that the personality it is intended to figure to us is utterly lost; nor is it hoisted on a pedestal of its own, clapped upon the top-heavy capital of an overgrown column—a truly unhappy combination, productive of the most harsh abruptness of outline at the general summit. Here, on the contrary, the statue is incorporated with the architectural mass, of which it is the efflorescence, springing out of it as its finial or acroterion, and continuing to a point the lines of the obelisk-shaped part of the structure which it crowns.

V. Though it does not say much for Allan Cunningham’s diligence or aptness for the task he undertook, it is perhaps as well that he omitted a memoir of Hawksmoor, for it would, in all probability, have proved little more than a mere echo of such senseless judgments as that of him who bas pronounced St. George’s steeples to be “a masterpiece of absurdity.”—Would that our modern architectural absurdities were but half as poetical, as graceful, and as picturesque! In regard to that stupidly camouflaged church, there is another curious fatality, for no one has ever bestowed even so much as a syllable upon its north façade. Indeed, it may be fairly questioned whether it is yet known to exist, for of the thousands who pass the portico, scarcely one, perhaps, suspects that the other side of the building shows a picture of architecture of no ordinary merit—certainly one marked by no ordinary degree of architectural energy; and so far affording an excellent and much-needed study. Still, I may be committing mischief by thus calling attention to what is by no means calculated to put us into better conceit with what has since been done upon any similar occasions. Improved we may have in some respects—such, perhaps, as normal correctness of design, and normal attention to matters of detail; but we seem, on the other hand, to have lost the valuable qualities of boldness and vigour. If we are more reduced, we are also more enucleated in our taste, and our buildings show as open castellations. Buckingham palace being one of the panions of them—by the side of such architectural “thaws and pinwheels” as Vanbrugh and Hawksmoor put into their works. Unluckily, however, architects seldom look to more than “orders” and other mere matter-of-course circumstances, without perceiving, or if they perceive, without noting and investigating, artistic qualities—some of them so subtle as to elude satisfactory explanation; consequently, much less are they reducible to exact technical definition. We have, however, only to compare any one of Wren’s churches with this of Hawksmoor’s, to be able to account for one great difference of quality—the flatness and poorness which set their mark on the former, and the energy of expression which stamps the other. Although not entirely, this difference in a great measure arises from what is a very simple matter itself, namely, the lesser or greater degree of relief produced according to the shallowness or depth of the external embasures of the windows—in other words, according as the plane of the glazing is approached to or set back from the plane or external surface of the wall. In the windows of all Wren’s churches, there is scarcely any revealing; in Vanbrugh’s and Hawksmoor’s buildings, great depth of reveal—a difference that does not show itself in geometrical elevation, but which is an exceedingly important and influential one in perspective effect—consequently, in the buildings themselves; for while the former mode is attended by the insipid arising from the absence of boldly-defining shadows, and of corresponding lights on the opposite sides of the apertures, the other secures them. Besides which, we are impressed in the one case with the disagreeable idea of the walls being unusually thin, while in the other we at once perceive that they are unusually thick and substantial.

VI. The north side or front of St. George’s, Bloomsbury, has escaped the notice of architectural draughtsmen as completely as it has that of other people; which, to whatever else it may be owing, most certainly cannot be because it would not show well as a subject for the pencil. In that respect, however, it is by no means singular, for hundreds and hundreds of subjects for architectural delineation in the metropolis might be pointed out, which are yet absolutely untouched, although draughtsmen go or appear to go again and again to very spots and places where they are to be found. Entirely fresh pictorial representations of them might easily enough be made of buildings which, although they have been shown again and again, are shown almost invariably in just one and the same way, and that their most formal and unpretentious attitude. Now, it is all very well to have such a general view of a building as serves to exhibit it in mass, but we do not want so many repetitions as we get, of what is identically the same view,—unless, indeed, there be visible improvement also in regard to architectural delineation and artistic effect. Instead of which, deterioration is far more frequent than improvement, and many views of the kind that are published are only wretched, vamped-up copies of better ones which have preceded them.

VIII. Many both extol the simplicity of Grecian architecture and speak of simplicity itself in the abstract, as if it were the most excellent and paramount quality in art, and which ought therefore, on every occasion alike, to be the predominating one. Not content with admiring simplicity themselves, they insist not only that others shall admire it too, but that, like themselves, they shall admire it exclusively, and be intolerant of the qualities opposite to it, even though they should be so applied as to be merits. Of Grecian architecture, the simplicity was by far too much of exactly the same kind. The simplicity of one building just resembled the simplicity of another; and, in fact, the simplicity was in a great measure quite involuntary, and of a rather negative kind, arising as it did chiefly out of the absence of complexity, or any other counteracting circumstances. How could it fail to be obtained in buildings constituted like the temples of the Greeks, which admitted of no combination, scarcely any other variations from one uniform general design than as they were tetrasyllable, hexastyle, or octastyle, and deriving their individual character entirely from the particular order employed, and the unassuming to give it its details and execution? As far as we ourselves are concerned, pure Grecian architecture is all very well for us in theory, but not to be thought of by us for actual practice. We may study the Parthenon as we study the Iliad, but would do well to desist from copying the one until we begin seriously to think of imitating the other, and endeavour to bring the lofty Epic strain into fashion again.

VII. It looks very much as if the decision of the Army and Navy Club had been arrived at in deference to Count D’Orsay’s opinion, as expressed by him in a note to the Builder, contradicting what had been rumoured as his being concerned with Messrs. Parnell and Smith’s design (No. 45), but expressing his hearty approbation of the design itself—of “the taste which selected one of the most beautiful palaces (palazzi) in Europe for the model,” and declaring, that for the embellishment of the metropolis he should very much like to see it executed. It is singular enough, I may remark, that what is “one of the most beautiful” pieces of architecture of its kind in Europe—viz., the Palazzo Cornaro at Venice, by Sansovino, should hitherto have obtained so very little notice—scarcely any at all, beyond the mere mention of its name—from either architectural writers or cognoscenti travellers. Woods, for instance, does not even name it. We ought, therefore, to be the less surprised at the Club’s not being struck by its pre- eminent merits, until their eyes were coated by the Count,—and had they discerned them before, they would doubtless have awarded the second premium, at least, to Messrs. Parnell and Smith. All that we ourselves can now recollect of that design is, that we merely glanced at it and passed on, perceiving at once that it was a direct and very palpable copy of some Venetian architect of Sansovino’s time; and we wanted not to be at mere copies and lose a lot of books, or published designs, but to discover what fresh ideas had been produced for the occasion. In what position, then, do Messrs. P. and S. put themselves, if not in that of mere architectural transcribers? And is what position is architectural design now put, except that of mere copyism, to which a bonus is thus directly held out by the success of those who are unable to produce anything sust
HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elms, M.D., F.R.S.

"Epitomes are helpful to the memory, and of good private use."—Sir Henry Wotton.

(Continued from page 238.)

Wren's immediate successors were his contemporary, Sir John Vanbrugh; his friend and colleague, Robert Hooke; his pupil, Nicholas Hawksmoor; Gibbs, who finished the church of St. Clements Dames; and a few others of less notability.

Robert Hooke was the assistant and sometimes rival of Wren, during the greater part of that architect's career. He, like Wren, was an experimental philosopher; like him, he had received a doctorial degree, when that honour was conferred only upon men of first-rate talent. To use a theatrical phrase, Hooke may be considered as Wren's double, and took the part of his principal whenever called upon. Hooke added much to the useful inventions of the day, as may be seen in his memoirs by Dr. Waller, and in the contemporary proceedings of the Royal Society. He appears to have been more of an imitator than an inventor, for when Wren, or any other original genius of the day, brought forward a scheme or an invention, Hooke was always ready with another of a similar nature.

The great and extensive charge which devolved upon Wren after the fire of London, induced him to take up ingenious and able associate, Robert Hooke, the learned professor of geometry at Gresham college; whose avocations, under Wren, were chiefly those of measuring, adjusting, and setting out the ground of the houses in the private streets to the several proprietors, while he reserved the higher and more important works of designing and superintending the execution of the public works to himself. Hooke, at the same time, divided the labours and honours of the Royal Society with Boyle, Moray, Wren, and other philosophical members. Among the subjects submitted by Hooke to the Royal Society, were a new method of making bricks, with less charge and more speed than had been then practised, and a design for a collegiate building for the use of the Royal Society, to be built on a site of ground presented to them by their immediate associate, Mr. Howard of Norfolk. This collegiate design did not please the Society, nor did the manner in which Hooke appeared to trench upon his master's ground, for at a meeting of the council on May 4, 1668, the president (Lord Branncker) moved, that the building of the Society's college might be begun forthwith, and Dr. Wilkins was desired to procure, at the next meeting of the council, Dr. Wren's design for the building. This was done, and Hooke ordered to get a model made of the approved design, to contract with proper persons for the execution of the work, as also to find someone to be constantly present, and to see the workmen do their duty; thus appointing Wren as architect, Hooke as surveyor and valuer, with a resident clerk of the works.

Of Hooke's repeated invasions into his master's province, abundant proofs are found in the records of the Society, and Wren at last complained of these interferences. Few men had more reason to say sic sis non nobis than Wren. Hooke appears throughout to have followed, trust, and attempted to support in the public estimation his friend, patron, and principal, in every thought, invention, and discovery. Not content with his independence upon Wren's reputation, he dared to impugn the philosophical theories of the then youthful Newton, whose important discoveries were the constant theme of the discussions of that eminent Society of which he had just been admitted a member. It may not be irrelevant to mention in this place, that this greatest of modern philosophers was, at the commencement of his illustrious career, in such strained circumstances, that it is recorded, in the history of the Royal Society for 1675, that at a meeting of the council, Mr. Oldenburg having mentioned that Mr. Newton had illustrated his being in such circumstances, that he desired to be excused from the weekly payments, it was then agreed to by the council that he should be dispensed with. Hooke's audacity in impugning the doctrines of this great philosopher is not without its parallel, even in our own times, when the truth of all his articles has been so firmly established. The late Sir Richard Phillips, author of many clever imaginative works, has informed the writer of this article more than once, that all he desired after his death, was to be buried in Westminster Abbey, and to have inscribed upon his tomb—"HERE LIES THE DEAN OF SIR ISAAC NEWTON."

Hooke's attempts to supersede Wren have been alluded to. Among the most prominent is that recorded in the transactions of the Royal Society, of his submitting to the council on September 19, 1666, a model for rebuilding the city, with the Society's consent, which had been well pleased. It appears that he had previously shown it to the lord mayor and aldermen of the old city, as Sir John Lawrence, the late lord mayor, addressed himself to the Society, and expressed the lord mayor's (Sir Thomas Birdworth) and aldermen's approbation of the said model, and their desire that it might be shown to the king, they preferring it very much to that which was drawn up by the city surveyor. The president answered, that the Society would be very glad if they or any of their members could do any service for the good of the city; and that Mr. Hooke should wait upon the king with them and his model, if they (the lord mayor and aldermen) thought fit to present it: which was accepted, with expressions of thanks to the Society.

Dr. Waller, in his life of Hooke, affects to wonder why this model was not accepted. The reason was, that the superior and more digested plan of Wren, to say nothing of Evelyn's, had been previously before the king and council. Wren had no opportunity to communicate his design either to the Royal Society or to the city authorities, before it was sent to the king; and it is probable that neither of these bodies had then seen it.

Hooke is believed to have been the architect to the Duke of Montagu's house in Bloomsbury, afterwards the British museum, and recently pulled down to make room for Sir Robert Smirke's improvements. Of his authenticated works, the best are the royal Hospital of Bethlehem, which formerly stood on the site now occupied by Finsbury-circular, Moorfields,—and Aske's Hospital, at Hoxton, built and endowed by Sir John Aske, an alderman and past lord mayor of London, for the use of aged and decayed laymen of the worshipful company of haberdashers, of which he was a liberal and distinguished member. The former of these buildings had a Frenchified palatial look, not in accordance with its destination—a hospital for lunatics and the latter, a collegiate appearance, with colonnaded ambulatories for the aged inmates, a hall and chapel for their accommodation, and a school for the education of orphan boys of the company, with a handsome statue of its founder in the centre. The style of both these buildings may be seen in the various illustrated histories of London; and a large perspective drawing of Aske's Hospital, by the architect, is among the pictures that decorate the court room of the haberdashers' company, who are the trustees and governors of the hospital. This building has also been pulled down, and its place supplied by one of smaller dimensions, and of less architectural pretensions.

It must be recorded, however, to the honour of Robert Hooke, that he, Boyle, and Wren, formed that illustrious trio of philosophers that paved the way to the important results established by Sir Isaac Newton.

He died, after a long and useful life, on the 3rd of March, 1705, in the 64th year of his age. He was buried in the church of St. Helen, Bishopsgate, and was attended to his resting-place by all the members of the Royal Society who were then in London. Hawksmoor, the pupil of Wren, one of the most original and inventive architects England has produced, was born, singular enough, in 1666, the year of the great fire of London. He erected many fine and substantial
buildings in the metropolis, and other parts of England, which still remain to prove his skill as a builder, as well as his taste and science as an architect. In his seventeenth year, he was placed as a domestic clerk, or pupil, with Wren. His genius is unquestionable, but his taste not of the most refined order—nearer approaching the bold flights of Vanbrugh than the chastened correctness of his master. His knowledge of every science connected with his art is allowed, and his character has been spoken of, from authority, with commendation. He was deputy-surveyor, under Wren, at the building of Chelsea college, and clerk of the works at Greenwich hospital; in which offices he remained during the reigns of William, Anne, and George I., at Kensingtom, Whitchall, and St. James’s. He was appointed superintending surveyor to all the new churches, and of Westminster abbey after the death of Sir Christopher, and designed many that were erected in pursuance of the statute of Queen Anne, for building fifty new churches.

Hawksmoor’s best works are the churches that he built pursuant to the above-named statute: among which are, Christ church, Splistafeilds, that was seriously injured a few years since by a destructive fire—but which, owing to the substantial nature of its construction, did comparatively little damage to the body of the fabric—the church of St. George, Middlesex, called St. George’s in the East, so distinguish it from its namesake in Bloomsbury: this is also a large and capacious edifice, with a singular tower, which with its lofty flag staff, when viewed from the opposite side of the river, looks, amidst the forest of masts with which it appears to be encircled, like a tall ship with its white sails dangling from the topmast;—its neighbour, St. Anne, Limehouse, alike distinguished for originality of design, solidity of construction, and utility of its interior arrangements; and St. George’s, Bloomsbury, which has been condemned by haughty critics, from not falling within their narrow rules of art. This church is a bold, original, and striking composition, built in a masterly and scientific manner, and designed in a masculine style. The interior is commodious, appropriate, and picturesque—worthy of its author, his master, and his school. The portico, of the Corinthian order, is remarkably handsome and well proportioned, and the tower is placed in a judicious and proper situation. The steeple is novel, ingenius, and picturesque; and the statue of George I., in spite of the epigram, looks like the father of his people, surveying his good city with complacency, and holding forth his protective hand over it. Nor must his beautiful church of St. Mary Woolnoth, Lombard-street, be forgotten. Its exterior is singularly substantial and well proportioned; its twin towers, resembling, in application only, those of some of our Gothic cathedrals, look particularly striking from Mansion-house-street, since the destruction of the old houses by which it was formerly surrounded, and the opening of the vista of King-street, now making it a beautiful architectural foreground. The interior is well arranged for the service of the Anglican church, and is characterised by a most happy union of elegance and substantiality. The proportions of the Corinthian order that support the richly-pavement roof and coffered ceiling are scarcely inferior to those in the interior of Wren’s masterpiece—St. Stephen’s, Walbrook. A correct and well-engraved plan and section of this church are given in Britton and Paget’s 8vo. work of “London Edifices.”

Hawksmoor also rebuilt part of All Souls college, Oxford, but, I believe, from Wren’s designs; as also the mansion of Eaton Neston, in Northamptonshire; restored a defect in Beverley minster with great skill; and re-paved the west end of Westminster Abbey in a judicious manner. The great advocate of the Restoration, Blenheim and Castle Howard, as associated with Vanbrugh. He died in March, 1736, in nearly his seventieth year.

The witty, but too often indelicate, Vanbrugh, of whom Pope says—

“Van wanted grace, but never wanted wit,”

contributed in a considerable degree to the architectural reputation, as well as the dramatic literature, of his country. Blessed with considerable talents, good education, and manners deteriorated by a profligate age, Vanbrugh figured as a gentleman, a dramatic author, a builder and manager of theatres, a herald, and a would-be engineer. Swift ridiculed this latter propensity and his ludicrous imitation of a fortified residence in his Vanbrugh castle, Grenewich, by saying, that he expected the queen (Anne) would

“make me next peer.”

A monster—man chief engineer.”

In 1696, shortly after the commencement of Greenwich hospital, Vanbrugh was appointed secretary to the commissioners, on the nomination of Mr. Evelyn. In 1716, he was appointed surveyor of the works at Greenwich hospital, comptroller general of his majesty’s works, and surveyor of the gardens and waters: thus superseding his illustrious predecessor, who was still in the full possession of his faculties. This was not the only insult that this eminent architect had to encounter, at a time when bribery and corruption existed in a greater degree than ever before known in English history. Mr. Ker, of Kerland in Scotland, asserts in his autobiography, that “it is very well known that Mr. Benson was a favourite of the Germans; and I believe nobody had more occasion to be convinced of the power of this influence than myself: so great, indeed, that Sir Christopher Wren, the famous architect who contrived the stately edifice of St. Paul’s church, and finished it in his own time, was turned out of his employment of being master of the King’s works, which he had possessed with great reputation ever since the Restoration, to make way for this favourite of foreigners.”

The influence of Benson over the king and his German advisers, obtained by means to which Wren could not stoop, was so great, that even Walpole, who resisted, with just indignation, an open offer of a large sum, which Benson made to the minister for a place for his son, was obliged to succumb to this back-stairs influence.

Benson and Vanbrugh were thus in full possession of Wren’s offices, the principal of which Wren had held, with unparalleled honour and abilities, for nearly half a century. But what a contrast did these disgraceful transactions present! Benson held the situation scarcely a twelvemonth, with unexampled incapacity, and was disgraced by an ignominious expulsion from his office to avoid a prosecution, and by an immolation in the “Dunciad,” while Wren retired to a peaceful home at Hampton Court.

In the first edition of the “Dunciad,” this architectural empire is thus celebrated:—

“Beneath his reign shall Eulensiger wear the bays, Ober predestined Lord Chancellor of pranks, Benson sole judge of architecture sit, and many a pain’s be pretend for wit.”

In the subsequent editions the poet altered these lines to—

“See, see, our own true Phineas wear the bays! Our Mole, our Lord Chancellor of plays! On poets’ tombs see Benson’s titles writ! Lo, Vanbrugh, for wit!”

And in a note he adds—“In favour of this man, the famous Sir Christopher Wren, who had been architect to the crown for above fifty years, who built most of the churches in London, laid the first stone of St. Paul’s, and lived to finish it, he had been displaced from his employment at the age of near ninety years.”

But of Wren our great poet says:—

“See under Ripley rise a new Whitehall, While Jones’s and Boyle’s united labours fall; While Wren with sorrow to the grave descends, Gay dies unpunish’d with a hundred friends.”

Vanbrugh built the first theatre in the Haymarket, and managed it conjointly with Congreve. It is singular that this theatre has been rebuilt by the late John Nash, himself an actor, manager, and architect. An eminent comedian of the present day, who was originally an architect and joint surveyor to a public company with the author of this article, before he had abandoned his former profession, requested him to state in his “Life of Wren,” as an apology for his uniting the two professions, that in addition to Vanbrugh and Nash, might be added the name of our great English Vitruvius, as being an actor as well as an architect. He informed me that in an old quarto play, translated from the “Pittico” of Aristephanes, is the following manuscript remark, in the handwriting, and with the signature, of Isaac Reid, the commentator:—“This is the play in which Sir Christopher Wren, our great English architect, performed the character of Neemall, before the Elector Palatine, Dr. Seth Ward, and many others, probably in 1632.”

The works of Vanbrugh are solid and judicious; but he neglected the lighter graces of his art, and is, in spite of all his picturesque beauties, cumbrous and inelegant in detail. Swift’s epigram on this architect is well, and in some instances he merited the satirist’s

“Lie heavy on him, earth, for he
Laid many a heavy load on thee.”

There is, however, another version in a rather better spirit, and more like the sif levis of the ancient Romans, and is

“Lie light upon him, earth, though he
Laid many a heavy load on thee.”

Yet, Castle Howard and Blenheim will keep alive the memory of the witty and accomplished Vanbrugh among those of our greatest architects. A fair specimen of his picturesque and singular style may be gathered from his own house near the Priye-gardens, which was also a subject of Swift’s satire, who compared it to a dirt pie heaped up by children.

Sir Joshua Reynolds, in his inimitable discourses on painting, gives great and deserved praise to the artist-like compositions of this architect, particu-
The church of St. John the Evangelist, Westminster, which has been falsely attributed to Vanbrugh, is characterised by a bold originality in its quadrifrontal form, of an Italian-Doric order, surmounted by four Corinthian turrets. It has been ludicrously compared by Swift, or some other satirist, to an elephant on its back, or a huge butcher's block reversed, with its clumsy legs rising upwards. But had it been finished as intended, with a lofty cupola or lantern in the centre, it would have had a different and perhaps a good effect.

As an example of the state of architecture and its patrons at this period, may be cited the fact, that when the corporation of London proposed building a mansion-house for the official residence of their lord mayors, Lord Burlington submitted to them an elegant design by Palladio, which the citizens rejected as being the work of a foreigner and a papist, and executed the present building from a design of the elder Mr. Dance, who was both a citizen and a Protestant. This architect has been said to have been originally a ship-builder, and the two lofty attics that were formerly over the Egyptian-hall and the ball-room have been sarcastically compared, from this circumstance, to the bulk-heads or poop's of a deeply-laden Indianman. The plan is well arranged for the purposes it was built for; some of the apartments are magnificent, though somewhat heavy in style, and there is no feature in any part of it but what may be traced to some of the then existing books on Italian architecture. The Corinthian orders of the portico and of the Egyptian-hall have more the character of the Stadt-house at Amsterdam, than those of any of the fair cities of Italy; and the whole building bears more affinity to the Batavian than to the Italian style of architecture.

Dance was, however, a man of some genius, and exhibited much skill in his churches of Bishopsgate and Shoreditch. The Roman-Doric portico of the latter is as well proportioned and as happily applied as any similar structure in the metropolis. The spire, though insolently placed behind the portico, which occasions its tower or basement to be hidden, and gives it the appearance of being mounted on the roof, is a free and successful imitation of Wren's St. Mary-in-Bow, and is one of the handsomest spires in London. The deeply indented scotia that supports the terminating obelisk is boldly original, is productive of a fine effect, and could only have been executed by a man of science. The bodies of both these churches present the appearance that their author had studied Vitruvius in a Dutch translation.

Hogarth has satirised the want of architectural taste in England at this period in one of his inimitable pictures of Mariage a la Mode, where the portico of the mansion in progress for the noble father of the bridegroom, is formed of five columns, the middle one being under the apex of the pediment. The satirist little dreams that his pointed ridicule would find an imitator, yet it is so, for the architect, if so he may be called, of Bedford-square, has on two of its sides perpetrated the atrocity of a sham portico of five attached pilasters, the middle one being after the mode of Hogarth's architect,—under the apex of the pediment.

Batty Langley, who found more time than any of his predecessors, had a school or academy of architecture, but his disciples were all carpenters; and although his taste as an architect was deservedly derided, he formed a school of excellent workmen, and gave form to many a skilful artisan in a certain line of art.

Emlyn, in an after age, attempted the forlorn hope of inventing a new order of architecture, as if those of Greece and Rome and Italy were not sufficient for the grasp of his capacious mind. He used oak leaves instead of acanthus or parsley for foliation, the star of the order of the garter for the rosette between the volutes; the shaft was single, one-third of its height, where it divided itself into two, like a forked elm, and terminated of course with twin capitals. He was permitted to dedicate his book, entitled The New Greek and Roman Architecture, by George III, who wished that good nature which always characterised monarch's patronage of artists, allowed him to execute a specimen of his biforked "British order," at Windsor: but I believe it has been removed.

Batty Langley however soared higher, for he published his invention of no fewer than five new orders, namely, The Gothic Tuscan! The Gothic Doric! ! The Gothic Ionic! ! The Gothic Corinthian! ! and The Gothic Composite! ! ! The principal novelties were making the shafts of the columns treble, quadruple, and quintuple, clustered and banded like the pillars of our ancient cathedrals, making the tops of the triglyphs pointed like lancet windows, the friezes notch'd and filled with frets, and other equal abstractions. Some speculations about these "Gothic orders of my invention" were, and perhaps are, to be seen in a street near the north-eastern corner of St. James's-park—Pudsey-street, I think.

During this state of transition, several elegant and substantial mansions of
considerable dimensions were erected in various parts of the country. Wanstead-house, a splendid edifice, with a magnificent Corinthian portico and extensive wings, worthy the name of a palace, was built by the opulent and plebeian family of the Longs; and has since been torn down, its pictures, statues, and materials sold, and the park disfigured of its lofty oaks, by an aristocratical parasite, who married and illustrated the last heiress of the Tilney Lords. Harrow-wood-house, near Leeds, in Yorkshire, one of the residences of the noble family of Lascelles, is a fine imitation, without being a servile copy of the mansion at Wanstead, but with the advantages of a fine situation, and of being surrounded by a truly princely demesne, and commanding some of the finest views in the country. The mansion of the late Sir Gregory Page, at Blackheath, a truly Palladian villa, on a vast scale, was too extensive for the fortunes of his successors, and met the fate of Wanstead-house. Some others, possessing no originality of character, were erected about this time some of them from the designs of Giovanni Battista Leoni, an Italian architect of skill and taste. There was a palace with plans, elevations, and sections, in the "Vitruvius Britannicus" of Colin Campbell, himself an architect of industry and talent.

Such was the state of architecture when George III. ascended the throne of his German ancestors, neither of whom loved art or literature, and one of whom could see no merit in the transcendent works of Hogarth, and amused him for ridiculing, as he said, his German guards in the celebrated picture of "The march to Finchley;" this offence the painter revoked by dedicating the print to Frederick the Great of Prussia. Nor could he discover any genius in Garrick, but talked German and took snuff whilst the British Ruscia was illustrating Shakespeare's Richard the Third; but rose, commanded silence, and made an obsequious bow to the actor, whereupon George, Lord Mayor, saying, "Gentlemen, we must pay respect to our lord mayor." Such were the military gloths who had the art, literature, and science of the kingdom, in an enlightened age, at their command.

Frederick, Prince of Wales, father of George III. received an English education, was a mild gentlemanly man of no great abilities, but possessed a real love for the amenities of literature and art. He patronised Thomson and Gay, and his little court was divested of the rough manners of his father's. He was upon ill terms with his father, did not live happily with his wife, a princess of coarse mind and manners, and died young. The education of his son was left to the care of his mother, who neglected the more severe parts of his studies, and applied the money entrusted to her for that purpose to her own pleasures.

King George III., fortunately for the arts, and particularly architecture, was endowed with an innate love for such pursuits which soften and improve the human mind. He was also well acquainted, for a prince, with both the theory and practice of the graphic arts. When Prince of Wales, he studied architecture, under Mr. Chambers, and was taught to delineate its proportions with accuracy from the rules of Palladio and Vitruvius. From the before-mentioned circumstances, there was no Englishman who practised architecture as a profession. Chambers, who had been a naval officer, was partial to the art, and had travelled in countries where architecture was better understood than in England. The young Prince also studied the science of perspective, under Mr. William Kirby, whose practical work, founded on the theories of Dr. Brook Taylor, was formerly in much esteem, and has obtained great celebrity from Hogarth's sarcastic frontispiece of faults likely to occur from the want of a knowledge of that science. Prince George contributed, it is said, a design for his tutor's work; and his drawings are reported, by persons who had seen them, and they were extant in the royal library in the late Buckingham-house a few years since, to have been correct in detail, and, for their day and style of art, tasteful and elegant.

George III. ascended the throne of Great Britain with more advantages than most of his predecessors. Born and educated an Englishman, he gloated, as he said in his first speech from the throne, in the name of a Briton. Unpractised in the cruel scenes of warfare, he had been bred in peaceful retirement—perhaps too recluse for the government of a nation then involved in such momentous transactions. He loved art, was fond of literature, partial, lary that of his own country, was slightly skilled in music, and read Shakespeare with propensity and enthusiasm. A speech from the throne, delivered in correct and elegant English, was a novelty unknown to almost all its auditors. The explanation of Quin, the tragedian, who had been his master in elocution, and was admitted to a place in the House of Lords to witness the debat of his royal pupil, of "Brave! I taught the boy," was more sincere than curious. Artists and literary men were no longer bidden for their instruction in their profession. Chambers was appointed to the office of royal architect. Hammay, a well known portrait

paister, was employed to depict the youthful sovereign and his consort; other artists and their interests were attended to, and the management of the academy, or association of artists, in St. Martin's-lane, began by Hogarth, Thornhill, and others, was patronised, and its concerns investigated. The King's consent was said even with their little quarrels, and suggested measures for the enlargement of its utility; it being then merely a school of adult artists, for the study of the human figure, and not an academy of the fine arts, which the king desired to see established in England. It had, however, its series of annual public exhibits of the works of its members, which the king duly honoured regularly with his presence.

Chambers, from the circumstance of being the royal architect, and repairs and additions to the royal palaces being necessary, had more interviews with his royal master than others; and their former relations of master and pupil, had given more than usual freedom of intercourse to these interviews. The King designed to establish a Royal Academy of painting, sculpture, and architecture, upon the plan of those founded by the illustrious Colbert and Cardinal Richelieu in France, and to build a palace for its occupation. The king entered into this grand project, and Chambers became the organ of communication between him and the leading artists of the day upon this important subject.

Having now adopted architecture as a profession, and being a Chevalier of the order of the Polar Star, his royal master honoured him with English knighthood, when such an honour was more rare than in later days. Hence the origin of the Royal Academy of the fine arts and the building of Somerset-house.

Sir William Chambers threw off no new lights on the art over which he was destined to preside. In its practice and more scientific department of construction he was, comparatively with such men as Wren and Hawksmoor, totally ignorant. His taste was Roman, and being unacquainted with the sublimir beauties of Grecian art, was consequently less refined; yet his works have a chastened correctness of detail of the best style of Italian art. He is less exuberant than Scomozzi, Serlio, and Borromini, and even than Palladio himself, except in his very best examples. He may be called the Palladio reformato of the Georgian era. In the course of his travels he had visited parts of China, and published a treatise on the gardening and architecture of that strange people. The royal gardens of Kew and its lofty pagoda are among the results of the Chinese phantasy that he had inflected on his royal master, and led to the introduction of that fanciful and inelegant style. Yet the Somerset-house of this architect has many redeeming beauties, and his work on "Civil Architecture," in spite of bad taste in reviving the architecture of ancient Greece, of which he knew nothing, abounds with sound doctrines, and is the best elementary work that we possess. A new edition, remarkably well edited by the late John Buonarrotti Papworth, whose recent death, full of years and honour, the profession have to deplore, was published a few years since, and also a smaller one, with a treatise on "Grecian Architecture," by Mr. Joseph Gwilt.

The establishment of the Royal Academy by George III. is the next great epoch in the arts of this country, after the fire of London, and will form the subject of the next section. (To be continued.)

RAILWAY LEGISLATION, ACCIDENTS, AND INSPECTION.

A paper was published some short time ago, to show that if it had not been for the operation of prejudice, we might have been in as full possession of the railway system in 1817 as 1847, and that we had spent some half century in keeping back and thwarting improvements. Much the same kind of thing might be said of railway legislation: at this date we are fighting for the same points as we have been for years. Surely no bantling ever suffered so much from officious nurses than has the railway system; never were bandages, rollers, and go-carts more numerically applied to hinder, under the name of fostering, growth.

The pages of our Journal will show that we have always stood up against all legislative and government interference with any form of engineering enterprise. If this be prejudice, we are quite willing to own it, and stand by it, and we have held most unflinchingly to it. It happens, however, that if we have stuck to a prejudice, our opponents have not fared in the least well with their several legislative and inspectional measures; and we are at this late hour strengthened in our views by their
ill-success, which they have on many occasions acknowledged. At all events, then, they cannot say that experience has been against us, whatever they may choose to say and think about the soundness of our theories.

We believe by this time everything has been planned and tried about the railway system, except letting it alone, but we very much fear this is the only experiment with it that will never be tried. It is, nevertheless, one encouragement to persevere, to us and other friends of non-intervention, that the experience as to railways, and the enlarged experience of every similar establishment and institution, results in confirming the propriety of our convictions.

In the teeth of the truism, that all human undertakings are fallible and all new undertakings imperfect, no allowance is made for the railway system, but every accident is seized hold to authorise its condemnation and restraint. The result of such interference has never been followed out, but a careful examination of railway accidents from the first returns would show, that while many accidents are due to carelessness beyond the control of any authority, still more are due to the progressive condition of the railway system, and still more to the attempts for the prevention of accident. Luggage trucks used at first to be put between the passenger carriages and the engine, to provide against the possibility of injury from explosion of the engine. A train having been run into from behind, the luggage and goods trucks were then, on the demand of the public, put behind. This was followed by an accident, from a train being injured from the front. The public then required trucks to be put fore and aft. Notwithstanding this, a train was cut in halves at a junction.

In order to give stability to the trains, it was an early practice to mix goods and passengers. This was, on the public voice, given up, but there was a demand for empty horse-boxes and luggage vans to be mixed with the trains for safety. We believe these have been the cause of very many accidents, from their unequal weight and construction leading to their being thrown off the way, and to the passenger carriages riding upon them.

From the public demand for signals, signal-men, and pointsmen, has resulted certainly no greater safety, but certainly many more accidents from neglect of signals.

While the jumble of passenger carriages, trucks, and horse-boxes might do very well for the 50-mile-an-hour speed of 1844, it was very unsuitable for the 50-mile-an-hour speed of 1847. A new system must require new safeguards, and to no one can the care of these be more properly entrusted than to railway managers.

As non-interference seems to us the best mode of legislating for railways, so railway managers seem to us to constitute the best and only safeguard against accident, and the only one on which no reliance has been placed. It cannot now be very well denied, that a railway accident, whosoever else it may affect, inflicts a certain, and nearly always a very heavy, loss upon the railway company, exposes the directors to very great odium, blame, and misrepresentation on the part of the public press, and subjects railway officers to the fear of losing their appointments. Fecundity and merit of responsibility of this kind is what our institutions teach us to rely upon in every other case, but the word "railway" has the magic power of shaking our convictions and our prejudices and banishing our common-sense. It is contended that railways are only to be treated by exceptional law, and this has only to be asserted to be allowed,—so much the worse.

To find out the means of avoiding accident is to find out a means of saving money, and this is a further inducement, which affects railway managers and no other parties. The time is not so far back when the engines, lines, railways, and the lines were ignorant, drunken, brutal, ill-conducted, and desperate barbarians from the coasts of the north of England, who were extravagantly paid, and who were under no restraint. It is well known that having no fear of death, they have purposely risked accidents for the sake of the fun, as they esteemed it, whereby human life was perilled and property injured and wasted. Fines they paid by common contribution from their wages,—criminal punishments had no terrors for those whom death and danger did not scare. As to dismissal, it was only a change of employment,—perhaps at higher wages. The man who was dismissed from an old line went to a new one; and after having made the tour of England, accepted higher wages abroad. More engineers were wanted than could be found, and, though wages were so high, respectable men could not be got to enlist themselves in a body the members of which were so desperate, the nature of which was then so hazardous, and which the legislature were called upon to brand with a special penal code.

Thus the lives of passengers and the property of the companies were fully and truly at the mercy of a set of desperadoes. This is language which is strange now, but which was that of the press only a few years ago. The companies exerted themselves, they gradually trained a better conducted body of men, and they have now engine-drivers more intelligent and more trustworthy, at very much less than the wages which they then paid. The saving to the companies under this head is very great; so the consequent saving which they have been able to effect in the consumption of fuel and the wear and tear of the working stock. All this is over and above the greater freedom from accident.

It seems strange to look back and peruse the virulent attacks and abuse which were lavished on railway directors at the time of which we are speaking, and the Times did not forget to demand that directors should be made criminally responsible for the engine-drivers. We believe there was but a very narrow escape from a Draconian code, whereby railway directors, officers, and engine-drivers would have been left open to criminal pains and penalties. This is an ultima ratio for railway abuses which is a great favourite now, though how it would work it needs no great cleverness to foretell. The office of a railway director at the present moment is one of much more honour and vanity than employment—sometimes nothing a year and a vote of censure being the salary, but most frequently the liberal sum of fifty or a hundred pounds a year; which latter is, we believe, the sum forming the civil list of a railway king.

The establishment of a body of gentlemen, who are not to be well paid nor to be greatly honoured, but who are to be marked out for the application of the most hateful criminal proceedings for acts and persons beyond their control, would be a novelty in English society. What class of persons would succeed members of the legislature as railway chairmen and directors? We do not pretend to say; we only know that the present class of directors would retire, and that a lower class would take their places. The nearest model we can get of the effect of such legislation is supplied by the newspaper press, wherein the wisdom of parliament has so hedged the proprietorship with criminal liabilities, that it is most rare for the real proprietor to be registered and published, and an ingenious deceit is practised which would do credit to China. In some provinces of that enlightened empire, substitutes are to be obtained for the price of seventeen pounds in hard money, who will undergo the penalty of death or the greatest tortures; and, in England, the Attorney-General is paid to content himself with a substitute, who, for a given consideration, will consent to be fixed in the Exchequer, or sentenced to imprisonment in the Old Bailey. Instead of the class of newspaper proprietors being raised by the presence of Sir John Easthope, Bart. M.P., or John Walter, Esq. M.P., whose public character and responsibility might be brought publicly to bear, the legislature has effectually provided that public and personal standing shall be of no value, and a virtual protection shall be given to the libeller and scandalmonger, for whom under no circumstances has the law any terror, and under whom our new railways and our new character is allowed to be of no weight in the decision. The same results would attend the application of criminal responsibilities to railway directorship, and the least of all consequences of such ill-advanced legislation would be the substitution of men of straw for men of character and responsibility.

What benefit has resulted from Board-of-Trade inspection we do not know, and we are hardly aware that the inspectors put forward any very prominent claim. Indeed, so small is the appreciable benefit, that we apprehend the days of railway inspection are numbered, and that many years will not elapse before it becomes obsolete. We have an example of this in gas inspection. It is singular that the progress of the steam-engine goes on, and the railways keep the same proportions at an early date. The blowing-up of one of his first engines in Wales was the true cause why Trevithick's locomotive remained unused, and it was charged with the two faults of a dangerous construction and a want of bite, which in the present day do not present themselves as common objects of fear. The dangerous explosion of a locomotive is now one of the least-known causes of accident, and two cases only have, we believe, occurred of late years—one in the United States, and one on the Sheffield and Manchester Railway. The blowing-up of one of the first steamboats gave rise to two consequences which are always dangerous; and those who remember the destructive construction of the boats which first ran on the Thames, can bear witness to their clumsiness and liability to derangement. Within two years of the establishment of a gas company in London, a gasometer blew up with a terrific explosion, and so much was the public alarmed at the seeming hazards of these magazines of dangerous combustibles, that an act was passed, which we believe still unenacted, placing very great
restrictions on gas companies, and requiring them to comply with certain regulations and to undergo a government inspection, before they were allowed to open their works.

Whereas the Board of Trade now claim to be the inspecting department over public establishments, the Home Department was the one at that time to which the gas companies were subjected, and in conformity with the same predilections which now rule at Whitehall, a military officer was appointed as among its generals. The first Inspector-general of gas-works was the celebrated and ingenious Sir William Congreve, but, except as the means of giving large fees to the gallant general, the inspection, even in his hands, became quite a nullity, and we believe that since his death, no Inspector-general of gas-works has been appointed; and at the present day, no one knows anything of the safeguard of gas inspection or places any faith in it, while the explosion of gasometers is so rare that it is not thought of.

If steam roads and gas-works are now able to do tolerably well without inspection, and are daily brought nearer to absolute safety, it may be expected, by cool-minded men, that in due time railways may likewise be able to do without inspection. As, too, so many public establishments have been formed and matured without public inspection, we can see nothing so peculiar in railway undertakings as to prevent them from advancing to perfection without government help.

At any rate, the present inspection is fruitless and unsatisfactory. The only person who has been able to find any kind of utility in it has been Pinnock, who says that when an accident takes place, and the public mind is in great alarm, General Pasley or Captain Coddington is sent down, and makes a report, complimenting everybody about everything, and showing that nobody is to blame; and thereupon the public terror is quieted. Certainly the inspectors' reports contain nothing else, and it would be vain to seek in them for any practical suggestion or any original contribution.

Whether this state of affairs is attributable to the employment of military engineers we do not allege, but, nevertheless, whatever value we may attach to our millitary brethren in their own department, we cannot, either a priori or from any acquaintance with their actions, place any faith in their civil capabilities. We very much regret the consequence of putting officers of the Royal Engineers in a false position, and putting them in an unequal contest with the heads of the engineering profession here, who are acknowledged to be the greatest civil engineers in the world. Civil engineers have exercised the greatest forbearance under the insult to which they have been exposed, of the intrusion among them of incompetent persons; but opportunities have necessarily arisen, in which eminent men in this country have been compelled to express their contempt for the judgmean and attainments of the government functionaries. General Pasley, with all the proceedings of the Board of Trade, has remained exempt from the suspicion of corrupt motives, and whose character as a highly honourable and well-intentioned man, secure for him personal respect, has lately, by an officious interposition on the subject of the Menai Bridge, laid himself open to the observation of Mr. Robert Stephenson, that he does not know anything about the place, to which the General supposes he offers insurmountable objections.

One objection we made in the first instance to the appointment of government officials, was the impossibility of government paying an adequate salary to secure the services of individuals against the competition of private enterprise. Sir Charles Pasley being a general no one of course wants, and Mr. G. R. Porter is content to be promoted to Mr. Macgregor's place as joint secretary to the Board of Trade; but most of the other parties attached to the railway department have passed over to the side of the companies. The celebrated Mr. Samuel Laing, who concocted the whole system of aggression on railways, and who was the ambitious spirit of the Board of Trade, has for some time been a flourishing railway parliamentary counsel, and is the author of a pamphlet against the railway department. Captain O'Brien is a railway man; Sir Frederick Bache is still, we believe, chairman of the Brighton Eastern Junction Railway, and we think in directorship; Captain Coddington has accepted the management of a railway. The time is perhaps not far distant, when the Railway Board being disbanded, the Right Honourable Edward Strutt, M.P., may succeed the Right Honourable George Hudson, M.P., in a chairmanship;—say, who knows but in time, when he has seen a railway, and gets to know something as to what it is, the Right Honourable Sir Edward Grey may be elected to a seat at some board? These things would not be more extraordinary than Mr. Laing writing pamphlets against the Board of Trade.

In the men of the Railway Board we have no confidence, and in their measures no more; and we are very little disposed to trust a progressive institution like railways to their mercuries. In a new age we have got a new experience to learn, and we must have time to learn it. The only thing we have to fear is, lest by our prejudices and our ill-timed meddling, we keep back the benefit which are tendered for our enjoyment. We have kept back railways and we have kept back electric telegraphs; but we are still on the verge of enjoying a vast extension of the resources of science. This year the telegraph will speak with its lightning tongue to the ends of the land; the word which is said in London shall in the same time be known in the great cities of the island, and shall meet with its instant answer from beyond the utmost limits of the hearing or gazer of man. The electric telegraph will be claimed by the same despots as the railway; gentle dullness will find evils in the telegraph which demand its chasting care, and the concessions in railway inspection will be urged as a reason for placing our correspondence under the same inquisitorial review.

The effects of the electric telegraph prudence forbids us to limit or assign, but it is evident a very great change must be produced in our habits and associations. Not only must the whole range of commercial transactions be affected, but even the operations of the law must be modified. It may be questioned whether, in the present state of jurisprudence, the beneficial use of the telegraph in arresting the course of criminals be not illegal, for it must often involve the absence of a writ or trespass on a jurisdiction. We leave it to the lawyers to determine what form of writ and what form of service they will adapt to the electric telegraph, in what manner a Master in Chancery in Southampotn-buildings shall take the examination of a party at Liverpool, or how a Telegraph Assistant Office is to be organised in Paper-buildings, Temple; but they are very likely to be called upon to provide for a new state of circumstances, caused by the revolutionary influence of the telegraph.

We cannot but think it fortunate in every respect that the monstrous Railway Bill of 1847 was not carried, for it would have greatly aggravated the difficulties which now beset railway enterprise. How it can have been brought forward in a country claiming to have a great school of political economy seems wonderful, still more so that it should have received the sanction of a department, which claims to be the scientific political department, and boasts of Huskisson, Lord Sydneyham, Deacon Hume, Macgregor, and Porter. We know no greater slur on the political economy of this country than the series of railway bills, and we fear that it is to be attributed to the sacrifice of political principles to personal ambition. The present state of political economy is a complete truism to trade; the doctrine of non-interference, which is violated by every railway bill.

The provisions of the Railway Bill of 1847 were intended to improve railway administration, and to prevent undue speculation: the result would have been to diminish directorial responsibility, and to favour the operations of stage. Of all provisions, that immediately affecting the surveys is the one, which coming in our own line, most interests us, and we are able to affirm that nothing could work worse. To require the deposit of 2000. a mile in addition to the other exactions would have the exact effect of furting many good undertakings, of impeding all during times of commercial distress, and of promoting the views of the stages in times of speculation. The demand of any deposit as a security for a bond made origination of an undertaking is a fallacy, which has nothing but the imagination of its inventors to give it countenance. It is evident that during any tightness of the money market the enforcement of a deposit must act as a strong check; but it touches good undertakings as well as bad. In a time of speculation, whether the deposit be 5 per cent., 10 per cent., 50 per cent., or 1 per cent., it is perfectly immaterial, so far as the possibility of raising it is concerned, and the unfortunate experience of 1835, before the time of railway manias, proves this. It makes a great difference to the speculators how much they can get into their bands to spend, but it makes no difference to the speculators, who are imagined to furnish the deposit, as the deposit, in a financial point of view, is for the most part fictitious.

The famous deposits of 1845, which were used by the Times as such a bugbear, involved only a few changes of figures in the bankers' books, and it may be said that they never were in existence. Even of those sums which got into the hands of speculators, the whole was not wasted, for as they largely dabbled in scrip, and gambled with each other, so they in effect worked for scrip, which may be considered an etherial medium.

An acquaintance with the circumstances of railway engineers, surveyors, solicitors, secretaries, and projectors, will fully convince the
that whatever the supposed gains of these parties in 1845, their present possessions, taken generally, are very small; and the solution of this is, that their wealth in 1845 resolved itself into that proverbial bubble—scrip, the certificates of which, for that matter, they may still possess, but the imaginary value and premium of which they have lost for ever. Making allowances for scrip operations, the actual waste of capital in the gambling of 1845 was very small, and certainly very far below that of 1842, when so much capital was sunk abroad in worthless and unprofitable operations.

That some few engineers, lawyers, brokers, and capitalists have realised money is indisputable, but the number of these, and the gross amount of their acquisitions is very small, and the mass of speculators and operators have not realised anything.

What is the real amount of capital wasted or lost to the country in 1845, it is hard to calculate, but we do not believe it can anyhow be more than two millions, while perhaps it may be only one million—perhaps it may be that, comparatively speaking, it is nothing. In this country a great number of persons are always maintained in idleness, so that it does not make much difference if some of the funds of these classes are distributed for a time in making some of its members railway committee men and surveyors, instead of keeping them, as they otherwise would be, cigar smoking, billiard playing, or fox-hunting.

If, moreover, we consider that a larger amount of real and effective labour was performed by the population of England in 1845 than in any previous year, and a larger amount added to the fixed capital and resources of the country, it becomes still more questionable whether on the balance of transactions the country was in anywise a loser by the gambling share transactions of 1845. We know that we are great gainers by the extension of the railway system.

For whatever purpose the leading organ of the world, the Times newspaper, is pleased to devote itself to a crusade against English railways, which it seems determined to injure per se and as such, by any means, by any representations, by their merits and by their demerits, by truths and by falsehood. With an ignorant population, and with railway managers not overskilled in political love, a subtle and unscrupulous adversary is able to present everything according to its own ends; and little more than good fortune, and some want of faith in the objects of the Times, has secured this country from being victimised into surrendering a most valuable institution to the clamour of a most audacious system of misrepresentation.

Without going back to the earlier efforts of the Times, it may be enough to signalise some of the later assertions of the Times. The charges against the railway system for its operations in 1847, include the following:—

1st. A large importation of foreign corn.
2nd. An increased consumption of foreign luxuries during a time of severe privation, when greater saving was the more needful.
3rd. A diminution in the stock of cotton and other raw materials of manufacture.
4th. An increased use and higher price of iron at home and lessened consumption abroad.
5th. Causing the stock of gold to be sent abroad.
6th. Depriving government and the commercial interest of capital.
7th. Depressing and ruining the manufacturing industry of the country.

We believe this sample is such a one as the Times will accept, as not going beyond the bounds of its accusations.

There was in this year a very large importation of foreign corn, in consequence of the failure of last year’s harvests. This failure could only be supplied by import from abroad, and has no connection with railways.

It is quite true that in 1847 there was an increased import of foreign sugar, meat, butter, cheese, and other provisions, but which has no connection with railways. Had there been no such increase it would have been duly noticed by the Times, and charged against Sir Robert Peel and Lord John Russell, as a failure of their tariffs measures, which were purposely framed to increase the consumption of sugar and foreign provisions.

The diminution of the stock of cotton was owing to the failure of the cotton crop in the United States, and with a short crop there must be short stocks and high prices. All this has no connection with railways.

There has been a greater demand for iron at home in consequence of a greater number of railways; but as these are very useful, we do not think this is any harm. A higher price of English iron in foreign markets is a necessary consequence. This charge has a connection with railways.

Gold was sent abroad to pay for foreign corn, and nothing else could be sent. Whatever the League partisans and currency theorists may persuade themselves, gold must a ways be sent out to meet a sudden demand for gold. Mr. McCulloch showed this long ago. The failure of a harvest is a sudden and irregular event, requiring a sudden and irregular supply, which can only be settled immediately in gold, and not in goods, as the theorists expect. The farmer on the banks of the Mississippi or the Vistula will not lay in a stock of cotton or ironware enough for four or five years’ consumption, and take the hazard of fire, damp, and waste, let the goods be offered to him at any price however low. He will always prefer to take English goods as he wants them, and at the price of the day. The merchant of New York or Dantzig, though he may be tempted to a small extent by cheapness to increase his stocks, will not do so to the full extent required, because the risks are not worth the advantage. The English manufacturer and merchant will always be left to bear the risks of the stocks, as he does now, while as a mercantile fact it is well known that from the greater wealth of England the stocks are in her hands. The gold therefore must go out, and it will come back, as the goods are ultimately taken in the final liquidation of the account. The gold always has come back and always will, while the goods instead of being sold at a depression are sold at more favourable prices.

It is a recognised expedient of the Bank of England, supported and calculated by the highest authorities, to raise the rate of discount to a rate pitch in the event of gold going out of the country, with the view to force goods abroad and prevent gold going. It is supposed that by raising sales here at ruinous prices, foreign merchants are induced to take goods instead of gold, and that thereby the gold is kept in the country. As, however, the larger stocks of English goods are always in English hands and not in foreign hands, no great increase of sales can take place, but only a depreciation in price. The goods offered in the market, however small, determines the price of the stocks, however large.

In the face of this admitted doctrine we assert that the effect of raising the rate of discount, or putting on the screw as it is called—

Does not cause goods to be sent abroad instead of gold.

Does not prevent gold from going out of the country.

What it does do is—

To cause severe distress at home.

To depress all our stocks of goods abroad.

The deduction is—

That the screw does not effect the proposed end, that it does no good, and does great harm.

If no "screw" were applied, the country would suffer no possible harm; no more gold would go out without the "screw" than with the screw; but distress would not be produced at home, nor would our goods be disposed of at depressed prices abroad.

Although the "screw" principle has passed unquestioned, it has no single statistical fact, and no solid mercantile experience, to recommend it. It is quite groundless.

Railways did not deprive government and the commercial interest of capital; the Government has got the capital it wants, and if it has to pay a higher price it is not on account of the competition of railway companies, but chiefly in consequence of the "screw" having been applied by the Bank of England. The commercial interest, on account of the depression, has required a smaller amount of capital, and there is no statistical foundation for the assertion of any interference on the part of railways. What has been wanting during this year has been confidence and not capital,—the want of confidence being greatly aggravated by the exertions of the Times newspaper.

The railways have not depressed or injured the manufacturing interest of the country in any way. They have not diminished the gross amount of capital; they have not interfered with the manufacturers' share; they have not diverted labour. The manufacturing interest has suffered from the famine, the want of raw material, depression of prices, and want of confidence: the two latter circumstances made much more oppressive by the "screw" and its votaries.

While the railway system has been falsely accused, it has had no acknowledgment of the vast good it has done. Putting aside the large addition made to the fixed capital and permanent resources of the country, the railway system has, during a year of grievous famine and great commercial distress, allowed an efficient scheme to be carried out for the employment of a large body of the population. If no railway works had been provided, the population of England would still have been fed; but in 1847 they would have been unemployed and discontented, and while their labour would have been lost to the country, there is no saying what would have been the political and social consequences; whereas in no year even
of prosperity there has been less political agitation than in 1847, when a general election is held, during which party feeling is almost extinct.

The experience of every fact confirms the truth of that theory which asserts that railways are not made with new capital or new labour, but by the increased energy of the labour of the country. This or something like it must be the truth, and it is neither inconsistent, nor improbable; no more so than the admitted fact, that while the ratio of agricultural labourers is diminishing, the extent of cultivation and production is increasing.

If new labourers and new food be not required for railway purposes, new capital cannot be required to the amount proposed, and the capital required can only be the small amount of ready money necessary for the temporary representation or "clearing" of the transactions.

This may appear very difficult to those who conceive that every figure of £ a. e. put forward must be the representation of solid bullion; but it has nevertheless the guarantees of truth. The development of the machinery whereby a hundred million's worth of railways is produced in a year may clode analysis in our imperfect acquaintance with the true operations of currency, but it does not invalidate the conclusions. We may expect that as the machinery acquires perfection the operations will enlarge, and it is instructive to look back for a few years and to witness our present progress. In 1840 a return of railway calls, made by Mr. Earle Langton, a Manchester sharebroker, gave as the total for that year, £24,918,800. This sum, during the time of getting it in caused the greatest alarm, the calls is the first quarter of 1840 amounting to so less as £23,106,000, and it was pronounced utterly impossible for the resources, capital, income, and surplus revenue of the country to produce any such sum. It was, however, produced.

In 1847 the amount of calls in some single weeks was as much as the whole yearly amount of 1840; and we are not aware, notwithstanding what the Times says, that the capital of the country is exhausted.

We cannot conceal the uneasiness with which we contemplate the prospects of the country in reference to railway operations, in consequence of recent operations and events. When the continuous period of depression arrives, and when it is most difficult to work the financial machinery, the construction of railways will have so far diminished, that the means of adequate employment and exercise for the working population will not be found. If, in every case of distress, the capital is not invested, and the fall in prices which will result, a period of speculation and share gambling should next year arise, it cannot now be directed towards railways, and will there, fore, in all probability, take the only open field of foreign mining, which is under no such restrictions; and therefore the evil of 1825 may be renewed.

We will only say a few words by way of conclusion. "Let railways be free, and the less legislation and inspection the better for the country."

THE BRITISH MUSEUM.

No. II.

The dispersion of the Greek and Roman antiquities consequent upon the demolition of the old rooms, and the non-completion of the new ones, causes some confusion, and there is a difficulty in finding them; but this will soon be remedied. The arrangement is altogether so imperfect, that it leads us to remarks more discursive than they otherwise would be. It is, however, the temptation of a large collection like that of the British Museum, to present a great variety of objects to the gaze, and to invite at each moment some new thought, little dependent on those which have just gone before.

This is the great medicinal power of such collections to a mind diseased or worn down; it is a quality of refreshing the jaded theories, of awakening new ones, of altering the weary gaze, a temptation now to close and busy scrutiny, and to sit down in quiet meditation. We may call such a place a censorium for the artist and man of taste, while it is the best place of exercise and refreshment for one in the full vigour of his powers. The Museum is however much less visited by architects and other artists than might be expected, though it is not neglected by the amateur. If we are to judge by their modes of acting, our English professors have strange ideas as to the cultivation of taste, for they seem to think that it will grow and feed, like some exotic plants, on air, or rather grow without feeding. How many men are to be found not wasting in means, who have neither library nor museum, who never read, and who never study works of art at home and abroad, but trust to the daily plodding of an office as their only school.

In going round the Museum, and seeing the number of unintelligible, say even of brutalized and debauched countenances among the visitors, the question is naturally raised, "Can the Museum do such parties any good?" Take, for instance, those least capable of appreciating the immediate worth of the objects they see, who pass round, scarcely moved by the wonders about them—the observer will not deny that even they feel a beneficial influence. Novelty or strangeness will always operate upon every mind to awaken it to some extent, and it is a great object to effect this in those minds which are most brutalised; to awaken attention is to cultivate the first quality of the mind, and to lay the way for its further exercise.

It is scarcely possible to look at any department of the Museum, without finding some useful example, even if wandering amid the chaos now reigning. Who, for instance, can look at the collection of tombs and urns, without seeing the grandeur of the Roman in all artistic exercises over ourselves? An English churchyard is a set of stereotyped stones; the modern Whilst sometimes varied by a pile of monstrous ugliness. One head-stone is like another, except in so far as it is necessary to inscribe it to John Thomas, instead of Thomas John; for, could the inscriptions be interchanged, the speculators of the head-stones would be none the worse which is which. The cemetery system has in some degree broken in upon this monotonous, and created a greater variety of forms; but still they are limited, and confined, as we may say, to sets. The mower may purchase a No. 1 obelisk, or a No. 3 urn, as he would select a knife from a Sheffield pattern-card, or a printed menu from a numbered specimen. A large lot of number ones and number threes is manufactured and worked up; for as to individuality of design, it is out of the question. It is not seeked for, and the tombstone is guided accordingly. Any one who goes into a tomb-yard either in the New-Beast or elsewhere, will find that the tradesman has an urn, an obelisk, a cross, a sarcophagus, a broken pillar, an altar-tomb, a coffin-tomb, and one of each of the recognised patterns.

In looking at the Roman urns in the Museum, and which being for one general purpose, are in some degree restricted in form, it is notwithstanding exceedingly pleasing to notice the great variety of design. It would be hard to find an English grave-yard which, with a greater number of tombs, could show such a pleasing application of artistic taste. Limited as to size, which goes little beyond a foot or inches cube, the Romans have made the most of their small material. The block of marble, alabaster, or stone, is carved into various forms. Some are perfect vases, one is a circular temple, another a fragment of a column; this is a square block decorated with a simple fustoon, another has a façade with pilasters in antis; again, the proportions being those of a double cube, a raised oblong with fustoons and table is flanked by torches at the corners; on some, the deceased is represented in various attitudes. The form and decorations vary in each example.

The Roman urns must have been wrought at little expense of material and little cost for workmanship, and yet very pleasing works are produced: while we, with greater material and more artistic effect, have not made the same degree of labour which with us is bestowed on the mason's work, would suffice for that of the carrier. While we acknowledge the artistic qualities of the Roman example, their design is not always the most fitting, and it is very rarely applicable for modern purposes; some of the emblems are suitable only to Roman associations, while some seem to have no significance. Other designs are, however, pleasing. As urn, which is not numbered, has two very sharply cut medallion half-lengths of husband and wife; others have high relief busts of the deceased, or of a married pair. Again, the deceased is sometimes represented reclining on a couch in such an attitude half-raised as to allow the likeness to be given. We, who like richest picture and cabinet work, shall not be at all disturbed by this.

We have long thought that the establishment among us of public graveyards and cemeteries is well calculated to promote the application of art to memorials of the dead, and though we have noticed above our present deficiencies, yet we are quite ready to acknowledge the great improvement which has taken place of late years. We believe the chief obstacle now is the want of proper workmen, for the execution of a common design of foliage or flowers is still expensive. The Schools of Design are partly remedying this, by supplying better trained men; but the demand is still great, and the remuneration is too great for a class of labour which cannot be raised much higher than mechanical labour. Had the prejudices of the academicians been completely removed in the establishment of the School of Design at Somerset House, and the declaration enforced, we should have been worse off than we are now. A declaration that a student in a school of design would not become a history painter or sculptor, portrait painter, animal painter, landscape or flower
painter, whatever supposed monopoly it would have given to professional artists, would have deprived the public of workmen, instructed to execute at a cheap rate common carvings and decorations. Whatever the sculptor academician may arrogate to himself as his province, he does not undertake a chimney-piece, or chimney-piece; and there is therefore no reason why the public are to have no choice between a costly work of art, and a work without any art at all.

It will be one result of the establishment of a body of cheap workmen in art, that the man of taste will be able to suggest his own design; and thus there will be a greater application of intellect and taste than can be contributed by the artists alone. Hitherto we have been dependent for our applied taste on the body of artists, and we can expect no greater progress than we have made with such a body, which is little in comparison with what might be effected by the operation of the great mass of the educated community. To arrive at this will be to arrive at a new era in art, and it will likewise supply a great defect in our artistic economy as it now stands; it will bring to bear that refined scholarship and education, in which our artists almost without exception are lamentably deficient. How few artists in the present day are able to take their stand as scholars and men of learning by the side of Michael Angelo and Leonardo da Vinci, to say nothing of artistic proficiency?

There is a strong call for the home application of art among us, but this can never take place until it ceases to be an extraneous luxury, and becomes an accessible pleasure. If a gentleman of scholarly tastes and refined education have the disposition to suggest the decorations and furniture of his house, he has not the pecuniary means of accomplishing it. He must at high rates choose furniture as cabinet-makers choose to give it, chimney-pieces made by machinery, wood carving from the patent process, statuary in terracotta, mouldings in cannabis, paper mâché, or leather; everything on the stereotype plan, and yet at prices for which he should be able to have something original.

What would be more pleasing to one of good taste than to have, from his own suggestions or designs, and at a moderate price little above that of mechanical or ready-made articles, the furniture of a room, the chimney-pieces, fire-grates, carpeting, and decorations made in harmony with his own habits, associations, and sympathies, the events of his life, the feeling of his home circle, or the traditions of his family? One who has the power may just as well have for emblem and design his own armorial bearings, his own loved flowers, or even favourite objects, as be dependent on the good graces of the manufacturer, whose object is perhaps to sink individuality for generalities. Wherever gentlemen, even under present circumstances, have the means, preference is always shown to individualities themselves.

It is much more agreeable to go into a room in which the decorations are so formed than where they have no relevance. If family crests and badges are introduced in a corner, or animals or flowers are adopted in ornament which recall perhaps some distant climate where honour has been achieved or wealth sustained, there are ideas communicated to the mind beyond even the pleasure from well designed and well executed artistic productions, and the mind likes what is most practical, most individual, and most human.

Pursuing the train of these reflections, we have little doubt, and with the evidence there is, we ought perhaps to say no doubt, that it was the cooperation of all intelligent minds which among the Greeks and Romans gave a catholic impulse and progress to art. The suggestions of a Pericles must have been of value to Phidias; the inspiration of Michael Angelo was refreshed by his associations with the learned of his day; the companionship of Johnson and Goldsmith had its charm on the works and writings of Sir Joshua; and we believe that the energies of Barry may be upheld by his cooperation with those who are most eminent in scholarship, most refined in taste, and most illustrious in political action. Looking at our group of tombs it is not displeasing to imagine that sometimes the design was prompted by the mourner, or was a tribute to the feelings of the deceased; that there was something higher than the compliance with a form of society, or the self-satisfaction of paying a last debt, and accepting a free discharge from all further claims on sympathy or remembrance. If the ready wit of the carver sometimes prompted the design, we may allow that quite as often the half-uttered feelings attendant upon affliction and death may have influenced the inspiration; at any rate, on looking around us we cannot recognise our English church-yard characteristic—"To headstone as per pattern."

Among the urns is a small one to which we should like to refer, but which is now unnumbered. It is a square block, with a base-relief of a husband and wife, each a halflength in profile, looking at the other. The design of the comb in the wife's head is worthy of notice, it is in shape something like the crest of a helmet. The execution of these figures is good.

No. 12 is a sepulchral vase or bowl of albaster uninscribed, which is elegantly covered with foliage. It was found in a tomb near Naples.

No. 22 is a square block with a carved top. One face of the square is carved with a tablet covering a chair or a table, covered with a very large, freely designed.

It is dedicated to Claudius Fortunatus, by his husband, and was at one time in Sir Hans Sloane's collection. As these urns were for holding the ashes of the dead, they mostly have a top, which in the case of cubic blocks, is designed like a pediment with returned ends.

A tablet to Cornelia Servanda (15) has a female figure in relief sitting or lying on a couch, so that her face is shown. On each side of the couch is a larger sized medallion, half-length. The size of the tablet is about 16 inches by 16. This small space is well filled by the several parts of the design, and is much more pleasing than the tablets usually seen on our church walls, and having more surface than work.

Letter-cutting seems to be the chief art in tomb-making here, and even in this mechanical pursuit we have not gone beyond the ancients. Most of the Greek votive inscriptions in the Elgin room are by professional letter-cutters, and are remarkable for their sharpness, neatness, and regularity. The lines are straight and equidistant, the characters uniformly cut and placed in exact accordance with each other. On the Roman tombs the inscriptions are often cut by the workmen, and are not so regular.

No. 11 is an urn of a flat square altar-shape. It is dedicated to Julia Attica, and was formerly in the Burlion Villa. The composition is very pleasing, though the details are inappropriate. The top forms as usual a pediment.

No. 37 is a square altar-shaped urn, dedicated by Marcus Julius Hamillius to himself and his wife, Junia Perea. The size is about a foot cube. The composition represents a pediment supported by two pilasters, and is, like some others, of an architectural character. The pilasters are fitted in with foliage. Within these there is an oblong tablet bearing the inscription, and supported by two griffins. Underneath the tablet, and between the griffins, is a wreath surrounding a medallion.

The urn of Pompeius Justinianus (No. 7), is original. It may be called a slice of a cylinder fluted, and having in front a large tablet with dentilled ends. The labour on this is not much, but it is recommended by the singularity of the design.

No. 4 is dedicated to Vernanda Cyclis, the wife of a man of liberal rank. This is one cube placed on the top of another, with a pediment over the composition shows much variety of detail. The pediment is supported by two jointed torches flaring, and which rest on lions' claws. The upper part of the space within is occupied by the tablet, which is inscribed. Hanging over this is the festoon of flowers, the ends of which fall down nearly to the bottom of the composition. Below the tablet is a doorway with a pediment; within are the figures of the husband and wife in high relief. The whole rests on a moulded base, but which is perhaps modern.

No. 18 was presented, in 1837, by Mr. Mackinnon, M.P. It is dedicated to Tiberius Claudius Lupercus, a freedman. It is a square block with a pediment top. Within the front of the pediment are two birds pecking at a vase. The corners of the cover have a honeysuckle ornament. The face below is filled with an inscription within an oak leaf wreath which is held up on each side by a winged genius, forming likewise a support to the corner. The plinth is moulded, but is modern.

No. 1 is remarkable for being solid and without any inscription, and therefore it can never have been used. It is a square block, having on its front a base-relief of a figure leaning on a couch and offering a fillet or wreath to a boy. This is said to represent a funeral feast. This unfinished urn was likewise presented by Mr. Mackinnon.

No. 8 is a square block dedicated to Titius Titulinius Isauricus, formerly in the Matzel collection. It has on its front a relief of a figure reclining on a couch, and below it an inscription. The pediment is enriched.

No. 22 is a square block urn, with a plain pediment top. In this case, there is no artistic decoration, and the simple inscription is the only matter of interest about it, for the means of him who raised it were most likely less than his affection. The inscription, which is in large letters covering the front, is—"To Lucritius, who lived xvi years and vili months. Her father raised this to her memory."

No. 38 is an urn dedicated to Decius Allesius Cilicius. It is a flat cubic block, with a high pediment top, which is enriched with a vase at which two ravens are pecking; they are freely carved. Below is a tablet
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with a masque of Bacchus on each side, from which a festoon falls, amid which are other vases.

No, 17 is dedicated to Cosctia Prima, and was found, in 1788, in the grounds belonging to the Villa Maroni, near Rome. It is a cube and a half without a top. At each corner is a pilaster, filled in with foliage. Within is a large tablet, surrounded at the top and sides by rich foliage, or what is called arabesque. Below is a Cupid in a car driving four horses, perhaps those of the Sun. The whole is very pleasing. The sides of the urn are ornamented with pine-trees.

No. 23 is a vase of a broad oval form. On the front is a small tablet. On each side is a stock, between which, turning around their heads, is a serpent. On the back are two stocks sticking out of a vase. There are other ornaments. The urn was discovered in what is called the Ager Romanus, in the neighbourhood of Rome. It is remarkable as being dedicated to Pompey Lucco, aged 66, Attilia Clodia, his wife, aged 69, and Pompey Lucco, their son, aged 21, who all died of poison in one day.

The introduction of the stork in this monument suggests how frequently and appropriately it might be used in our tombs, as the emblem of filial piety, while the flayed pelican may be made to represent maternal piety.

While speaking of the urns, we cannot but regret the destruction of the No. V. Room of the Townley Gallery, which was fitted up with niches like a Roman family vault. The niche was called a columbium. One sepulchre near Rome, that of the dependents of Livia, the wife of Augustus, broken open in 1726, contained at least 20 urns. Fabricius asserts that the freedmen formed themselves into guilds for building these tombs at a joint expense, the niches being appropriated by lot, or otherwise. Perhaps there were spectacles among the Romans who sold niches to the lower classes, in the manner of grave-yard trading in London.

No. 9 is a specimen of an oil or round urn of earthenware. One is dedicated to Annius Severilla. The alms were used for persons of the lower classes, freedmen, and slaves, and were sunk in the wall, within an arch, the lids only being visible. An inscription was put in front.

On the urn No. 15, a family are represented mourning over a dead female. Under the couch are her sandals and a dog.

No. 14 is an urn formed as a round temple. The cornice is upheld by three Termini and by six Ionic pilasters. The whole decorated with festoons. It is dedicated to Severilla Zosimenes.

No. 14 is not remarkable for its subject, but as having been engraved so long back as 1598 in Boisard's "Antiquitates Romanae."

No. 21 is not Roman, but Etruscan. It is of baked clay, with a base-representing, it is said, Echelles fighting for the Greeks with a phalangbarate at the battle of Marathon. The top has a leaning female figure, lying on a pillow. This is rudeely executed, and has an Etruscan inscription undeciphered.

No. 28, a plain urn or vase, dedicated to Flavia Valentina, still contains the ashes of the female to whom it is inscribed, and was found, in 1773, on the Latine Plateau near the Appian Way. It is a fine specimen of its kind.

Many of the urns are brought from the immediate neighbourhood of Rome, and are, therefore, specimens of the metropolitan workmanship. They are, however, chiefly of late date. The locality of No. 4 is not stated, but it is dedicated to the wife of a Servis Claudeliusus, and it is most probably Roman. In Gruter's time it was in a collection at Rome. There has been some discussion, by the bye, as to the letters F. A. P. on this monument. They are, perhaps, the carver's initials. No. 17 was found, as already stated, near Rome. Nos. 20, 31, and 34, were found in the Villa Feliscio, near the Pincian Gate at Rome. No. 30 was found at Rome. No. 30 seems to be Roman. No. 30 is already described as Roman.

Some of the urns are Neapolitan, as No. 12 and 20, from Sir William Hamilton's collection.

Besides the urns are Roman cippi, in the form of a low square or round column, or rather portion of a column. They resemble altars in form, and were used for other purposes besides monuments. There are many in inscribed sepulchral cippi in the British Museum, the designs of which are equally worthy of attention with the urns.

Though we have alluded to Etruscan tombs, we shall not here give any description of the collections of funeral monuments in the Museum, which are large. The Romans have been already extensively detailed; the Etruscan are no less interesting. The Lycian tombs in the new rooms are of a large scale. Many of the Egyptian relics are of a monumental character; and the Etruscan paintings in the upper rooms are likewise from tombs. There are various specimens of Greek monuments.

It is much to be regretted that the collection of Roman busts is not larger, for a series of this kind is very interesting from its practical and individual character. Such an assemble as that in the Louvre, the Vatican, and other continental galleries, awakens very agreeable emotions. The constancies are truthful and life-like, while there is an independent interest in the historical associations they suggest. Thus there is a double influence of art and liberal study, which is well worthy of cultivation. Whoever compares the two, will find far less attraction in the most beautiful busts of the ideal—even in the Apollo, Venus, or Diana—as in the company of a few plain Romans. There is generally a steadiness and solidity in Roman features, which is agreeable to English spectator; it seems at home among a people who have been dead for fourteen hundred years, and under the influence of the conformity of character he recognises little difference of race. Strange as it may seem, a gallery of Romans is not un-English, and is much less strange than a gallery of ancient Greeks or modern Frenchman. We should, therefore, much like to see the series of heads and busts in the Museum extended, even by the addition of copies, which can be readily obtained, as so many busts of Roman emperors and public characters have been found.

When put in comparison with portrait heads, the ideal busts of gods and heroes are tame, and they suggest strong doubts as to the soundness of idealisation in art. This is to be accounted for on simple principles: in nature there is nothing without its beauty, so there is nothing without its defect; still less is there to be found the unalloyed preponderance of any quality, for the balance is always kept up. It may be said that the idealisation of a Jupiter or a Venus in which imperfection is not to be found, is therefore beyond humanity and godlike; but as the mind of man has a greater sympathy for many attributes than for godlike qualities, of which it knows nothing, so whatever praise may be awarded to the ideal, it is disenchanted by reference to the natural, and a higher idea is communicated by the latter than by the former.

In the Museum, the busts are, for the present, arranged in groups on shelves. Thus we have a group of gods, of heroes, of emperors, and of empresses. We recommend the visitor to compare Minerva, Bacchus, Apollo, Diana, and Juno with Julius Caesar, Hadrian, Nero, and Severus, or even with Octavia, Sabina, Fanitas, Domitia, and Olympia.

We believe a greater development of the department of portrait busts would be found useful in its influence on the public mind, being congenial with the English character. It is much to be regretted that in the metropolis there is not as yet any large collection of ancient or modern busts, though the Palace at Westminster promises in some degree to supply the loss of the latter. This Palace will give us the example of an historical gallery, of which the French have a specimen at Versailles, and the Bavarians at Munich. A zealous chief commissioner of the Woods and Forests might cheaply distinguish himself by collecting together the portraits and historical pictures in the royal palaces and national museums, and laying the foundation of an historical gallery. It is true we have fragmentary collections of busts in the British Museum in the Natural History Rooms, and of marine pictures at Greenwich. It might, perhaps, be worth the while of the British Institution, or some other artistic body to get up an exhibition of historical works of art. The Society of British Artists is ambitious of distinction—it may take advantage of the hint.

The British Museum collection of heads, although small, has many of interest. In the Greek series are two attributed to Homer and Pindar. No. 43 is Periander, a tyrant of Corinth, one of the seven sages, who lived about 2470 years ago. It may be questioned whether this is a likeness. No. 36 is the tragedian Sophocles, the contemporary of Pericles, Thucydides, Phidas, Eschylus, and Euripides. No. 32 is Pericles, and these two busts bring us in association with the illustrious men of twenty-three centuries ago. It is to be noted that Pericles wears a helmet, which Pintarch says was adopted by the sculptors to conceal the bad proportions of his head, which was thickened in shape to that of an ox. No. 29 is thought to be Hippocrates, the physician. It is from Albano, from what are thought to be the remains of the collection of M. Waro, who says Pliny collected seven hundred portraits of eminent men. No. 20 gives us Diogenes, the cynic, the contemporary of Alexander the Great; and No. 34 is another, the great orator Demosthenes. No. 34 is the philosopher Epicurus, the head of a sect. No. 8, Room XII., is the head of Aratus, a poet and philosopher, and bears the name of Eratiste. Sophocles and Demosthenes are two very well known names; however, a view of this collection cannot but regret that it is not larger, that we might become more familiar with the constancies of the favoured heroes of our boyhood. We think it would be no unfruitful compliment to the memory of
an eminent promoter of art, to place the bust of Polycles in the Elgin collection, the chief beauties of which were created under his patronage, for Phidias could not have wrought but under the treasurership of Pausicles.

The Roman heads are happily more numerous, but far from enough to satisfy curiosity. No. 51 is Augustus, a Napoleonic countenance. No. 53 is an original bust of Marcellus, the favourite nephew of Augustus, dedicated by the body of Decemvirs. Tiberius Caesar follows Augustus in time. No. 68 is Messalina, one of the wives of Claudius, and the most infamous woman of her day. The fashion of her hair is worthy of notice, as it is that of most of the empresses. Their shackled Mohican head-dress are far from ineligible, while others are quite as peculiar as anything modern, as for instance those of Sabina and Domitilla. At any rate, a Roman collection is one of the last places in which any support can be got for the doctrine of classicity in bas-reliefs. The Romans were quite correct to be featured according to the fashion of the day—the women in particular; while the greatest fear of a modern sculptor is to pay any such homage to the costume of his time.

No. 44, Nero, pins attention. His low forehead, marked eyes and nose, and large lower jaw, countenance the unfavourable accounts of his character, and make our prejudices—such as it may be probably the Romans did, by looking at the likeness of the man.

No. 18 is the statue Vitellius. No. 1, Room IV., is Trajan, a very business-like looking man, with a forehead not over large. Of Hadrian there are two busts.

No. 53 is Julia Sabina, niece of Trajan and wife of Hadrian, a matronly lady with her hair plaited and netted, as already mentioned, in rather a peculiar manner. No. 18 is Atticus, the notorious favourite of Hadrian. No. 43 is Elbus Cesar. No. 11 is the illustrious Antoninus Pius. As we have noted of the hair of the ladies, so may we of the other sex. There is much variety in the mode of wearing it, which often approaches the modern style. No. 5, Room IV., is Marcus Aurelius, another philosophic emperor. He is dressed as a Praetor Avallia, a priestly officer. No. 39, Anna Faustina, is his wife. Her hair is worn quite plainly, simply parted.

No. 7 is Lucius Verus.

No. 39 is Severus, one of the emperors who visited Britain, where he died at York. No. 31, Room VI., is Caracalla, a fitting companion head to that of Nero. No. 39, his wife, Plautilla, has a fanciful mode of wearing her hair, but one not ungraceful. No. 36 is the elder Gordianus. No. 81, Room IX., is that of a Roman lady of rank, whose head-dress is remarkable and rich. As the lady is not known, it is most valuable as an illustration of costume. No. 54, the bust of a little girl, shows one of the fashions of wearing the hair, made up into little plaits and tied in a top-knot. (To be continued.)

PHOTOGRAPHIC MANIPULATIONS.

The great beauty of photographic pictures and the varied uses to which the art of photography may be applied, invest this wonderful discovery of modern science with surpassing interest, and to the successful operator it possesses great fascination. As the manipulations, however, are numerous, and require great care—for a defect in a single one may prevent any results from being obtained—the art has not yet been so extensively practised as it deserves to be, and as we have little doubt it will be ere long. Many have been prevented from commencing by the difficulties which encompass the process, and many, after making the attempt, have abandoned it in despair of being able to succeed. These obstacles are in a great measure owing to the want of clear and satisfactory directions for conducting the various manipulations, and though it is extremely difficult to describe the processes of an art requiring so much nicety so as to insure success, we will endeavour to give such directions that we trust will enable most persons, by a little practice, to produce good photographic pictures. We are the more induced to hope that we shall succeed in this attempt, having worked out the problem with such imperfect light only as the printed directions afford, and having experienced by many failures the points wherein such directions are vague and imperfect.*

Since the original discoveries of the means of fixing the images of the camera obscura, by M. Daguerre and Mr. Talbot, many variations in the processes have been discovered, but we shall confine ourselves to the description of the Daguerreotype and Calotype, which have hitherto been unrivalled in practice by any. The distinguishing characteristics of the inventions of M. Daguerre and of Mr. Talbot are, that in the former the image is impressed on a metal plate, and is subsequently rendered visible by the vapour of mercury; whilst in the Calotype process the picture is produced directly on paper, by the influence of the rays of light on the salts of silver. We propose in the first place to describe the manipulations of the Daguerreotype.

The apparatus essential to the Daguerreotype artist, in addition to the silvered plates, consists of the following articles: an achromatic camera obscura fitted with appropriate slides for holding the plates, iodine and bromine boxes, a mercury-box, three or more "buffs," and a spirit lamp with stand for holding the plates. The chemical and other materials are iodine, bromine, spirits of wine, mercury, cotton wool, tripod powder, roege or "finishing powder," and nitric acid.

The plates are now so well finished in the manufacture that with new plates comparatively little preparation is required. There are two kinds sold by philosophical apparatus makers, the one French, and the other English; the former of which are cheaper, but the plating of silver being much thinner, it is advisable for beginners to pay the higher price, as in the course of cleaning the plates after failures, they soon come to the copper, and the plate is then useless. In order to clean the plate it must be placed on a holder of some kind, to keep it firm when rubbed. For small plates a piece of wood, nearly the same size, will answer very well, the plate being held by the edges. Then take a small piece of prepared cotton wool, freed from all grease and dirt, which form into a ball, and dip it into a mixture of tripod powder and of nitric acid diluted with one-fifteenth part of water; a few drops of the mixture will be sufficient. In rubbing the plates, it is usual to direct that the cotton wool should be moved in a circular direction, forming circles on the plate of different sizes; but we believe the most successful artists polish their plates by a motion directly across. In giving the last polish, indeed, it is essential that the motion should be in lines across the plate, otherwise it would look misty when held in the direction in which the picture is to be viewed. This effect is owing to the minute scratches which will remain even after the most careful polishing, but when the plate is looked at transversely to the lines of the scratches they are invisible, and a black mirror-surface is presented. After rubbing with cotton wool and tripod, take some fresh cotton wool, and rub till a bright polish is obtained. The finishing polish is given with the "buffs," which are pieces of wood covered with well washed cotton velvet. Some finishing powder, consisting of lamp-black and rouge, is dusted over the first buff, and the plate is rubbed along it briskly, taking care that the fingers do not touch. This operation is repeated on two or three other clean buffs, in order to remove the slightest trace of grease. When the polishing is finished, the plate should have a fine black mirror-surface, when held in the direction in which the picture is to be looked at. If the plate after use becomes scratched, it will be requisite to apply some fine emery powder and oil with cotton wool before applying the tripod. In case any drop of mercury should adhere to the silvered surface, the plate should be heated by holding it over the spirit lamp with a pair of piers until the mercury is evaporated. Some operators, always heat the plates, for the purpose of expelling greasy particles. It cannot indeed be too strongly impressed on the Daguerreotype artist, that the perfection of his pictures will depend in a great measure on the cleanliness of the plates.

The next operation is to coat the plate with iodine. The iodine must be scattered evenly over the bottom of the iodine-box, and the plate exposed on its frame with its silvered surface downwards. In about half a minute the silver will become a gold colour, in consequence of the vapour of the iodine having entered into combination with it, and formed an iodide of silver. The length of time requisite for exposure to the iodine depends much on the temperature. At about 70° Fahrenheit, 30 seconds will be sufficient for a small plate, but it must remain till it acquires a golden tint, distinctly different from the brass plate at first assumes. If it remains longer, the colour changes to pink and to leaden colour; in such case the plate must be polished afresh, and the operation renewed. The light need not be excluded during the iodizing process, but the plate should only be exposed to its action instantaneously. The iodized plate might now be put in the camera, and in the course of five minutes, in a very bright light, a perfect picture would be obtained after exposure to the vapour of mercury. It
light to throw on the figure and face without being too bright; but this is a point that the judgment and taste of the operator will determine, bearing in mind that the red rays make little more impression on the plate than black, and that the brightness of yellow and orange is also greatly diminished. Another point which it will be advisable to attend to is the personal appearance of the sitter. If a child, or a handsome young person, be the object, the focus should be as accurate as possible; but for those advanced in age, or who have defects on the skin, it is advisable to adjust the focus of the lenses so as to obscure those defects by bleeding the rays of light. There are many other minor points that will require attention, but taste and experience will guide the artist to perfection in such details; and the general directions here given will be found sufficient for most occasions.

When everything is properly adjusted, the case which contains the prepared plate must be substituted for the screen of ground glass, and the slide that exposes the plate to the image must be drawn up, taking care not to shake the camera so as to alter its position. The instant that the light impinges on the plate an effect is produced on the sensitive iodine coating; and it is the most critical point of the whole process to determine how long the action of light should continue. As there is no visible impression made on the plate by the rays of light, to guide the operator, he can only judge by experience—after numerous failures and a few successful efforts—when the light should be excluded. To aid in gaining this experience, however, some general directions may lessen the number of failures.

We will suppose the artist to have prepared plates in a uniform manner, and of such a degree of sensitiveness, that they will take a building on which the sun is shining in three seconds. When the sun is obscured, the plate will require six, eight, ten, twenty, or thirty seconds to sufficiently receive the impressions of the ray from the same object, according as the clouds are rare or more dense. As so much, therefore, depends on the state of the atmosphere, and as a second or more will effect a much greater change when the sky is bright than when it is obscured, it is always much better, especially for tyros in the art, to operate on a gloomy day, for then the error of a few seconds will not much impair the effect; taking care to give, under such circumstances, what is considered rather an excess of light. In taking the largest-sized view that the camera will admit, a diaphragm is used to confine the rays to the centre of the glass, for the purpose of avoiding the effects of aberration; and as the diaphragm greatly diminishes the quantity of light, it will be necessary to make allowance in the time of exposure in proportion to the covered surface of the object-glass. For portraits, it is desirable of course to diminish the time of sitting to the least possible quantity, and some portraits have been taken in the fraction of a second, but the chances of success under such circumstances are greatly diminished. It is hazardous, therefore, to attempt to operate in so bright a light, and the effect is not nearly so pleasing, even when successful, as when the portrait is taken under a more sombre influence. We have been most successful when operating in the open air, about six o'clock on a summer's evening, with the sun obscured by light clouds, allowing the plate about twenty-five seconds exposure to the light in the camera, which is one of Mr. Ross' manufacture, with double lenses and a 1-inch aperture. When portraits are taken in a room, a longer time is required, because the light is then screened from the sitter on all but one side. Much, again, will depend on the characters of the objects to be depicted. If they be light, the impressions will be more quickly made, and if dark an additional time should be allowed. The effect when a Daguerreotype plate has had too much or too little light is very decided.

Too much light will cause the white parts of objects to appear blue, the bluestones to become green, and the finer demarcations of shading are destroyed. Such a picture is said to be "solarized" or "burned." On the contrary, in a picture which has not had sufficient light, the lights and shadows are in strong contrast, and the darker portions of the object are not developed. With a still less degree of light, there is a general feebleness of impression, which no length of exposure to mercury vapour will strengthen.

The plate having been withdrawn from the camera, it is next transferred, in the dark, to the mercury-box, to bring out the latest picture. This is the exciting part of the process, for now we have to ascertain whether all the trouble and care we have bestowed have been thrown away, or whether we have succeeded in obtaining a perfect picture most exquisitely finished. The impressions made on the iodine and bromine by the rays of light, though invisible, have yet such efficacy as to expose those portions of the silvered plate to the action of the vapour of
mercury, whilst the other parts are impervious to its action. The mercury vapours thus form the lighter parts of the picture, whilst the denser portion of the silver plate constitutes the shadow. The particles of mercury deposited will be so minute as to be scarcely visible by a powerful microscope, and the evaporation of the liquid metal at the ordinary temperature of the atmosphere is sufficient to bring out the Daguerreotype picture when placed over it—but this would require three or four hours. To facilitate the operation a spirit-lamp is used, which should be carefully applied, that the mercury may not be too much heated. The mercury-boxes usually sold have thermometers attached to them, and the temperature should not exceed 160° Fahl.; but a little experience will enable you to regulate the heat without a thermometer, by applying the fingers occasionally to the bottom, which should not become too hot to be touched. In a minute or two the picture will begin to develop itself, and will then gradually come out till it attains its greatest distinctness. If it remain too long, the details become less sharply defined; it is better, therefore, to remove the plate when all the objects appear distinctly developed. It is generally recommended to heat the mercury to the highest point allowed, then to withdraw the lamp till the mercury cools, and apply heat again, and so on until the deposition of mercurial vapour is completed; but we prefer lowering the flame of the spirit-lamp, so as to produce a mere glimmer, and to allow it to remain burning for three or four minutes, after which to leave the plate undisturbed till it cools. If, when this process is completed, there appears a perfect picture when the operator peeps into the box with a taper's light, the pleasure he experiences amply repays all the trouble he has taken, and he will feel disposed to insist as much on the product as if it were the result of his elaborated skill, whereas his only achievement has been that of having fixed the pencillings of Nature.

The picture is now obtained, but it is not yet secured. Water is to be exposed to light, the sensitive coating still adheres to the plate; in fact, the diameter of salt containing distilled water, if warmed well, and again in another bath of distilled water, to remove all traces of the gold. If these washings be done carefully the picture will be unjured, but it will require great care in the subsequent process of drying to avoid impairing its effect. The plate must be held in a slanting direction for the water to drain off; care being taken to see that no particles of dust have settled on it, for there have it must be again immersed in water. The spirit-lamp should be applied at the upper edge of the plate, and by blowing on it the drying will be promoted. Should the water collect on parts of the plate as it was gently, instead of spreading over the surface evenly, it must be blown away if possible before it dries, otherwise a mark will be left on the plate that may spoil the picture. Numerous annoying occurrences of this kind will happen, and it may be observed that the more strongly the picture is brought out, the more liable it is to be injured in the washing. It has occurred to us that one of the most beautiful pictures we have succeeded in obtaining, which was very distinct in details, forcible, and a pleasing likeness, was completely spoiled by stains in the subsequent process. The soda solution and water should not be twice used, lest any iodine remaining in the vessel should cause a stain.

After washing the picture is permanent, and in this state all the first Daguerreotypes were finished. The thin film of mercury, however, is yet easily removed by a touch, nor has the picture attained the brilliancy and tone which it receives from the subsequent process of fixing by gilding, which was invented by M. Fizeau, to whom the Daguerreotype art is much indebted. For gilding the plate, a diluted solution of chloride of gold and of hyposulphite of soda is employed; in the proportions of 15 grains of the chloride to a pint of distilled water, and 46 grains of the hyposulphite in the same quantity of water. These should be dissolved in separate vessels, and then the gold solution poured very gradually into the other, stirring with a glass rod all the time. If this mixture of the two solutions be not carefully made, or if the soda solution be poured into the gold, the resulting mixture will be black, owing to the deposition of sulphate of gold. The quantity indicated will serve to gild a great number of plates, and may be kept for use as wanted. The plate to be gilded must be placed horizontally, with its face upwards, on the lamp-stand. The surface is to be then floated over with spirits of wine, which may be poured on it and quickly drained off,—the only use of the spirit being to facilitate the flow of the gold solution. As much of the diluted chloride of gold is poured on as the plate will retain on its horizontal surface, and then the spirit-lamp is to be applied beneath to heat all parts equally. Presently the liquid will emit vapour, the picture will improve in brilliancy, and soon afterwards small bubbles will appear, at which point the process must be stopped. The gold is then poured off, and the plate washed with warm distilled water, and dried with the aid of the spirit-lamp, in the same manner as after the first washing.

The operation is now completed, and if every part of the process has been conducted with care and judgment, the artist is in possession of a picture which, in accuracy of outline and to the acquisitive beauty with which it is finished, far surpasses any work of mere art. He may spend long upon its wondrous details with delight, which will not be a little enhanced by the pleasing self-deception that it has been done by himself! All his trouble seems recompensed—all his fatigue—but increase the pleasure of this one complete success—and the difficulties he has had to encounter in gaining the prize only add to its value. He sees henceforth all difficulties removed, and in full confidence of his powers be even hopes to attain still greater perfection.

Let not the variety and required care of the manipulations discourage any who have a taste for the art from commencing the work, since perseverance is almost sure to be crowned with success. For two whole days were we in our first efforts without obtaining the trace of an image; and when at length a perfect picture burst into view in the mercury-box, the delightful feelings of the days of childhood seemed to be restored. By attending to the directions which our experience and recollection of difficulties surmounted give us, the way will be in a great measure cleared, and it will be a source of gratification to think we have removed any obstacles that obstruct the attainment of success.

THE HOUSE OF PEERS.

SIR,—My ideas and notions may be so very peculiar that there is no danger whatever of their contaminating public taste; which being the case, you will, perhaps, allow me to express my own opinion of the House of Peers. In a word, then, I take it to be if not exactly a failure, very far below what was to be expected—at least derisitorily. As to conception, it is positively null: the character is that of a chapel, not of a senate-house; such is certainly the general idea, without any attempt at further or definite. No original and poetic grasp of mind has been exhibited by the architect, who has merely appropriated to the occasion what he found ready made. The impressive solemnity which bedeck a hall in which are held the counsels of a widely extended empire, does not express it. On the contrary, it expresses the opposite. The idea of a chapel in some respects, there is too much of the ball or banqueting room in others. There is by far too much of glare and garishness, and not a little of mezzetint also. Yes, I venture to say it, of mezzetint, which, repulsive as it may, I think, be very unjustly ascribed to the throne. Instead of forming a principal feature of the general composition, that seat—perhaps exactly an "easy chair"—is no more than a piece of furniture which might be put into any room,—a mere gilded chair, instead of being made to form an interesting and leading feature in the ensemble. Judging from the one already executed, the frescos will be altogether insignificant—mere spots in the general decoration, and by no means brilliant ones; rather very flat and insipid specimens of pictorial art, and will show all the more so in consequence of the injurious contrast with the painted windows, which latter, in turn, owing to the same contrast, must appear harsh and glaring in colour.

Such at least is my feeling; and I must be allowed to say that I am greatly disappointed in the new House of Peers. No doubt it is calculated well enough to strike and also satisfy those who merely go into it, and just look about them; and who therefore giving themselves up to the mere first impression, are captivated by the sumptuousness of the place. Yet the test of architectural excellence is not the mere first impression alone, before the judgment has time to rally and collect itself, but the increased satisfaction produced on every fresh visit. If we did not exactly act as we are actuated by more convincing evidence of artistic power and artistic grasp of mind than I there discover; for while on the one hand the "house" is decidedly too ecclesiastical in character, it is on the other more characteristic of a ball-room or a boudoir than of a senate-house. The most momentous interests are to be discussed. I may be wrong; and if so, either you or some one among your correspondents will have the trouble to set me right. It is the meanwhile I remain,

Zeno.

[We have given insertion to the above communication, not because we agree with the observations, but to give an opportunity to our readers for fair criticism.]—Ed.
CONSTRUCTION OF SEA WALLS.
(Continued from page 264.)

BREAKWATER IN DELAWARE BAY.

ANNEX (L.)—Report of Commission of the United States Engineers and Naval Officers, which should be given to Commissioners, and Report on the Construction of the Breakwater in Delaware Bay.

Section of Breakwater in Delaware Bay, United States.

s. Top of breakwater, 30 feet wide.—t. Highest tide known.—e. Highest spring tide.—d. Lowest spring tide.—c. Level 15 feet below lowest spring tide.—f. Bottom 27 feet below lowest spring tide.—p. Average bottom 29 feet, 4 feet dute.*—three dotted lines on the top show a parapet to be made, if useful, 22 feet wide.

The following description of the Delaware Breakwater is compiled from the Report of a Board of Commissioners to the Secretary of the Navy, which was approved by the President of the United States in February 1899. The computations were made by Commodore Rodgers, U.S. Navy; Brigadier-General Bernard, U.S. Engineers; and William Stickland, architect and engineer:

With respect to these objects, upon which the solidity and durability of the work so far as practicable, and not hasty and careless, it should be acknowledged that the theory and more speculative are utterly incompetent to fix, within precise limits, the degree of resistance to be given to a work exposed to so many and such incalculable violent efforts of the sea. But valuable inferences may be deduced from experimental results afforded by the construction of similar works in Europe, and described in an able paper presented to the French Institute by M. Cachia, general inspector of French Civil Engineers. Thus the stupendous works erected in Cherbourg in France, and at Plymouth in England, have been resorted to as guides in the investigation of the leading principles upon which the breakwater under consideration should be constructed.

If the road of Cherbourg is of the highest importance to France, that of Plymouth is of equal importance to Great Britain; as, among other advantages, it enables her to assemble at one point the fleets destined to watch the movements of her neighbours in the roads of Brest and Cherbourg; added to which, the connexion of the road of Plymouth with an extensive naval arsenal makes it a matter of much consequence that it should be rendered perfectly secure.

The works at Cherbourg fully answer the purposes for which they were erected, and demonstrating their importance, the Government of Great Britain has determined to erect a breakwater in the road of Plymouth, which was accordingly commenced in 1818.

At Plymouth the interior slope has an inclination of 67 feet altitude to 90 feet base, making an angle of 33° with the horizon. At Cherbourg this slope is of 45°, or inclination; and, since it descends firmly under the water of more than 70 feet, it may be inferred that at Plymouth the interior slope might also have been kept at 45°.

The Board was, therefore, of opinion that, as the Delaware Breakwater must be 16 feet lower than that of Plymouth, and 30 feet lower than that of Cherbourg, there should be no hesitation in adopting the slope of 45°. At Cherbourg, as at Plymouth, experience has taught that, if human power was able so to heap up materials as to fill up such a space in the deep, it acquired the agency of tempestuous waves so as to dispose of them as to secure their permanent stability. On this score it would seem that the results obtained at Cherbourg from vicissitudes in 1819 were but partially known to the able projectors of the Plymouth Breakwater. Indeed, the base of 190 feet of that work, and its altitude of 82 feet, have received precisely the same ratio as that which the action of the sea had fixed between the base of 388 feet, and the altitude of 78 feet, of the work at Cherbourg.

The surface of the former work having been assumed to be a plane, while at Cherbourg the efforts of battering waves have produced a serrated surface, it is hence to be apprehended that at Plymouth it may become necessary, in progress of time, to add new materials to the lower part of the slope.

The slope herein submitted has been framed out of the following facts and principles afforded by the Cherbourg Breakwater.

1. The part above the highest spring-tide having been for a short time battered by the waves, which had lost by their ascension a portion of their momentum, received from the action of the sea an inclination of nearly 2 feet base to 1 of altitude.

2. The part comprehended between the highest and lowest spring-tide is exposed, during the time of its rise and fall, to the greatest violence of the waves. Thus permanently swept by the sea, this portion of the slope has received an inclination of 11 feet base to 2 of altitude.

3. The part comprised between the lowest spring-tide and an horizontal plane 15 feet below it, is exposed to the shock of the waves only during the interval between the termination of the fall and the commencement of the rise of tide: it has, therefore, to withstand the effects of the sea under less inclination, viz., 3 feet base to 1 of altitude.

4. The lowest part of the slope comprehended between the latter plane and the bottom of the sea, remaining permanently submerged, and to a depth at which the agitation of the waves has attained its maximum, has received an inclination still less than the preceding, viz., 3 feet base to 4 of altitude.

These experimental results show that the effect of water against loose materials has to give to the mass in progress of time a slope, the inclination of which will increase in proportion to the force exerted against it.

It is on these data that the profile of the Delaware Breakwater has been delineated.

The fact, with others not dissimilar which have happened at Cherbourg, shows that the top of a breakwater must be elevated beyond the reach of submergence, and loaded with the largest and heaviest materials that can be procured, which should be laid in such a way that each shall press to the action of the sea the smallest possible superincumbent, and to the lateral materials the largest surface of friction.

These considerations induced the Board to recommend for the Delaware Breakwater a profile, or transverse section, of the following dimensions:—

The inward slope at 45°, the top 80 feet in breadth, and at 9 feet above the highest spring tide; the outward slope of 39 feet altitude, and of 106 feet base; both dimensions measured in relation to a horizontal plane passing by a point taken at 27 feet below the lowest spring tide. The base below 80 feet altitude nearly the same as in the profiles of Plymouth and Cherbourg Breakwaters.

The experience acquired at Cherbourg has taught—

1. That stones of small size are not sufficient to withstand even a moderate wave; and it would appear that a breakwater of a moderate sea.

2. That stones measuring 18 or 24 cubic feet, and weighing 16 to 23 tons, present a suitable resistance to the breakers of a moderate sea.

3. That larger blocks are required to withstand a violent sea; and that in the more exposed parts of the work their sizes should be still larger.

4. That if small materials were to be used, it would be indispensable to proceed internally by others of large tur.

5. That the smaller the external surface of a large block, the greater will be its stability.

6. That the largest blocks should be placed towards the top, in order to continue, with their greater steadiness, the loss of weight and of stability caused by immersion to the materials located immediately under the water line.

The foregoing description of the Delaware Breakwater includes, with occasional alterations, the Report of the Board of Commissioners. The work has been executed so far in accordance with the views and plans thereto detailed. The dimensions recommended in the Report have been adopted in its erection, with the exception of that portion designed for a breakwater, which is 1,600 yards in length; the length recommended was 1,900.

The work may be considered now so far finished as to have accomplished all the purposes for which it was projected. Indeed, the plan of operations in the work at the same time, and in due order, was taken the fortifying the roads of Cherbourg.

The Bay of Cherbourg was selected as being opposite to the many almost natural harbours which Great Britain possesses in the Channel; as being in the rear of the Mole, having every desirable facility for watching the movements of the enemy, interrupting his convoys, and for concentrating all the details of a grand maritime expedition.

The works designed by the Departments, which had been charged with proposing the divers projects for this grand enterprise, neglected to sound the roadstead, and to observe its maritime properties; and judging its extent as a harbour by its apparent surface, proposed the adoption of a plan which had been submitted to the French Government in 1778, by the director of fortifications at Cherbourg, for closing the roadstead by means of caissons filled with masonry, forming a jetty or "digue" from Point Homel to Peize Island.

CHEBROUB HARBOR.

ANNEX (M.)—Extracts from the Memoire of Mons. J. M. Cachia, on the Breakwater of Cherbourg.

At the close of the 18th century, the French Government had resolved to provide, by means of art, those advantages for France which nature has conferred with such prodigality upon England, in the many ports she possesses in the English Channel.

It was more particularly, however, after the battle of La Hogue, that this necessity was more strongly felt, and the Government determined to create at Cherbourg a grand naval establishment, which in providing a safe and secure place for vessels of war, would also provide defence for the Channel, and give the French nation the degree of power befitting its maritime position.

The American war had realtime in the French mind the ambition of disputing with England the empire of the seas; and at the general peace, which ended the war, was taken the fortifying the roads of Cherbourg.

The Bay of Cherbourg was selected as being opposite to the many almost natural harbours which Great Britain possesses in the Channel; as being in the rear of the Mole, having every desirable facility for watching the movements of the enemy, interrupting his convoys, and for concentrating all the details of a grand maritime expedition.

The works designed by the Departments, which had been charged with proposing the divers projects for this grand enterprise, neglected to sound the roadstead, and to observe its maritime properties; and judging its extent as a harbour by its apparent surface, proposed the adoption of a plan which had been submitted to the French Government in 1778, by the director of fortifications at Cherbourg, for closing the roadstead by means of caissons filled with masonry, forming a jetty or "digue" from Point Homel to Peize Island.
This project was most insufficient: it left exposed and without defence the most essential portion of the bay, that part best suited for the anchorage of large ships; and the very circumscribed area which it was proposed to protect was against the violence of the sea and the attacks of an enemy, would have been accessible only to trading vessels, privateers, and other small craft.

In the year 1777, M. de la Bretonniere, capitaine de vaisseau, who was thoroughly acquainted with the localities, had proposed a similar plan for the protection of the naval property at Cherbourg as a port of refuge for all classes of ships under all circumstances of wind and weather.

The project of constructing the breakwater in the direction of Point Rotin, was abandoned at the remonstrance of M. de la Bretonniere, and, in 1780, it was resolved to adopt the direction which has since been given to it by the breakwater of Querqueville to the Isle of Groix.

After a long delay as to the means to be adopted for enclosing the anchorage by advanced works, M. de Cessart recommended the ingenious system of wooden caissons, in the form of truncated cones, 149 feet diameter at the base; 85 feet diameter at the summit, and 65 feet of vertical height.

It was proposed to sink 90 of these cones in all, leaving a passage at the east end of 2709 feet, and one at the west of 7874 feet.

It was, in the first instance, intended to fill them entirely with loose stones, but it was subsequently determined to fill them up with regular masses of stone. The cones were too deep for low tides, and by being filled to the cones with strong iron chains, thus forming a sort of open net work, which should divide the action of the sea, and create smooth water in the roadstead.

The proposed construction, mode of launching, and immersion of these cones, appeared to promise every success. One was built at Havre, and floated in 1783. It was then taken to pieces, transported to Cherbourg, and after some delay, caused by a gale of wind, was floated and sunk, on the 7th of July following, when it was found perfectly sound and in the first place been placed.

A second was sunk tangent to the base of the first, in a westerly direction, on the 7th July following, but a gale coming on the 18th of August, this second cone was filled with stones, it was carried away down to low water mark. This event was the cause of, or the pretext for, great disturbances and disorders which have been occasioned by the first place been placed.

It was found that the stones, dispersed by the breaking of the second cone, would entail the necessity of sinking a third at such a distance from the first, that the interval would not be protected from the violence of the sea.

It was likewise considered, that, as the cones could be sunk only during the spring tides, the completion of the work would require 18 or 19 years' consecutive labour, and would cost 90,000,000 of francs. These considerations led the Government to direct that the cones should be future be employed at intervals of 56 metres, 50 centimetres, and the intermediate space filled in with large blocks of stone, and thus to form a breakwater, which was to be carried up to low water level. These intervals were subsequently increased to 1896 feet; but after sinking 18 of these cones, it was perceived that the work was not in any way progressing, and the employment of large stones than those hitherto used, and which had become much diminished in size by their frequent displacement and friction; that large blocks, 51 to 60 centimetres cube had a presumed stability sufficient to resist the action of the sea, and that this stability would increase with the volume of the blocks of stone employed.

The general dispositions recommended by the Commission of 1792 were adopted by the Government, upon the strength of the advice of a committee, composed of several general officers and admirals, and engineers of the greatest eminence in the three departments of War, Marine, and the Engineer.

It now only remained to determine the height to which it was necessary to elevate the breakwater, in order, not only to procure smooth water in the roadstead, but to make it as safe as possible for the passage of vessels, and to afford protection to the ships in the roadstead, the sea having risen 4 metres 70 centimetres.

Hence it was naturally concluded that it would be advisable to carry the summit of the breakwater at least 4 metres 70 centimetres (14 ft. 5 in.) below the level of the highest tides; that is to say, 3 metres 44 centimetres (7 ft. 6 in.) above the level of the lowest tides, the rise in the sea outside being calculated at 32 feet, or 7 metres 15 centimetres.

But viewing the great advantages which would result from its being carried up to the level of the highest waves, it was not hesitated to propose to elevate it to 9 feet (2 metres 92 centimetres) above the level of the highest sea outside, that is to say, to 31 feet (10 metres 7 centimetres) above the lowest tides.

But the revolutionary troubles put a stop to all further proceedings connected with the recommendations of the Commission of 1792; and the completion of this vast enterprise appeared to be indefinitely delayed, when, in November 1800, a new government turned its attention to this important object of public utility, and named a Commission, upon whose report the future of the great work of the breakwater would be elevated 2 metres 92 centimetres above the level of the highest tides, with a breadth of 106 metres, whereupon to construct a battery of 30 pieces of artillery of the largest calibre; and that the extremities of the breakwater should be, ultimately, similarly constructed for a like purpose.

This was recommended in consequence of the great distance (7,017 metres) between Forts Royal and Querqueville, which was deemed too great to permit of any immediate communication in case of alarm.

At this period (1803) those works previously undertaken, which had
had entirely disappeared. The
sea had carried away from 15 to 18 feet of the summit, giving to the
breakwater the following configuration:

<table>
<thead>
<tr>
<th>Section</th>
<th>Base</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior slope, or that to the south</td>
<td>12.50</td>
<td>12.50</td>
</tr>
<tr>
<td>Superior slope, north</td>
<td>47.50</td>
<td>0.20</td>
</tr>
<tr>
<td>Inferior slope, north</td>
<td>9.00</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Upon this base, thus formed by the action of the sea, it was determined to attempt the artificial construction of the breakwater of Cherbourg to
withstand the agitation of the waves. By the end of the year 1809, the central portion of the work was completed to low-water mark of ordinary tides. The modifications and changes which the original breakwater had undergone, led to the conclusion that the small stones of which it was composed, would not resist the winter gales; that it would be necessary to consolidate the whole by a superstructure on the south side, composed of immense blocks of stone, to be raised to the height of the highest tides, as the only means of covering the breakwater, and of keeping it away from the interior of the work by the north-east and north-west gales of winter. As anticipated, this superstructure resisted the force of the sea, prevented the washing away of the smaller materials, which, arrested by this barrier, gradually augmented the height of the breakwater, forming a solid and compact surface at a new slope, of which the base was about quadruple the vertical height.

It was, however, soon observed, that these small stones pressed up, and, transported by the waves, filled the interstices of the new slope, and yielded to the same action in north-east and north-west gales. Under these circumstances of weather, of frequent recurrence in the winter of 1809, a portion of the stones which had been thrown in on the sea side because subject to a certain degree of displacement, and were deposited in a conical mound at each extremity of the recently elevated central portion of the digue.

It was observed, that the winds and the currents had both tended to give this mound a configuration equal to that of the proposed batteries; and though it was naturally concluded, that the form proposed was that best adapted to insure stability, since it agreed so perfectly with the natural arrangement of the sea itself, and had assigned to the mass of stones set in motion in bad weather, by the waves.

From motives of economy, the interior of the fort was composed of small materials; but the whole was necessarily revetted with large blocks, capable of offering an adequate resistance to the action of the sea. This was performed in the following manner: the small blocks were cast overboard from the stone vessels, above the places which were dry at low water. In five or six days this was discontinued, and the stone vessels were moored over the required spot, or were sunk, so as to rest upon a heap of stones placed at the base of the revetments. The vessels, their blocks and stone, were hoisted by their own tackle clear of their decks, when they were transported by cranes, or derricks, disposed on the summit of the breakwater, and deposited in their proper places on the revetments.

These simple and expeditious means, the central portion of the breakwater having been raised to the height of 2 metres 99 centimetres above the level of high-water, during tides, upon an extent of 195 metres in length, and 19 metres 40 centimetres in breadth. The establishment of a breakwater, armed, provisionally, with forty 32-pounders and two heavy mortars.

In the subsequent construction of the terreplein and part of the parapet of the battery, owing to the bad weather and too great haste in constructing it, it was necessary to use stones of which the stones of the parapet, and a violent gale coming on the exterior revetment was completed, a portion of the temporary parapet, which had been formed with small materials not cemented, was destroyed. The mass of the battery suffered no injury; and the centre and the extremities of the terreplein resisted the action of the sea without the least alteration, and, notwithstanding the insufficient height and imperfect state of the exterior revetments, a garrison of 60 men remained in the battery in perfect safety.

In May 1809, the works were sufficiently advanced to arm the battery with 30 pieces of ordnance, and to place the terreplein in repair.

The works suffered little material injury until the 18th February 1809, when, during a dreadful gale from the north-west, the sea submerged the battery, destroyed and swept away the terreplein, and the wooden barracks of the garrison.

The main effect of this violent gale was to put an end to any further displacement of the materials; and the work has ever since presented the appearance of a natural slope of rocks, over which the ordinary "varebbe" crosses, and are developed in a compact and undisturbed mode which proves the perfect stability of the work.

The examination made at this time of the new configuration which had been given to the breakwater, and verified by subsequent experience, has established the fact, that breakwaters thus constructed, and exposed to the action of the sea, assume, between their summit and their base, four slopes essentially different, and which vary according to the violence of the sea and the action of their action at the several parts in the rise and fall of the tides.

The situation of the exterior revetments of the battery being the effect of the natural action of the sea in its greatest agitation, was considered as that most suited to insure the permanency of the materials of which the work was composed; and, accordingly, after the storm of 1808, new breakwaters were constructed for 60 men; a new parapet was raised to cover the artillery of the port, but without making any modification in the exterior slopes, which have ever since maintained the exact degree which the sea had assigned to them, though these slopes have, since that period, never had the least care bestowed on them.

The digue thus completed in its central portion, remained armed with 20 pieces of artillery during the whole war. In the year 1811 it was decreed to substitute for this temporary fort a permanent defence, thus decreed in the decree dated 7th July of that year:

The central portion of the digue in the future line of breakwater of Cherbourg will be constructed in an elliptical tour of masonry, of dressed blocks of granite, of which the great axis shall be 35 toises, and the smaller 19 toises, in conformity with the plans and sections annexed to the present decree, and to follow the specific orders for the digue itself, these to be performed at the cost of the state, with a garrison of 120 men, of which the walls will be pierced with 78 loopholes, capable of containing a garrison of 60 men, water-cisterns, and powder-magazines.

The gorge of the battery will be defended by two flanks. A second platform will be constructed above the casemates, to serve, in case of the necessity of covering the second platform. That portion of the existing battery without the site of the tower will be preserved, and the slopes towards the sea, which protect it, will be carefully kept in repair.

BREAKWATERS OF CHERBOURG AND PLYMOUTH.

ANNEX (N).—Report made to the Academy of Sciences, Paris, by M. Girard, in the name of the Commissioners of the Marine, Piron, Girard, and Dupin, upon a Mémoire by the Baron Cauchy, Inspector-general of Bridges and Roads. entitled, "Mémoire sur l'Étude des Digue de Cherbourg, comparé avec celui de Plymouth." The Secretary of the Academy of the Mathematical Sciences certifies that the following are extracts from the proceedings reported in the sitting of Monday, May 3, 1816.

The Commission appointed in 1799 assured itself by an attentive observation of the effects of the sea upon the digue, that the materials of which it was constructed had not suffered any change; and it was ascertained that there were no rocks of from 15 to 50 feet cube at least; but the most important modification which this Commission proposed in the construction of the work was, to carry the summit to the height of three metres above the highest spring tides. It was only under the pressure of the solidity of the work itself, which was the main object it intended to effect. The old digue or jetty, which had been provisionally carried up to the level of low-water mark in the year 1784, had now offered an experience of 25 years. It was ascertained that the action of the waves had taken place at the amount of three metres above the level of low-water mark, and it was found that the sea was entirely changed, and presented two distinct slopes; that of the lower portion was of 9 metres of base to 6 metres 38 centimetres of vertical elevation, whilst the inclination of the superior or upper slope had become five metres 19 centimetres; that is to say, of 47 metres 50 centimetres base to 6 metres 20 centimetres vertical height.

These observations demonstrated what was the profile of the greatest stability, which was the market-point of the work, and as it was remarked that the principal effect of the action of the waves, in strong winds from seaward, was to carry from the outside to the inside of the breakwater the materials of which it was composed, it became necessary, having opposed a sufficient obstacle to this displacement, to abandon the action of the water, and to place the exterior surface which was exposed to its force in the manner and in the slope most suited to their object.

Accordingly, towards the end of the year 1808, M. Cauchy was caused to raise in the top of that portion of the digue which had been already elevated, a sort of parapet, built with very large blocks, of which the summit was carried up to the level of the highest tides; thus the smaller stones which had been cast into the sea, by chance, or by the sea itself, that the 50 toise wide, were borne up by the force of the waves to the foot of this parapet, and were there disposed on a regular slope, offering the least resistance to the movement of the waves, possessed the greatest stability. During the passage of the current, the central base of the exterior slope became about quadruple that of its height.

Besides the movement of the materials in a vertical direction, whenever the wind blows hard from the north, or perpendicular to the digue, these waves produce an impulsion from the effects of the wind which blow from the north-east and north-west, and in consequence of this impulsion two accumulations have been formed at the extremities of that central portion of the digue destined to support the battery, in the shape of two conical mounds, which serve for épaulements for the work.

This peculiar configuration, the effect of natural causes, is also found to
The combination of extraordinary circumstances produced such a heavy sea that it submerged the floor of the battery, upset the parapet, and destroyed the wooden buildings which had been constructed on the terraplen of the work for the accommodation of the garrison.

The last-mentioned storm, the most violent on record, stowed the large blocks of stone with which the digue had been faced in fresh slopes, and with such regularity that they appeared to have been cemented by the hand of nature. The successive examinations which have since been made have proved that, by the effect of this extraordinary overthrow, the materials have acquired a most perfect stability.

These examinations have also taught, that this equilibrium once established, the transverse section of the digue on the sea side, assumes four essentially different slopes from the summit to the bottom of the sea.

Thus, the upper part, which is only reached by the tops of the waves, presents a slope of which the vertical height is to the base as 100 to 185.

The portion immediately below this, comprised between the high and low water (equinoctial) marks, is exposed to the most violent action of the sea during the whole flood and ebb; its slope is likewise the most inclined, the height being to the base as 100 to 64.

Below the low water of the side, and extent of the works respectively requisite to complete the Digue de Cherbourg and the Jetty or Breakwater of Plymouth; and also between the probable expense of each. The result of this is very simple, and easy to comprehend.

The length of Cherbourg Digue is 5,878 metres, and the area of its transverse section is 1,834 square metres. The expense of one metre of this profile, upon an experience of 16 years, is 9,717 francs. The length of a square metre of granite; its profile, 993 square feet; and the expense of construction, 14,691 francs the metre.

After the experiences of these two works, incomparably the greatest of their sort which the mind of man has ever contemplated to undertake, M. Cachin concludes with the remark: "if man be able to keep together rocks in the midst of the ocean, the action of the sea can dispose them in the manner most likely to ensure their proper stability.

Your Committee, partaking in this opinion, consider that the able engineer, in making known the result of his observations on the difficulties which he has encountered in the execution of his important labours, the means he has put in operation to surmount them, and, above all, his observations upon the configuration of both waters, of which, according, so sagaciously, to give to obstacles opposed to them, has rendered eminent service to those who may be hereafter called to the direction of similar operations. We have the honour, in consequence, to propose the insertion of M. Cachin's Mémoire in the collection of the foreign men of science.

Decorating the Palace at Westminster.

Report of the Committee appointed to select subjects in Painting and Sculpture, with a view to the future Decoration of the Palace at Westminster.

Your Committee have first to observe that the general plan on which subjects were proposed to be selected has been defined by the Commissioners in their sixth report to her Majesty, in the following words:—"In accordance with the principles which have already guided us in the plan of Decoration in the House of Lords, viz., with reference to fresco-paintings, stained windows, and statues, proposed for that locality; and also in the selection of statues proposed for St. Stephen's Porch, St. Stephen's Hall, and the royal approaches: we conceive it to be the duty of this Commission, for the better guidance of present and future artists, and in order to maintain a character of harmony and unity worthy of such a building, to determine a complete scheme for the future decoration of the Palace. We are of opinion, that in determining such a scheme, the especial destination of each portion of the building will be considered as a necessary object to be regarded; that the expression of some specific ideas; and the second, its illustration, by means of some well-known historic or poetic incident adapted for representation in painting."

The duty which has devolved on your Committee being thus defined, their labours have been directed to the selection of subjects in accordance with the principle above explained. They have, for the present, given their attention to subjects for painting; of the considerable number of instances selected, some might with propriety be erected, having been before proposed, and of these, some have been selected by former Committees for particular localities.

St. Stephen's Porch,

Containing two compartments, one measuring 36 feet high (to the point of the Gothic arch) by 12 ft. 8 in. wide; and the other measuring 11 ft. 8 in. high, to the point of the arch, by 11 ft. 4 in. wide.

In this Porch will be four pedestals, on two of which has been recommended to place the statues of Marlborough and Nelson; and your Committee were of opinion that the subjects of Peace and War would be appropriate in the two compartments intended for painting.

St. Stephen's Hall,

Containing on the side walls, eight compartments, each measuring 14 ft. 6 in. wide, by 9 ft. 8 in. high; and two end compartments, each measuring 30 ft. 9 in. high, to the point of the arch, by 11 ft. 8 in. wide; the other measuring 17 ft. 8 in. high, to the point of the arch, by 11 ft. 8 in. wide.

An opinion has before been expressed, by the Commission generally, that as St. Stephen's Hall stands on the spot where the House of Commons was, during many centuries, in the habit of assembling, it should be adorned with statues of men who rose to eminence by the sequence and abilities which they displayed in that House. Twelve personages selected on this principle, were accordingly named in the fourth report of the Commission to her Majesty.

Your Committee conceived that the walls might properly be decorated with paintings, illustrating some of the greatest epochs in our constitutional, social, and ecclesiastical history, from the time when the Anglo-Saxon nation embraced Christianity to the accession of the House of Stuart; and that the following subjects would be well adapted for this purpose:

I. In the State.—(For the Side Compartments).

- A Sitting of the Wittenagemot.
- The Abolition of Villesenge.
- The Signer of Magna Charta.
- The Privileges of the Commons asserted by Sir Thomas More against Cardinal Wolsey.

An early Trial by Jury.

II. In the Church.—(For the End Compartments).

- The Conversion of the Anglo-Saxons to Christianity. The Preface of St. Augustine.
- The Reformation. Queen Elizabeth receiving the Bible in Cheapside.

West End.

The Central Hall,

Containing four compartments, each measuring 17 ft. 7 in. high, to the point of the Gothic arch, by 12 ft. 7 in. wide; and three small panels underneath three of the large compartments, each measuring 5 ft. 5 in. high, to the point of the arch, by about 4 ft. 6 in. wide.

Your Committee, being informed that this Hall is the central portion of the whole building, were of opinion that the nationality of the component parts of the United Kingdom should be the idea here illustrated, and would appropriately be expressed by representations of the four patron saints, St. George, St. Andrew, St. Patrick, and St. David, in the four compartments intended for painting; and that in the three small spaces underneath three of the compartments the heraldic emblazonments of the Orders of the Garter, of the Thistle, and of St. Patrick, might be introduced.

Corridors from the Central Hall,

Consisting of the Peers' Corridor, the Commons' Corridor, and the Central or Public Corridor.

Your Committee were of opinion that the corridors which join the two Houses might properly be decorated with paintings illustrative of that great contest which commenced with the meeting of the Long Parliament and theoust the holy fathers, monks, and friars, in their confession, and specially in their extreme and deadly sicknesses, burdened the conscience of them who they had under their care, so that, by reason of that terror in their conscience, were glad to maim or all their vileness."—Sir Thomas Smith's "Commonwealth," book iii. c. 19.
and terminated in 1699. It will be seen that the subjects have been
selected on the principle of parallelisms, and that an attempt has been
made to do justice to the heroic virtues which were displayed on both
sides.

The Parks’ Corridor,
Containing eight compartments intended for painting, each measuring 9 ft. 9 in. wide by 7 ft. 6 in. high.

Charles I. erecting his Standard at
Nottingham.

Resigning House defended by the
Cavaliers against the Parliamentary
army.

The Expulsion of the Fellows of a
College at Oxford for refusing to
sign the Covenant.

The Burial of Charles I.

The Commons’ Corridor,
Containing eight compartments intended for painting, each measuring 7 ft. 6 in. wide by 6 ft. 6 in. high.

Charles II. assisted in his Escape by
Jane Lane.

The Executioner tying Wharton’s
book round the neck of Montrose.

Mons de laisser for a Free Par-
liament.

The landing of Charles II.

The Central Corridor,
Containing six compartments, each measuring 8 ft. 9 in. high by 7 ft. 6 in. wide.

The paintings in St. Stephen’s Hall, and in the corridors which join the two Houses, illustrate the gradual progress of our institutions during the interval which elapsed between the introduction of Christianity and the Revolution. It has been thought that the corridors might with advantage be adorned with paintings exhibiting in strong contrast the extremes which are separated by that interval. With this view, six subjects have been selected: in three, Britain appears sunk in ignorance, bloodshed is the constant companion of the throne; in the other three, she appears instructing the savage, abolishing barbarous rites, and liberating the slave.

The Phoenix is in Cornwall.

A Dravidian sacrifice.

Asio Saxos Captivas exposed for sale in the Market-place of Slaves.

The Upper Waiting Hall.

The subjects for six (out of eight) compartments in this locality, have been before proposed to be selected from the following poets: Chaucer, Spenser, Shakespeare, Milton, Dryden, and Pope. The choice of such subjects being left to the artists appointed, or to be appointed, to execute them, after they shall have been approved by the Commissioners.

The House of Peers.

The subjects for the six compartments intended for painting, and the selection of historical personages proposed for statues to be placed in the niches, as well as the decorations for the stained windows, have been determined by former Committees.

The Peers’ Robing Room,
Containing three large compartments, two measuring 20 feet wide by 10 ft. 6 in. high, the third measuring 22 ft. 6 in. high; and six smaller compartments, each measuring 7 feet wide by 10 ft. 6 in. high.

Your Committee being desirous to vary the proposed decorations, and according to Scripture subjects, as affording scope for the highest style of design, and as being especially eligible for other grounds, should by no means be excluded, considered that the above-named locality, in which the principal compartments intended for painting, are of considerable magnitude, would be well adapted for such subjects. Your Committee were of opinion that the illustrations should have reference to the idea of Jesus as the foundation of all, and its development in Law and Judgment, and that the following subjects would be appropriate:

In the single large compartment on the west side, 1. Moses bringing down the Tables of the Law to the Israelites.

In the two smaller compartments on the east side, 2. The Fall of Man, and 3. His Condemnation to Labour.

On the south side, 4. The Judgment of Solomon; and in the two small ones, 5. The Visit of the Queen of Sheba, and 6. The Building of the Temple.


The Royal Ante-Chamber,
Containing in the upper part of two of the walls, six large compartments (from north to south), measuring 18 feet wide by 10 feet 6 inches high.

Twenty-eight upright narrow compartments, measuring 5 feet 7 inches high, by about 3 feet 6 inches wide; and 12 panels for carved work, four measuring 6 feet 9 inches wide, by 3 feet 9 inches high; and eight measuring 5 feet 7 inches square.

Your Committee considered that the six large compartments in this locality, being at a considerable height, might be filled with copies in tapestry, of the defeat of the Spanish Armada, taken either in part, or altogether from the designs of the tapestry originally existing in the Houses of Lords, which your Committee conceived, it is of great importance to preserve, as far as possible, to the nation.

That the 28 upright compartments might be appropriately filled with portraits relating to the Tudor family.


That the twelve panels might be filled with the following subjects in carpet work:

1. 2. The Field of the Cloth of Gold, and the visit of Charles V. to Henry VIII., in the two compartments on the east and west sides.

3. 4. The Escape of Mary Queen of Scots, the Murder of Rizzio, and Mary’s return to France, in the three compartments on the south side, west of the door. The Escape of Mary Queen of Scots occupying the central panel.

5. 6. Queen Elizabeth kneeling Drake, Raleigh spreading his Cloak as a banner for the Queen, and Raleigh landing in Virginia, in the three compartments on the south side, east of the door. The subject of the kneeling of Drake occupying the central panel.

7. 8. Queen Elizabeth kissing Drake, Raleigh spreading his Cloak as a banner for the Queen, and Raleigh landing in Virginia, in the three compartments on the south side, west of the door. The Escape of Mary Queen of Scots occupying the central panel.

9. 10. 11. 12. On the north side, Edward VI. granting a Charter to Chelsea Hospital; Lady Jane Grey; the execution of the second Trent Martyrs; and the marriage of the Princess Elizabeth.

The Royal Gallery.
A considerable space on each side wall, measuring 77 feet 6 inches wide, not being subdivided into compartments, your Committee were of opinion that such space should be occupied by one large, and two smaller subjects; the smaller corresponding in width with the width of one window, and measuring 18 feet 6 inches wide by 11 feet 6 inches high; the larger comprehending the width of three windows, and measuring 45 feet wide by 11 feet 6 inches high. Of the remaining compartments, defined by the architect, two on the side walls measure each 13 feet 3 inches wide by 11 feet 6 inches high; four on the same level, in the end wall, measure 15 feet 5 inches wide by 11 feet 6 inches high; the six remaining compartments, three at each end, in the upper part of the walls, measure 12 feet 6 inches wide by 19 feet 7 inches high. The compartments would therefore be eighteen in number.

Your Committee were of opinion that the subjects for the Royal Gallery should relate to the military history and glory of the country, and that the following subjects would be appropriate:

In the three upper compartments in the south wall:

1. Boudicca inciting her army.


3. Brian Boromhae overcoming the Danes at the Bridge of Clostraff.

4. The three upper compartments in the north wall:

5. Edith finding the dead of Harold.


7. Eleanor saving the life of her husband, afterwards Edward I., by sucking the poison from a wound in his arm.

In the compartments next the proposed large compartment on the west wall:

8. Bruce, during a retreat before the English, protecting a woman borne on a litter, and checking the pursuers.


In the lower compartments on the north wall:

10. Edward the Black Prince entering London by the side of King John of France.

11. The Marriage of Henry V., at Troyes, with the Princess Katharine of France.

In the compartments next the proposed large compartment on the east wall:

12. Elisabeth at Tilbury.

13. Black at Tunis.

In the remaining compartment on the east wall:


In the lower compartments on the north wall:

15. The Death of Wolfe.

16. The Death of Abercrombie.

In the remaining compartment on the west wall:
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL. SEP. 10. Lord Cornwallis receiving the Sons of Tipoo as hostages. In the large compartment on the west wall:—
In the corresponding compartment on the east wall:—
16. Waterloo; the meeting of Wellington and Blucher.

THE QUEEN'S BORING ROOM,
Containing compartments of various dimensions, adapted for painting and other decorations.
Your Committee, influenced by the considerations before expressed as to the securing of varying the character of the decorations proposed, were of opinion that a series of paintings, and other works of art, illustrating the legend of King Arthur, would be appropriate in this locality; and your Committee unanimously agreed to recommend to the Commission, that the two compartments next the corners should be set apart and the pictures in the three corridors leading from the Central Hall, and the pictures in the Refreshment Rooms should be painted in oil; and that the Queen's Robing Room, St. Stephen's Hall, and the Royal Gallery should be painted in fresco. The representations of the four Patrons Saints, from their size and situation, might be advantageously executed in mosaic (like the four Evangelists in the pendentives of the Cupola of St. Peter's), thus giving an opportunity for the introduction into England of an art highly valued in other times and countries.

Your Committee have further to observe that movable oil paintings, not coming within the general plan proposed, might be placed in Refreshment Rooms and in other parts of the building.

BRITISH ASSOCIATION.
(Continued from page 561.)

"On Anemometers and Resolving Scales." By Captain Cockburn.

The advantage of a correct statement of the winds at sea has, for some years, been most apparent to me. Since the introduction into the naval service of a certain formula for stating the force of the wind, represented by the number 1, it has been the object of a well-conditioned man-of-war, and this depending upon the opinion of the officer of the watch, the notations are as various as the opinions on such a subject must be; and I certainly have seen great discrepancies noted on the ship's log-book. This evident evil is the immediate cause of my attempting to make an anemometer which might correct it. The concave form of the revolving wings of this instrument was taken from a paper read on the subject last meeting. The concave surface holding one-third more wind than the convex, by theory it would revolve one-third as fast as the wind; consequently, three times the distance described by a cup in a revolution would be the velocity of the wind in the time occupied; this is supposing the form of the cup to be a perfect hemisphere, and no friction either in the mechanism of the instrument, or the air itself; but as there must be friction and resistance from both these causes, this necessity involves a correction, which must be determined by experiment, in order to establish the value of the revolutions. From the experiments I have made on the top of railway carriages and in steam boats, the correction for the large sized cups is '5 or 4. I do not by any means consider this to be decisive; the results have been various, from the unsteadiness of the wind during the trials, and from the mass of air carried along by the moving body: this will make the multiple 3 to 4 instead of 3. If I persuaded my friends that a different multiple will be required at moderate and at great velocities; but I have not been able to ascertain it. This value depends also upon the circumference of the circle described by the cups, their form, and weight. I shall not enter into the relative advantages of the forms I have had made: the diameters of each are, from centre to centre of the cups, including the arms, 12, 10, and 8 inches. Those simple multiplying wheels I have used may be substituted by the plan adopted for gas-meters, which I think preferable.

"On Changes in the Position of the Transit Instrument occasioned by the Temperature of the Earth, from the Observations of Prof. C. P. Smyth, of Edinburgh." By Prof. Powell.

Mr. Mallet, in an address to the Geological Society of Dublin, mentioned that Sir W. R. Hamilton had noticed certain changes of level is the transit instrument, and that Dr. Robinson had also found such a change both in the general level of the observatory and also a motion in azimuth, recurring at annual periods, and apparently depending on the temperature of the earth—but no details of each observation were given. Prof. C. P. Smyth has pursued such observations in detail at the observatory on the Calton Hill, Edinburgh, aided by the thermometric determinations of the changes of the temperature in the subjacent soil, made under the direction of Prof. Forbes, by thermometers sunk in the ground. The data used were those observed within depths of 6 feet, 3 feet, and in contact with the pier of the observatory. The movements, both in the level of the transit, and also in azimuth, are laid down graphically in curves, and exhibit a remarkable agreement with the changes in temperature, the western end Crossing being quite in summer, and the deviation from the east end of the transit axis being greatest towards the south in winter.

"On the Coloured Glass employed in Glazing the new Palm House in the Botanic Garden at Kew." By R. Hunt.

It has been found that plants growing in stove houses often suffer from the smothering influence of the solar rays, and great expense is frequently incurred in fixing blinds to cut off this destructive caloric influence. From the enormous size of the new Palm House at Kew, it would be almost impracticable to adopt any system of shades which should be
of colouring maps by introducing a system capable of universal adoption. The same colour, he says, should always be employed for the same group of rocks, various shades of that common colour being sufficient to distinguish, and at the same time combine, all the subdivisions of that group. Again, the colours used to designate systems of strata should follow in some constant order. The chromatic scale naturally suggested itself as the most harmonious gradation of colours, and accordingly Mr. Salter proposed to represent the Silurian strata by Violet; Carboniferous, Blue; Triassic, Green; Oolitic, Yellow; Cretaceous, Orange; Tertiary, Red. It was necessary to use a more intense red, with the addition of various markings, for the granite rocks.

Mr. Greenwood referred to the pamphlet accompanying his geological Map of England, for an exposition of the principles by which he was guided, which were approved by the English geologists, and from which the French had departed with regret. Mr. Phillips and Sir H. de la Biche recommended the adoption of one colour for each system, employing engraved lines of various kinds to distinguish the subdivisions, thereby diminishing the cost and increasing the accuracy of coloured maps. Sir R. I. Murchison said he had once attempted to apply the scheme now advocated by Mr. Salter, but found it, practically, less serviceable than Mr. Greenough's, which was the basis of all the other maps.

**HYDRAULIC MACHINE FOR RAISING WATER, &c.**

Invented by Michael Scott, Engineer of the Liverpool Water Works.

This machine was originally planned as a substitute for the common air pump in marine steam engines. As such I will first speak of it. Some years ago I was engaged in designing an engine which was destined to be used in an hydraulic pumping machine, and the object difficulty was the air pump and its attachments, which, if the ordinary arrangement was adopted, would occupy valuable space and make the engine complex. Observing this, I determined, if possible, to get rid of this pump altogether, and with this view, designed the machine as represented in Fig. 1, where A is a pipe passing through the bow of the vessel, which, at a convenient distance aft, diverges into two branches, which branch pipes again respectively debouch into the sea near the stern. D is a double hinge valve, movable by a brass rod passing through a stuffing box on the top of the pipe. By this rod the valve D may be thrown to either side of the chamber so as to shut the communication between the pipe A and the pipe B or C, as the case may be, on the one side, and on the other side, so as to open the port between one of the pipes B or C and the pipe E, which descends from the condenser.

It will be observed, also, that there are two valves marked 1 and 2, one in each pipe opening upwards, which allow the water to pass out, but prevent its return. These valves may be equilibrated, and also opened or shut, by a crank joined to the axle which passes through the side of the pipe. So much for the construction; now for the mode of action. Suppose the ship to be in motion (going ahead) and the valve D in the position shown, then the water will rush through the pipe A, and there being no obstruction offered, will pass through C and out at the stern. But let us throw the valve D to the other

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**On the Potassium Battery.** By Mr. Goodman.

An amalgam of mercury and potassium was placed in a vessel closed with a diaphragm at one end, and holding mineral naphtha. This was plunged into a bath of acid or salt below and in the point fixed by Sir William Herschel, Sir H. Englefield, and Sir J. Herschel, as the point of maximum colorific action. As it is to this class of rays that the searching influence is due, there is every reason to conclude that the use of this glass will be beneficial in protecting the plants, and at the same time, as it is unobjectionable in point of colour, and transparent to that principle which is necessary for the development of those parts of the plant which depend upon external chemical excitation, it is only partially so to the heat-rays, and it escapes to those only which are the most injurious. The absence of the oxide of manganese, commonly employed in all sheet glass, is insisted on, it having been found that glass, into the composition of which manganese enters, will, after exposure for some time to intense sun-light, assume a pink hue, and any tint of this character would completely destroy the peculiar properties for which this glass is chosen. Mr. Leesol, in his investigations on radiant heat, discovered that a peculiar green glass, manufactured in Italy, obstructed nearly all the colorific rays; we may, therefore, conclude that the glass chosen is of a similar character to that employed by the Italian philosopher. The tint of colour is not very different from that of the old crown glass; and many practical men state that they find their plants flourish much better under this kind of glass than under the white sheet glass, which is now so commonly employed.

**On a System of Colouring Geological Maps.** By J. W. Salter.

Hitherto geologists have represented the British strata by colours taken from the general hue of the rock, modified by the necessity of using bright tints and distinguishing adjacent formations by colours strongly contrasted. Continental geologists have not entirely adopted these colours, nor is there perfect accordance even in the maps of England. Mr. Salter proposed to remedy the inconvenience and uncertainty attending the present method.
side of the chamber, as shown by the dotted lines, the water entering at A now flows through pipe B, but the water in pipe C having been in motion its momentum will carry it forwards in the original direction, leaving a vacuum behind; at the same time it will be observed, that the port has been opened between pipe C and the condenser, and the water of condensation and vapour will rush out of the condenser into the pipe C, and then reversing the valve D, the same effect is produced in pipe B, and so on alternately.

Having thus briefly explained the form and operation of the machine, we have now to inquire what extent of vacuous space is likely to be obtained under ordinary circumstances.

Let \( P \) = the weight of the column of water in lbs; \( G \) = the coeff. of gravity = 32; \( V \) = the velocity in feet per second.

Then the vis viva of the water is \( \frac{P}{G} V^2 \).

Again, let \( A \) = the area of the pipe in square inches; \( R \) = the resistance due to the immersion at atmospheric pressure; \( L \) = the length of the vacuum in feet.

Then we have the mechanical effect overcome by the water while stopping = \( A \times R \times L \). But this mechanical effect is equal to half the vis viva.

Hence, \( A \times R \times L = \frac{P}{G} V^2 \), or \( L = \frac{P \times V^2}{2 \times A \times G} \).

Let us now apply this formula to a particular case. Suppose the vessel to be 116 feet between the perpendiculars, and the length of the pipe to be 90 feet, diameter 6 inches; say she is propelled by one engine of 30-inch cylinder, and 8 feet stroke, then the air-pump would have a capacity of about 4,500 cubic inches.

Again, take the speed of the vessel at 14 miles per hour, or 20 feet per second, then we have:

\[
P = 1022 lb. \quad A = 58 \text{ square inches.} \\
G = 32 \quad V = 20 \text{ feet per second.} \\
R = 17
\]

\[
L = \frac{1022 \times 20^2}{2 \times 32 \times 17} = 14 \text{ feet 4 inches.}
\]

The contents of which is 4896 inches, and with a velocity of 20 feet per second, the machine will make one stroke per second, whilst the engine will not go above 45 strokes at most; therefore, the machine would be one-third more powerful than the pump.

Though the above example proves the practicability of the application as a substitute for the air-pump in such cases as contemplated, viz., light river boats moving at a high velocity, still I wish to be clearly understood that in ordinary cases, such as we meet with in this country, I would prefer the common air-pumps, which are more effective, but there are circumstances in which this machine might be adopted with advantage, and which may excuse the introduction of the foregoing.

Applying as a Ship's Pump —The arrangement for this purpose is remarkably simple, being identical in principle with that just described, but different in detail. Fig. 3, a plan and Fig. 4, a vertical section, showing the valves. It will be observed that the general form is similar, but the construction of the valves, unlike the machine previously explained, is less complicated. In the present case, the valve D is a single hinge valve, movable as before, by a rod passing through the top of the pipe; secondly, instead of the valve at E, Figs. 1 and 2, we have here two valves, 1 and 2, opening upwards, being placed on the top of pipes E, passing into the bilges; and, lastly, we dispense altogether with the valves in the branch pipes. Presuming I have made myself understood so far, let us suppose the ship at sea in a gale of wind, and leaking badly, and let the valve D be in the position shown, then the water will rush through the pipe A, pass through C, and out at the stern; then reverse the valve D, the water now flows through B, and at the same time we have the water in pipe C passing on by virtue of its own momentum, leaving a vacuum behind; when this takes place, the valve 2 will open and admit the water from the bilges to fill the vacuous space. On reversing the valve D, the operation is repeated, and so on.

Let us now apply the formula, that we may acquire some conception of the power of the apparatus. I shall take that celebrated ship, the “Great Britain,” with a length of keel = 283 feet; and as it is an object to keep the perforations made by the pipes as small as possible, they must be situated where the line of pipe meets the bend at bow and stern, as nearly as may be, at a right angle. This condition will diminish the effective length of the column to, say 250 feet, diameter of pipe = 12 inches, area 113 square inches, ship's load, draught 16 feet, immersion of pipe 11 feet, or 5 lb. pressure per square inch, speed of ship 12 miles per hour, 17-5 feet per second. Then

\[
P = 12250 \text{ lb.} \\
V = 17-5 \\
R = 5 \text{ lb. per square inch.}
\]

\[
G = 32 \\
A = 113 \text{ square inches.}
\]

\[
L = 12250 \times 17-5 = 2105 \text{ feet.}
\]

The contents of which is 8093 cubic feet nearly. Again, our velocity is 1056 feet per minute, and if we reverse the valve D, when the water has passed on, only 53 feet, then we get the initial velocity 1056 feet, and the final velocity 3288 feet, the mean of which is 792 feet. The machine, at this rate, might make 15 strokes per minute, but if one-third be deducted for friction, &c., or if we get 10 effective strokes (that is 5 to each pipe) we shall have 411 cubic feet, or nearly 12 tons of water thrown out of the ship every minute, equal to 180 pumps 4 inches diameter, and 11-inch stroke, going 30 strokes per minute, and if kept working during 24 hours requiring from 900 to 1000 men. This machine can be kept in operation during the same time by two men, and if desired may be made self-acting.

If the machine be worked at a low velocity, say four miles per hour, it will then discharge 127 cubic feet per minute, which is equal in efficiency to 60 pumps, worked by 300 men.

With respect to the machine as a substitute for the air-pump, it will be observed by referring to Figs. 1 and 2, that on reversing the valve D, the branch pipe into which the water is flowing is nearly vacuous, that is, there will probably be a vacuum equal to 10 or 12 lb. per square inch (I speak of the indicator), and the pressure being thus removed from the end of the column, the external pressure of the water and atmosphere will force the water through the pipe with a great increase of velocity. Suppose, for instance, that the length of the vacuous space (irrespective of that occupied by the water of condensation) was 10 feet, and the elasticity of the vapour filling this space equal to 1 lb. per square inch, then, according to the law which regulates the elasticity of gases under pressure, if we take half the length—five feet, and half the difference between the initial and final pressures—7 lb. per square inch, this will give the force tending to accelerate the velocity of the water through the pipe, viz. 7 lb. per inch acting over a space of 5 feet, and this power is available every time the valve D is reversed.

In the event of the vapour being of greater elasticity in the condenser, say 7 lb. per inch, still as it would be to keep the water in motion in the after part of the pipe, it would reduce the quantity of resistance from 17 lb. per inch, as it stood in the calculation, to 10 lb., so that either view is favourable to the machine. In fine, a considerable amount of the power taken to produce the vacuum is again given out.

Figs. 5 and 6 show an arrangement which might be used advantageously to withdraw water from a cofferdam where there was a current, produced either by the natural stream of a river or by the effect of the tide. The apparatus is supposed to be formed of four planks of wood nailed together, and a section pipe constructed in the same manner. On the top of this section pipe there is fixed a
clack made of leather, with a plate of iron secured to the flap; and as a substitute for the hinge valve, formerly described, we have a piece of wood made to slide through the top, and in two grooves, one at each side of the pipe. The machine being immersed beneath the surface of the river, and a communication made between the suction pipe and the interior of the dam, if only remains to raise the slide $S$, and permit a current to be established inside of the main pipe or box; then by pushing the slide down, a vacuum would instantly be formed, which, as before explained, would elevate the water from the interior of the dam, to be expelled into the river when the slide would again be raised.

I have erected a machine of this form; and as it can be constructed and put in operation in a few hours, and as it is both effective and costs but little, I recommend it to parties who have hydraulic works in progress, where the situation will admit of its being employed.

In conclusion, this machine is evidently applicable to the raising of water, or producing a vacuum, in every situation where we can command a fall or running stream; and experiment having proved it to be superior to the undershot water-wheel, for these purposes, whilst with this great power it combines simplicity, durability, and cheapness, in the highest degree, I am humbly of opinion that it is likely to be extensively used. In which case, the foregoing description will not have been written in vain.

RAILWAY-CARRIAGE BREAKS.

At the last quarterly meeting of the Institute of Mechanical Engineers, held at Birmingham, Mr. G. G. McConnell was in the chair, the following communications were read:

Mr. G. Stephenson, President of the Institute, "On a new Self-acting Break," a beautiful model of which accompanied the paper.

"The various accidents on railways arising from concussions and collisions (and especially the late accident at Wolverton) have induced me to draw my attention to the construction of a self-acting break, which I have been for several years had in view, a plan and model of which I have had made, and now lay before the Society, with my description of its action and effects. When a railway train is moving at the rate of from 40 to 60 miles an hour, the momentum is so great that it cannot be stopped in any reasonable distance by the breaks at present in use; or if an axle-tree breaks, or any accident happens to the engine so as to prevent its progressing, the sudden shock causes the carriages to overturn each other, and those next the engine are almost certain to be crushed. In an accident of this kind, neither engine-driver, stoker, or guard can be prepared, and before there is time for any of them to put on the break at present in use, so as to be in the least degree effective, the collision or concussion has taken place.

The engine-driver shuts off the steam or applies his break on the tender, the self-acting break is immediately brought to bear upon every wheel attached to every carriage in the train so powerfully, if necessary, as to bring every wheel into the condition of a sledge. I think the train will be brought to a stand by this break in one tenth of the space in which it can be by the breaks at present used. My plan is as follows: - I attach a couple of spiral springs to each side of the break of every carriage, and also connect them with the buffers, and if the carriage requires gentle breaking (which will always be the case when a train approaches a station), the engine-driver, by shutting off a portion of the steam, or applying the break gently, will have complete command over the train, without any of those violent uneasy motions, which are very frequent and excessively disagreeable to passengers; and as the guard is frequently compelled to apply his break so powerfully as to make the wheels slide on the rail, and cause considerable amount of wear and tear on the type of the wheel, by which it becomes flat-sided, and makes the carriages uneasy, and creates a jumping motion on the rail. Suppose a train of carriages moving at the rate of from 30 to 40 miles an hour, and a signal is held out for the engine-driver to stop, a break is taken on the steam, the whole of the breaks are brought into instant application of sliding the wheels, which will be more effectual than fifty men applying the common breaks, as the mischief is frequently done before the guard is apprised of the approach of danger. It is frequently necessary for these breaks to be backed into a siding. When this is required, the train will first have to be stopped, and in one minute the whole of the breaks can be disengaged from the buffers, as is shown in the model, and when the train proceeds they are again dropped into gear.

The plan altogether appears so simple that any ordinary mind can easily understand the whole of the action; I think the cost of the break in each carriage would not exceed more than from 5l. to 10l. Any effectual plan for increasing the safety of railway travelling is, in my mind, of such vital importance, that I prefer laying my scheme open to the world, to taking out a patent for it; and it will be a source of the greatest pleasure to me to know that it has been the means of saving even one human life from destruction, or that it has prevented one serious concussion." —In consequence of Mr. Stephenson's absence, the invention was not discussed, it being agreed that a special meeting should be called to consider the subject.

The consideration of Mr. Buckle's experiments on fan blast, now exciting considerable interest, was then resumed. The chief object of Mr. Buckle was to show that the present fan blasts were imperfect in construction and operation. He proposed, as the result of experiments extending over a period of nine years, to have a series of fans, revolving in such a way as that the blast of air thrown from one would be communicated to each. He also showed the advantages of having a large inlet-pipe. By these means it was estimated that not only would the blast be stronger with less horse power, but it would also be uniform; thus improving the quality of the iron, as well as producing it at a cheaper rate.

DREDGE'S SUSPENSION BRIDGE.

Sir,—I beg, in reference to an extract you made from a Calcutta paper, in the last number of your Journal, to observe that I published no statement in the Mechanics' Magazine that I have not documents and drawings by me to substantiate.

Bath, Aug. 23, 1847.

JAMES DREDGE.

REVIEWS.

Tables for the Calculation of Earthworks. By F. Bashforth, M.A.

In our last notice of Mr. Bashforth's tables, we explained to our readers the method of determining the volume of earthwork when the height of the slopes on either side of the trench was the same; and the calculation involved only an integral number of feet and chains; we now propose to show how the tables can be applied to determine the amount of earth both in ordinary and side-long cuttings, when the heights contain decimal portions of feet. Suppose, as before, the slopes of the side-long cutting to be produced until they meet in some straight line below the formation level; then if the vertical sections of such a cutting be similar triangles, we can apply the tables to determine the quantity of earth excavated; all we have to do then is to determine the area of these triangular sections a chain apart, take the square root of the areas, and substitute them for the $a$ and $b$ of the tables.

For the method of using the scale of proportional parts we shall quote the following example, given by Mr. Bashforth himself:

"Suppose $a = 37^\circ 68'$

$b = 12^\circ 53'$

By the general table ($37^\circ 12'$) = 1595

Place 37 on (A) for $6$ we get $42$

Place 12 on (B) for $6$ we get $53$ $r$

Place 12 on (A) for $5$ we get $24$ $r$

Place 87 on (B) for $2$ we get $1$ $r$

Therefore ($37^\circ 68$, $12^\circ 53$) = 1699 nearly.

The mode of construction of the scale is so minutely explained by the author, that any illustrations of our own would be quite superfluous. In conclusion, we cannot but express a hope that this will not be the last time we shall have the pleasure of recording no other member of the profession possesses an equal amount of scientific knowledge with Mr. Bashforth; and we trust that gentleman will not allow the talent committed to his care to be idle. There is plenty of room for a skilled and plenty of occupation for men of science amongst engineers; and while we are willing to admit the paramount importance of a practical acquaintance with details, we must firmly declare that unless the engineer combines with that knowledge of facts a knowledge of principles, the lives of both parties will be jeopardised whenever they are intrusted to the stability of his structures.

The Double Gauge.—Observations by Mr. R. Stephenson, on Mr. Brunel's report on the Double Gauge.

The public were greatly indebted to the scientific labours of Mr. Robert Stephenson for opposing the fallacious reasoning of the advocates of the atmospheric railway system, in the height of its popularity—he has now, in a work recently issued under the above title, in a masterly manner laid the axe at the root of the double gauge system, recently promulgated and proposed to be adopted on the Oxford and

* A railway break, answering a similar purpose as the one described by Mr. Stephenson, has been patented by Mr. Bunton, and described in the "Journal" for 1847, page 72.

Rugby railway. He has in his report exhibited in their true light the
great danger and difficulties attending such a project. We shall here
briefly give Mr. Stephenson's reasons for the conclusions at which he
has arrived.

Although Mr. Stephenson admits the possibility of laying an inter-
mediate rail, he entirely disregards from Mr. Brunel; as to the number
of crossings required. He states that on the 112 miles of the London
and Birmingham line, 65 crossings are required, and where there is a
mineral traffic a still larger proportion. Even on the Great Western
no less than two crossings are allowed to the Slough station. Work-
ing out in detail Mr. Brunel's rough sketches, he shows that according
to one plan there must be at each crossing two additional half switches,
two additional crossing points, two additional pairs of overcrossing
points, four additional gaps, and three additional meeting points.
On another plan, two additional switches, two crossing points, two
overcrossing points, six gaps, and four meeting points—all additional,
to be passed over by trains of either gauge. On another, two auto-
maton switches of dangerous construction, to be passed over by all
trains—one of which being placed the wrong way, would meet all the
trains in one direction—with two half switches, four crossing points,
two overcrossing points, six gaps, and four meeting points—all addi-
tional, to be passed over by every train.

From this Mr. Stephenson argues that great difficulty and danger
would be brought into railway traffic, and that the increase of inter-
ruptions or gaps in the line would be as two to one in the present
system. Mr. Stephenson concludes, 1st. That the mixed gauge system
increases the complication very much, so as to be inadmissible. 2nd.
That it increases the danger greatly. 3rd. That it increases the ex-
 pense. His estimate of the increased expense per mile of a narrow
gauge line is very large, and figures a broad gauge at 1,200 l. per
year. He calculates the gross capital cost as equivalent to 18,474 l.
per mile, while he denies that there is any equivalent advantage.

The drawings of points and crossings attached to Mr. Stephenson's
report show the great complexity to which they have arrived in the
progress of railways, and the great attention now required in their
study. Members of the profession will therefore derive great ad-
vantage from these practical examples.

The Barony and Ecclesiastical Antiquities of Scotland Illustrated.
Part II.

The second part of this work illustrates the chapel of Holyrood, as
the first part did the cathedral of Glasgow, and we can now recom-
 mend it with still greater confidence as worthy of support.

The Engineer's and Contractor's Pocket-Book, for the Years 1847 and

This work contains the usual very valuable information, and much
additional matter that will be useful to the engineer; but we doubt
the policy of leaving out the standing orders, which, in consequence
of the alterations made this year, particularly interest engineers and
surveyors.

REGISTER OF NEW PATENTS.

GAS METERS.

THOMAS FOWDEN, DICKENSON, of Newcastle-upon-Tyne, share-
broker, and JOHN FALCONER, of the same place, gas engineer, for "cer-
tain improvements in gas-meters."—Granted December 15, 1846; En-
rolled June 15, 1847.

![Fig. 1](image1)

This invention relates to the construction of wet gas-meters, for
preventing any tampering with the meter, by tilting it, to produce a
greater flow of gas through the meter than indicated by the index.

By the improved meter, if it be tilted, no gas will pass through it.

Fig. 1, is a front elevation of the improved meter, showing part of
the interior, and fig. 2, a vertical section through the centre of the
same; 1, 2, is the exterior case, within is the drum, 3, on a horizontal
axis, 4, with an endless screw on the front end, which takes into a
worn at the bottom of the vertical axis 5. The upper end of this
axis 6, is also provided with an endless screw, gearing into the first
wheel 7, of the index apparatus. The front plate 2, has a chamber, 7,
in front divided by a partition 8, 9, 10; the space beneath the lowest
part 8, is for water, it communicates with the water in the case 1, 2,
through two openings 11, 11, the space above the partition 8, is divided
into two, being for gas. An exit valve 12, with a float is fitted to
an opening in a partition, so that if the water be at the proper level,
the float will raise the valve to allow the gas to pass through the par-
tition 10, to the exit-pipe; but if there be a deficiency of water, the
float will descend and close the valve. On the top is a pipe 14, with
a stopper for supplying water to the case under the partition 8, to
the required level. If there be any excess of water it will overflow
as hereafter explained.

The above parts are similar to the ordinary gas-meters; but the
following, indicated by letters, vary.

- a, gas entrance-pipe communicating with the drum 3, by means of an
- elbow-pipe 5, at the back of the case 1, and protruding through the additional end-plate 6, of
- the gas entrance-pipe 4, a little above the water in the case, for the
- purpose of introducing gas above the water: the pipe b, is introduced into
- the space between the additional end c, and the real end of the
- drum, as in common gas-meters, excepting it is at the back of the
- meter, instead of the front. a', is a continuation of the pipe a, which
descends at the back of the case 1, and is then continued at right
angles along the bottom and again at the front, where there is a small
hole at f. Any excess of water in the case 1, 2, will flow over the
top of the pipe b, and pass down the pipe a, as the escape at the hole,
so that no water will stand higher in the pipe a, a', than the level of
the hole f, and consequently no obstruction is offered to the flow of
the gas from the pipe a, to the pipe b. But if the meter be tilted back-
wards, the water in the case will flow through the pipe b, and the
escape hole f, being raised, in consequence of the tilting, the water
will be retained in the pipe a, a', at the same level as the hole f,
and will prevent the gas passing through the pipe b, into the case 1, 2,
and consequently the measuring will be suspended so long as the meter
remains in that position.

The gas, which during the revolution of the drum 3, is discharged
from the compartments into the upper part of the case 1, 2, passes
through an opening c, into the space above the partition 8, and then
turns through a protection-valve 6, into an elbow-pipe g, and is then
conveyed to the space above the lower part of the chamber 7. From thence the gas ascends through the valve 12, then through the exit-pipe j, which extends over the upper part of the
- case 1, 2, to the back of the meter; so that both the exit and entrance-
pipes for the gas will be at the back of the meter.

If the meter be tilted forward, the water in the case 1, 2, will rise
in the front part of the meter, within the space beneath the par-
tition 8, 9, 10, and against the upright part 9, of that partition, where-
STEAM POWER FOR CRANES.

WILLIAM JOHNSON, of Grosvenor Wharf, Milbank, Westminster, gentleman, for "certain Improvements in machinery for raising or lifting and lowering weights or ponderous bodies."—Granted Dec. 1, 1846; Enrolled June 1, 1847. [Reported in Newton's London Journal.]

This invention consists in a peculiar adaptation of steam power to a drum barrel or cylinder, round which a rope or chain, for raising the weight, is passed. Rotary motion is given to the draught-barrel or pulley by a water-engine; the steam is applied to a piston-rod being attached to a chain or rope, coiled round a winding-drum, of small diameter, fixed upon the axle of the draught-barrel.

Fig. 1 represents the apparatus in a elevation, a portion of the frame being removed to show the internal parts of the machinery more perfectly; and fig. 2 is a horizontal view of the same. A is a rectangular frame of iron, which contains and supports the machinery. It may be fixed firmly into the ground, or mounted upon wheels to admit of its being transported to different parts of a wharf or warehouse. In or near the centre of this frame, A, the working cylinder of a steam-engine, B, is fixed,—its piston-rod, C, C, passing through both ends of the cylinder, for the purpose of rendering the machinery capable of raising and lowering heavy bodies, through the agency of cranes, fixed one at each end, when the machinery is required to be made double-acting, as it is supposed to be in the drawing, although but one crane is shown; but in a single-acting machine it is obvious that the duplicate parts of the apparatus may be dispensed with. D, D, are the upright parts or standards of a crane, with the usual jib, X, and pulleys. Y, Y, is a horizontal axle, turning in plunger-blocks, fixed upon the bottom of the frame. This axle carries a conical pulley, N, which has several grooves formed in it, of different diameters, for the purpose of receiving severally the draught-chain or rope of the crane; the different diameters of the conical pulley being designed to act upon different powers of draught. This pulley is enabled to slide laterally along the axle N, for the purpose of bringing either of the grooves into a line of coincidence with the leading pulley of the crane; and the pulley is confined to the axle, when it revolves, by a key passed through a notch in the pulley; or it may be by the axle in that part being formed square. Upon the axle there is also a smaller pulley, R, fixed to the axle, and turning with it. This pulley is intended to receive the coiled chain attached to the end of the piston-rod, C, so that as the piston recedes in the cylinder the chain may draw the pulley round, and with it the axle and the cone-pulley, M. It will be seen that there is a cone-pulley, N, connected to a draught-chain, at each end of the working steam-cylinder, B; and that upon the axle to which this cone is keyed, there is affixed a small pulley, L, with a chain connected to the end of the piston-rod, as before described,—thus making the machinery double-acting; that is, when a heavy weight is raising at one crane, a heavy weight may be lowering at the other crane.

In working this machinery steam, at a high pressure, is to be provided in a boiler contiguous, from which the steam is to be conducted to the working-cylinder, B, by a pipe, K, shown as broken off in the drawing. The steam when passed through this pipe will occupy the steam-box, L, and by the sliding of the valve within the box the steam will, in the usual way, be admitted into the cylinder at its ends, for the purpose of working the piston: the action of the slide-valve is produced by the hand of a workman applied to the lever, M, so that the operations of the machine shall be always under command. Supposing that the piston in the cylinder, B, is, by the pressure of the steam, passing from the right-hand end of the cylinder to the left, the chain connected to the piston-rod and to the pulley, L, will draw round the pulley, L, its axle, O, and the cone-pulley, M; and the draught-chain of the crane being attached to the periphery of the pulley, M, as the pulley revolves the chain will draw up the weight suspended from the jib-head. Now, to prevent the raised weight, suspended from the crane, from descending, the pulley must be made fast; this is effected by means of a break, formed by a band, X, and lever, O. The band being passed round the pulley, M, as shown in fig. 2, the workman by moving the lever, O, will cause the band, X, to be drawn tight round the pulley and prevent its rotation; the lever being held in its position by a click or pawl, resting in the teeth of a ratchet, M, as shown in fig. 1; and in lowering the weight the break may be gently released until the weight has reached its proper situation. The steam may be allowed to escape from the cylinder by a pipe, Q, into the air; and it will be seen that a similar arrangement of parts being adopted to the reverse end of the machine, heavy weights may be either raised or lowered by their reciprocating actions.

WARPING VESSELS.

GEORGE BRADON, of Taunton, Somerset, a commander in the navy, and ANDREW SMITH, of Princes-street, Leicester-square, engineer, for "Improvements in warping or hauling vessels, which improvements are also applicable to moving objects of light weight."—Granted Jan. 31; Enrolled July 21, 1847. [Reported in the Patent Journal.]

These improvements consist in the use of certain machinery for warping or hauling vessels on rivers or canals, and which machinery, with slight modifications, is also adapted for propelling carriages on railways or common roads by ropes or chains. The first part of the specification consists of a description of the improved apparatus or machinery for moving bodies on water, and which, by the aid of the annexed engraving, will be readily understood. A represents the hauling apparatus or help-wheel, mounted
upon standard bearings, in the usual manner, and fitted to the deck of a vessel, with a horizontal crank-shaft passing through it; this shaft is fixed to the wheel-wheel, and receives motion from two reciprocating steam cylinders, in connection with double cranks, on the driving-shaft; each arm of the wheel which is employed for the purpose of receiving the wheel, is furnished with a slot, diverging from the centre to the periphery of the same, and forming the surface of a radial or circular channel, in which the rope, c, is to be fitted, and placed at equal distances from the central driving-shaft, and are made fast by wedges, which can be withdrawn at pleasure, and allow the circumferential or radial distance of the wheel to be increased or diminished, producing thereby corresponding rates of motion when required. By this arrangement the wheel, being set in the coil in the wheel, and being wound, and so grasp the warping-line, which is fixed firmly at each end to some stationary object or holdfast upon the land or water; so that when the wheel, a, is rotated to the vessel, the wheel, by reason of the rope aforesaid, alternately embracing and leaving the wheels, forming the rope, is propelled backwards or forwards, by motion being given to the wheel carrying the warps in the required direction; s, o, are horizontal rollers mounted in cast iron standards, fore and aft of the warping-wheel a, and serve the double purpose of guiding the warping-line and keeping it tight on the reel; f, f, are two pairs of vertical guides mounted in a bracket bearing, to control the upper rollers, s, s, the lower horizontal rollers, e, e, a bevel-wheel, g, is mounted, which bears into others on the horizontal shaft, h, a pair of bevelled wheels, g, b, at the forward end of the shaft, h, is intended to be of a less speed than the aft pair, for an object hereafter explained. The friction of the warping-rope, as the vessel moves, will cause the rollers to slow up and the upper rollers, s, s, to be weighted by the weight, press on or nip the rope or chain against their under rollers, and the speed of the rope is less than the aft pair, the latter will have a tendency to take up the rope or chain quicker than it is given off from the reel, and thus keep it taut.

In order to allow one vessel to pass another on a single line of warping-chain or rope, it will be necessary to throw one vessel out of connection with the rope temporarily; for this purpose the rollers, s, s, may be readily lifted out from their bearings, which will admit of the warping-chain or rope being thrown off from the rollers, s, s, when required.

A further modification of the above arrangement is next described, which consists of a roller, mounted upon suitable bearings, having two smaller ones above it attached to the same framing, the upper ones being pressed down by means of screws or springs, or otherwise made to nip the chain or rope sufficiently, so as to prevent its slipping when the lower roller is caused to revolve by the steam-engine or other motive power employed in the vessel.

The next mode described by the patentees for applying such arrangements to locomotive purposes, consists of placing in the front of the engine the whelp-wheel aforesaid, and attaching it thereto, causing it to be driven by means of connecting rods from the engine; in this respect, differing but slightly from the ordinary construction.

The fourth part of this invention has reference to different modes of nipping the rope or chain, and consists first of three or more cylinders fixed to the arms or periphery of the whelp-wheel, which is placed across the vessel fore and aft; pins are inserted in the periphery of the wheel a, for the purpose of receiving the coil of rope or chain around it, and preventing its slipping; the cylinders, which are placed at equal distances apart, are supplied with steam at different intervals through the same shaft on which the when the wheel is having suitable value for that purpose; so placed has a piston and piston-rod, and, when in operation, receives the pressure of steam on one side of the piston only, while on the other is fixed an elastic medium, such as a spring or otherwise suitable contrivance, the effect of which will be thus understood:—The rod of the piston, which in this instance forms the nipper, having a crotch end for the purpose of holding the rope or chain, is pressed forward by the force of the steam acting behind the piston, and made to nip the rope or chain against the flat flange of the wheel-wheel a, through which the rod on one side passes; when, upon the steam being condensed in the ordinary mode, the action of the spring being free, the piston-rod or nipper is again withdrawn and the rope wound upon the wheel. When the wheel a, having the warping rope or chain passing round, is employed for the purpose of propelling, it will be at times necessary, in order to ensure a firm hold for the rope or chain and prevent its slipping upon its drum or periphery, to resort to other means, such as a bar of iron or any other arrangement for pressing the rope or chain in the running groove against the sides of the flange, until another nipper or wheel is brought to bear upon the rope or chain, alternately pressing and slipping the rope or chain during the revolutions of the wheel.

The application of vibrating-levers with sliding-rods is next described, for the purpose of pinching or nipping the rope; these levers are mounted on centres resting on the sides of the wheel, to the outer ends of which two sliding bars are attached, and pass in a horizontal direction through one flange of the wheel, so as to press upon the insides of the lever, against which the rope or ground; the requisite action is communicated to them by means of a fixed cam, situated near the centre of the wheel, whilst the re-action is effected by springs, the cam pressing the sliding-bars by the motion of the lever against the rope, and the springs releasing them. Placed on the wheel are small boxes having springs, with a tendency to draw into the boxes the sliding-bar aforesaid, which, by being attached to one end of the vibrating-levers worked by the cam, keep the rope tight by throwing the hook or notch upon the same; thus enabling each bolt, nipping rod, or buffer (forced back against the chain in succession) to release its hold alternately as the wheels revolve.

The adaptation of the principle hereinbefore mentioned, when applied to steam tug-boats, consists in arranging the apparatus in the centre of the boat, and casing it in upon the top, that the central portion thereof may act as a bridge, and thereby offer sufficient resistance to the strain, at the same time enabling the steersman to perform his duty about any interruption from the warping-line or rope.

Lastly is described the means employed for raising boats and barges from one level to another, and consists in forming at convenient distances along a canal, a number of inclined surfaces or banks crossing the stream, between which the water of different levels is confined; each bank so formed being at an angle of 45°, and having on its face trams or rails. The boats or barges on the lowest level, in order to be raised to a higher one, are mounted upon wheels for the purpose of traversing the rails; other boats or barges on the next level are then attached by means of ropes to the lower ones, and when the apparatus is put in motion from above by steam or other motive power, the lower boats or barges are drawn upon the incline, and thus caused to pass from one level to another by the use of the hauling apparatus hereinbefore described.*

* An invention similar to this latter part has been adopted on the Morris Canal, U. S. America, and described in the Civil Engineer and Architect's Journal, for 1843, page 104.


ELECTRO COPPERING, GILDING, AND SILVERING.

LOUIS HYPOLITE PLAUT and PHILIP HENRY DU BOIS, of Wyyatts- street, Clerkenwell, Middlesex, for "Improvements in producing ornamental surfaces."—Granted November 12, 1846; Enrolled May 12, 1847.

This invention consists of improvements in depositing metal, by the employment of a bath in the following manner, as shown in fig. 1.

The bath consists of an earthenware vessel, A, with a circular plate B, perforated, and with one or more apertures C, to receive tubes D, and a long opening, E, in the centre, for suspending the model or electrolyte plate.

Fig. 1.  Fig. 2.

For electrolyte plates the bath is to be filled with a solution of 14 lb. blue vitriol dissolved in 7 quarts of water, and when it is cooled put on the plate B, with some pieces of vitriol laid on the top; then fill the tubes D with a preparation consisting of 5 pints of water, 1 lb. common salt, 4 pint of fresh human urine, and 6 drams sulphuric acid. The tubes to be filled up every six hours, until the third day, when they must be emptied and refilled, as before, till the deposited plate is as thick as desired. Care is to be taken that not a drop from these tubes falls into the bath.
The model to be used in the bath, either of gold, silver, or copper, is to have soldered on the back a piece of copper wire, for a conductor; and the model must be well cleaned with plumago and its back fixed in wooden enclosures so that the required surface exposed. Take a piece of zinc, about five ounces, and fasten on a screw, then attach the copper wire to the screw, and place the piece of zinc in one of the tubes D, suspending at the same time the model through the centre hole, E, of the plate B, into the bath; when the plate is taken out of the bath, the zinc is detached from the model, leaving a clean polish or dead appearance, according to the preparation of the model; it will also be found to be good and pliable metal, bearing to be made several times hot without injuring or destroying the copy of the finest engine-turning or engraving.

**Preparation for Sintering.**—First dissolve 700 drams of sulphate of soda recently prepared in four parts of warm filtered water. Secondly, dissolve 35 drams of carbonate of soda (when used with electric currents, but when to act by simple immersion, 75 drams are used) in a pint of warm filtered water. Thirdly, dissolve 31 drams of moist carbonate of silver. When these solutions are cold, mix the sulphate of soda and the carbonate of soda together, then add the carbonate of silver, and stir all well with a glass stalk till the silver is well incorporated. This preparation is to be used with the above purposes, it is preferred to employ the battery shown in fig. 2, which is constructed as follows: a is a glass jar; b, a tube of charcoal; c, a porous vessel; and e, a tube of amalgamated zinc. In making small articles of silver, or of gold as hereafter explained, such as watchcases, three such batteries connected together form a proper strength for the purpose; but for larger articles, more as 4 batteries ought to be used. Into the vessel a, put nitric acid and water, mixed in equal quantities; the tube of charcoal, b, is introduced into such vessel, a, and the porous vessel, c, is introduced into the tube, b, and the liquid should then nearly fill the vessel a. Into the vessel, c, put a mixture of 8 oz. sulphuric acid, 1 oz. common salt, and two pints of water. The copper bands, d, of the three or other number of batteries used are to be connected together, and these metal connections are to be made between the models which are introduced into the bath to receive precipitations thereon; the copper straps, e, are to be connected to each other, when the metal is put into the bath, to have a piece of platinum wire soldered at its end, and this platinum wire is to be dipped about half an inch into the liquors of the bath.

**Preparation for Gilding.**—First dissolve 376 drams of pure phosphate of soda in 43 pints of warm filtered water. Secondly, dissolve 50 drams of recently-prepared sulphate of soda in half pint of warm filtered water. Thirdly, dissolve 7 drams of perfectly dry chloride of gold in half pint of warm filtered water. Take the solution of gold and mix it in the solution of the phosphate of soda and the sulphate of soda. Care must be taken that they are well mixed. This preparation is to be used warm, but not boiling. This bath is to be used with electric currents, preferring to use for this purpose the battery above described for sintering.

**Preparation for Gilding by Immersion.**—First dissolve 700 drams of pure pyrophosphate of potash in five pints of warm filtered water; if this solution is not clear, filter it and let it remain till it is cold. Secondly, dissolve 7 drams of dry chloride of gold in half pint of water, then pour gently into the pyrophosphate of potash, taking care to stir it well. This preparation is to be used warm. This bath is to be used in like manner to what has heretofore been done when gilding by simple immersion, without the aid of electric currents.

To prepare an electrotype model plate for gilding or silvering, after it has been in the hands of the workman, first, put it in the essence of turpentine for 1 hour, then wash and brush it well, after which put it in nitric acid diluted with water (8 oz. of nitric acid of commerce with two pints of water), to take away the oxide; then place it in cold water, 1d. again brush it with rouge to give brilliancy; place it next in fresh human for eight or ten minutes, and then again in cold water; the plate is now fit for gilding or silvering by the bath above described. By this process a coating of gold or silver will be obtained, which when taken from the bath will only require to be brushed with spirits of wine and rouge, and in less than half a minute it will be as brilliant as when taken from the model. It is not necessary to use the scratch-brush, or to burnish any part of the plate, which is always required after other modes of gilding and silvering, and which always injures the engine-turning and engraving.

**ROTARY ENGINES.**

WILLIAM BRENTON, of the Inner Temple, in the city of London, gentleman, for "certain improvements in rotary steam-engines."—

Granted January 21; Enrolled July 21, 1847. [Reported in the Patent Journal.]

This specification is accompanied by a diagram (see the figure) illustrative of the principle on which the rotary engines are to be constructed. A, B, C, D, is an ellipse, described with for, E, and F, the half major axis, or transverse diameter of which, is represented by O, B, = a, (a known number = 1:5904) whilst half the minor axis or conjugate diameter is represented by O, A, = b, (another known num-

ber = 1:9); the focal distance is represented by O, E, and O, F, = c, (== 554). A, K, H, L, is a circle described with centre G, and radius, G, A, which radius, = d, (= 1/2 of O, A). X, Y, represents a circle described with centre, G, and radius G, O, = e, (= 5); the remaining parts will hereafter be more easily observed, and alluded to; but it may be as well to observe that N, S, represents a piston passing freely through the centre of the circle, A, K, H, L, (and having a sliding motion in the direction of its length,) whilst m, n, is intended to show the thickness thereof. In an engine constructed upon the principle above shown, A, B, C, D, then would represent the outer iron case as it would appear in vertical section, and which case, therefore, would be of an elliptical form, although employed for a similar purpose to that part of an ordinary steam-engine known by the name of the cylinder; below, or at C, would be the foundation-plate, upon which the said elliptical case would have to be fixed. A, K, H, L, marks the part that would have to be occupied by a hollow cylindrical shaft or piston-rod (of considerable diameter), and which is placed at such a distance, it will be observed, from and above the centre of the elliptical case, A, B, C, D, as that the circumference of the said shaft or piston-rod shall come in contact with the inner surface of the elliptical case at a point, A, and at which would be the slide-valve so arranged, that the steam might be introduced into the elliptical case, say at or near to such point, A, or at p, when by acting upon the sliding-piston, N, S, it must, thereby, impart a rotary motion to the shaft, A, K, H, L, and the steam ultimately would be discharged through an aperture or eduction-passage, somewhere near also to the point, A, or at t; or the steam might be introduced and allowed to pass off through the ends of the case, if found advisable. For reversing the engine, or causing the piston and shaft to move in a contrary direction, it would only be necessary to make the eduction-pipe available for the passage of the steam out of the cylinder, by altering the position of the cock or slide-valve, and in the usual way, the shaft, A, K, H, L, must pass through steam-tight stuffing boxes at each end of the case, and revolve in bearings in the upright frame attached to the foundation-plate. The sliding piston, N, S, will be rectangular, its breadth being equal to the distance between the ends or side-plates of the elliptical case, A, whatever that may be, and its length (as shown at N, S,) equal, or nearly so, to the shorter diameter of the same. This piston must slide through a slot or aperture in the shaft or piston-rod, so that whilst the rod moves in a circular direction, the sliding piston moving with it and through it, performs an elliptical course by reason of the pressure of its extremities against the inner surface of the case, and the ends of the piston, as well as it should be kept in close contact with such inner surface of the case by any means.
The shaft or piston-rod may be of any proportional part of the shorter axis of the ellipse, the longer axis being varied accordingly, and so that the correct principle of action may still be retained; but the proportion, which the patentee recommends as having been found to be most efficient in practice, is that the revolving shaft shall (as seen in the diagram) have a diameter of no less than two-thirds of the shorter diameter or minor axis of the ellipse, and which will make the longer diameter or major axis about 1.06 times such shorter diameter; for if the diameter of the revolving shaft or piston-rod be materially smaller than this, the figure of the case must either cease to be a perfect ellipse, and thereby become very difficult to bore, or else the increased length of the piston will involve the necessity of the metallic packing moving through a very considerable space, and which would be inconvenient.

**MAKING ZINC AND GAS.**

DANIEL TOWERS SHEARS, of Buckingham, Southwark, for "Improvements in the treatment of zinc ores for the purpose of producing zinc ingots, which improvements are applicable to the reduction of other ores and metals." (A communication.)—Granted January 19; Enrolled July 19, 1847.

The invention relates to making zinc from ores in combination with the making of gas for the purposes of light and heat by using a blast high furnace and anthracite, coke, charcoal, or other suitable fuel, and other metals may be made at the same time.

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**Fig. 1.**

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**Fig. 1.** is the section of the furnace and apparatus. The furnace a, is charged through a funnel b, at the upper part, there being slides to prevent the passage off of the gas which may be at the upper part of the furnace, the lower slide being closed when the upper one is opened at the time of introducing a charge; the upper slide being closed when the lower slide is drawn out to allow the materials to descend into the furnace. The materials for charging the furnace are raised by an endless chain c. If iron be contained in any of the ores or materials to be used (and such is found sometimes to be the case), then the lower part of the furnace is to be made suitable for tapping off the iron from time to time in precisely the same manner as iron furnaces have heretofore been constructed. No claim is made for the construction of such furnaces, but only the mode of making zinc therefrom. At the upper part of the boiler the furnace is contracted, in which the gas and the vapours of zinc accumulate and pass off through the pipe d, into the receiver e. The pipe f passes through the vessel g, which has a flow of water constantly through it, passing into it by a pipe h, at the lower part and off at the pipe i, at the upper part. Or oil may be used in place of water, in which case, as long as the oil is kept below its boiling point, it will indicate that the gases are not carrying off zinc vapours, and the receiver is kept sufficiently heated to prevent the zinc solidifying, which is preferred to do by a gas burner supplied with gas from the apparatus, and there is a tap hole at the lower part of the receiver to draw off the zinc. The gas passes from the receiver through a pipe i, in order to convey the gas to be burned for any desired purpose, whether for light or heat, and it may be used for heating the furnaces themselves by placing the same in suitable ovens or retorts, and heating such retorts with high furnaces. This furnace is similar to that described by Mr. Constable, in his patent for making gases from anthracite and other fuel in blast or high furnaces, and would, if no ores or matters capable of yielding zinc be introduced with the fuel simply produce gas, but by introducing zinc ores with the fuel, zinc will be made and be received into the receiver, thus beneficially employing the heat of the furnace. The quantity of ore introduced into the furnace may be varied according as it is desired to make a large or a smaller quantity of zinc. Any quantity up to one part by weight of roasted ore to three parts of the fuel employed is recommended. Iron or other ore may be introduced and treated with the zinc ore.

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**ELECTRIC TELEGRAPHS.**

ALFRED BRETT, of Holborn-bars, gentleman, and GEORGE LITTLE, of High-Holborn, electrical engineer, for "Improvements in electric telegraphs, and in the arrangements and apparatus to be used therein, and the parts of such improvements are also applicable to time-pieces, keepers, and other useful purposes."—Granted Feb. 11; Enrolled Aug. 11, 1847. [Reported in the Mechanic's Magazine.]

The improvements claimed under this patent are ten in number. We shall give the claims in the words of the inventors; and such explanations of them as may be necessary to show their general scope also nearly in their own words.

**First Claim.**—"We claim, as an improvement in electric telegraphs, the use of a ring, or piece of metal, partially magnetised, in combination with a reel or coil of wire, whereby and wherein the electric current so acts, that the motions take place in a direction transverse to the axis of the coils, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies."

The electrical fluid is made to pass through a number of coils of fine wire, properly coated or covered with silk, or other suitable non-conducting material; which wire is wound round a flat reel, or reels, of ivory, or other suitable material. The ends of these fine wires are alternately brought into contact with the galvanic battery, by suitable arrangements, whereby the current is made to act on and give motion to a partially magnetised ring, or piece of metal, suspended and moving on a fixed centre in a plane parallel to the side, or face, of the flat reel, about which the wire is coiled; that is to say, parallel to the planes in which the wire is so coiled; the motions of this partially magnetised ring being communicated to an indicator or indicators, whose motions in connection with a peculiarly arranged dial-plate with symbols thereon, may be employed to designate letters, figures, or other conventional signals, and transmit intelligence by means of electricity.

The patentee says, "We wish it to be perfectly understood, that although we have described the foregoing, by the application of circular coils of fine wire prepared as above described, wound round or upon a flat circular reel or reels, in conjunction with a flat metallic partially magnetised ring, moving parallel with such coils of fine wire for the giving motion to inductors, by which letters, figures, or other conventional symbols are designated; the same motion can be obtained, and the same principle applied, by other modifications and arrangements, but we prefer using and adopting the arrangement above described."

Several exemplifications of such modifications are afterwards given.

**Second Claim.**—"We claim, as an improvement in electric telegraphs, an indicator, or indicators, deriving motion respectively from a current of electrity transmitted through a coil arranged and acting on a partially magnetised ring or piece of metal, as above described, and the adaptation of such motions to communicating intelligence between distant places or points."

**Third Claim.**—"We claim, as an improvement in electric telegraphs, the adaptation of an indicator or indicators to a dial-plate, constructed and arranged as described."
signals the letters of the alphabet are designated by single or repeated motions of either of two indicators (right and left hand), or both in conjunction. Thus the letter A, which is placed opposite to fig. 1, is indicated by one motion of the left-hand indicator; the letter B, which comes opposite to fig. 2, by two motions of the same indicator; the letter C by four motions, two left and two right; and so on.

Fourth Claim.—"We claim, as an improvement in electric telegraphs, the working of two indicators, so as to give the requisite motions by means of a single handle constructed and arranged as described."

Fifth Claim.—"We claim, as an improvement in electric telegraphs for giving audible signals, the use of a ring or piece of metal, partially magnetised, in combination with a reel or coil of wire, as above described, whereby and wherein the electric current so acts that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies, and actuate suitable apparatus for giving such audible signals."

A bell or gong is substituted for the dial-plate and indicators, and the signals expressed by striking one, two, or more successive blows on the bell or gong, which is effected by wheelwork, for which no separate claim is made.

Sixth Claim.—"We claim, as an improvement in electric telegraphs, the use of an apparatus for conducting the atmospheric electricity to the earth, in which the two semi-spheres of the lightning-conductor, as usually constructed for that purpose, may be adjusted to or from each other, as circumstances may require."

In lightning-conductors, as ordinarily constructed, there are two metal plates (say A, A'), which are fixed to and kept apart by blocks of ivory, and two semi-spheres (c and c'), which are made fast, one to each plate. The improvement here consists in making the semi-sphere c fast to the plate A (as usual), but attaching the other by a screw to the plate A', "by which means, and by the aid of a regulating screw-cam, the semi-sphere of metal may be brought either closer or farther distant from the semi-sphere c, as may be rendered necessary by the expansion or contraction of the instrument, or other circumstances."

Seventh Claim.—"We claim, as an improvement in electric telegraphs, the insulator, and stretching of the long circuit wires upon and by means of an insulator, bell-shaped in the interior, so as to prevent the rain establishing a circuit for the electricity from the wire to the support upon which the insulator is affixed, and so shaped on the exterior as to admit of a stretcher, constructed as described, being applied at pleasure, to stretch the long circuit wires from insulator to insulator."

These insulators are to be made of glass, earthenware, porcelain, or metal.

Eighth Claim.—"We claim, as an improvement in electric telegraphs, a deflector, constructed and arranged as described, in combination with an earth-plate to each instrument, whereby the electric current may be diverted, and the instruments insulated in such manner as to allow the instruments at two or more stations on a long line to communicate with each other, independently of the other stations."

Ninth Claim.—"We claim, as an improvement in electric telegraphs, the use of the apparatus called the hydraulic battery, in which the acid to the sand, or other retainer of moisture, is supplied from above, drop by drop, and escapes from below, drop by drop, as thereby to keep up continuously a percolation through the sand, or other retainer of moisture, the passage of which percolation, carried off the sulphate of zinc, and prevent its becoming crystallized on the plate; and we claim the said hydraulic battery, both as an improvement in the working of electric telegraphs, and as applicable to the working of time-keepers or clocks, where electricity is employed as a motive power, and for other purposes in which a steady uniform current of gelvanic electricity is required.

Tenth Claim.—"We claim for time-keepers, in which electricity is a moving power, the use of a ring or piece of metal, partially magnetised, in combination with a reel or coil of wire, as above described, whereby and wherein the electric current so acts that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies, and are adapted to suitable apparatus for measuring and indicating time."

As electric time-keepers require but a small power for keeping their pendulums in motion, "a sufficient current may be obtained from two series of any one kind of metal (for which purpose zine or iron is the most economical), buried in the earth;" and "when zinc is used for the series, the supply of electricity may be augmented by surrounding one set of the plates of the series so employed with a solution of ammonia."

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**IMPROVED EXPANDING DIE**

**FOR MAKING DRAIN-TILES, CONDUTS, TUBES, CHIMNEY-POTS, AND OTHER ARTICLES MOULDED IN CLAY.**

Registered by Joseph Salt, Brick-Maker, Uxbridge-Common, Middlesex.

The advantages of the improved die are, that with the same machine, much larger pipes and tubes may be made than heretofore. The improvement is shown in the section, fig. 1, which consists of Fig. 1.

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**Fig.**

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**NOTES OF THE MONTH.**

**Railway Lift Bridge.**—In last month's Journal we gave Mr. Rastick as the engineer who designed the bridge; we have since been informed that it was designed by Mr. Hood, the resident engineer of the Brighton railway, and that some alterations have been made in the design.

An "Architects', Builders', and General Fire and Life Insurance, &c., Company" is about being established; already a preliminary meeting has been held, and an "ad-interim committee" formed. Among the names we see Mr. George Smith, Mr. Donaldson, Mr. Salvin, Mr. Sidney Smirke, and several other architects and builders.
University College.—The classes of Engineering and Architecture at University College have been rendered more complete by the recent appointments of Mr. Egan, as Professor of Hydraulics, and Mr. Knight, as Professor of the Strength of Materials, and on Machinery. The lectures to be given by this competent exponent of the principles of the subject will include important results not previously given, and the theory will be illustrated by a description of a great number of original experiments upon the strength of the materials used in construction, such as cast and wrought iron, building stones, timber, &c., and the results of which have not been published. The distribution of prizes occurred on the 1st of July, Sir H. De la Beche being in the chair. First year's course—Fine Art: Charles Poland, 1st prize and 1st certificate; T. Watts, 2nd prize and 2nd certificate; W. N. Smith, 3rd prize and 1st certificate; H. Darbishire, 1st prize and 1st certificate; Charles Poland, 2nd prize and 2nd certificate; T. Watts, 3rd certificate. Second year's course—Fine Art: W. Turner, 1st prize and 1st certificate; G. B. Smith, 2nd prize and 2nd certificate; J. W. McKenzie, 3rd certificate. Scientific Constructions: G. P. Boyce, 1st prize and 1st certificate; W. Turner, 2nd prize and 2nd certificate; G. B. Smith, 3rd certificate.

The Royal Italian Opera, Covent Garden, has now closed, and the results of the season, while we hope they have given every encouragement to the lessees, have fully responded to the exertions of the architect. The arrangements for hearing, seeing, ventilation, and accommodation have been perfect, and have given a good example of the progress of comfort in public buildings.

New Gardens.—The works at these gardens are proceeding, and Sir William Hooker seems determined to carry out a botanical garden, which shall be the finest ever seen in the world. The grand palm-house in the grounds is now in the state of the framework, but we doubt whether the house will be in a fair state for opening before 1849. A small museum has been built, as a Museum of Economic Botany, which will in time rival the Museum of Economic Geology.

The New Parliament is now filled up. It includes many parties connected with the prosperous interest. Mr. Robert Stephenson and Mr. Locke represent the engineers; Mr. W. Cubitt and Mr. S. M. Peto, the railway contractors. What may be the political merits of these new members we do not know, but as practical men they will not be without their value.

Damp Walls.—Dr. Murray recommends when damp walls proceed from dampness, the use of a mixture of soda, &c. In infilling and plastering with sand in the mortar, it is only necessary to wash the wall with a strong solution of alum. This converts the deliquescent salt into an efflorescent one, and the cure is complete. Or alum may be added to the plaster in the first instance.

Portable Cannon.—The American papers make mention of a new sort of cannon, invented by a Mr. Fitzgerald, which is so constructed that it may be carried by hand or on horseback over mountains, forests, or marshes, where an ordinary cannon would be altogether useless. It consists of a series of circular perforated plates of the best wrought iron, to 1/4 inch thick, with well planished faces, which are arranged in contact, and are connected together by wrought iron rods or bolts, passing through holes near the periphery; the bolts having strong heads at one end, and a screw nut at the other, whereby the plates are held firmly together. Several of the plates at the bottom of the gun are filled with the powders in the centre. The series being thus connected, they are bored and polished inside, and turned off to the proper shape outside. While this cannon is stronger than those of common cast iron, it can readily be dissected, and each section may be carried by a man, a woman, or a child. Artillerymen, engineers, &c., may be readily taught to use it, and the parts may be put together and secured ready for action in ten minutes.

A Wide Suspension Bridge is now erecting over the Ohio, which will be the largest structure of the kind in the world, having a span of upwards of 1,000 feet, whereas that of Fribourg is but 800 feet.

A Railway Club for engineers, architects, parliamentary agents, and solicitors, is proposed to be established in the vicinity of the Houses of Parliament.

The Revue de Haute states that a young chemist of that town has invented a system of lights for ports and coasts, consisting of a thick globe of glass, in which is enclosed a preparation giving a light like that of the moon, and the cost of which for one year will not exceed a franc.

Improvemets in Gun-Cotton.—Mr. Costhupae recently forwarded to the Commissioners of Agriculture a patent application, with a view to carry out greatly increased explosive effects that are to be derived from a subsequent immersion of the gun-cotton, when properly prepared in the ordinary way, in a saturated solution of chlorate of potash. "Having experimented with solutions of nitrate of ammonia, nitrate of potash, nitrate of soda, bichromate of potash, and other solutions, I find from the properties of its interesting substance, I can affirm that none of the results will bear the slightest comparison with those obtained from the solution of chlorate of potash, either in rapidity of ignition, or in intensity of flame. The process of burning the mixture of equal measures of strong nitric acid, and of oil of vitriol, specific gravity 1.945, the cotton was immersed and stirred with a glass rod during about three minutes, it was then well washed in many waters and dried; a portion of it was then soaked for a few minutes in a saturated solution of chlorate of potash, well squeezed and dried."

New Fulminating Powder.—M. Sobrero in a paper to the Académie des Sciences, Paris, described what he calls the "magnesia nitride"; viz., the magnesium obtained from manna, honey, &c., and treated with nitric acid. The magnesia nitride or fulminating magnesia, explodes on the blow of the hammer with the same violence as fulminating mercury and is used in its place in detonators. M. Sobrero has prepared capsules in which, instead of fulminating mercury, is placed a little nitric magnesia crystallized in alcohol, and discharges a small quantity of powder with them several times with the same certainty as with ordinary capsules.

LIST OF NEW PATENTS.

Granted in England from July 24, to August 23, 1847.

Six Months allowed for Exorcism, unless otherwise expressed.

John Plast, of Oldham, Lancashire, and Thomas Palmer, of the same place, for "taper improvements in machinery or apparatus for making cards, also for preparing splintered cotton and other fibrous materials, and for preparing and dressing yarn, rendering the same."—Sealed July 24.

Charles De Berge, of Arthurs-street, Westminster, City, for "improvements in building and decorating apparatus, and in springs for railway and other carriages."—July 26.

Arthur Coal, of Aldrige, manufacturer, and Henry Beer, of New-road, manufacturer, for "improvements in the manufacture of tobacco paper."—July 29.

Edward Ryas, of Park-place, Hayeswater, Middlesex, for "improvements in connecting the smoke and condensing the fuel of steam-engines, breweries, and manufactories generally."—July 29.

James Morison, of Patley, shewi manufacturer, for "improvements in applying water in delivering or moving carriages."—July 29.

Joseph Paul, of Thorp Abbott's-hall, Norfolk, farmer, for "improvements in curing or drying grains in land, and for raising subsidies to the surface of the land."—July 29.

Francis Burr, of Wanstead, for "the delivery of water and other fluids in which he styles the 'Protas Jet.'"—July 29.

William Bacon, of Norwich, inspector of railways, for "improvements in the manufacture of parts of railways, and in the machinery and apparatus used in constructing railways."—July 29.

Alfred Vincent Newton, of 66, Cheapside-lane, mechanical draughtsman, for "an improved plan, or even, for laying porcelain and other similar wares."—July 29.

William Phillips Parker, of 46, Lime-street, City, gentleman, for "an improved plan of manufacturing grimace."—July 29.

George Williams, of New York, America, for "improvements in manufacturing iron for various useful purposes."—July 29.

Edward Thomas Jones, of Newport, surveyor, for "improvements in machinery and engines for propelling vessels."—July 29.

John Hastie, of Greenock, Scotland, engineer, for "improvements in the application of steam power to perform certain kinds of machinery with a continuous motion."—July 29.

Hector Sandeman, of Tallock Blessfield, in the county of Perth, blacker, for "taper improvements in the materials and processes employed in dressing, cleaning, &c., and bleaching certain textile fabrics, and the materials of which such fabrics are composed."—July 31.

Theodore Fletcher, of Birmingham, brass-founder, for "an improved machinery for various purposes."—Aug. 3.

John Yule, of Sebright-street, in the city of Glasgow, practical engineer, for "improvements in railways and other apparatus used on railways, and in laying the same."—Aug. 3.

Joseph Bourne, of Derby Pottery, in the county of Derby, for "improvements in the manufacture of burning stones, and brown wares."—Aug. 4.

Arthur Boyle, of Birmingham, umbrella-maker, for "improvements in the mechanism of umbrellas."—Aug. 4.

William Broadhead, of Manchester, for "improvements in the manufacture of paper."—Aug. 5.

James Simister, of Birmingham, manufacturer, for "improvements in the manufacture of paper and wools."—Aug. 5.

Benjamin Bailey, of Leicester, machine-maker, for "improvements in the manufacturing of knitted fabrics."—Aug. 6.

Edward William Eaton, of New Winding, Berks, bachelor of medicine, for "certain improvements in machinery for improved railways."—Aug. 19.

Osborne Reynolds, of Desden, Essex, clerck, for "improvements in making hop-poles, binding ropes, baskets, or wicker-work, and other similar articles."—Aug. 19.

Edward Bacon, of Shrewsbury, in the county of Shropshire, engineer, for "certain improvements in steam-engines."—Aug. 19.

William Eaton, of Camblerwell, Surrey, engineer, for "certain improvements in railway water and other stores from one level to another."—Aug. 19.

Orlando Brothers, of Blackburn, in the county of Lancaster, for "certain improvements in the method of introducing returns, and in the machinery or apparatus connected therewith."—Aug. 19.

Archibald Tartie, of Preston, in the county of Lancaster, gentleman, for "improvements in propelling carriages in propelling carriages on railways."—Aug. 19.

Frances Augustus Bernard of 40 Rive du Rocher, Paris, merchant, for "improvements in preserving and colouring wood."—Aug. 19.

James Weber, of Rotterdam, engineer, for "an apparatus for evacuating the atmosphere, to be applied to carriages and other vehicles travelling on railways."—Aug. 19.

Aims Brown, of Bathstone-place, Middlesex, dyer and scourer, for "improvements in the colouring of textiles."—Aug. 19.

Alexander Speil Livingstone, of No. 7, Bridge-place, Lewes, Kent, civil engineer, for "certain improvements in the manufacture of locomotive engines intended to be used on railways."—Aug. 21.

Thomas Denman Price of the Freemasons' Tavern, Great Queen-street, Middlesex, for "certain improvements in apparatus for reducing vegetable and other substances to small particles."—Aug. 23.
THE CARLTON CLUB-HOUSE.

(With an Engraving, Plate XV.)

Since Mr. Smirke chose to forego the opportunity of exhibiting a production of his own, under such peculiarly advantageous circumstances as the occasion afforded, we are, for several reasons, very glad that for a work of repetition he has gone to the example he has done. Independently of its intrinsic merit, we welcome that composition of Sansovino's as being likely to disabuse us of many prejudices,—although prejudices are apt to be so dreadfully obstinate and inveterate, that it may be questioned if even ocular demonstration will help to correct them. The Library of St. Mark at Venice,—of which, we presume, our readers are fully aware that the new façade of the "Carlton" is a direct copy, the original design being so well known by engravings of it in various architectural publications,—is so admirably contrary to all rules and all systems of the orders, as quite to confound them, and so antiscipates that plodding sort of criticism which speaks according to book, orthonomously enough, of course, but sometimes very stupidly. Had Mr. Smirke himself ventured to deviate in the same degree, or even half as much, from "approved recipes" for the orders, he would most assuredly have been taken to task by small critics for his extravagant licentiousness,—would perhaps have been put into the same category with Borromini, at least have been sneered at by the fribles, for his conceit in presuming to make so exceedingly free with the established and only legitimate proportions of the ancient orders. To one who is acquainted with the orders only formally,—who knows them only by rote, as a schoolboy does his grammar, Sansovino's treatment of them must appear most extravagant, and little less than detestable; to the eye of an artist, on the contrary, it will show itself to be truly admirable, because highly effective; and what, let us ask, is the purpose and object of architecture as art, except to produce effect?—since, take away that, and it becomes mere building, than which common-sense, if we are to abide by mere common-sense, demands no more.

In Sansovino the artist predominated over the architect,—that is, over the regularly-trained one, being less attentive to direct authority and precedent—as far, at least, as the orders are concerned,—than to artistic sentiment and effect. He was more of the sculptor, or we may say of the artist, than the mere architect. As if for the purpose of exemplifying that line of Pope's, which says:

"And match a grace beyond the rules of art,"

he snapped his fingers at rules, and proportioned the entablature of the Ionic or upper order, rather to the entire elevation than to the columns themselves, it being, in fact, somewhat more than half the height of the building. In latter defiance of the regulations laid down by such exemplary martinetas as Mearns, Vitruvius, Palladio, Vignola, and Co. In palliation of this enormity, it is alleged to have been in a manner forced upon him by the necessity, at least desirableness, of making his building agree in height with the adjoining Procuratie Vecchie in the Piazza di San Marco. Yet as no such consideration can possibly have influenced Mr. Smirke, it may be presumed that he adopted the license for the sake of the happy artistic effect attending it, knowing also that he himself was well shielded from the reproach of desperate innovation and disregard of all system, since he has only adhered to his precedent for it.

Besides serving as an excellent lesson against narrow priggish systems respecting proportions—which some have laboured to reduce to the "rule of thumb,"—such an example as Sansovino's, and as here carried out by Mr. Smirke, may be efficacious in correcting that excessive tameness and pedantry in architectural design which we have been wont to dignify to ourselves by the flattering epithets of "chaste" and "simple." It is true, thanks in a great measure to Mr. Barry, the miserable "starvation style"—more intolerable perhaps than the mere "hole-in-the-wall" style—has been brought into disrepute; still, some specimens of bold, freer, and more copious modes of decoration than we have hitherto been accustomed to in modern architecture, are desirable. We need something too true to correct our taste for that flashy and frivolous mushroom sort of design which puts a showy barrack-looking front to a mille-long range of houses, and then dubs such brummagem a "Terrace."

Not very many years ago,—when such truly prosaic buildings as Stafford-house were looked upon almost as architectural marvels, and as indicating nearly a seven-league-boot-stride forward in taste—the idea of such a façade as is the new portion of the Carlton Club-house, would have been deemed most startlingly extravagant. It certainly does make the original Club-house, which of the façades is entirely a dowdy and insipid figure than ever. The contrast between the two is positively curious, and worth being recorded by the pencil, are the first-mentioned structure be removed to make way for the completion of the other. Not the least curious circumstance of all is that two such strongly antibalistic and antagonistic tastes should be exhibited in the works of two brothers, who most assuredly do not at all fraternise in their architectural sympathies. The contrast presented by the old (although not very old) and the new Club-house may, besides, be taken as an index of the revolution in architectural taste generally, for perhaps neither would Sir Robert veture to propose such a design now, nor would Mr. Sydney Smirke have thought of bringing forward Sansovino in the ways of architectural purity, innsness, and water-gruel. Sir Robert's work will, of course, be very shortly expended; not so, however, that Soane in the adjoining ducal residence, unless his Grace of Buckingham should now be spirited up into contributing his share towards the architectural eclec of Pall-Mall, by giving his mansion a new façade in aristocratic palazzo costume, to which latter it makes no pretensions at all at present, although when first erected it was perhaps considered both ducal and dignified enough. Whether that be ever done or no, the ducal Buckingham-house in Pall-Mall will be less shamed by comparison with the new Carlton, notwithstanding that it is in immediate juxtaposition with it, than the royal Buckingham-palace in the Park, the building added to the latter being a contemporary work. Sansovino was surely wasted there,—at least might have been as well consulted on that occasion, as we are, or perhaps the more so, if we may say forthright, declaration. It does not even so much as pretend to Doricism, except normally and nominally, by having the usual indelicat marks appropriated by custom to that order. Quite as much do we regret the omission of sculpture in the metopes of the frieze; and regret it all the more because such embellishment would have been a very great novelty here, there being, as far as we are aware, not a single example in all the country of a Doric entablature so enriched—not even among those ultra-Greek porticos which modestly call themselves "after the Parthenon." The only excuse that might else have been alleged for the omission—and a most preposterous one it is—lives in the building itself, which totally forbids the supposition that the requirement of figures which contributes so much to the unity of ensemble in the original structure, was occasioned by any more money-saving considerations. If the tone of decoration was to be at all moderated, it ought to have been done more uniformly, so as to preserve keeping. Happily, it is still in time to amend the error in some degree; wherefore we would advise, that in the centre part of the composition the Doric frieze should have its metopes sculptured. Such variation there from the rest of that entablature, while it would give us a very desirable specimen of such embellishment, would be a difference conforming to no more than a very allowable kind of distinction on the central portion of the façade. At any rate, we would not altogether hold this, but earnestly entreat Mr. Smirke to re-consider, ere it be altogether too late, his entrance porch and the door within it. How, with Sansovino before his eyes, he could have conceived the idea of such a porch is to us incomprehensible,—a small loggia of that kind, with an entablature whose architecture is supported on columns alone, being quite at variance with the mode so systematically observed for the rest of the façade. Why not fill up the front of the porch with an open arcade similar to those of the ground-floor in the original building? Besides keeping up consistency of design, it would give the expression of compactness to that projecting feature, and boldness of effect in regard to light and shade. It would produce greater richness also, as the arch would almost as matter of course, have arcade-like mouldings, as ought also to have the window on each side of the porch in that division of the front; not forgetting sculpture in the spandrels of the arches.

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* For some account of him we refer our readers to what can be more easily referred to than Tempeste, the second series of Gethsemane's Ancient and Modern Architecture, containing the description of the very edifice which has now been repeated in Pall-Mall.

* We here employ the term "modern" in contradistinction from medieval architecture and instances of it.
as in the upper story, at least not for that of the porch. Harshly led we
add that the doorway ought to form a corresponding arch to that in front,
or that the ceiling should be likewise semicircular and coved. If this
would not materially improve the whole design, and render it more true to
the spirit of Sansovino's work, we are willing to forefeit for the future our
pretensions to judgment in such matters.

With regard to the species of polychromy introduced in the exterior, by
employing dark polished granite for the shafts of the columns, it remains to
be seen how it will bear the test of time, when the granite shall have lost
its lustre, and the rest of the stone-work be tarnished and discolored.
At present, the effect—of which an outline elevation conveys no idea—is
striking and vivacious enough, perhaps somewhat more so than is exactly
desirable for other neighbouring façades. It is, however, a question whether
colour does not require to be carried out a little more, and whether, if they
were not to be sculptured, the metopes of the Doric frieze might not very
properly have been filled in with polished granite also, like the panels on the
Ionic frieze, the form of which last-mentioned ornaments might have been
improved, they being now of more fanciful and arbitrary than tasteful de-
sign.—Our remarks are as impartial as they are free: whoever had been the
architect, whether Mr. Barry or Sir Robert Smirke, we should have spoken of
the "Carlton" façade just the same, except that had it been the latter,
we should have heartily congratulated him on his emancipation from pseudo-
Grecian, and his adoption of a style that, be it ever so impure, recommends
itself by Artistic spirit.

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXIV.

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

I. Archæology may be likened to fire,—not on account of any brilliancy
and vividity that it possesses, for to say the truth, it is apt to give out far
more smoke than flame, but this it has in common with fire, that it is a good
servant, but an intolerable bad master. So long as archæology is made
only as an auxiliary study to Architecture and Fine Art, it is serviceable
enough. With that, however, it is not content, or more properly speaking,
those who call themselves archæologists, are not content to have it kept
within its proper bounds. They insist upon its being allowed to become
quite dominant and rampant,—completely dictatorial. They themselves,
knowing merely what has been done, and limiting the powers and capa-
cibilities of art just to their own little neo plus ultra, beyond which they have
not an idea, insist upon nothing being done that cannot be shown to
have been done before; thereby either insensibly denying that we of the
present day possess any sort of genius or talent, or still more insensibly
refusing us the privilege of exercising it. And what do architects them-
selves do? They quail and—silence, or else fawn and flatter, thank-
ful, perhaps, that nothing worse than mere indignities are cast upon them.
Nay, some, who were thought to have the interests of architecture
chiefly at heart, seem to do all in their power to throw it into the shade,
and bring forward in lieu of it the most amiable rubbish imaginable,—such
arrest rotten lumber that a sensible antiquarian is downright ashamed of
it.

II. Unless it be restrained by that judgment and discrimination which
will render it subservient to the advancement of Art, archæological study
comes to be considered as an end rather than a means, as which latter alone
it is of any value to the architect, good architect. It may, indeed, enable
him to talk or write very learnedly, and to display a deal of recondite
erudition and curious research; yet, if he addict himself to it in such man-
er as to make it at all his hobby, it will play him—or else cause him to
play, many strange hobby-horse tricks. He will be always looking
backwards when he should be looking forwards,—will even be afraid of
getting onward a step fasterward than Precedent will permit him.
That same Precedent—or rather the nonsensical and superstitious rever-
ence affected for it, is made a positive dead weight—a millstone hung
round the neck of Art. It is a chain apparently bestowed on it as a badge
of honor, but made use of in reality as a halter whereunto to strangle it.
Nor is it an overweening fondness for medieval archæology alone that is
to be deprecated, that for classical antiquity, with its consequent blind and
indiscriminate deference to classical authority, being equally apt to mislead
—or if not exactly to mislead, to fetter, impede, and retard. Far better,
in all probability, would it have been for Wilkinson, had he seen either
Athena Magna Grecian, or been but the donor of the Vitrivianus entirely from his thoughts whenever he set himself down to de-
sign, and instead of thinking of what had been done, had studiously be-
thought him how to make the most of the subject in hand, had considered
what new ideas it might be made to produce, and how artistic effect might
best be secured for it. But, alas! artistic composition and artistic effect
were almost the very last things that he, like many others, ever thought of.
Had not such been the case, Downing College would have exhibited a very
different piece of design from what it now actually does,—pseudo Grecian
and all. No modern architect, who has not long ago, at least, seen a large
building, will have vapoured so much as he did about the mere intercollocation of the portico of the National Gallery, but would have attended much more to the
general composition of that façade. The eye of an archæologist, and that of
an artist—and an architect ought to be one—have very different powers of
vision. The former is so myopic that it cannot discern a single inch be-
fore Precedent, while the other—we are speaking of the true artist—can
discern with prophetic ken, what will be Precedent to after-ages. It is all
very well to understand Precedent, but to be enslaved by it is equally ab-
surd and despicable.

III. In a letter from a friend who is now a temporary resident at Edin-
burgh, I have lately received some exceedingly clever and welcome criti-
cism on the architecture of the self-styled Modern Athens,—which desig-
nation, by-the-by, he observes is a complete misnomer as far as architecture
is concerned, although Scotchmen may be sufficiently Greek in some
respects. After expressing a rather mean opinion of the Gothic architec-
ture of Scotland generally, which, he says, affords no studies worth the
attention of an English architect, his correspondent adds, "the general
rate of recent imitation of that style, in Edinburgh, is lamentably below
eternally below that of a local standard of antiquity. The exterior of the Assembly Hall
has unquestionably many fine parts, but where is the climax which the an-
cient builders produced, in the interior?" The Scott Monument again, the
beast of all Edinburgh, obtunds itself upon you in twenty different sizes
in every print-shop—is painted on every snuff-box—graven in metal—
yes! built up in confectionary; yet no architect would now get practice
in England in the Gothic line, on the strength of such a master-piece—I
might say such a misfit piece as that same Scott Monument;—so defective
is it in detail, and most signaliy so in the proportion and graduation of its
lower story, which, from almost every point of view, reduces its apparent
height one-third. Instead of the thousands and-one representations of that
precious Monument, I would far rather see one satisfactory view of
Donaldson's Hospital, the finest building in Edinburgh, ancient or modern.
In this structure, designed for similar objects as George Heriot's founda-
tion, we have a very successful adoption of the combined forms known as
Elizabethan, and exemplified in Burleigh. Like Heriot's Hospital, its
plan is quadrangular, with a tower at each corner, flanked by four ogre-
domed turrets, and a corresponding tower of bolder and loftier design
marks the centre of the principal or southern front."—Thus much by way
of specimen, and I hope my friend will be induced to work out his remarks
fully in extenso, and give them in some shape or other to the public, who
will then for the very first time get any thing at all like intelligent criticism
relative to the architectural of the northern capital, and its public build-
ing. One thing there is which the Edinburghers themselves might do, at least get
done, which is, instead of publishing again and again ad nausem the
Scott Monument, to publish a collection of some of their best edifices,
illustrated architecturally by plans and elevations, in some such economic
form as the "Public Buildings of London," and Landon's "Édifices de
Paris." Surely Playfair, Hamilton, Rhind, and others who have shown
talent in some of the recent structures, would gladly promote an under-
taking of the kind,—in which sections and interiors ought not to be quite
forgotten—certainly not such as the hall and principal apartment in the
new Commercial Bank, which last-mentioned apartment appears from
description to be quite unique as a public "business-room," it having a
Corinthian colonnade on each side, and being moreover enriched with dec-
orative painting, marbling, and gilding, most probably by Mr. Hay—al-
though that is merely my own conjecture. The hexastyle Corinthian per-
deant, with its colonnade of six, and its three large columns, with its full relief,
might pass for classical, were not such character sadly marred by the two
ranges of windows within; whereas had there been none below, but only
the doorway there, the upper ones might have been excused.
IV. Leaving the question unmounted as to the propriety of making the palace of the legislature a sort of museum and gallery of art, we may reason- sably suppose that when they come to be in the very atmosphere of art, the members of the Two Houses will be in some degree infected by it. How much—that is, how little they now understand or care for art is tolerably evident from the truly unfortunate event, that sanctioned the adoption of such a design for the new façade of Buckingham Palace as the one "presented" to them by Royal Command. Not a single voice was raised to protest against the architectural inanity of inflicting upon us such a piece of commonplace and even vulgar design—the subject considered— for the front of a royal palace, at the present day; and after all the revil- lings, too, that have been heaped upon the original building, as concocted by George the Fourth and John Nash. To aseer at their taste now would be akin to questioning the sublime taste of Queen Victoria and Edward VIII, and compromising our loyalty. Nevertheless, I do wish that Ben D'Ioransell's excellent advice were taken, and that an architect were hanged as aforesaid to the rest of the tribe. And if such wholesome example is to be made at all, let it be not on some paltry Pevsken, the architect, perhaps, of a gin-palace, but on some higher offender—even the architect of a royal palace.

V. Estimating the elaborate richness of the Palace of Westminster, one critic has very naïvely expressed his astonishment at Mr. Barry's herculæan task in having designed such a prodigious quantity of details, there being hardly a square foot of plain surface in the building, either externally or internally. The manual labour and workmanship are of course prodigious, but the number of drawings required is comparatively very moderate, and it is a wise plan to confine the structure serving almost for an entire side of it; so much as a single portion of the kind once designed becomes the pattern for as many others as are to be made similar to it. Or does the sagacious critic imagine that an architect makes working drawings for every individual column, window, and other part that are repeated again and again without variation? If so, he must be first cousin to the Irishman who went to a tailor to order two suits, and having been measured, stood waiting the renewal of that operation, exclaiming, "I told you that I want two suits, and you have taken the measure for one only.

VI. Some who, if not more talented, are cleverer than Mr. Barry—that is, show greater cleverness in sparing themselves trouble—make very short work indeed of designing details, taking them ready-made, and applying them on every occasion alike. One architect, who shall be nameless—for proper names are sometimes highly improper things—has had for his whole stock of ideas, in the course of a long practice that must have been a profitable though hardly can it be called a successful one,—just a couple of patterns for columns, and the same number for windows, which he has served up again and again, with no abstinence of invention and imaginatión truly marvellous. Let us hope, however, that the day is approaching when it will be exacted of architects that they shall exhibit good-fide design in their compositions, and also that their compositions shall be legitimately entitled to such name, by being framed according to artistic principles, instead of being, as is now generally the case, mere crude haphazard compilations, in which, though every one of the separate features may be good in itself, being taken from here and there, they do not well assort together, or else are not so suitable as they ought to be to the express occasion. Detail ought to proceed invariably from the architect's own pence; or if he be incapable of producing it, and be so far a mere mechanic, by what right, or rather with what specious show of right, does he usurp the style of Aestes?—rendering himself thereby a mere quack. Or if, as seems to be the case, we really do not care for having Artist-architects, let us have the honesty to declare so at once, let us desist from vapouring about the excellence of architecture as a Fine Art, and let us fling ourselves into the arms of those two doxies—Camerdonism with its vinegar-visaged orthodoxy, and Peksnillian with its drunken gin-palace heterodoxy.

VII. The following, from Donaldaid's Maxims, can not be too sedately recommended to a quiet and you have taken the measure for one only.

VIII. Of delectable heresies in matters of Art, the most delectable of all is that which would persuade us that Art can be taught by rules, and ought to be subservive to rules. It is the most delectable because the most galling and abject,—the most alien from the very spirit of Art. Rules are for dull-witted pedants and schoolboys; the artist, if he really be one, has got beyond them, and abandons himself to those inspirations. Inspirations!—if I am, I also green while I write the word in reference to architecture. Inspirations! where do we find them in graphic art? Nor may we hope to find them so long as a merit is made of the most barefaced copyism, and of the most servile regard to Precedent. Now, if Architecture really be not a Fine Art, let it be exposed as a mere pretender and impostor, and let us hear no more of it. For my own part, I would much rather pronounce its doom at once, and say with the stern Roman patriot, "I, licet, collega manus."
HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."

Sir Henry Wotton.

(Continued from page 271.)

The four great epochs of architecture in England are, as hath been shown,

I. The introduction of the art into Britain by the Romans, until its decline by the Saxons.

II. The introduction of the Ecclesiastical or Pointed styles by the Normans, through all the rich exuberance of the florid Plantagenet and Tudor styles, to mixed anomalies of the Holbein, Elizabethan, or picturesque styles, which fell into desuetude shortly after the death of Elizabeth.

III. The revival of the Roman and introduction of the Italian styles by the Stuarts, to the absence of all style and schools which marked the reigns of our first two princes of the house of Hanover.

IV. The patronage of all the polite arts which distinguished the succession of George III, and the establishment of the Royal Academy, to the present day; in which period all the styles have been revived and practiced, with various degrees of success, and to which we owe the introduction of the pure simplicity and unrivalled elegance of the Greek style, as well as the eccentric architecture of the Chinese and the ponderous ethnologies of the Egyptian.

This latter epoch, so abundant in materials both in theory and practice, will form the subject of the following section.

The overflowing exuberance of our English language, which soars above the pure simplicity of a mother tongue, borrows its words, phrases, and idioms from the Hebrew, Latin, Saxon, Norman, German, French, Dutch, and even from the Arabic and other Eastern tongues, at pleasure; engravings such as are suitable for its purpose, rejects the useless or those which are merely pedantic, and thus renders it the most powerful and rich of modern languages. So have the architects of the Georgian-Victorian period, by a similar unscrutiny of every known style of their art, rendered the architecture of our time more exuberant and usefully elegant than any other single people. They have not used the Greek style to monotony, the Italian to littleness, the Gothic to florid pedantry and heraldic exaggeration, nor any to sallowness; but, with a few solitary exceptions, have engraved a freedom of style and an untethered selection from the beauties of every clime to their productions. Hence, although we have no style of architecture that can be properly called English, we have a rich engraving upon our parent wild stock, domestic utility, a mixed but not incongruous style, rich and exuberant as is our language. Therefore, the architecture of England, if it cannot be called romantic architecture, is like the Venus of Praxiteles, composed of the choicest elements of beauty.

In the early part of the reign of George the Third, Sir William Chambers enjoyed the royal favour and almost the whole of the architectural employment of the day. Fond of ease, he indulged in his professional reverses in his office at the Board of Works. Not being a regularly bred architect, or even builder, he educated no pupils—that is to say, as the word is now understood: he therefore formed no school, and left little more than his Somerset-house, his Royal Exchange, Dublin, a few editions of lesser note—

—riesty, his Chinese buildings at Kew, and his "Treatise on Civil Architecture," to perpetuate his fame; but his name will always hold a distinguished place in the list of British architects. His only followers or pupils were bred in the office of the Board of Works, in which he held the situation of surveyor-general. Among the principal of these were his friend and associate, John Yenn, for whom he obtained from his royal master the diploma of R.A. and the honourable office of treasurer to the Royal Academy; William Chambers, who distinguished himself by his able editing of the last two volumes of the "Vitruvius Britannicus," his splendid buildings of the Custom house, the four Courts, and Parliament house, Dublin, and some private edifices in other parts of Ireland; the late Mr. Hardwick, father of the present eminent architect of that name; and the late Mr. John Buonarroti Papworth, who received sufficient directions for his professional studies and advice in the selection of models, to warrant a small claim to that title. This gentleman's father and elder brother were the eminent plasterers to the Board of Works, and as they executed the beautiful ornamental plastering and stucco work to the cornices, ceilings, coasts, and panels of Somerset-house, some of which in the Royal Academy form frames for decorations from the pencil of Reynolds, Cipriani, Regan, Mary Lloyd, and other members of that institution, the young Buonarrotti, who exhibited early in life a decided love and taste for ornamental design, had often easy access to the architect and to the building.

Of the first of these, namely John Yenn, notwithstanding the honourable addition of R.A. to his name, his only known work is that part of the Treasury which faces St. James's Park, and grins horribly upon Holland's pretty edifice of Melbourne-house, and Kent's picturesque composition of the Horse Guards: and this is his only voucher to the honourable title of Royal Academician, in the newly-established Royal Academy of Painting, Sculpture, and Architecture, and "architect," and architect commemorated by presenting his brother academicians with a geometrical elevation of his design, shod with Indian-ink and tinted with gambege, in the manner of the day, and framed and glazed, with his autograph (John Yenn, R.A., Architect). Of his right to this title Dr. Johnson bears witness in his Dictionary, wherein he says that "architect" is a noun substantive, and means a contriver of anything;—e.g., John Yenn is an architect, for he contrived the north front of the Treasury. His original (?) design for that contrivance is still in the collection of works presented by the Royal Academicians to the Academy, and is preserved, though rather in an obscure corner, in the council-room of that institution, honoured by a companionship with the self-selected works of Reynolds, West, Lawrence, Hogarth, Wyatt, Dance, and other eminent contemporaries; his successors being purposely omitted from the comparison.

The first symptom of a regular-bred genuine architect in the reign of George III. was James Wyatt. Being the son of an eminent and opulent builder in the city of London, who was much concerned in government and other large building contracts, he received the elements of a sound scientific education necessary either for the builder or the architect. After being thus far qualified in his father's establishment, he refined and purified his taste by investigating the finest ancient and modern structures, and in visiting the best schools of architecture in France and Italy. Foreign travel in those days was absolutely necessary for one who aspired to the eminent profession of an architect; for, with the exception of Sir William Chambers's little Goshen in Scotland-yard, there was no school or master of the art, properly so called, in England. It is true, that at the commencement of the Royal Academy, Thomas Sandby, brother of the facetious painter Paul Sandby, an architectural critic and draftsman, read occasional lectures on architecture in the Academy; but of his works and lectures we have no records. His brother Paul, an amiable, agreeable, and facetious man, and a considerable artist for his period, was among the earliest R.A.'s, and doubtless persuaded his brother Thomas to read Vitruvius and Palladio, and to transplant their stern ideas into their art into agreeable essays, salted to the mixed assembly of painters, sculptors, incised architects, engravers, drawing masters, and others, who were admitted as members, associates, and students, to draw from the antique and living figure, and to listen to the biennial discourses of Reynolds, and the annual platitude of Penn, R.A., Professor of Painting, of whom we have no more room than to say, that he painted the death of General Wolfe with all nude figures, modern drapery being in his opinion beneath the dignity of an historic pencil; the clever compilations of Thomas Sandby on architecture, and the few but earnest productions on anatomy by the celebrated Dr. Hunter. Wisely then did

* This work is still preserved, among some really fine works of art, in the Fitzwilliam Gallery at Cambridge.
Wytty determined to increase his store by visiting the academies, schools, and buildings of France and Italy; and the result was, that on his return to his native country he gave proofs of a taste that wanted nothing but a visit to the still more refined cities of Greece to have completed. But alas! a residence in that country, owing to the wars between the Turks and Venetians, and other turbulences, rendered it even more unsafe than it was in the time when Stuart and his fellow travellers visited that afflicted and long-suffering country. On his return to his native land, he astonished the connoisseurs and travelled patriots of England, by his first work, the Pantheon in Oxford-street, a work which more deserved the name of the building it professed to imitate than any other in Europe, as pictures and engravings still extant sufficiently prove. It required but to have been built of more substantial materials than was the timber cupola, niggardly allowed him by the owners, nor had he prepared the Pantheon of London incomparably the best imitatio that of Rome. The best part of this fine work, the cupola and all its decorations, was unfortunately destroyed by fire, and was never afterwards adequately restored. After its re-instatement, it was used as a saloon for masquerades, ridottos, and exhibitions of pictures, and once of Lanardi's monster balloon, which was constructed to ascend with fifty people. The upper half alone of this stupendous machine reached from the eye of the cupola, from which it was suspended, nearly to the pavement, as was witnessed by the writer of this article. The superior part of the balcony was to have represeined the cupola of a temple, from which was suspended a circular tambour of cloth, painted in imitation of columns and inscriptions. It was never to have been built, and in its present state it is an instance of Wytty's genius, but was not so pedantically correct in its details as to please the hypercritics of the Camèse school. The tower was lofty and imposing in effect, visible at a great distance, as was the intention of its proprietor; its apartments were numerous, magnificent, and elegant, replete with all those exquisite niceties that so marked the fancies of Beckford, and was a vast shrine, cabinet, or jewel-case, filled to every corner with gems of art and literature of the most precious description that the lordly wealth of its splendid owner could cram into it. The design and execution of this unique building reflect the greatest credit both upon the talents and taste of its architect. Its unfortunate fate is too well known to be described here, but the enquiring reader may be fully gratified by the general statement and details, in Mr. Britton's elaborate and careful work on Woffith-abbey.

Wytty's greatest offences against the rigid laws of Gothic architecture are the exterior of the palace at Kew, and the west front of the Parliament-houses that were burned down some few years since. Both consisted of a series of sash windows and piers, in the manner of any common dwelling-house, Gothicised as plasterers call it by Roman cement, spayed reveals, Gothic water tables over the apertures, a spayed coved moulding over the upper tier, and a series of little port-holes by way of a parapet. The arcade or cloister to the House of Commons was below criticism. Although the style of these two buildings receive the sobriquet of the Wyaty-Gothic, it is more than surmised that a higher power had a hand in it and Wytty bore the blame. His houses, villas, and mansions are among the most convenient, splendid, and tasteful in the country, and bear upon their face that their builders were not their own architects. As an instance of his power of combining splendour and elegance with comfort and convenience, uniting the state-rooms of the Italian palace (where one room is but a passage to another) with the comforts of an English mansion, which was often rendered insipid by too many passages for the sake of privacy, Wytty's own mansion, at the western end of Poley-place, with its two web projecting wings that gave it the complete appearance of a town house, and its garden-front next Portland-place looking like a country villa, is a forcible instance. I have often visited it in the architect's life-time, when my late friend and fellow-student, John Westmacott, a younger brother of Sir Richard West- macott, R.A., was its pupil. I have since revisited it about five years ago,
and can bear testimony to the truth of this assertion. It is a pity that the family of this eminent architect do not permit some competent person of leisure and talent to publish some of the choicest of their father's works, the size of the "Vitruvius Britannicus," for the use of the architectural students of the present day. In the eastern front of this mansion, Mr. Wyatt has used that very elegant specimen of the Corinthian order without modillions in the entablature, and with the horns of the abacus of the capital coming to a point, instead of being cut off immediately above the volute, as in every other known specimen, given in Stuart's "Antiquities of Athens." This is the only instance, I believe, of this order ever having been used since the time of the Athenians, and is a proof of Wyatt's great taste in seeing the advantages of a thing, though the taste is old. The capital, however, loses much of its fine effect by being made the finishing of an attached pilaster, instead of a detached column as in the original. A popular legend was common, soon after the completion of this mansion, among the office boys and junior pupils in architect's offices, which proves how much it was the admiration of the travelled cognoscenti of England,—which was, that Mr. Wyatt had as many rooms in his house as there were styles in architecture, each appropriated to an order or style; the Tuscan in the basement, the Doric on the ground-floor, and so on upwards—whereas Mr. Nash, as near the truth as Jaxey's belief that Fuseli, who was notoriously fond of nice cookery, lived upon raw beef-steaks, to encourage those horrible phantasmagories of the Latin, with which he stored his pictures.

One more instance of Wyatt's great power to arrange the apartments of an English mansion will suffice to show how much this portion of his works would pay for their contemplation by the aspiring student for architectural fame. It is the Ardrucuan-house, near Navan, in the county of Meath, the palace of a bishop of that diocese. In its exterior it is a plain, well-proportioned, gentlemanly-looking edifice, with the windows and their intervals in harmonious relation to each other. The customs of the Irish pravity often cause their residences to be filled with visitors on the occasions of ordinations, meadings of the clergy at the cathedral (always near to the palace), and other public gatherings, that is usual in England. Irish hospitality also leads them to follow the scriptural exhortation for bishops to use hospitality, who not only invite their clerical brethren to take their bed and board at the palace, an invitation which is always extended to the wives, and sometimes to the brothers and sisters of the invited, but Irish custom allows barricade-rooms on such festive occasions, which causes a dozen or a score perhaps of single men being placed together, as close as beds will admit, into one room, and a similar establishment for single ladies on the women's side of the house. The whole establishment is, in fact, on those occasions, like a barrack on a small scale, and good quarters found for every one, there being often no inn in the place or for miles round. I was an inmate at this house for some weeks, on the invitation of the late bishop of Meath (Dr. O'Beirne), while writing my life of Sir Christopher Wren,—Miss Wren, the great-grand-daughter of our illustrious architect, having been for many years domiciled with Mrs. O'Beirne, in the bishop's family. The lady would not trust her manuscripts to the uncertain risks of perils by land and by water in their transmissions to and from Ardrucuan and London; therefore, as the mountain would not come to Mahomet, Mahomet was obliged to go to the mountain. There it was I first became acquainted with this peculiar characteristic of Wyatt's architecture, and sorry am I now that I did not take a plan of at least its principal story, but I was occupied entirely with other objects. The worthy prelate, a tasteful and a travelled man, the friend of the Duke of Portland, the Earl of Northumberland, and other illustrious personages of his age, was proud of his house and his friend Wyatt, and often pointed out both to me as models to follow. He called his house an extensive, an extensive, a contractile house, for when opening all its apartments and arranging them according to art, he could by closing certain doors, and excluding certain passages and apartments, reduce it to the very moderate size that his small and unpretentious family required, and with as much comfort as if residing in a house no larger than they wanted for themselves. My apartments, consisting of a sleeping and dressing room, and a sitting room, where I wrote and had all the Wren papers entrusted to me, communicated with the bishop's library. This suite of apartments, so complete in itself, was as private and detached from the other part of the house as a set of chambers in the Temple; and if I was ever called upon to leave my study without time to put away my papers, I could either lock that room or at the end of an outer passage the whole suite, so that no one could enter them but myself, and yet they could all be made subservient to the hospitable purposes of an Irish ordination.

James Wyatt received and educated many pupils, some of whom obtained eminence, as may be mentioned herewith, and not a few are enrolled in the list of gold and silver medalists, embellished originally by that elegant pensman, Tomkins, and continued to the present time, that hangs framed and glazed among the records of the Royal Academy. The portrait of this eminent pensman, who surpassed all his predecessors in this line of art, and has been equalled by none since, was the last that Reynolds ever painted. Mr. Wyatt was never knighted, whether it was ever offered is unknown; but it may have been declined on account of his being a widower. He was elected a fellow of the Royal Society, much to the annoyance of Sir Joseph Banks, its then president, who preferred twaddlers and titled nonentities to men of genius, whom he feared he should allow presentations to fill the chair, so gloriously occupied in by-gone days by Brunner, Wren, and Newton. Wyatt was one year, during a misunderstanding among the Royal Academicians, as to which of their important selves should supersede Benjamin West, who was then growing aged, in the presidential chair, elected president without his knowledge. It was upon this or a similar occasion that Fuseli, who wanted a younger and more effective president than the aged painter of the death of Wolfe, wrote in his ballasting paper the name of Mary Lloyd. One of West's supporters asking the sarcastic Swiss why he voted for an old woman, he replied, "Why should I not vote for one old woman as well as another?" Wyatt proved a perfect King Leg during his reign, for he never troubled either himself or them, and on the few nights that he ever took the chair at a lecture, he fell asleep during its delivery, to the great amusement of the students, who laughed at every oscillation of the presidential cocked hat from shoulder to shoulder. This propensity to do after dinner was unapproachable in poor Wyatt, who indulged it even at Beckford's table, the most entertaining man of his day, when Nelson was present, interesting the whole party by the recital of his hair-breadths 'scoops and gallant deeds performed by himself and his valiant brothers in arms in the then recently fought battle of the Nile. Homer est il Nilis; not so thought the lethargic architect, for he didze, and dosed, and dosed again.

This eminent man was unfortunately overthrown in his carriage, on a return from Windsor, from the effects of which he never recovered. The office of surveyor-general of the Board of Works, as held under the crown from Inigo Jones and other eminent architects to his death, has never since been filled up; some of its duties having devolved upon the office of Woods an Forests, and others being filled up by special appointment of the crown, or acts of parliament, as in the cases of Sir Jeffrey Wyatville, and Messrs. Nash, Boile, and Barry.

(To be continued.)

THE BRITISH MUSEUM.

No. III.

The collection of Etruscan antiquities carries the mind back to a most interesting period, that of a people possessing a high degree of civilization, and a great extent of political power, the masters of the Iberian seas, the teachers of the Roman commonwealth. Yet of such a people the chief records are those monuments now before us in the Museum. Of their origin, their language, their political institutions, and their history, we know almost as little as if they were pre-Athamite; so unstable is human power, so sickle is human glory, so great the vicissitudes of national progress. In this Museum we have, however, before us the liveliest paintings of their persons, their dress, and their manners; and the scholar will be able in time to restore the Etruscans on the page of history, as he is now able to restore the Egyptians and the Assyrians. Thus the jealousy and neglect of the Romans, although for so long they overshadowed the Etruscans, will not be able to hide them from us for ever; perhaps also we may in the end make the monuments of Africa speak of those other rivals, the Carthaginians, whom Roman sway has subdued in darkness. Had the Romans told us more, we should have had less to discover, and less pride in the success of our endeavours.

The origin of the Etruscans is at present involved in doubt—the legends of the ancients have the air of fables, the discussions of the moderns want the support of facts. We can neither admit of a Lydian origin nor can we refute it, and we must know more of the early history of Italy before we can assign the exact value to facts or conjectures. Nevertheless, it does not seem beyond the compass of sound historic synthesis to enable us to solve the problem of Etruscan origin; and this must be done to allow us to
determine that of the Romans, for notwithstanding all that has been written, this latter question is by no means set at rest.

If we avail ourselves of the comparison of facts in other countries, we shall first have to learn the events affecting the Celts, for that those were settlers before the Pelasgians appears, from the names of the rivers and mountains, and from other such signs, very certain. It is moreover much more likely that the Pelasgians and Etruscans should drive the Celts back, as the Germani did on the Rhine, and the Belgians in Britain, than that the Celts should drive the Pelasgians from Cimabue Gaul. Although we have very strong assertions of this latter event, we have every reason for not admitting them in their full bearing. Gauls might have passed the Alps, and settled in a Celtic country, weakened perhaps by war with the Bruttians; and this will satisfy to the full the declarations of the Roman historians, while it will be in accordance with historic science.

The spread of the Pelasgian tribes would cause the withdrawal of the Celts; and we can see this concurrence, in accordance with what took place in Greece, that the new settlements would receive the elements of civilization from the busier spirits of Phoenicia and the centres of the arts, who sought, among ruder peoples, the field of distinction which at home was already too crowded.

If we allow for a Celtic action in Italy, we ought likewise to be prepared for a Germanic influence. This alone will account for some of the phenomena affecting the Romans, for which Pelasgic or Greek causes are incompetent. Allowing to the full for the indirect action of Greek civilization through Etruria, Rome certainly owed little to the Greek spirit.

That Etruria had a very close fellowship with Greece is certain, and her sea trade would help this, but we are not therefore to admit that Etrurian civilization is purely a Greek derivative. The people represented to us in the Museum, particularly those in the paintings from the tomb at Vulci, found in 1839, have so little of a European cast, and so much greater likeness to the Indo-Persic and Syriac types, that we can hardly refuse to acknowledge some eastern influence. It might be said that the Etruscan artists adopted an artificial or conventional type, as the Greeks for instance did with regard to the form of the eye. Those, however, who will take the trouble to compare, will find that there is every difference between the grim outlines of early Greek art, and the paintings of the Etruscans. In the several specimens we have of the latter, the same portraiture is not observed throughout, and there is difference enough between the personages of Vulci and those of Tarquinii to enable us to determine that the paintings are in portraiture of a people, and not in simple conformity with a conventional type. The paintings from Vulci present us with an eye, nose, and profile belonging to people who now and then lived in the west of Asia, and the features in the Vulci paintings are as strongly marked as the features of Arabs, in some of the Egyptian paintings of Ramses II. or Seti-Meneses, in the adjoining rooms. It may perhaps be said that the representations of the Etruscan Charon in the Bronze Room are conventional, but these are more strongly marked—the nose is a large aquiline nose, like that of the Syrian or Arab race. The countenances represented in the Tarquinian paintings approach nearer to a Pelasgic type, but are peculiar in their formation.

From what we know of the Etruscans, it is by no means incompatible with facts, that they may have received a civilization independent from that of the Greeks. The Phoenicians we know ranged the Iberian seas, as well as the Iolar, and it was quite competent for a Cadmus to carry Phoenician letters to Etruria as to Thebes. It is much more satisfactory to suppose that the Etruscans and Greeks drew from a common spring, than to suppose that the Etruscans drew only through the Greeks. There was an intercourse between the Phoenicians and Greeks—as for anything we know, a greater intercourse between the former, while the Etruscans were susceptible enough of cultivation, that they were hardly likely to have been unimpressed with their first visitors, the Phoenicians, and to have waited for the Greeks before they took the seeds of civilization. There was no sympathy of language to cause a greater favour for the Greeks, for the Etruscans were decidedly not Greeks, whatever kindred they bore to the Pelasgic family. Commerce with the Phoenicians would account for the likenesses between the Etruscans and Greeks, as well as for the differences. The Etruscans would draw from the same springs of letters, arts, laws, manners, and belief, as the Greeks did; and it is as easy to picture the growth of Etruria, as of Athens, Corinth, or Thebes; while after intercourse with Greece would fashion a greater likeness between Etruria and Greece, as intercourse between the cities of Greece brought them to one common form of civilization. There could have been no large Greek settlement in Etruria, or we should have had results equivalent to those of Magna Græcia or Campania, instead of being able to trace only general proofs of Greek intercourse and influence.

Perhaps a large fusion of Phoenician blood determined the formation of the Etrurian people, though we must not expect to find an equal influence throughout Etruria. The prevalence of so many large commonwealths shows that Etruria rose, as Greece did, from the gradual development of separate settlements, which would each possess a distinctive character. Hence we are able, even in the few remains we have in the Museums, to trace in great degree the differences between the works of Tarquinii and those of Vulci. A Phoenician settlement would explain the Etruscan taste for shipping and sea trade, and perhaps for other characteristics. If we allow of such a settlement, yet we need not suppose that it would permanently influence the language or national features; for a small body of settlers among a larger people would be absorbed, as the Longbeards were in the north of Italy, and the Northmen were in the south. This is a simple explanation of a common historical phenomenon; but where the foreign population is concentrated, as the Jews in the Ghetto, and the Greeks in South Naples, national characteristics may be long preserved even among a small community.

The study of Etruscan antiquities is likely to have a special value as illustrating the early history of Rome, which is now hidden in mist. The Etruscans were a highly-polished people when Rome was a nest of robbers; and from Etruria was derived much of the laws, learning, manners, and belief of the Romans. It is an interesting historical investigation to determine how Rome, of late growth, succeeded in undermining and uprooting Etruria, though we can acknowledge that it was effected as much by the greater moral vigour of the former, as by any other circumstances.

The Etruscan collections in the British Museum comprise several stone tombs, a vast number of vases, and copies of large paintings from inside of tombs. In these latter we have represented, with all the vigour of life, the domestic manners and public games of the Etruscans, and there is not in the Museum any collection which is in this respect so complete or so interesting. The paintings and bas-reliefs relating to the Egyptians, Greeks, or Persians, are fragmentary, except the friezes from the Parthenon, a work wonderful in itself, but teaching us little of the Athenians as a people. In the tombs from Tarquinii we have however bas-reliefs and public games, wherein men and women are represented in all the brightness and distinctness of colour. We have the dresses, the furniture, the vessels, the animals, the instruments, and those, as well as the persons, drawn so naturally, as to leave nothing to be desired for our well-understanding of the home life of this long-lost people. Subjects so varied offer of course many illustrations of the habits of the people, and one of the Tarquinian tombs we have all the public games which the people indulged. Although the representations from the Egyptian tombs are painted, and often enable us to distinguish portraits, national characterizations, and details of dress, yet their conventional execution wants the charm of the Etruscan designs. Seti-Meneses, of a colossal size, occupies the greater part of a picture, and attacks a chief of the Tahunus, who again overtops the people, who in diminutive shape are scattered in the corners of the panel. The Egyptians, moreover, want life, even if in any degree they comply with the requisites of likeness to the human form. They are serious, but are not pleasing; whereas the works of the Etruscans have both qualities, and are the expression of a very agreeable type of civilization.

The Etruscan collection in the British Museum was chiefly formed by Signor S. Campanari, who explored many tombs in Etruria, and made copies of the paintings. The whole of these were exhibited for some time in London and other towns, under the name of the Etruscan Tombs, as will be remembered by those who saw them some few years ago. The Trustee of the British Museum showed a very liberal mind in purchasing this collection from Signor Campanari, and securing it for England. Besides the Campanari collection there are great numbers of vases of various dates and styles, purchased or received by the Trustees, and which include many Etruscan specimens.

The collection may be considered as forming three parts. 1st. The paintings from the tombs. 2nd. The sculptured tombs. 3rd. The vases and terracottas. It is to the paintings we shall direct our attention chiefly on the present occasion.
They include four principal divisions, two in the Etruscan Room, and two in the Bronze Room. The paintings are placed on the walls above the cases, but the figures are of sufficient size to allow of their being well seen. Each subject contains the paintings on the inner walls of a tomb, and above is shown the ceiling of the tomb. The decorations therefore which once lined four walls, are now spread out flat, whereby, which is well suited to display the grouping. On account of the distribution around the walls, the composition is arranged into a centre group, with one on each side, the remaining space being left for the doorway.

In the Etruscan Room both subjects are from the ancient city of Tarquinii. We are obliged to distinguish them as the Right Tomb and the Left Tomb, according to their situation on entering the room. The Left Tomb includes three couples banquetting, attended by ten musicians and dancers, five on each side. The Right Tomb is in two compartments, and includes in the lower compartment three couples banquetting, attended by twelve musicians and dancers. In the upper compartment, or over the heads of the banqueting party, is a long subject with smaller figures, which represents all the varieties of public games, with two stages of spectators looking on. In the Bronze Room are two tombs from Vulci. That on the left has male figures, with Etruscan inscriptions, engaged in various games; that on the right is very much mutilated, and the subject cannot be ascertained. Two seated figures seem to be Pluto and Proserpine. This is a very different style as to countenance and treatment than the others, more nearly approaching the Greek style.

Besides these four principal subjects are some smaller. In the Etruscan Room are paintings from a tomb at Corneto, including a woman paying the last offices of her streched out body, men drinking and dancing, and men dancing and playing on the double tibia. In the Bronze Room are two paintings of the Etruscan Charon, from the entrances of tombs, with Etruscan inscriptions. Most of our readers are aware that the Etruscan character is of a Greek type, and used in the method originally obtained from Phricelis, of writing from right to left, instead of the later Greek way of writing from left to right.

The Right Tomb from Vulci is so different in style that we must speak of it separately, but the other tombs may be classed together. There is a smoothness and grace in the style which is particularly remarkable, and great care in the drawing of forms, though there is no attempt at minute anatomical delineation. Whether the figure is draped or naked, the same practice is adhered to of drawing in the outlines of the figure, which, when the figure is draped, are shown under the drapery. This has a singular effect, as however closely or loosely the male or female figure may be clad, the naked body is shown through the clothing, not in the mere pressure of the drapery, but in the exact anatomy, however far the drapery may be distant. Thus, the figures on the Left Tomb of Tarquinii, where the dancing women are clad in very full-skirted modern petticoats, the whole of the lower limb is rigidly drawn.

This practice shows how sensitive the artists and the public were to a close and accurate delineation of the human figure, and how very different from our modern artists and public. The frequent exhibition of the naked figure in public games made the Etruscan more critical in human anatomy, and as we have no longer the same opportunities, it is only by a close study of the antique and of the living model that we can hope to make up for our deficiencies. The Etruscan paintings will illustrate the soundness of that law, put forward for all classes of art, from high art to the least mechanical performance, that instruction must rest on the study of the human figure. Schools of design may draw from architectural casts as long as they like, and make as much use as they please of the rule and compasses, but we cannot have artists or an artistic public without the figure. This must be at the beginning of teaching, and it must follow it throughout. This fact was proclaimed ten years ago, and our schools of design will never enable us to compete with foreign manufacturers in works of taste, until we carry it out fully and faithfully.

To make a high artist, all will allow that nature must be studied—but what does this mean? Are we to draw trees and flowers, and to neglect that necessary foundation, the human form? The Greeks and the Etruscans walked among trees and flowers as we do, they enjoyed the beauties of the landscape—but they did not thus become artists, nor could they have become artists. A flower is most admirably organized, so is an animal; but the perfection of organization, the adaptation of physical means to intellectual ends, is man. It is in his form, in his structure, that we can study the highest applications of godlike skill—and to neglect this, is to neglect the greatest and noblest school of art. Anything so perversely blind as English practice on this head cannot be imagined, and it conveys the causes of English failure. In England, the artist is a mechanic in painting, nearly on a footing with a Wolverhampton locksmith or tailor, who goes on from year to year copying the same article, without reference to any higher principles. The Commissioners of Fine Arts, in fostering good drawing and correct anatomy, do most wisely for the interests of art; and it is to be hoped that all will unite in the same purpose, and that in our academies and schools of design we shall follow the only sound course of teaching and learning. The great end and aim of all teaching is to train the mind to the best habits, whatever may be the end of the learner, whether high or low; and in a right education, the mind of the statesman and the porter, the artist and the workman, will be equally trained in correct thinking, whatever may be the special object of their pursuits.

The Etruscan figures are of two classes, draped and naked; but none of the female figures are wholly naked, though some are naked from the waist upward. The drapery is so various in its structure and adaptation, as to afford much practice to the artist, and he has the whole range from the naked figure to the complex forms of modern female fashion. The garment most used by men and women is an oblong square shawl or mawd, worn in various ways. Sometimes it is a shawl or scarf. Sometimes a cloak, with the man a waistcoat. As a scarf, it is sometimes put on in the usual fashion, and the ends then put through the arms, so as to hang down. As all the garments are of various colours, white, blue, and red, and sometimes with braiding, patterns, and ornaments, the effect is much increased.

Many of the female dresses are very elegant in form and colour, and are of most various styles. We recommend to the ballet masters, who are always searching for something new, an Etruscan ballet, with some of the picturesque costumes of the Museum. In each subject a different general fashion is observable. In the Right Tomb of Tarquinii, the women have a long and rather close dress, with a shawl; a cap worn in the fashion Parisian women wear a coloured kerchief, with short curls. They have likewise sandals. In the Left Tomb of Tarquinii, the costume is almost modern—a bodice with short sleeves, a short and very full petticoat, boots or sandals, long hair worn with a wreath, earrings, bracelets. The third fashion is in the tomb of Corneto: a bodice, petticoat, pelisse, cloak or shawl, long-toed shoes, the hair worn in long tresses.

As an example of the mode of treatment, we may take the female playing the cæsartanes, in the Left Tomb of Tarquinii. She wears a red bodice, edged with bright blue, short sleeves of the pattern of the skirt, trimmed with blue. The petticoat, short and in full breadth or folds, is of a reddish tinge. The pattern is in red, and consists of three spots divided by horizontal striæ or lines of red, sometimes plain, sometimes destituted. The pattern of the skirt is said to have some slight connection with the Manchester loom. On her shoulders she wears a blue scarf, edged with red, the ends being, as before described, brought through the arms. Her hair is worn long, and around her head she has a blue wreath. Her boots are red. She has bracelets, and in her ears rings with a large round drop.

Besides the practice of showing the outline under the drapery, there is another conventional peculiarity of Etruscan art, which consists in showing all the fingers of the hands, which are arranged in perspective, fashionable, but close together.

In the Right Tomb of Tarquinii, in the lower compartment, the libel personages are three men and three women, seated in couples on three couches, which are laid in one row, so that the guests can be fully seen by the spectator. Throughout the subjects we notice that the women, like those of Rome, were treated with great deference and attention, being the companions of their husbands in their feasts and games, and that they held the position of a Germanic rather than of a Greek wife. In the banquet and the games the women are present, seated with the men; and even of the slaves or attendants, none of the women are naked. Two naked boy attendants stand near the couches, and there are small tables, of very elegant design, bearing refreshments: the men and women are drinking. As if for coolness, the men and women are naked from the waist upward.

Under each of the couches is a pair of ducks, painted in blue. Each of the ducks is in a different posture, but each is characteristic, and the artist shows a degree of skill and fancy which a modern rival could not surpass. The six ducks are pictures in themselves. From the introduction of them, it is to be supposed they were pets of the household, though rather strange ones.
The Right Tomb at Vulci is different from all the others in subject, style, treatment, and physiognomy. The personages, who are more of a Greek or Pelasgic character, are closely draped in cloaks of one colour, as blue, without ornaments or trimming,—more closely approaching what from our sculptural impressions is conventionally required as antique, than the gay and lively costumes of Tarquinii. This tomb, however, had a chequered ceiling, like those of the Tarquinian tombs. These ceilings are of a peculiar character, and are executed in various colours, showing, as usual, much fancy in the arrangement.

The paintings of the Etruscan Charon are coarse, and seem conventional caricatures or grotesques, quite different from the portrait-like character of the other designs.

The Etruscan paintings will well repay inspection, and are some of the best illustrations we have of ancient manners. The student who wants a comment on Homer will best find it here, and after perusing the book of games, he cannot do better than see them depicted in detail in the Right Tarquinian Tomb or Left Tomb of Vulci. The banquet scenes are fair illustrations of Roman life. Etruscan vases and Etruscan dancers, the double flute and the lyre, were to be seen at Roman banquets, where the guests likewise reclined. What is given merely in form in bas-reliefs is here given in form and colour; and what is in sculpture performed by the artist's imagination, long after the event, is here painted to the life from the men and women as they breathed and moved and dressed. Certainly, the Elgin frieze gives us a tamer idea of Athenian life, though executed under the eye of a Phidias, than the weaker paintings of the Etruscan do of Etruscan life.

In an artistic point of view, there is a benefit in studying the works of a refined people, for so the Etruscans were. They possessed a literature, and inscriptions were common on public works, showing that reading was generally diffused. Their dresses, manners, and games show that they possessed wealth and cultivation, and the works they have left us are ample proofs of their advanced taste and of their love of the pictorial arts. Music and dancing were advanced to the rank of arts. It is always useful to contemplate and analyse the progress of a people who had less advantage than ourselves.

The sculptured tombs in the lower part of the Museo do not show so favourably as the paintings, though they exhibit traces of artistic development. They are generally carved in soft, bad stone, and some are in coarse clay; yet, even in these, there is an attention to anatomy, to drawing, and to drapery, which draws our notice. Some of the reclining figures show considerable care in the arrangement of the muscles of the back. In the paintings, minute anatomical drawing is not attempted, but in the Right Tomb from Vulci the muscles of the abdomen are drawn in the Greek style in the figure of Pinto, which is only half-draped. From their progress in painting, from their sound principles of art, and from the indications in the rude sculptured works we have, we may rest assured that these latter are not fair samples of Etruscan art; and we may expect, that though most of the finer works have perished by the effect of time or by the hands of the Romans, that more favourable specimens will yet be discovered.

The vases commonly called Etruscan, are now brought together in the Etruscan Room, and arranged, which was very needful, for during some years they remained in a deplorable state of confusion, so that it was impossible for the student to get any benefit from them.

The vases are now arranged chronologically and according to the localities in which they are found. They form six groups, besides a collection of terracottas, chiefly Etruscan.

The first group consists of vases of heavy black ware, some with rude figures upon them in low relief, the work of the ancient Etruscans. These are mostly found at Cerreti or Caser.

The second group includes the vases called Nolan-Egyptian or Phocian, with pale backgrounds and figures in a reddish maroon colour. The figures are chiefly those of animals. These vases are mostly found at Nola.

The third group contains early vases with black figures upon red or orange grounds. These are rich in mythological subjects. These vases are found at Vulci, Canino, and the Ponte della Badia, to the north of Rome.

The fourth group is formed of vases more carefully finished. The districts from which these are obtained are Canino and Nola.

The fifth group is a later class of works, more slovenly painted. The subjects relate chiefly to Bacchus. The vases are got from the province of
DESCRIPTION OF A UNIVERSAL TIME TABLE.

BY F. BASHFORTH, Esq.

The calculation of Railway Time Tables is attended with considerable difficulty and liability to error, owing to the various velocities of different classes of trains and the variation of gradients and stations stopped at. The importance of the correctness of these tables, coupled with the difficulty of obtaining that result, have led me to contrive a little instrument which, when the stoppages and the time of starting and arrival are determined, will give the times of arrival at each station exactly as they appear in the bill, regard being had to varying gradients, and consequently varying velocities. There could be no doubt of the perfect success of a mere geometrical contrivance, but to remove any doubt that might be felt, and to explain my notions to my friends, I have constructed a universal time table for the main line of the Manchester and Leeds Railway, which is about 61 miles long, and has 21 stations. The result is perfectly satisfactory. I employ two scales; the vertical is of 40 minutes—the horizontal of 8 miles to the inch, but they might have been respectively 60 and 20. The instrument is arranged on a board 11 inches square.

Let A B, Fig. 1, represent 30 miles, and the perpendicular C B, 60 minutes, and suppose a train to be travelling along A B with a uniform velocity of 30 miles per hour. The time of describing A b will be found by applying the vertical scale to measure the perpendicular c b; for

\[
\text{Time in } A B = \frac{A b}{A B} = \frac{b c}{B C}
\]

But B C represents time in A B, and therefore b c represents time in A b; and so on for any other distance.

Suppose, however, that when the train comes to D, the velocity falls from 30 to 20 miles per hour. Draw E F parallel to A B, and cut off E F = 30 miles. Erect the perpendicular F G, and make it 60 minutes by the vertical scale. Join E G. Then the time of arrival at any point d, will be found by applying the vertical scale to the perpendicular d e, and reading off the minutes; and so on if there be more changes of velocity.

The above is applicable to a train travelling with varying velocities, but without stoppages. If we suppose the train to lose 5 minutes by stopping at a station at e, then this time will never be recovered, and every point in the time line to the right of e must be raised 5 minutes. If there be another loss of 4 minutes at d, every point in the time line to the right of d e must be raised through 4 minutes additional; and so on for other stoppages.
Fig. 5, is placed on a level surface as in fig. 4, and the separate pieces of wood are kept in their places by two fixed pieces X Y, with parallel faces. O S, O' S', are two straight bars movable about O O', capable of being clamped in any position. Fig. 5, represents the scale used in reading off the time. The head moves along the bars O S, O' S like a T-square. The slide carries divisions for every 10 minutes, and the circles on it represent the ivory studs on which any required consecutive hours are written, as it would be inconvenient to have it of sufficient length to hold 12 hours.

Let it be required to read off the times for a train stopping at C and F. Breaks must be made in the time line at O and Y, by the contrivance, fig. 6. Secondly, move the slide and the strips of wood between X and Y, up or down till the time of starting on the scale falls on the end of the time line at A. Thirdly, move O S, about O, till the other extremity of the time line coincides with the required time of arrival, and then clamp the bar. The scale must be applied to show the hour and minute coinciding with the breaks at m and n, and this time must be registered in the table. For the return train, I to A, the head of the scale slides along O' S', and the second and third adjustments have to be made.

Few stations have been supposed for illustration, although the advantage of using this method is not so apparent in such a case. However great the number of stoppages, it is scarcely possible to make a mistake that will not be detected. If any error is made in making the breaks in the time line, the time table will show either the omission or excess, as the time and station must be read off at each break in the time line, and registered in the table.

There is no necessity for having the velocity per hour given for the rate of travelling over each particular part of the line, for the purpose of laying down a time line, as it may be plotted from the observations of the times of arrival at several points of the line of a train travelling without stoppages. Let train be travelling along A D, fig. 7, and let O, B, E, C, F, and G, at right angles to A D, represent the times of arrival at A, B, C, and D. Join A, E, F, G, which will be the time line. The time allowed for stoppages must include the whole loss consequent on lowering and getting up the speed.

Mr. J. Samuda employed diagrams constructed in a manner similar to figs. 1 and 3, to explain the proposed arrangement of the trains on the London and Croydon, and Croydon and Epsom railways, which are given in the "Minutes of Evidence," printed by order of the House of Commons, June, 1844. I have also seen in the Builder, of August 21, 1847, a notice of a new time table, patented in Paris, but the description there given does not enable me to say whether it resembles the one above described. I am not aware that the method of allowing for a stoppage at any given station, for varying the time of performing the journey, or for reading off the times ready for insertion in the time table has ever before been adopted.

ENGINEERING AND RAILWAY MEMBERS OF PARLIAMENT.

A new parliament under usual circumstances is not of much importance to professional men, but for once the case is different. Engineers and surveyors have now much at stake in the measures likely to be subjects of legislation; while the elections have brought forward many men whose opinions on these subjects, or whose connection with our professional pursuits, create much interest. We have been handed over to the mercy of a Board of Trade already, while many measures deeply affecting professional interests are sure to come under discussion, such as the health of towns' bill, a general act for drainage, railway legislation, the survey of London, and steam-engine inspection. How these subjects are likely to be treated is not unreasonably a matter of anxiety.

The last parliament began the new class of railway directors, for we can hardly consider the election of Mr. Charles Russell, the late member for Reading, and chairman of the Great Western railway, as being of more value than a single and accidental circumstance. It was the return of Mr. Hudson and Mr. Chaplin which constituted the class now so greatly increased by the last elections.

With some it has been a matter of fear that we should have a railway parliament, and it has been put forward, under the authority of Mr. Dodd, that the present parliament contains more railway directors, engineers, retail tradesmen, and political lecturers than any former parliament, and fewer officers in the army and navy, and landed gentry. If a parliament now have railway directors in it, it must have more than in former parliaments, because as it may be said railway directors did not exist as a class in former days. We might as well be told that in the streets of London there are more cabmen and omnibus-drivers than in former days, and that on the river there are more steamboat stokers and fewer watermen. Admitting the fact that there are more railway directors and engineers in the house, we do not therefore see any ground of alarm to the country. As to the retail tradesmen we have little to do with them, except so far as they have been mixed up with railway directors, and insomuch we are bound to say that we put no worth on the increase of retail tradesmen, for we believe that the whole body of retail tradesmen in the House of Commons consists of one or two individuals. The inquiry to the country cannot at the worst be very great in having Mr. Williams, the haberdasher, instead of Mr. Alderman Wallihan, the haberdasher, or Mr. Alderman Sidney instead of Alderman Sir Matthew Wood. We confess likewise to obtuseness as to the inquiry likely to arise from Mr. Alderman Sidney, Mr. Williams, or anybody else who makes money behind a counter, sitting cheek by jowl with the members for Waterford county, Finsbury, and Wallingford. With regard to the political lecturers, they mean Mr. W. J. Fox, Mr. Fearous O'Connor, Mr. George Thompson, and Mr. Wilson; and even though political lecturing has taken the place of political pamphleteering, it grieves us little that Messrs. Fox and Thompson sit as members of the house to which Burke, Sheridan, O'Connell, Cobett, and Hunt belonged. We need not enlarge the latter list.

The only fact with which we have to grapple, indeed the head and front of the grievance, is the number of railway personalities; though we are bound to say, that when admitting the new classification of railway directors, we must not forget that it strips Mr. Hudson of his quality as a landed proprietor, Mr. Glyn of his title as a banker, and every other individual of his previous description of enrolment. One question therefore is, whether in accepting the new class of railway men, we admit a body less wealthy than officers in the army and navy, government functionaries, or landed gentlemen. We believe that on the whole Mr. Hudson, Mr. Glyn, Mr. Robert Stephenson, Mr. Cubitt, Mr. Chaplin, Mr. Parkcr, Mr. Locke, Mr. Peto, Mr. Waddington, Sir Joshua Walmley, Mr. Jackson, etc., have not too small a stake in the property of the country to disqualify them from sitting on the same benches with other gentlemen, whose names it is unnecessary to mention, as the state of their finances may be learned of any
of countries not governed by literati; nor do we think that the latter country is likely to come under the system. We must therefore take it as we find it, and in so doing, it may be worth while to consider how far railway directors as much as likely to prove efficient law-makers and public counsellors.

England is a practical country, and a preference is always given to practical training over theoretical training, and we question whether Englishmen would not any day much sooner elect a good brickmaker than the greatest poet or dramatist on whose fame they ever prided themselves. Give a man a good practical training, and he may set his hand to anything—that is, the English teaching and schooling: and we are none the worse for it. It is perfectly national to see Richard Cobden and George Hudson in their present positions, and it would not be surprising to find them exercising still greater influence. The standing of a man is an exposition of the national sympathies and character—not what some have been pleased to call it, the worship of Mammon, but the result of that innate appreciation which the English have of business habits applied to business purposes. We are very certain that as much would not be done for Charles Dickens, and we are not ashamed of it. Dickens has his reward in another way. We give to a Cobden or a Hudson political power and influence, but we do not award to them the undying esteem of all ages. It is the pride of genius to labour for the applause of posterity; the politician has only a life interest in the present. Whether it be to become a Shakespeare or a Cobden it lies with the aspirant to judge, but he must not complain if he do not receive the rewards of both. We know that there is a large party who complain that in this country literary and scientific men do not receive political rewards; we cannot see that there is any ground for sympathy with this complaint. We think a successful railway potentate much more fitted for a lawyer than a proficient poet, physician, or artist. A man who can look well after his own affairs is, in the common acceptance, best fitted to look after the affairs of his neighbours; and railway kings comply much better with this condition than poets, painters, mathematicians, musicians, or actors. The sample we have had of literary men in the House of Commons has not been encouraging enough to induce us to wish for more; and while there is no specific exclusion of them, and while they have the means of purchasing a qualification by the purchase of a small sum of money, the system of general remuneration of their labours, we are not disheartened nor ashamed that Dickens, Ainsworth, James, Leigh Hunt, and Sheridan Knowles, are not members of the House of Commons. It is quite as much to open it as it is to Bulwer, D'Israeli, and Macaulay; and when they can command the political confidence of the public, let them demand political honours.

We consider the training of a railway man as particularly qualifying him or parliamentoary duties. He must be a man in whose pecuniary ability and trustworthiness a large number of persons have placed their confidence. He is trained in the habit and feeling of public responsibility and accountability. He must have working habits of business as the member of a board. For good judgment he has adequate command of temper and ability, he cannot countenance the colleague of a dozen or twenty men of standing. The crookbety, prattling, meddiling, or ill-tempered man is either sifted out, or he has his rough points polished off. He acquires a considerable degree of financial and fiscal knowledge in dealing with large sums of money. He is compelled to enter upon the consideration and application of many newly developed principles, which require close discussion and accurate comprehension. He is schooled in meeting the exigencies of new and progressive institutions. He is called upon to conduct important negotiations with able men, and to make arrangements which shall be applicable to circumstances of great difficulty and complexity. This is no exaggeration of the capabilities of a railway man, and we consider it not a bad stock wherein to engrat the responsibilities of a seat in the House of Commons.

Except among our Indian functionaries of the civil service, it will be difficult to find men who have had a wider field of administrative practice than our railway directors. Responsibilities far exceeding those of the finance minister of many an independent nation devolve upon Mr. Glyn, or Mr. Hudson. The yearly expenditure of millions, the management of a floating capital of twenty millions, and of a current revenue perhaps of two millions, with the administrative control of a thousand subordinates, afford a wide field for the attainment and exercise of practical ability,—and we opine that that is what is wanted in the House of Commons. We have spoken enough and wisely enough; we want thinkers and doers, and the more of them the better.
House of Commons has been refreshed with new blood, and that Mr. Macgregor, Mr. Fox, and Mr. Wilson will not prove useless members, still less Mr. Glyn, Mr. Hudson, and the many other gentlemen whom we have already enumerated. Before leaving this part of the subject, however, we cannot well refrain from making some remarks on a few of the individuals most prominent in the railway legion.

Mr. George Carr Glyn is the son and grandson of a baronetal family of that name, and a member of the banking firm in which his brother, the present baronet, is a partner. Mr. Glyn made his debut in joint-stock companies during the mania of 1824, at which time, among other such occupations, he was auditor of the Columbian Pearl Fishery company—one not among the brightest enterprises of that speculative period. Of late years he has shown less ardor in the pursuit of gain. In the next great period of speculation, we find him chairman of the London and Birmingham, now the London and North Western railway company. For a long time he has been the head, out of parliament, of the railway interest; as much from being put forward by his colleagues, as from being recognised by many of the minor companies. His policy in this capacity is the index of his parliamentary policy, and it has not been that which in our view has been best calculated to promote railway interests. Mr. Glyn has no confidence in independent action, and has always been inclined to lean upon the government. He was the introducer and the chief supporter of the Board of Trade inspection system, and his last public act is a declaration of his adhesion to the same principles, though he has already fallen into so many positions of inconvenience that he has entrusted to such hands. Mr. Glyn has no defined views as to the operations of railway capital, the principal of private enterprise in joint-stock companies, or the principle of fares. What convictions he has are opposed to what is assumed to be the best theory and the best practice, and Mr. Glyn only acts in conformity with these latter, when he can no longer withstand his action, though he does not seem to give his acquiescence. With a very distinct delivery, and a seeming logical severity of language, Mr. Glyn is a very indistinct thinker. As a railway chairman, with the prestige of a great reputation, and with a case carefully got up, Mr. Glyn has been an impressive speaker. Whether he will be so successful in the House of Commons, where he will no longer stand alone, but have to contend with other men, remains to be seen. Undoubtedly he has great advantages: a pleasing person, polished language, a confident but insufficient address, and the assertion of high moral principle, when backed by power and reputation, are calculated to produce a favourable impression on an audience. On some points of religious profession, Mr. Glyn is, we believe, likely to take the same part as his cousin, Mr. Plumptre, whose strong opinions are well known. Success and ill-success have been about equally balanced in Mr. Glyn's career: the resignation of the North Midland chair, defeat by the Great Western, and recriminations with Mr. Moss and Mr. Russell, in which mutual charges of breach of faith have been banded, have been counterpointed by Mr. Glyn's maintenance of the London and Birmingham chair, and by his amalgamation of the Grand Junction railway, after difficulties which might well have been regarded as insurmountable. Mr. Glyn's maiden session will be anxiously watched by many.

Of Mr. Hudson little need be said. He has successfully passed through an anxious railway session, and the next series of half-yearly meetings can scarcely present anything inanipaculous. The prestige of his reputation is untouchable, while is the present temerity of the Bentinck party, being unshackled in his political movements, and released from his patronage of protectionism, he is likely to exercise great and useful influence in the house. Mr. Hudson is certainly the railway man of the most original powers of thought, of the most advanced mind, and of the most progressive character. He is one of the most ably constituted of the joint stock system, than in that of all the railway members put together. Mr. Hayter is the representative of the Great Western.

Mr. Chaplin is a man who will hereafter be better understood by the public. A sketch of him in Fraser's Magazine, does honour to him and to the writer. Mr. Chaplin is a man who by great prudence has raised himself to a very high position, who undertakes nothing without careful and laborious thought, and who, although often behind hand and not always in the right, commands respect from the known fact that his opinions are the result of a well-studied conviction. Mr. Chaplin, we conceive, is much more likely for the present to follow Mr. Glyn's line of policy than any other; for he is, like Mr. Glyn, only a forced follower— we cannot say convert—of what may be called the railway movement party.

Mr. David Waddington has not hitherto been well known in any important capacity. His chief claim hitherto has been the unbounded confidence reposed in him by Mr. Hudson, and his administration under Mr. Hudson of the Eastern Counties railway, against the most difficult circumstances.

Mr. Robert Stephenson, the son of the patriarch of the locomotive system, has been less known by the public in his personal capacity than as an engineer. His ability in those gladiatorial combats before parliamentary committees, his practice in negotiation and correspondence, and the confidence reposed in his diplomatic skill by leading railway men, are guarantees of his powers to those who know him. A good figure and pleasing address will help him in making an impression in the House of Commons. He has been always acting with Mr. Hudson. Mr. Locke has tried his skill in the same arena of the committee-rooms, and with equal success. Mr. Locke at one time co-operated with the Great Western in their struggle with the London and Birmingham, but still must be ranked among Mr. Glyn's followers.

Mr. Jackson, of Birkenhead, has only a provincial reputation. He is a fluent speaker in the Liverpool style, but is likely to require a long training in the House of Commons before he will have weight. He has no decided views on general principles of railway policy, but is an advocate for nationalisation in currency matters. He has no weight among the railway interest, and will not be admitted by them as an exponent of their views, whatever course he may adopt.

Sir Joshua Walmsey is a Liverpool merchant, a colleague of Mr. Jackson's. He has served the office of mayor of Liverpool, when he was knighted. He is likewise a fluent speaker.

Mr. William Unbitt, the contractor and builder, not the engineer, will not, it is supposed, take any active part in parliamentary proceedings.

Mr. Samuel Morton Peto is considered a man of education, ability, intelligence, and practical business habits. He speaks well, but his railway principles are not known.

Mr. Wyld has never had any intimate connexion with railway management, but is well acquainted with the general policy, and is supposed to be an advocate for non-interference.

Mr. Humphrey Brown was the founder of the Birmingham and Gloucester railway, and afterwards its manager. He enters with very strong feeling into every subject he takes up. He is not so well liked as a speaker out of doors, but in the House of Commons is likely to be well listened to, as he is a well-skilled statistician, and can get up his case carefully and studiously. He tends to non-interference in the management of joint-stock enterprises.

There are abundance of railway directors in the house, but very few others who are likely to take part in debates in such capacity beyond those we have named. As the matter stands, we fear the prospects of the railway interests are very uncertain, for in all likeliness the voices and votes of Mr. Glyn, Mr. Hudson, Mr. Chaplin, Mr. Locke, Mr. Stephenson, and Mr. Waddington may all be given for a Board of Trade bill, or for more stringent standing orders to restrict new companies: This, however, is matter of speculation, for Mr. Hudson is far from the men as intimated to the regulation of the Board of Trade, and he last year vehemently condemned their railway bill. If, then, they should bring in some measure trenching too much on the vested interests, they would only have the support of Mr. Glyn and Mr. Robert Stephenson, and the government would find itself attacked by Mr. Hudson, Mr. Chaplin, Mr. Hayter, Mr. Waddington, Mr. Locke, Mr. Peto, Mr. Jackson, Mr. Humphrey Brown, Mr. Wyld, and Sir Joshua Walmsey. This would make a grand railway debate; and a severe defeat of Mr. Sirrut might jeopardise the ministry.

We must treat the railway members carefully to consider the mischiefs which have already accrued from Board-of-Trade interferences, to withstand every new bill, and to repeal or modify all the restrictions which have been placed upon joint-stock enterprise by the standing orders and enactments, such as the length of notices to parliament, the ten per cent. deposit, the limits on the payment of interest on calls, on the amount of dividends and fares, the power of suing for calls, the registration of joint-stock companies, and all the other new-fangled devices for impeding the free progress of railway enterprise. Old companies may be fearful of encouraging competition, but experience must have already pointed out that there is only one sound way of promoting railway enterprise, old and new; that is by unbolting the fetters. The same argument which authorises the fettering of new schemes, authorises the fettering of the old. What the companies have to fear is not competition from each other but spoliation on the part of the government. As matters are going now, there will at an early period be a demand for a limitation of dividends.
SLUICE GATES AND RAILWAY LIFT BRIDGE.

Sir,—At page 244 of No. 119 of your excellent Journal, is the description (taken from the Franklin Journal) of a new sluice gate, invented by F. C. Lowthorp, civil engineer, of Pennsylvania. Allow us to claim the priority of this invention for one of our countrymen, long since deceased, and thus discharge a debt due to the memory of one who directed the first steps of our professional career and who was to us both a friend and a master.

It is now about 30 years since T. Blanken, Inspecteur general du Waterstaat in Holland, well known by his grand Canal of the Holder at Amsterdam, erected in this country the first sluices with what are termed fan-gates (a cocéilet, watersturen). These gates are precisely similar to those described in your Journal, except that their application and the flow of water are arranged in a simpler manner than by the American engineer. The first experiments having perfectly succeeded, the king Louis Napoleon decreed that these sluices should bear the name of the inventor, and gave them the title—Blankenstuwes.

A large number of the sluices of this country, of which the openings vary from 4 to 12 metres (15 to 30 feet), have been constructed on this principle, and their use has become general among us. M. Wiebecking has given a description of them in his large treatise on hydraulic works.

Permit us, at the same time, to claim the priority of the application of the Railway Lift Bridge, of which you give a description at page 241 of the same number. A moveable bridge, on this principle, was erected last year on the railway from the Hague to Rotterdam.

We trust, Sir, that you will have the goodness to insert this brief explanation, and beg you to receive the assurance of our perfect esteem.

(Signed)

F. W. CONRAD
L. J. A. VANDER KEN,
Hague, Sept. 15, 1847.
(Dutch engineers.)

REVIEWS.


Both the engineer and architect are under great obligations to General Pasley for the very elucidious manner he has set forth in this treatise the result of many years' laborious researches and experiments on limes, mortars, and cements. When the first edition of this work appeared in 1836, we then perused it with great pleasure, and strongly recommended it to the profession; and as a proof of the correctness of our opinion, the work was very soon out of print, and has since been much sought after, which induced the author to publish a second edition. He may well be gratified to find that his laborious researches have induced several manufacturers under different appellations to manufacture the artificial cement recommended by him. The General observes in his introduction—

"When he first published his researches on the subject, all the previous attempts to make a good artificial cement in this country had so far failed, that only one sort, that prepared by Mr. Frost, had found its way into the market, which was of inferior quality, owing chiefly to certain defects in the mode of preparing the ingredients, pointed out in the First Edition of this work. At present there are three manufactories of artificial cement in England, which have all been used more or less extensively in works of importance, and have given satisfaction; viz., first, that of Messrs. John B. W. and Sons, in the parish of Swanscombe, Kent, the present proprietors of Mr. Frost's works, who, after gradually relinquishing the objectionable parts of his process, have succeeded in making a good artificial cement, which they call their Portland cement, by a mixture of chalk found on their own premises with the blue clay of the Medway; secondly, that of Messrs. Evans and Nicholson, of Manchester, who make an artificial cement, which has been called the PATTERN LITHIC CEMENT, with the very same ingredients, and in the same proportions nearly, that were used in the Author's experiments, but the most important of which is obtained in a round-about manner from the residual matters or waste of certain chemical works, instead of working with natural substances; thirdly, that of Mr. Richard Greaves, of Birkenhead upon Mersey, who makes a powerful water cement, which he calls the LIME CEMENT, by mixing a proportion of indurated clay or shale with the excellent blue lime line of that neighbourhood, both of which are found in the same quarries; the former being previously broken and ground, and the latter burnt and slaked, which is absolutely necessary in making an artificial cement from any of the hard lime stones."
The success of this process, as a commercial undertaking, though the most expensive of all that were suggested in the First Edition of this work, is therefore peculiarly satisfactory, considering the great importance of good water cement, and the probability of the natural cement stones of this country, which are only found in certain localities, becoming unequal to the demand, or, if they are, for the price.

We will now proceed to give a few extracts from the treatise, to show its practical character; first, as to the qualities of sand and lime, constituting Mortar.

The sand used in making mortar should be sharp, that is, angular, not round, and clean, that is, free from all earthy matter, or other silicious particles. Once mixed, a sand must not be mixed with mud, and Pit Sand generally, as being scarcely ever without a proportion of clay, should be washed before they are used, which is seldom necessary in river sand, this being cleansed by the force of the current which is the cause of the name. Sharp sand will ever form good mortar, and the intimate mixture of the sand and lime, which should be done with a moderate quantity of water, is of no less importance.

I have ascertained by repeated experiments, that one cubic foot of well-burned chalk lime, fresh from the kiln, weighing 35 lbs., when well mixed with 4 cubic feet of good river sand, and about 1 cubic foot of water, produced about 52 cubic feet of as good mortar as this kind of lime is capable of forming. Some readers may be surprised that this mortar should occupy rather less space than the sand alone originally did, before the water and lime were added to it. The principal reason is, that dry sand, and all dry loose materials generally, settle into a much smaller space when wetted. Hence the same quantity of sand measured dry, then moist, and afterwards wet, will occupy unequal spaces. The clean sharp river sand, rather moist, as we, when finishing 17, were filling gradually pouring water upon it in the measure it settled down from 13 to 89 inches in height, thus occupying only four-fifths of the space, which it had before filled.

Pure lime has no capable of resisting the action of water, that it is unfit even for the external joints of walls exposed to the common vicissitudes of the atmosphere. For by degrees the beating rains, to which the outside of such walls is subject, will gradually destroy the mortar of all those joints connected, as may be seen by inspecting old walls built with chalk lime mortar, which have not been needed with for some years. . . . Walls built with the water limes settle less, and those with cement are entirely free from this action, because the cement used in the lower part of the courses for the brick or masonry added above to make any impression on the joints. Now though the difference of settlement, even between those extremes, may be very small, it does not appear prudent to use more than one species of mortar in the same building, or in the work of the same size as it would give trouble to the workmen, and occasion loss of time.

Pure lime mortar has sometimes been used for the backing of wharf walls, the front or facing of which has been protected by water cement, usually to the depth of about 16 inches, or two bricks thick, from the outside of the wall, in which case the mortar does not stand, the ruin of the wall, is highly to be reprobated. The cement protects the pure lime mortar from the direct action of water in mass, but not against wet or damp, because the moisture penetrates through the pores of the brickwork and of the cement, and the quantity in the size of the pores of the pure lime mortar, it effectually prevents it from setting, that it always remains in a state of soft pulp, and is of no more use towards the consolidation of the wall than so much moist clay.

The next division of the work treats of Plaster of Paris, as it is generally called. To test its quality—

\[ \text{Mix a small quantity of it with water in the form of a ball, and it will set with a very hard fine white substance, and will even continue setting under water, but being partially soluble in that liquid in process of time, it is not applicable to the purposes of hydraulic architecture.} \]

The division on Hydraulic Limes describes the different limes called in London as follows:

\[ \text{The blue lime limes are considered the strongest water limes of this country, and are found on opposite sides of the Bristol Channel, near Watchet in Somersetshire, and Aberhaw in Glamorganshire, and also at Lynne Regis in Dorsetshire. The first of these, mixed with puzzolana, was used by Smellon in building the Edystone Lighthouse. The Dorking or Mersal grey and the Halling lime, so termed from a village on the left bank of the Medway above Rochester, but which is also found near Burham on the opposite site of the same river, though not possessing such air of the first, as the properties, are also much esteemed; and these two limes, the former of which is more used in metropolitan than the blue limes, probably from the greater proximity of the quarries where they are found, and from very little land carriage being requisite.} \]

All the water lime stones are of a bluish grey or brown colour, which is communicated to them by the oxide of iron. They are usually termed 'stone lime' by the builders of the metropolitan, to distinguish them from common chalk lime, but so improperly, that the Dorking lime is not much harder than chalk, and the Halling lime stone is actually a chalk, and not harder than the pure chalk of the same neighbourhood, from which it is only distinguished in appearance by being a little darker.

In fact, all the coloured chalks found in various parts of England, commonly termed Grey Chalks, which are the Lower Chalks of the geologists, and generally free from flints, are possessed of hydraulic properties more or less powerful.

The chapter on Concrete contains some useful directions for mixing the ingredients, which is followed by some observations on ‘growing.' Among architects and builders there is a difference of opinion as to its advantages; our author's opinion appears to be favourable to its use.

\[ \text{Upon this subject, I may be permitted to remark, that unless every course be grouted, it appears to me that there is a risk of the grouting not penetrating lower than the single course immediately under it, for the beds of concrete is not in the next place has an opportunity to intercept the grouting, unless those beds themselves should have been imperfectly laid, which seldom or never happens, even when middling or indifferent hands. Fears are expressed of a flaw or crack in an scarcely exist in brickwork, unless every course be grouted, especially in thick walls, although the more general custom is to work with mortar only; when one of the many walls of the new British Museum, after being grouted in the manner before described, was cut through for temporary cement, it was remarked that the brickwork resisted the tools of the workmen quite as much, and appeared equally firm in the joints, as if the latter had been filled with plastic mortar instead of grouting. The same is the case with vertical joints being left dry may occasionally in masonry, and there can be no method of testing against it more effectual than to grout each course.} \]

Water cement, or what is called 'Roman cement,' comes next. This material, we consider, has been abused in its use more than any other connected with building, and from its repeated failures in exposed situations, and particularly where used near the ground, has established on the top the character of those as mere accidents, much as some doubt its boasted durability for such works; but whether its failure be owing to the improper mixing of too much sand, or the cement being of bad quality, it is difficult to say: we mayinstance as a failure the failalustrade enclosure on the east side of Regent's-park, which has been frequently repaired; and the construction work of the bridge have shown the walling to be very stow well, and might be advantageously used to a greater extent than what it is; when all circumstances are taken into consideration, the expense is not very much more than lime-mortar. General Pasley observes, that 'cement' is always weakened by the addition of sand, whereas every kind of lime is improved by it. But a part of the founda-

\[ \text{tions it is requisite to use double the quantity of cement than is required when lime is used, consequently it is not recommended for that purpose; but for the lower parts of a wharf-wall or pier under water, one measure of cement mixed with three, and not more than four, of gravel or sand, may be advantageously used.} \]

The valuable information communicated by the General on the manufacture of Artificial cement made from chalk and clay, form the most useful part of the treatise, and deserves the attentive study of all parties connected with building. We will select one or two of the author's successful experiments, detailing the process of making the artificial cement, which we here suggest should be called Pasley's Cement, as the distinction of these experiments are in the market; none of which, however, appear to be superior, if equal, to the one recommended in this treatise, and which the General found to be the best after a long series of trials and experiments. The first experiment on a large scale is thus described:—

\[ \text{Having, towards the close of the year 1836, and in the beginning of 1837, tried as many experiments on a small scale as I then considered necessary, I determined to prepare a considerable quantity of artificial cement composed of chalk and blue clay, with a view of applying it on a larger scale, to those purposes for which the natural cements have been used in architecture.} \]

The chalk, after having been broken small and dried in the air, was poured into small quantities at a time, in iron troughs that had belonged to a forge, with iron rammers made for the purpose, and was passed through sieves with brass wires, having 35 meshes to the inch, being the finest used in Austria. Having the gaspowered work, a large mass may be pulverized for chalk being thus provided, 5 cubic feet of it were laid on a wooden platform, and made into a paste with a moderate quantity of water, after which 2 cubic feet of the blue clay were added, and the whole intimately mixed, as it was on the same principle that when a sufficient quantity of water was prepared, the mixture was next moulded in the same manner as common bricks, excepting that water was used instead of fine sand to prevent adhesion. After these bricks of raw cement, which were twelve inches square, became dried, and were cut into the form of a cube of rather less than 24 inches side, this being the average size of the lumps into which chalk is usually broken, before it is burned, in the common open lime-kilns in Kent. I made my moulds exactly 18 inches long, and 24 inches wide by 24 inches deep, in order that 23 bricks, or 125 cubes, should be exactly equal to one cubic foot. Thus, by merely
counting the number of bricks, we could ascertain the quantity of raw cement made, without the trouble of measuring it.

This experiment not proving so successful as was desired, some experiments were again made on a small scale, and subsequently on a larger scale, in a small lime-kiln about four feet diameter at top, and six feet deep.

In this little kiln, than which nothing could have answered better, we burned 4 cubic feet of lime, using 6 measures of dry lime cement, and half a measure of coal-dust, and in burning it, after putting in shavings and wood at the bottom of the kiln, we laid half a bushel of coals over the wood, then four bushels of the raw cubes, after which another layer of half a bushel of coals, then four bushels of cumbes as before, and thus we continued applying the cumbes and cement cumbes in alternate layers, until we filled the kiln with one measure of coals to half a measure of raw cement, the former being broken rather small, so that no piece of coal used exceeded an inch in thickness, and both being thrown loosely into the baskets with which we measured them.

In the third and fourth measure of raw cement prepared for burning at the same kiln, we dispensed with the coal-dust altogether, using 6 measures of chalk to 2 of blue clay; and we merely pounded and sifted the chalk, without grinding the powder afterwards in the mill; and in consequence of there being no fuel combined with the raw cement in this mixture, we used one measure of cumbes to five measures of the raw cement cumbes in burning them, which proportion we always adhered to afterwards, as the best for this mixture.

The remainder of the treatise details the numerous experiments made by the General to test the strength of all kinds of cement, to which we refer our readers.

In conclusion, we confidently recommend an attentive perusal of this treatise to every one who may be desirous of obtaining sound practical information on limes, mortars, and cements.


The first paper contains an account of the projected Dodder Reservoir, and of the steam-engine, now in course of construction. Mr. Mallet has likewise favoured us with a description of his self-regulating syphon weir, which seems to us extremely ingenious, and perfectly correct in principle, whatever it may turn out in practice.

"Over a common weir, or embankment, is thrown a large flat-shaped syphon tube, made of boiler plate, and stiffened divided into two parallel tubes by vertical plates. One end of this syphon (which may be extended indefinitely along the crest of the weir) dips into the water ponded above the weir, the other end lays open at the lower side of the weir. The crest of the syphon tube reposes upon the crest of the weir, and the depth of the syphon tube, or distance vertically over the crest, is equal to the height to which the rise of water in times of flood may be permitted, (in the instance shown equal to 1 foot).

At a crest of the weir as it is determined shall be the lowest to which the ponded water shall be wasted by the syphon, there is formed a range of air holes, or simple apertures through the upper plate of the syphon tube. The action of this arrangement is now very obvious. When the water rises to the standard level, the water runs over or through the syphon; as its level rises above this, a sheet of water flows over the crest of the weir, and also down through the flat syphon tube, as part of the weir. This continues as the level of the water rises higher and higher, until it reaches that marked as the limit for the highest floods, that is, the level of the upper side of the syphon tube. The moment the water reaches this point, the syphon, being quite full, instantly commences to act as a syphon, and discharges a quantity of water, usually greater, than before—a quantity due, not to the mere area of overflow through the partially filled syphon, but to the area of the syphon tube, and to the head of water now acting upon it as a syphon. This vastly increased discharge, now more than a match for the supply of the stream, begins to lower the water above the weir, and its surface continues to fall until it reaches the point marked as the lowest level that it shall attain. Here the range of air holes are situated, and the instant the surface of the falling water reaches these, air enters the syphon, and it directly ceases longer to act as a syphon, and becomes merely a part of the weir conducting the ordinary overflow. This process, the sudden bringing

of the syphon into action when the water reaches a given level, and sudden cessation of its action again when it has fallen to a given level, may be endless repeated; and the effect of the syphon, when in action and suitably constructed, is in fact very nearly the same as suddenly opening a sluice, equal to its entire area, at the level of the bottom of the weir or dam.

Experiments on the discharge and flow of water from orifices and through tubes are much needed. Eytelwein's formula is generally adopted by engineers, though we much doubt whether it would be found applicable if the height of the head of water were to exceed a certain limit—say 10 or 150 feet. The second paper—"Experiments on Locomotive Engines"—has rather a formidable appearance; the tables contain as many figures as Mr. Adams employed in the calculation of Neptune's orbit. We noticed an allusion to the fact of the difference of pressure in the cylinder and boiler being a function of the load, as a theory of Mé de Pambour—for this difference and the cause of it, we beg to observe that Nature, and not M. de Pambour, is responsible; although that gentleman, we believe, first correctly interpreted her laws on the subject.

The last paper is a highly-interesting historical summary of the labours of the late Sir Samuel Bentham.

The Indicator and Dynamometer, with their Practical Applications. By Professor Main, of Portsmouth, and Mr. Thomas Brown, Engineer. London: Hebert, 1847.

The object of this work is to explain the use of two valuable instruments for ascertaining the work done by the steam engine. The Indicator is one of the many of Watt's valuable instruments, and on which great men set high value from cout of its utility and importance. By the application of the indicator the working condition of an engine is at once tested. The Dynamometer is introduced into screw vessels for ascertaining the amount of pressure given off by the screw shaft, and consequently the force the engine is exerting to propel the ship. The use of both these instruments and their application are very clearly explained in the little work before us.


Mr. Weale's object is to train for soldiers all the able-bodied men who may apply for relief at the Union, and he very earnestly points out the great dangers to which England is liable from the sudden invasion of the French. We should be very sorry to see England turned into a country of bayonets; we much prefer the epitaph of "a country of shop-keepers." Let men be taught how to avoid war, and not teach them the use of the carbine, to murder and pillage their fellow beings. Knowing Mr. Weale's disposition, we must say that we never suspected that he would have recommended such a system as he has promulgated in the pamphlet before us.

COLONIAL RAILWAY PROGRESS.

Madras and Arcot Railway.—A company has been started to effect the junction of these two important points in India. The line has been highly recommended by Mr. Simms, the government engineer. Its length is 71 miles, and is nearly a dead level, the average inclination being only 1 in 633 feet; there is no tunneling, nor any cutting of consequence. The proposed line is the first stage out of Madras on the great western line of communication from Bombay and Madras to Calcutta, Bangalore, Hyderbad, Cannanore, and Trichinopoly; and is second in importance to no line in India. It will be constructed at a low cost at £5,000 a mile.

Australian Railway and Sydney Water-Works Company.—This colony being in a starving condition, it has been determined to introduce railway communication on the same economical system as practised in America. The line is intended to run from the port and town of Sydney to Richmond, passing through Parramatta, Castlelogh, Windsor, and other places of minor importance, with a branch from Parramatta to Liverpool; and it is also intended to supply Sydney with water from the hills. This is of great importance to that town, as it is at present supplied with water from a lake, which is almost dry in the summer season. The line is 45 miles in length, and can be constructed remarkably cheap, as government will find land, and the country abounds with a very hard and durable timber, called iron-bark wood, particularly well suited for sleepers and rails, by merely arming the edge with angle iron.
MEASUREMENT OF ANGLES.

A New Method of Measuring the Degree, Minutes, &c., in any Rectilinear Angle, by Compasses only, without using Scale or Protractor.

By Oliver Byrne.

Let it be required to find the number of degrees, minutes, &c., in the angle \( \angle ABC = \theta \) (Fig. 1). With any radius, \( AC \), describe a circle; then take \( AB \) in the compasses, and apply it from \( B \) to \( 1 \); from \( 1 \) to \( 2 \); from \( 2 \) to \( 3 \); &c. (the numbers outside the circle are referred to). If, in applying the arc \( AB \), we find that on our return to \( B \), after \( n \) applications, we have a coincidence, then it is well known that the number of degrees, &c., will be \( \frac{360}{n} \). But, in the present example, after eight applications the point falls at \( S \), putting \( \Delta_1 = \) from \( 8 \) to \( B \), continue to apply the same arc or opening of the compasses from \( 8 \) to \( 9 \); from \( 9 \) to \( 10 \); from \( 10 \) to \( 11 \); &c., on to \( 16 \). This process is to be continued till we have the half or more than half the arc \( AB \) between the last point found and \( B \). In this case 24 is the point. Any error that may be involved in the process will be much neutralised by thus determining the points \( 8, 16, 24 \), &c. independently. Theoretically, the arcs \( 8, 16, 18, 24, \ldots \) &c. are all equal, but practically they may imperceptibly differ. We might have taken the arc \( B, 8 \), and applied it from \( 8 \) to \( 16 \); from \( 16 \) to \( 24 \); &c., but this process would multiply any error that might be involved in \( B, 8 \); while the process just described has a correcting tendency. To lessen error further, we are again to begin at \( A \), and apply the arc \( AB \) in a contrary direction, from \( A \) to \( 1 \); from \( 1 \) to \( 2 \); from \( 2 \) to \( 3 \); &c. (the numbers inside the circle are the case referred to). Should the points 24 and 16 coincide, as in Fig. 1, then we have

\[
8 \theta + \Delta_1 = 360^\circ; \quad \Delta_1 = \theta; \quad \Delta_1 = 360^\circ - 8 \theta = \frac{1800}{41} \approx 43^\circ 54' 83^\prime.
\]

If the points 24, 24, overlap or fall, as in Fig. 2.—Then put \( \Delta_2 = \) from 24 to 24: this arc will be very small in most cases—in this case it is the 30th part of \( AB \);

\[
\theta + \Delta_1 = 180^\circ, \quad \Delta_2 = \frac{1800}{41} = 43^\circ 54' 83'.
\]

From these equations, which involve the unknown quantities \( \theta, \Delta_1, \Delta_2 \), \( \theta \) is readily eliminated.

\[
\Delta_1 = 360^\circ - 8 \theta, \quad \text{from the second}; \quad \Delta_1 = \frac{2160 - 48 \theta}{6} = 360^\circ - 8 \theta, \quad \text{from the third}; \quad \theta = \frac{2160 - 48 \theta}{6} = 360^\circ - 8 \theta, \quad \text{from the third}.
\]

If the points 24, 24, do not overlap, as in Fig. 3, and \( \Delta_1 \) be in excess instead of defect, that is, that some multiple of \( \theta \) made less by \( \Delta_1 \) make up the circumference. In this case the three equations will stand thus:

\[
5 \theta - \Delta_1 = 360^\circ; \quad 10 \Delta_1 + \Delta_2 = \theta; \quad \text{and} \ 29 \Delta_3 = \theta.
\]

In this example, the distance between 24 and 24, or \( \Delta_2 \), is found to be the 29th part of the arc \( AB \).

\[
\theta = \frac{2200}{711} = 32^\circ 23' \text{ nearly}.
\]

This method of measuring an angle is more accurate and expeditions than may at first appear from the above lengthened details, and will often be found convenient when compasses only can be obtained. A general rule may be arrived at as follows: Let

\[
\theta = \frac{m \Delta_1 + n \Delta_2 + p \Delta_3}{m + n + p} \quad \text{(Q)}
\]

In example, Fig. 3, this expression becomes

\[
\theta = \frac{6 \times 20 + 8 \times 360}{6 + 8 + 360} = 43^\circ 59' 55'.
\]

In example, Fig. 5,

\[
\theta = \frac{10 \times 29 + 360}{5 + 10 + 29 + 1} = 73^\circ 23'.
\]

The only thing to be observed is (Q) is the sign of \( q \). In examples like the latter it is to be minus, but in those like the former plus.

This method of measuring angles will be found more correct than the ingenious one proposed by M. De Lagy, which consists in measuring angles with a pair of compasses, and that too without any scale whatever, except an undivided semicircle. Having any angle drawn upon paper, to measure it: produce one of the sides of the angle backwards behind the angular point; then with a pair of fine compasses describe a pretty large semicircle from the angular point as centre, cutting the sides of the proposed angle, which will intercept a part of the semicircle. Then take this intercepted part very exactly between the points of the compasses, and turn them successively over upon the arc of the semicircle, to find how often it is contained in it, after which there is commonly some remainder; then take this remainder in the compasses, and in like manner find how often it is contained in the last of the integral parts of the first arc, which will again most likely give some remainder; find in like manner how often this last remainder is contained in the former; and so on continually, till the remainder becomes too small to be taken and applied as a measure. By this means M. De Lagy obtained a series of quotients, or fractional parts one of another, which being properly reduced into one fraction, give the ratio of the first arc to that of a semicircle; or the ratio of the proposed angle to two right angles or 180 degrees, and consequently the degrees and minutes of the angle itself becomes known.

\[
\text{Fig. 4.}
\]

Suppose the angle \( \angle ACB \) (Fig. 4) be proposed to be measured. Produce \( AC \) towards \( D \); and from the centre \( C \), describe the semicircle \( ABD \), on which \( AB \) is the measure of the proposed angle. Take \( AB \) in the com-
passes, and apply it three times on the semicircle, at 1, 2, and 3; then take the remainder, D, 3, and apply it back upon 3, 5, which is but once, namely, at 4; again, take the remainder 4, 5, and apply it three times on 4, 3, at 5, 6, and 7; then take 3, 7, and apply it twice on 7, 6, at 8, and 9; lastly, take the remainder 9, 6, and it will be found to be contained just five times, in 9, 5. Hence the sequence of quotients in this particular example is 2, 1, 3, 2, 5, which give the continued fraction,
\[
\frac{1}{\frac{1}{\frac{1}{1 + \frac{1}{2}}} + \frac{1}{1}},
\]
which, when properly reduced, gives vulgar fraction \(\frac{13}{8}\) and \(\frac{13}{8}\) of 180° = 47° 44' nearly.

To those acquainted with the doctrine of continued fractions this method of De Lagrange is easy enough, and very accurate considering the means employed. If great accuracy be not required, our method may be much contracted, by only applying the arc once round the circle, and then using \(\Delta\), to find all the other required numbers. Taking the same angle as the one measured in example 3, apply A B (Fig. 3), from B to 1; from 1 to 2; from 2 to 3; from 3 to 4; from 4 to 5. Then take B, 5, in the compasses, and apply it from B to 11; from 11 to 12; from 12 to 18; from 18 to 14; and from 14 to 15, near the middle of the arc A B. With the same opening 8, or \(\Delta\), or \(\Delta\), as we have termed it, lay off, 4, 6, 4, 6, 7, 8, 9, 9, 10. Then the arc between the points 15 and 10 is found to be contained 33 times in the arc A B; but before it was contained 29 times, for 29 \(\Delta\) was found equal to 6. But by this latter contracted process we find that 33 \(\Delta\) equals 6. Our object is to show that this discrepancy will not alter in any great amount the result or measure of the angle in degrees, minutes, &c. From (Q) we have
\[
\theta = \frac{n \times 25}{5 \times 10 - 53 - 33 - 1} = 73^\circ 25' \frac{5 \times 10 - 53 - 53 - 2}{5 \times 10 - 53 - 33 - 2} = 73^\circ 25' \frac{5 \times 10 - 53 - 53 - 2}{5 \times 10 - 53 - 33 - 2}
\]
Result was 73° 25' \(\Delta\), when \(\Delta = 29\).

To obtain the divisor of (Q), the three numbers \(n, \Delta, \gamma\) have to be multiplied together; to their product \(\gamma\) is added if \(m\) be too small, or subtracted if too great; to this sum or difference we must add one if \(m\) be too great, but subtract two if \(m\) be too small. In the latter case, (Q) becomes
\[
\frac{1}{\frac{1}{\frac{1}{1 + \frac{1}{2}}} + \frac{1}{1}} = \frac{13}{8},
\]
results only by 6 or 7 minutes. This circumstance points out the great value of the rule, for it is evident that the result remains nearly the same, whatever be the positions of the points between A and B. Or in other words, the carelessness of the operator does not much affect the result; for in all cases it comes nearly right. I must digress and add,—what a pity that our statesmen, architects, engineers, &c., cannot discover a few rules of this kind.

A new Life boat was recently tried at Cowes, in the presence of several officers in the navy. The boat was built by Messrs. White and Sons, of Cowes; it is 80 feet long, 9 feet beam, has double sides, and air-tight ends. 185 men were placed in her, and she took in all the water that she could gunwale under, and when she righted gave a fifteen-inch side; in fact, it was found impossible to sink her. She sails very fast, stays in thirty-two seconds, and weighs only seventeen hundred weight. She will carry in her lockers a month's provision for fifty men. The novelty is principally in her form.
of interesting and somewhat romantic research, showing heralry to be chiefly a symbolical art.

Mr. Partridge also directed attention to those heraldic figures called "supporters"—such as the lion and unicorn of the royal arms; and he subsequently noticed the analogy existing between heraldic and natural forms. Supporters, it was said, came into use when tournaments and jousts were held; a scale of splendor requiring a system of distinctions; and it became a practice for the nobles and knights each to hang his helmet and shield, richly embazoned with heraldic insignia, on the front of his horse when in the field. Two attendants or equerries, who accompanied certain characteristic animal beings, were placed to guard or support them, and also to receive challenges when they arrived. Under such circumstances, it was argued, it is absurd to represent supporters as lying down, walking away, or half asleep, while the heraldic attitude rampant seems to be invariably maintained.

Mr. Partridge observed that frequent instances may be seen in St. James's Street and Pall-Mall, and even in the Gazette and the Times, in which the supporters of the royal arms are represented as crouving in mean-spirited positions, instead of "rampant, guarded, &c."—as set forth in the blazon.

Mr. Partridge remarked that he had not been able to detect an abuse of this kind occurring before about the commencement of the present century; and the supporters were never found in any other position than rampant either in architectural remains or in old works on heraldry. He attributed this infraction in a considerable degree to a volume of Peers' Arms, with supporters, by Mr. Cotton, R.A. ; who, being a skilful painter of animals, but quite ignorant of the science of heraldry (many of the arms, it is said, were incorrectly given), gave the supporters every variety of attitude, so as to contribute to a novel and pleasing pictorial effect. This course was much calculated to mislead many who possessed some knowledge of drawing, but were ignorantly insensible to the correct heraldic meaning. Mr. Partridge contended that, if one person may change the attitude of supporters for the sake of pictorial effect, another would be equally justified in changing colours, or in making still greater deviations.

Heraldry, he asserted, mainly consists of imitations of natural forms, but which are nearly always made amenable to symbolic and conventional treatment. In cases such as a stag, horse, or eagle "proper," nature may be in many respects faithfully copied from natural bodies; but it will be found that each of these is frequently placed in a symbolic form, such as a dragon, which must be depicted according to the regulations of heraldry. Instances in illustration of these views were offered. The Duke of Devonshire has for supporters "two stage proper," in which case colour and form must be true to nature, but the attitude remains heraldic. The Duke of Northumberland has one gold and one blue lion—which, if painted green, belong to the Earl of Rosebery, or if red, to the Duke of Bedford. Several similar cases were cited. A regard to proportion or relative size of the objects, the lecturer observed, would also tend to produce absurdities; and this went far to prove that they were never intended as forms for natural history, but as symbolical distinctions treasured by their possessors from feelings of high honour. Examples were given of many cases in which are often brought together side by side in arms—as a falcon and an elephant—a lion and a cock, for supporters; and similar ones were given applying to crests, quarterings, &c. It was explained that supporters are attached to arms of peers, and that, with a few exceptions, they do not pertain to those of commoners.

Mr. Partridge then noticed the opinion sometimes held that the extravagant forms of animals used in architectural decoration, as well as heraldry, during the Middle Ages, were the only period, when the people employed could do no better—and therefore ought not to be followed in the present advanced state of manipulative skill. But he argued that this is an erroneous view; and that the human figure and animals were depicted with great fidelity together with much skilful use of symbolic art upon ancient embroidered vestments, stained glass, and illuminated manuscripts. He considered that the apparent eccentricity proceeded partly from causes not unseen at the present day; and that many forms were desired to regulate the evil spirits and demonic influences. The form and size of shields and some other features in heraldry were pointed out for the purpose of illustrating its importance historically,—referring to Winchester School, Eton College, and other buildings, as well as to stained glass windows and various coats of arms of all the marriages of the British royal family. He also mentioned that he had been employed by Mr. Macready to emboss correctly the arms of each personage in Shakespeare's play of "King John."

The paper concluded with some suggestions for the appropriate introduction of heraldry into old churches—and it was stated that before now a shield bearing the proper arms placed on the frame to a portrait had formed an important link in establishing a complete chain of legal evidence.

NEW ARMAMENT FOR THE ROYAL NAVY.

Report of the New Armament which the Board of Admiralty has ordered to be prepared for the Ships of War of all classes in the Royal Navy. The Return includes the new Complements of Men ordered for each class of Ships, and directs the manner in which the Guns are to be Mounted:

**FIRST-RATES.**

129 Guns.---Britannia, Caledonia, Howe, Nelson, Neptune, Royal Albatross, St. George, Royal George, Sovereign of the Seas, and Victory; total 18; complement, 1,000 men; lower deck, forty 8-inch guns of 65 cwt., 9 feet; twenty-eight 42-pounder guns of 65 cwt., 9 feet; middle deck, two 8-inch guns of 65 cwt., 9 feet; thirty-two 32-pounder guns of 32 cwt., 9 feet; quarter deck and forecastle, six 32-pounders of 48 cwt., 8 feet 6 inches; fourteen 32-pounder carronades* of 17 cwt.; total, 150 guns.†

110 Guns.---Marlborough, Prince of Wales, Queen, Royal Frederick, Royal George, Royal George, Victory, Vanguard, and William; 850 men; lower deck, six 8-inch guns, twenty-four 42-pounders; middle deck, four 8-inch guns, twenty-six 32-pounders; main deck, thirty 32-pounders; quarter deck and forecastle, six 32-pounders; and fourteen 32-pounders of 25 cwt., 6 feet.

Total number of first-rates, 19, mounting 2,210 guns.

**SECOND-RATES.**

104 Guns.---Camerondown, Hibernia, Impregnable, Princess Charlotte, Queen Charlotte, and Royal Adelaide; total 6; complement, 800 men; lower deck, four 8-inch guns, twenty-four 32-pounders; middle deck, two 8-inch guns, twenty-eight 32-pounders; main deck, six 8-inch guns, eighteen 32-pounders; quarter deck and forecastle, two 8-inch guns, 32 cwt., 9 feet; and twenty-four 32-pounders.

90 Guns.---Albion, Abercrombie, Aligiers, Exmouth, Hambrook, Princess Royal, and St. Jean d'Arc; total 7; complement, 850 men. The armament of this class is precisely the same as that of the preceding, with the exception of there being only twenty-six 32-pounders on the main deck, instead of twenty-eight.

84 Guns.---Aigasson, Asia, Bombay, Calcutta, Cape Town, Creasy, Formidable, Ganges, Monarch, Powerful, Sans Pareil, Thunderer, and Victory; total 11; complement, 700 men; lower deck, six 8-inch guns, twenty-four 32-pounders; main deck, two 8-inch guns, thirty 32-pounders of 48 cwt., 8 feet; quarter deck and forecastle, six 32-pounders, and sixteen 32-pounder carronades of 17 cwt.

90 Guns.---Brunswick, Centurion, Collingwood, Colossus, Goliath, Irresistible, Lion, Majestic, Mars, Memnon, Superb, and Vanguard; total 11; complement, 720 men; lower deck, eight 8-inch guns, twenty 32-pounders; main deck, four 8-inch guns, twenty-four 32-pounders; quarter deck and forecastle, two 8-inch guns, 32 cwt., 9 feet; and twenty-four 32-pounders.

Total number of second rates, 19, mounting 3,750 guns.

**THIRD-RATES.**

78 Guns.---Achille, Bellerophon, Cambridge, Foudroyant, Hindostan, Indus, Kent, and Revenge; total 8; complement, 650 men; lower deck, four 8-inch guns, twenty-six 32-pounders; main deck, two 8-inch guns, thirty 32-pounders (2); quarter deck and forecastle, six 32-pounders (3), ten 32-pounder carronades.

72 Guns.---Agincourt, Armada, Belleisle, Black Prince, Carnatic, Cornwallis, Egmont, Hastings, Hawke, Hercules, Illustration, Implacable, Malabar, Medway, Melville, Pembroke, Pitt, Russell, Sultan, Wellesley, and Wellington; total 22; complement, 600 men; lower deck, four 8-inch guns, twenty-four 32-pounders; main deck, twenty-eight 32-pounders (2); quarter deck and forecastle, four 32-pounders (3) and twelve 32-pounder carronades.

70 Guns.---Boscawen, Cumberland; total 2; complement, 600 men; lower deck, four 8-inch guns, twenty-two 32-pounders; main deck, two 8-inch guns, thirty-two 32-pounders (2); quarter deck and forecastle, sixteen 32-pounders (3).

Total number of third-rates, 9, mounting 2,548 guns.

**FOURTH-RATES.**

56 Guns.---Ajax, Blenheim, Edinburgh, and La Hogue; total 4; complement, 600 men; lower deck, twenty-six 42-pounders, of 66 cwt., 9 feet 6 inches; main deck, twenty-two 32-pounders (3); quarter deck and forecastle, four 32-pounders, of 67 cwt., 10 feet, and four 18-pounder, of 66 cwt., 9 feet 6 inches.

50 Guns.---Alfred, America, Arthurs, Benbow, Conqueror, Con-
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FIFTH-RATES.

40 Guns.—Active, Cambria, Chesapeake, Fleur, Piques, Sybille, and Thelema; total, 7; complement, 350 men; main deck, six 8-inch guns of 60 cwt., 8 feet 10 inches, eighteen 32-pounders; quarter deck and forecastle, twenty 32-pounders, of 56 cwt., 8 feet 6 inches; total number of fourth-rates, 85, mounting 1,090 guns.

SIXTH-RATES.

Class I. 26 Guns.—Alarm, Amethyst, Caresfort, Cleopatra, Creole, Diamond, Eurydice, Iris, Juno, Malta, Meeha, Spartan, and Vestal; total, 7; complement, 240 men; main deck, twelve 8-inch guns of 56 cwt., 8 feet 6 inches; six 32-pounders of 40 cwt., 7 feet 6 inches; quarter deck and forecastle, two 32-pounders (1), and twelve 32-pounders of 35 cwt., 6 feet 6 inches.

24 Guns.—Amphitrite and Tricornia; total, 3; complement, 240 men; main deck, eight 8-inch guns, nine 32-pounders of 40 cwt., 7 feet 6 inches; quarter deck and forecastle, four 32-pounders of 35 cwt., 6 feet 6 inches, and two 32-pounders of 35 cwt., 6 feet 10 inches.

24 Guns.—Aigle and Ceres; total, 2; complement, 200 men; main deck, twenty 8-inch guns of 52 cwt., 8 feet 3 inches; quarter deck and forecastle, two 32-pounders (1), and six 32-pounders of 35 cwt., 6 feet.

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ENGINEERING EVIDENCE.

Extracts from Unpublished Evidence given by Mr. R. Stephenson before the House of Commons Steam Valley Committee. [Reported in the Railway Chronicle]


The Four-Rail System. Economy.—In consequence of our fixed establishment, we shall be able to carry the additional traffic we obtain cheaper than any other company can do. At present, as you converge towards London, the trains become more numerous, and when any of them are not in time, they give rise to great disorder; not because the railway is incapable of performing what it was designed for, but because they have not the requisite trains regularly.—for the London and Birmingham is capable of accommodating three times the amount of their present traffic, provided absolute punctuality is insured. More towards London the value of punctuality begins to tell most, and we want more trains from Treg to London than we have. As we pass each other, as it were, we may argue that it appears that they lost money by the conveyance of goods. This was done by charging the goods with a portion of fixed expenses, which would have been necessary under any circumstances even for conveying passengers. If you carry the goods on the basis of the value of the fixed establishment of the railway, then it does appear a loss to carry goods. There may be one or two of the Board that now look with an old opinion, but I know the management of the company has undergone a complete revolution in that respect. I have always entertained the opinion that the goods ought to come down with their fares and convey heavy goods, and have urged it on the Board. But I do not move out of the engineering department of the company. I think that railways as instruments for the carriage of heavy goods, have reached half their perfection or extent, and will not until we are permitted to separate the fast and slow trains. If we convey heavy goods at 15 miles an hour, I believe it will take the cost of conveyance to considerably lower than one half of what it is now; so that a large quantity of coal may come to London from the Midland districts. At present it costs us three farthings per ton per mile. In the North at Stockton and Darlington, where they convey the coal at 9 miles an hour, every charge is included, and they carry it at one halfpenny per ton per mile. The breakage of coal is so much increased by rapidity of movement, that it becomes impossible to move ordinary coal wagons when they are on any of the main lines without springs. The speed breaks the coal all to pieces. Experience has shown that the multiplication of railways facilitates and creates much greater traffic than was anticipated. They reach on each other. That is one of the most remarkable features in the extension of the railroad system—the extraordinary reciprocation of traffic. If by the multiplication of railroads, and the economical arrangement of a single system, you may cause the demand of coal, the demand for the article in London would be most prodigious, and in the country it would be very large. There are many agricultural counties where they do not know what coal is now.

REGISTER OF NEW PATENTS.

AMERICAN PATENTS.

NEUMATIC HYDRAULIC ENGINE.


The nature of the invention and improvement consists in making an improvement in the waste or escaping gases of condensing engines, and the fluid that is to be raised; said air being condensed in a pyramidal-shaped chamber, by means of the momentum of a descending column of water; said chamber having a communication, by a small opening at its top, with another chamber, into which the spring water or fluid is introduced, called the spring water chamber, and upon which the condensed air chamber is placed, in such a way that the air is caused to rise through a tube placed in the spring water chamber (open at its lower end, and closed alternately at its upper end by means of a valve), into a large air vessel, or receiver, of the usual form and construction, being conducted thence to its place of destination by pipes, or hose, in the usual manner.

Similar letters in the several figures refer to corresponding parts.
A is the main pipe for conducting the propelling water from the head, or reservoir, to the pyramidal air chamber. This pipe descends below the level of that portion of it which connects with the air chamber just before it reaches the said chamber, and then ascends, in a curved line to it, forming a curved bend in the pipe, as at A', for the purpose of preventing the air received at the valve B, during the time in which the vacuum is produced in the air and water chamber, as hereafter described, from filling the pipe A, as the air will be forced out of the tube, so that the surplus of said air, after having filled the condensing chamber L, may be carried off by the current of water, through the valve B.

The pipe A is enlarged below the air chamber L, as at A', and has an opening O into the air chamber S, through which the water passes when the valve B is closed.

B is a valve attached to a curved, vibrating lever C, turning on gudgeons D, in boxes, as its fulcrum, having a set screw E, for regulating the descent of the valve, and a counter-balance F, for adjusting the valve. When this valve B is down, as shown in fig. 8, the water from the head flows through the opening, which it closes; when it is up, as shown in fig. 1, the water rises into the pyramidal chamber L, through the opening O, and condenses the air therein.

H is a pipe for conveying the spring water to the spring water chamber. I is the air chamber into which the water is forced. J is the valve for holding it. K is a pipe or box, for conveying the water to its place of destination. The above-named parts, lettered from A to K, inclusive, are made and operated in the usual manner. The improvements are as follows:

L is a pyramidal chamber into which air is admitted through the valve B, when it descends by the pressure of the external air, to supply the partial vacuum created in the pipe A, and chambers L and N.

This pyramidal chamber has a communication, by a small opening M at the top, with another chamber N, called the spring or pure water chamber; through which opening M, the air, so condensed, is forced, and presses on the spring or other water, introduced into the same through the pipe H, by which pressure, the water in the spring water chamber is forced upward through a tube F, reaching near to the bottom of the chamber N, through the valve J, into the air chamber I; said valve being represented as open in fig. 1, and as closed in fig. 2.

To raise water with this machine, open the valve B, and let the water flow out; then, by closing the valve B, the water, which is now in motion in the pipe A, will pass through the opening O, into the pyramidal condensing chamber L, and condense the air the same as before; the condensed air will force the spring water up the tube F, (which had entered through the pipe H during the continuance of the partial vacuum above spoken of), into the chamber I, and condense the air therein, until its density is equal to that in the condensing chambers L and N, below; at this time the spring water will cease to flow into the air chamber I, the valve J closes, and the air in the chambers L, L', and N, commences expanding, that in the lower chambers, L and N, giving motion to the propelling fluid and driving backward, producing a partial vacuum in the machine, and the air in the upper chamber L, forcing the spring water to its place of destination.

The said partial vacuum in the machine, caused by the reaction of the machine, as aforesaid, and the pressure of the external atmosphere on the valve B, will cause it to open again. The water from the head then flows through this valve with an accelerating movement, until it has acquired the desired degree of velocity to cause the valve to close. The water having no longer any vent through the valve B, passes through the opening O, into the pyramidal chamber L, and repeats the operations above mentioned successively.

In this manner the operation will continue as long as the machine remains in order and there is a head of water to propel it. The valve V is for the purpose of supplying the chamber I with air, by admitting the air into the tube P. The said air is admitted during the time that the partial vacuum above mentioned takes place. The air thus introduced into the tube P ascends to the top of the same, and is forced into the chamber I at the next stroke of the machine; said valve V is represented open in fig. 2, and may be closed, or regulated, by screwing the thumb-screw W.

The principal advantages this machine possesses over other machines are,

1st. In case of forcing up pure water by the propelling power of a running stream of water less pure, there is no possibility of the impure water mixing with the pure, there being at that time a column of condensed air between the two waters.

2nd. The water being forced into the upper chamber L, by the condensation of air in the lower chamber, the valve J opens more slowly when water alone is made the propelling medium, and also shuts more slowly, thereby preventing the water from escaping back through the valve J after it is forced up—the valve J being nearly closed when the water ceases to flow upward into the chamber L. This advantage upon trial is found to be of considerable importance, enabling the machine, thus operated, to force, with a given quantity of water, several barrels more of water per day than it would otherwise do.

3rd. There being no valve between the condensed air in the lower chamber and the driving water, or at the opening O, the said air is permitted to act a longer time in forcing back the driving water, and thereby making a more complete vacuum than in other machines, and rendering useless the spring for opening the outlet valve B, as used in several machines.

It is not necessary that the spring water chamber N, and the air chamber L, should be enclosed by the same envelope, but they may form separate chambers, and they may be arranged in any convenient way or manner most acceptable to the constructor, provided that the capacity of the air chamber does not exceed a due ratio between the propelling power and the water to be raised.

LOCOMOTIVE AXLE BOX.


The arrangement of this box allows it to revolve in a vertical plane, at the same time that it floats up and down, the journals of the driver having, at all times, their full bearing upon the box; let the axle assume any position from a horizontal line caused by inequalities of the road, or the consequent raising of the outer rail, in passing curves, which must necessarily reduce friction in a great degree, and insure the most perfect working of the engine, without producing any undue strain in its several parts, and has only to overcome the friction which is due to the surfaces upon which it works. This evil has always been overlooked in the construction of locomotives, and which must occur when a box floats vertically in a pedestal. Fig. 1, elevation of
pedestal with vibrating box; fig. 2, cross section of the same; fig. 3, horizontal plan; fig. 4, vibrating box; fig. 5, bearing of vibrating box.

A., A., pedestal forming part of the wrought iron frame. B., vibrating box resting with the two pivots b, b' which are firmly attached to it in openings of the two sliding pieces, e, e'. Fig. 6. shows an end view of one of the latter, with its flanges, m, m', and the hole, e, which is to receive the pivot, b. These sliding-pieces are connected, by means of screws, s, s', with the cross-piece, d, the lower surface of which is cylindrical, and forms a bearing for the upper convex surface, n, n' of the box, B., f., wedge, kept by the set-screw, f, in a position which allows the box to slide in the pedestal, without being too loose or too firm. g., oil-box. In fig. 4, this oil-box is omitted. The same parts are marked by the same letters in the different views. — *Franklin Journal.*

**ENGLISH PATENTS.**

**LOCOMOTIVE ENGINES.**

George Fosseck, engine-builder, Thomas Hackworth, engine-builder, and Thomas Elliott, superintendent of locomotives, all of Stockton-upon-Tees, for "certain Improvements in locomotives and other boilers."—Granted March 8; Enrolled Sept. 3, 1847. [Reported in the Patent Journal.]

The improvements here specified relate, first, to the form or shape of the fire-box of locomotive and other tubular boilers; secondly, to the arrangement of the tubes; thirdly, dividing, in boilers of large diameter, the fire-box into two portions, by means of a vertical division.

The patentees in the specification of their first improvement state: we make the fire-box of a semi-cylindrical shape, corresponding in form to the cylindrical shell of the boiler, the top or roof of the fire-box being slightly curved; the roof is to be supported and sustained by the addition of wrought-iron stays, placed across the upper side of the roof and riveted thereto; as with fire-boxes of the usual construction, the end of the fire-box is closed by a thick flat plate, generally termed the tube-plate, through which the tubes pass as usual. The outer or open end of the fire-box is closed by double or treble plates, having a door formed of double or treble plates made thereto, and an opening to the ashpit beneath the said door; a bridge is placed, as usual, transversely in the fire-box, and the fire-bars are properly supported by bearing-bars, at a suitable height in the fire-box, as is usual in boilers with tubes or enclosed fire-places; the shell or case of the boiler is stated and represented by the patentees as cylindrical the whole length of the boiler.

The patentees state their second improvement to be the arrangement of the horizontal tubes through the boiler from the fire-box to the smoke-box; these tubes the patentees place in vertical rows, and not, as they are usually arranged, in diagonal horizontal rows; this arrangement of vertical rows allows a free space between each row of tubes, thereby allowing a free and uninterrupted passage for the escape of the steam, generated by the lower tubes: the patentees also state the facility this improved arrangement possesses of allowing the cleansing of the tubes from incrustation and sediments from the water, by a proper scraper or cleaner, being passed down the opening between the vertical rows of tubes, and thereby removing any sediment or incrustation from them.

The patentees state their third improvement to be the employment or introduction of a vertical division of water space, placed within the semi-cylindrical fire-box, and thereby dividing the said fire-box into two separate compartments; this arrangement the patentees propose adopting when boilers of increased diameter are required.

The patentees also desire defining the above improvements claim, first, the forming the fire-box of locomotive and other boilers of a semi-cylindrical shape, but slightly curved upon the upper side, and carrying the tubes from the said semi-cylindrical fire-box in such manner as agreeing with the general form of such fire-box, as hereinafore described. Secondly, the patentees claim the arranging the tubes in locomotive and other boilers known as tubular boilers, in vertical rows, whereby a free and uninterrupted passage is obtained between such vertical rows from bottom to top, as hereinafore described. Thirdly, the patentees claim the use and arrangement of vertical divisions, within the fire-box, of boilers, dividing such fire-boxes into separate compartments or fire-places, as hereinafore described.

**IMPROVEMENTS IN FURNACES.**

George Grundy, of Manchester, in the county of Lancaster, manager, for "certain Improvements in furnaces, and in the flues and tiles used in the construction thereof."—Granted February 8; Enrolled Aug. 6, 1847.

This invention relates to a novel arrangement of the flues and other parts of a furnace, whereby the heat is more effectually applied; and also in certain tiles to be used in the construction of the furnace. The annexed engravings show a furnace, constructed according to this invention, containing four fire-clay or tile cylinders or retorts, for generating coal gas.

Fig. 1 is a longitudinal vertical section of the furnace; fig. 2 is a transverse vertical section thereof; fig. 3 is a horizontal section, taken on the line A B of fig. 2; fig. 4 is a similar section, on the line C D; and fig. 5 is a section on the line E F. a is the brickwork of the furnace. b is the fire-place or chamber, wherein the fuel (which is coal or other fuel may be used) is introduced; it extends the whole length of the furnace, and is supplied with air through the openings c, from two parallel flues d, which extend from one end of the furnace to the other, and are furnished with doors at each end to regulate the supply of air. The oven, in which the tile or fire-clay cylinders or retorts e are fixed, is of the ordinary shape; and the course of the flame and heated gases, generated below, is indicated by the arrows in the horizontal sections, figs. 3, 4, 5, which are taken at different levels, in order to show the continuous traverse of the heated gases from end to end, or from end to centre of the retorts e, until they escape through the opening f, in the crown of the oven. The cylinders or retorts are made of tile or fire-clay, and may be strengthened, if considered requisite, by imbedding metal hoops in the clay. Each cylinder is open at both ends, and consists of several pieces, which are jointed together, as seen at g, fig. 5; the joints being made good with fire-clay, and supported by the fire-clay tiles A. The number of joints in each retort will depend upon its
length; but this may greatly exceed the length of ordinary retorts, on account of the facility of working at both ends, which the patentee considers an important feature of his invention. The retorts have caps fitted on each end, furnished with exit-pipes, for the gas. No accumulation of coal-tar is removed from the retort, by partially opening one end of the retort, and applying an end opposite end: which pipes then act as a throttle, the draft of air through the heated retort completely removes the carbonaceous deposit.

The patentee states, that the description of the manner of applying this improvements to a furnace for generating gas will enable a person to apply such improvements to furnaces for other purposes. He claims the general arrangement of the furnace and flues as described, which consists in a continuous fire-place from one end to the other, supplied with air from parallel air-flues—thus allowing the heat to be conducted from end to end, or from end to centre repeatedly; together with the peculiar form and construction of tile or fire-clay tubes, and the tiles forming the joints, as above described.

COOLING COKE OVENS.

Frederick Randome, of Ipswich, Suffolk, for "Improvements in working coke and other kilns or ovens."—Granted Feb. 24; Enrolled Aug. 24, 1847.

This invention consists of improvements in cooling ovens and other kilns or ovens, by causing air to circulate by mechanical apparatus through the cooling flues or passages. In the working of coke ovens the cooling has been extensively done by having air passages arranged so as to allow air freely to circulate in contact with the inner lining of the oven, the air not coming in contact with the charge, such circulation being caused by the rarefaction of the air by the heat of the flues. Such mode of working coke ovens is according to a patent granted to James Church, December 20, 1845. This mode of making coke is very superior to the old mode where the charge is drawn when hot, and cooled down by water. In working of such coke ovens, it has been found that the time of cooling an oven is very uncertain, depending on the nature of the outer atmosphere, and that it is important to cool down the charge as quickly as possible, so long as the atmosphere is excluded from the charge. In coke ovens constructed according to Church's patent, the air after passing through the flues simply rises through a short pipe into the air by its levity, the pipe having little, if any effect, in causing the circulation or passage of the air through the flues. But it has been found that by hastening the draft in ovens arranged with flues, the cooling process may be materially quickened. And this patentee prefers to do by connecting the cooling flues with a rotatory fan, in such manner as to continuously withdraw the air from such flues, by which means the external air will rush into the flues or passages, and thus cool the same quickly, and by these means the charge in the oven will also be quickly cooled.

The patentee does not confine himself to the fan, as other known arrangements of blowing and exhausting apparatus may be employed, or to pass the air or cooling flues or passages, or the pipe thereof, be connected into a high draft or chimney, or any additional power of exhaustion to that which results from the heat of the passages or flues.

CAOUTCHOUC.

Stephen Moulton, Esq., of Norfolk-street, Strand, Middlesex, gentleman, for "Improvements in treating caoutchouc with other materials, to produce elastic and impermeable compounds."—Granted Feb. 8; Enrolled Aug. 8, 1847.

This invention consists in treating caoutchouc by combining there with calcined and carbonates of magnesia and hypophosphite of lead and the other substances, setting the compound to heat, which process dispenses with the use of solvents. After the caoutchouc has been cut and cleansed, one or more pounds weight, as can be conveniently ground or mixed at a time, is put between two revolving iron rollers, heated internally by steam, when it presents a rough, uniform sheet, and is then ready for the mixing it with the following ingredients.

If the goods are intended to be elastic, and to be unaffected by heat or cold, mix in with 1 lb. of caoutchouc, from 1 to 8 oz. of the hypophosphate of lead and the artificial sulphuret of lead, both or either, but the patentee prefers them in equal proportions; but if they are used separately, then the whole quantity mentioned will be used. If the goods are intended to be hard, of greater tenacity, and of less elasticity, mix in from 2 to 8 oz. of the caustined or carbonate of magnesia with 1 lb. of caoutchouc, and then add both the hypophosphate of lead and the artificial sulphuret of lead, or either, in like manner and proportions, as used for elastic goods.

The materials above-mentioned and the caoutchouc having been passed repeatedly between the mixing rollers, so that the whole compound thus passed shall be well combined, pass to another pair of rollers denominated the grinding rollers, and treated in like manner, which rollers are placed nearer to each other than the mixing rollers, in order that by these rollers a more perfect mixture of the compound may be effectuated. After this second process, the compound is again removed to the third pair of rollers, also heated by steam, denominated the softening rollers, the compound again passing between the upper rollers and passes to the lower one, upon which the cloth for its reception passes round, and thus receives on its surface the different coatings of the compound required. If sheet rubber is desired, the compound is placed in like manner, dispensing with the use of the cloth, and the sheet takes from the lower roller. Both the coated cloth and the sheet rubber in passing over the lower roller are rolled up in dry cloth to keep the surfaces apart, and is then fit for making up into such goods as may be required. In manufacturing goods from the compounds thus prepared, when manufactured, they are covered over with paste, case, or other clay of similar quality; firmly powdered, to prevent the surfaces from cracking; but as they are as yet still liable to the action of all the solvents and other influences which act upon caoutchouc, and would accordingly become rigid in cold, and soft and sticky in warm weather; to free the caoutchouc therefore from these, its natural characteristics, it has been combined with the rolls of lead above-mentioned, and the goods manufactured from this compound have now to be subjected to heat in a suitable chamber or cylinder, and heated either by steam or dry heat (the former is preferred) of from 230° to 280° or 300°, according to the quantity of the goods heated at one time, and also as to the thickness of the compound. Upon heating, the caoutchouc changes completely, and becomes elastic and impermeable, as set forth in the title above recited.

RAILWAY SWITCHES AND TURN-TABLES.

Charles Heard Wild, of Mortimer-street, Cavendish-square, civil engineer, for "Improvements in constructing parts of railways."— Granted Feb. 24; Enrolled Aug. 24, 1847. [Reported in the Patent Journal.]

The improvements here specified relate severally to the form of the points of the moveable tongue rails of railway switches, and to the construction and application of certain mechanism to turn-tables, to facilitate their action. The object of the patentee being to remove, by the first of his improvements (namely, that improvement relating to railway switches) the objections attendant upon switches of the usual construction. These objections being, as stated by the patentee, of two kinds—one of which is as an alternative it has hitherto been necessary to adopt, as follows—When the point of the moveable tongue rail has been moved and the tongue is in position to support the weight of the wheel and the load of the carriage, it becomes necessary to have a notch in the fixed rail to allow the inner edge of the point of the tongue rail to coincide with the inner edge of the fixed rail, so that there might be no impediment or interruption to the passage of the wheel upon passing the points, while the switch is closed; thus far, while the switch is closed, no important objection exists, as usually constructed, as they present no unbroken surface of rail to the passage of the carriage wheels; but the contrary is the case, when the switch is opened; the notch now presents its objections and disadvantages to action, the carriage wheels in passing striking against the side of the rail, and the contraction of this objection is, making the depth of the notch much less; but to allow this, it is necessary to reduce the thickness of the point of the tongue rail, thereby rendering it too thin and weak to support the passing weight. These objections and disadvantages the patentee proposes to remove by the improvements in question, and which consist in cutting away so much from the upper table, and from the outer side of the middle web of the moveable tongue rail, at the immediate point or extrem-
sider of such moveable tongue rail, as to enable the end of the same to pass under, and be housed beneath, the upper table of the side rail of the main line of rails, when the switch is closed. The wheels of the carriages in passing along the switch will not press vertically upon the moveable tongue rail in consequence of the end of the tongue being below and beneath the upper table of the side rail; but the flange of the wheel will press laterally against the side of the tongue rail; the wheel will pass a considerable distance along from the end of the tongue rail, before it commences pressing upon it vertically, the upper table of the tongue rail being gradually developed as it recedes from the side rail; till, at a considerable distance from its point, it is of sufficient bulk and strength to receive the vertical pressure of the wheel without injury. The tongue rail still continues to develop itself for a further distance, where it is of the usual and proper form.

By these improvements, the patentee obviates the necessity of having a notch cut in the upper table of the side rail for the reception of the point or end of the moveable tongue rail, or the alternative of having the point or end of the tongue rail cut so thin, and thus so reduced in strength, as to be unable to support the pressure of the rails and load when passing over it. Fig. 1 is a plan of a railway switch, made according to the most approved construction usually used, but with the points of the moveable tongue rails, D and D', made according to the patentee's method: A, A', the rails forming the main or through line of rails; B, B', the rails forming the branch line or siding; C, C', the chairs supporting the same; D and D', the two moveable tongue rails joined to the jaw chairs, E, and sliding or moving laterally upon the table chairs, F, as usual; G, a rod or bar connecting together the two moveable tongue rails, and connected with any apparatus for the purpose of opening or closing the switch.

The second improvement of the patentee relates to supporting and balancing the upper or moveable portion of turn-tables, and thereby lessening the bearing weight, and consequently the friction upon the moving parts; and it also relates to the position of the friction rollers or wheels placed beneath the outer edge of the revolving table or plate, by arranging them in such a position that the upper edge of the rollers shall be in one horizontal plane, or plane at the right angles to the centre line of the axles of the turn-table. Fig. 4, a sectional elevation of the turn-table; A, the lower or outer curb firmly bolted to the foundation, B, and fastened by the radial bars, C, to the centre plate, D; also firmly secured to the foundation B'; E, a block of metal moving freely within the centre plate, D, and acted upon under the side of the inner ends of the levers, F, F, of which there are two; the other end of the levers, G, F, carrying the counter-balance weights, G, G, adjustable upon the levers, F, F; upon the block, E, within the centre-piece, E, rests the brass step, H, in which works the centre axe, I, of the turn-table; upon the exterior of the centre-piece, E, revolves loosely the disc, K, to which are bolted the radial arms or axes, L, L, carrying at their extremities the friction rollers or wheels, M; N, N, washers placed upon the axes, L, L, for adjusting the position of the friction wheels or rollers, M, thereon; these friction wheels or rollers revolve upon the raised portion of the curb, A, and carry the outer edge of the revolving table or plate, P; O, is an iron ring bolted to and connecting the radial arms or axes, L, together; the counter-balance weights, G, G, acting through the levers, F, F, upon the toe of the axes, I, of the revolving turn-table, P, relieve the friction rollers or wheels, M, from a very considerable portion of the weight of the revolving turn-table; thereby the friction is considerably lessened, and the turn-table moved with greater facility than by
HIGH-PRESSURE MARINE BOILERS.

The explosion of the boiler of the Cricket steamboat has given prominence to the question, whether high-pressure steam can be used with safety for the purpose of navigation. In considering the subject, however, at such a time, there is some danger that the judgment may be prejudiced, and a too-hasty decision given against the principle, when only the mode of carrying it into practice has been defective. It is most desirable to view the matter as freely as possible from the influence which such a disaster is calculated to produce, and to consider all the circumstances attending it, for the purpose of ascertaining whether they disclose any inherent defect in the use of high-pressure steam that should be removed, or whether the accident was the result of recklessness on the part of those employed, or of want of care in the manufacturing engineer—casualties altogether independent of the safety of high-pressure steam.

We will in the first place compile a brief narrative of the event, collected from the evidence of those who witnessed the explosion.

The Cricket was one of three steamboats built on the same principle, and employed in conveying passengers to and from the Adelphi-pier and London-bridge, at the low fare of one pence. On the morning of the 27th of August, the Cricket was at the Adelphi-pier, waiting for passengers. She had been waiting for ten minutes after having come from London bridge, with the steam up; yet, during that time, nearly all the witnesses declare that there was no steam blowing off. The captain had gone ashore, and the person in whose charge the engine was for the day—not the regular engineer—was standing on deck near the funnel talking to the stealer. The call-boy was in the after-cabin, and not one of the persons belonging to the boat was in the engine-room. The number of passengers on board is variously stated at from 100 to 200. Suddenly a loud noise was heard, which is described by some of the passengers to have resembled the sound of rushing steam and rending iron, rather than a sudden explosion; others, indeed, compare the noise to the discharge of a cannon.

The boiler casing was projected with great force through the after-part of the boat, which was completely destroyed. The whole flooring of the deck was blown down, the cabin was stripped bare, and the iron sides of the vessel, where it was narrowed, flat, and the boiler casing was carried into the water. The steam chest was projected upwards, carrying with it the funnel and the outer case of the boiler, and shattering the bridge which connected the two paddle-boxes. The front plate of the boiler and the tubes were driven against the frame of the engine, which was much injured, but it fortunately arrested the progress of that portion of the boiler, and thus preserved the fore part of the boat.

An explosion attended with such destruction on the vessel must, of necessity, have told with disastrous effect on the numerous passengers. Those on the after deck were blown into the air: some fell into the water, and others descended among the ruins of the vessel. The number killed, however, is wonderfully small considering the destructive effects of the explosion. The lives lost were only five, and among them was the call-boy, who was boiling coffee in the after-cabin when the boiler casing swept through it. Even he, continued to live sometime after the explosion. It is a remarkable circumstance also, to which we shall subsequently direct attention, that not one of those who were killed had been injured by scalding, or who had been so situated as might have been injured by the explosion, very few have been scalded, and none of them seriously.

The foregoing is a brief resume of the principal facts given in evidence before the coroner, respecting the explosion of the boiler and its effects; we have now to inquire for the cause of the disaster. The engine was constructed in accordance with a plan (patented by Mr. Smith, one of the proprietors of the boat, in which the principles of high-pressure and of condensing engines are combined, and the result is reported to have been a great saving of fuel. The engines were made by Mr. Joyce. The boilers were tubular, having the fire contained in a tube three feet diameter within them. The boiler casing, which was cylindrical, was about five feet diameter and six feet long, with a hemispherical end at the after part, and it was made of ¼-inch iron. The steam-chest was cylindrical, with a hemispherical top, and was composed of iron ¼ of an inch thick.

There were 60 tubes of 2½ inches diameter inside and 4 ft. 9½ in. long. The safety-valves were 2½ inches in diameter, being flat and resting on flax seats. The length of the levers was 37½ inches, and the fulcrum 2½ inches. Of these valves there was one on each of the two boilers, freely communicated by steam and water passages; and besides these lever-valves, each boiler had a Salter's spring-valve supposed to indicate 45 lb. on the index: there was also a mercurial gauge, for the additional guidance of the engineer as to the pressure of the steam.

Neither of the boilers had any stays above the tubes, nor in the steam chest. With respect to the boat itself, the following specification for its construction, as agreed between Mr. Smith and Mr. Joyce, shows that it was intended to be put together in the best manner:


| Length on deck | 120 feet |
| Breadth of beam | 13 feet |
| Depth of hold | 7 feet |

Draft of water 2 ft. 6 in., with machinery and coals on board. Is to be built of the best plates, flush jointed, and countersunk riveted.

Plating of bottom lower streak, one-fourth thick; Second, third, and fourth streaks, three-sixteenths thick; Fifth streak, one-eighth full; sixth streak, one-eighth. Angle iron frames 3½ in. by 3½ in., and 18 inches apart in centre of vessel, and towards the ends the angle iron to be lighter, and 18 inches apart.

Sleepers about 12 inches deep and one quarter thick, and of sufficient length to distribute the weight of engines and boiler over 30 feet length of vessel.

Keel and stem 6 inches by ¼-inch. Bulkheads and coal bunks ½ full, ½ bare.

Suitable half-round iron all round that portion of the boat designated the plack shear or gunwale streak, including sparsons.

Wood Work.

| Shelf piece of best red pine | 5 in. by 2½ in. |
| Beams, 2½ inches apart | 4½ × 4½ |
| Plankshear of Quebec oak | 7 × 4½ |
| Deck, best yellow pine | 6 × 6 |

Sheer streake of best red pine | 4 in. 

Paddle beams, spring timbers, and rim pieces of Quebec oak.

Cabin floors of good yellow battens, one inch thick, on suitable bearers of red pine.

Cabin-sheets fitted in same manner as the Ant and Bee, and the joiners' work
and fittings, skylights and companions, to be equal and similar to those vessels.

Glazing of the best character (with best bull's eye settle).

The whole of the wood and iron work to have three good coats of paint. This vessel is to be fitted with a pair of engines of 16 horse power, each similar in principle to those on board the Ant and Bee, with a much improved and very powerful boiler. A good cabin store in the after cabin.

And to be equipped with anchor, rope, and everything for her station. A small winch at the head for her anchor, and all necessary fittings complete to go upon her station for work, and to include an extra donkey-pump, steam pressure gauge, vacuum gauge, and a Salter's balance on one safety-valve, the balance to be a weight in the usual way, and all necessary fire irons and sparsers.

Speed to be equal to the fastest of the above bridge boats; consumption of fuel not to exceed 44 lb. of good whale coal per indicator horse-power (of 66,000) in 24 hours.

Time of completion—All, May 1846.

1. William Joyce, do hereby undertake to make, construct, finish, and supply you with the whole of the before-mentioned works, viz., the iron steamer complete, with her engines, boiler, and fittings, in all respects ready to go upon her station, of the very best quality, best of materials and workmanship, and without any extra charge whatever beyond the sum now agreed upon, viz., Two thousand five hundred and fifty pounds sterling."

[The periods at which the money was to be paid having been specified, the agreement concludes as follows]:

"In consideration of receiving the above order upon the terms specified, I also agree to put the engines and boiler which I have already been paid for into the new steamboat building by Messrs. Ditchburn and Co., called the Clack, to complete the same engine and boiler in every respect fit for work upon her station (with the exception of half the cost of a donkey-pump, pressure gauge, and Salter's balance, which has been settled at £239), before the expiration of the present month.

Signed by me and accepted by you on the 11th of February, 1846. O. H. Smith.

W. Joyce, day of February, 1846. Witness to the above signature, Bl. Nash.

The agreement, it will be observed, stipulates for one boiler only, but Mr. Joyce afterwards undertook to put in two smaller boilers instead of it, as he considered they would be safer. Mr. Smith, when examined before the coroner, said he had every reason to believe that Mr. Joyce had adhered strictly to the terms of the contract, and that the boat and the engines were constructed according to the specifications. It appears, however, from the terms of the agreement, that nothing was specified as to the form or strength of the boilers, which were left entirely to Mr. Joyce, under the stipulation that the engines were to be of 16 horse power each, "with a much-improved and very powerful boiler," and to work with a given quantity of fuel. Whether Mr. Joyce took any and what precautions to test the strength of the boilers before he put them into the boat, has not at the time we are writing been given in evidence; but the lever-valves were weighted to weigh as much as the screw-inch, and the spring-valves were screwed down to 46 lb. During the whole examination not one witness has spoken to having seen the steam blowing off at the spring-valves.

The circumstances that have been elicited during the investigation tend strongly to throw the blame of the accident on the gross mismanagement of those who had the charge of the boat. More careless and reckless conduct was scarcely ever disclosed, and the surprise is, not that the boiler burst on the 27th of August last, but that it did not burst at any time during the last six months. Clark, the engineer, who was appointed to the Clacket at Easter last, appears almost from the first to have pursued the plan of tying down the lever safety-valves when the boat was in motion, and the fact seems to have been so notorious that many persons avoided going on the boat, and a "blow up" was spoken of as an occurrence to be daily expected. Notwithstanding the notoriety of the fact among the persons connected with the Clacket boats, that Clark was in the habit of tying down the valves, the managing proprietor seems to have been so blinded by the false statement made to him in his veracity, that he dismissed Edwards, the stoker, who had complained to the captain of the danger of the practice, without any inquiry. There is indeed an attempt to deny, on the part of some of Clark's friends, that the valves were tied down; but the evidence of the fact is too strong to be doubted. Among others who deposed to having seen the levers tied down, was Mr. Meachem, the foreman of Mr. Joyce, who was driving the engine one day in the absence of Clark, and when he found the levers tied he instantly cut the strings, resolved, however, that Mr. Joyce had boilers would not stand as well as Clark. The boat seems to have been frequently entrusted to the care of persons quite incompetent to the duties of managing the engine, and among others to whom the charge was committed was a man who six months before had been the porter at a seed warehouse.

The evidence of the stoker who succeeded Edwards made the case still stronger against Clark than his predecessor. He said that he had regularly tied the valves down by the order of Clark when the boat got underway; that the pressure indicated by the gauge was sometimes 80, and that 'twas not at all unusual to have hot that the air was not condensed, and the engine-room became filled with steam. All parts of the boat became hot in consequence, and it was no uncommon thing at such times for the people on deck to call out, "All hot, all hot!" He further stated, in confirmation of the preceding evidence of Clark's recklessness, that he would sometimes start the boat before the water in the boiler was up to the bottom cock, and that on Sundays, when the boat was most crowded, he would have friends drinking with him in the engine-room, and "practising driving engines." As an instance of the strains the boiler sustained by the extreme pressure caused by tying down the valves, this witness said that,—

"On one morning, about three weeks after he had been on the boat, on proceeding to light his fires, he found the water all gone out of the boiler below the first row of tubes; in fact, below the lower cock. The water escaped through a tube which was split the previous day by a pressure of steam. On observing the want of water he began pumping, and pumped an hour and a half, when he found the water continued to run out as fast as he pumped it in. He did not notice anything particular the previous day. The valves were tied that day under the general orders. That was one Sunday morning. Clark had not arrived at the time he found the defect in the tube, having gone down to Greenwich the previous evening. Witness went on board the Bee, and told Mr. Buttiss of the split in the tube, and Mr. Buttiss was looking at it. Mr. Clark arrived, who proposed to caulk the tube, but Mr. Buttiss said that as the pressure would be the same as on the boiler, it would not answer the purpose, and proposed that it should be repaired by an iron bolt and washers. That plan was adopted. A round iron bar as thick as his finger, was passed through the tube—a washer placed on each end, and a joint made between the washer and the boiler. Witness pumped the engines to fill the boiler after that, when it leaked a little at first, but when they were running and the water got hot, it did not leak at all. It leaked only for a day or two after that occasion. He found the water leaked from a joint of another tube, where it was made fast to the boiler. There was no split in the tube. After pumping an hour, Mr. Buttiss came on board, and with the assistance of Mr. Ball, the leak in the joint was repaired, so that they could run. He believed it was hammered round."

In addition to the wanton sporting with human life on the part of the engine-driver, which the evidence discloses, there appears also to have been culpable misconduct by the persons employed to manage the affairs of the company. The engineers and stokers are represented to have been kept at work from morning to midnight, and kept on working a portion of the time to a temperature of 109°. The incessant working of the three boilers belonging to the company caused also greater difficulty with the boilers, there not being time to blow out the water and examine the boilers, as in other steam vessels; and the dismissal of Edwards, without inquiry, for complaining of the conduct of Clark, seemed effectually to prevent other complaints from being made.

It will be observed from the summary of the evidence we have given relating to the cause of the accident, that the question of the comparative safety of high-pressure and low-pressure engines is in reality scarcely involved by the explosion of the boiler of the Clacket. By tying down the safety-valves any boiler might be burst, and a low-pressure boiler would have the less chance of escape under such treatment. We have as yet no minute description of the construction of the Clacket's boilers, as Mr. Lloyd, the engineer appointed by the Board of Trade to investigate the matter, has not at the time we write made his report; but from the account given by Mr. Galloway and others, there appears to have been a want of proper stays in the steam chest and boiler casing. The safety of tubular boilers arises from the comparative weakness of the tube fastenings, by which when the pressure becomes dangerous the steam escapes through some small rent, and the pressure is relieved by the escape of steam. This principle might be still further applied, so as to render an explosion, in the ordinary meaning of the word, next to impossible.
quarried, by experience, with the fact that there is no heat given out by high-pressure steam when escaping into the air, having often held our hand in a jet of steam issuing from a pressure of 100 lb. to the square inch. It is only when such steam regurgitates, if we may so express it, that it gives out heat and scalds. When, for example, a jet of steam strikes against a solid body, and its issuing force is arrested, then it scalds; but when it has free room to expand, the sensation produced is that of cold, and not of burning. It may be remembered that when by the separation of the pipe of the boiler in an engine constructed by Messrs. Samuda, at Blackwall, several persons were killed, they all lost their lives by the scalding of the low-pressure steam. The high-pressure steam of the Cricket's boiler, on the contrary, did not seriously injure a single individual. This extraordinary property of high-pressure steam should form an important consideration in determining the comparative safety of the two kinds of engines, yet it has hitherto been disregarded.

Since the foregoing remarks were written, the evidence of Mr. Lloyd, chief engineer and inspector of machinery of the Royal Navy, has been given at the adjourned inquest, held on the 22d September, and we subjoin the greater portion of it, divested of the repetitions consequent on examination by different counsel. Some parts of his statements relative to the construction of the boiler and the pressure borne on different parts are not very clear or comprehensible, but his evidence proves that the boiler, however defective, was capable of bearing a pressure twice as great as that which would have lifted the weighted valves, if they had not stuck or been tied down. The corresponding boiler of the Cricket gave way under a pressure of 180 lb. to the square inch, but it had previously suffered a great strain by the pressure which caused the explosion, and therefore its strength at the time must have been much greater. Mr. Lloyd is of opinion that the other boiler must have had a pressure of at least 180 lb. to the square inch before it exploded.

Clark, the engineer, was examined after Mr. Lloyd, and he declared that the statements of the other witnesses against him were false, and that he never gave directions to Edwards nor to any one to tie down the valves. He seems to make a nice distinction between tying them down and twisting the end of the string fastened to the lever round a nail. He denied, however, that the string was ever tight, and he said that the object of twisting the ends round the nail was to prevent them from dangling and being in the way.

Mr. Lloyd's evidence was to the following effect:

The Engines.—"With regard to the engines themselves, I do not think many observations necessary. They are high-pressure engines, on the principle well known as Wolfe's. Each engine has two cylinders; in one the steam is used at a high-pressure, and, instead of passing into the open air, as in an ordinary high-pressure engine, it passes into the second and larger cylinder, and is then condensed in the ordinary way. The object of this arrangement is of course the saving of fuel, by effecting a saving of steam, and, therefore, of fuel. So far as I saw, the materials and workmanship of the engines were good. As compared with high-pressure engines, there is nothing objectionable in these engines, in point of danger—nothing but the ordinary construction. There were attached to the engines two pumps for feeding the boilers; another pump was worked by an auxiliary engine, which was commonly called the 'donkey'; and there was a fourth pump, to be worked by the hand, for feeding the boilers. These appeared to be all that was necessary.

The Boilers.—There were two boilers, consisting of an external cylinder,
in the same plane, and the inner part being considerably belted. From the best examination I can give the subject, I have come to the conclusion that the structure of the shell was such as to make the pressure of the steam inside almost equal to the outer pressure, and that the failure of the explosion was due to a violent bursting of the shell, and not to a gradual increase of the pressure, as is generally supposed.

The second point which I wish to bring forward is the manner of the explosion. The boiler was not only belted, but the outer part of the shell was belted very strongly, so that the boiler was composed of two shells, one inside the other, and the space between them was filled with water. The water in the inside shell was not sufficient to prevent the outer shell from bursting, but it was sufficient to carry the force of the explosion to the outside, and thus produce the effect seen in the illustration.

The third point which I wish to bring forward is the cause of the explosion. The boiler was not only belted, but the outer part of the shell was belted very strongly, so that the boiler was composed of two shells, one inside the other, and the space between them was filled with water. The water in the inside shell was not sufficient to prevent the outer shell from bursting, but it was sufficient to carry the force of the explosion to the outside, and thus produce the effect seen in the illustration.

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The tenth point which I wish to bring forward is the cause of the explosion. The boiler was not only belted, but the outer part of the shell was belted very strongly, so that the boiler was composed of two shells, one inside the other, and the space between them was filled with water. The water in the inside shell was not sufficient to prevent the outer shell from bursting, but it was sufficient to carry the force of the explosion to the outside, and thus produce the effect seen in the illustration.

In conclusion, I wish to say that the boiler was not only belted, but the outer part of the shell was belted very strongly, so that the boiler was composed of two shells, one inside the other, and the space between them was filled with water. The water in the inside shell was not sufficient to prevent the outer shell from bursting, but it was sufficient to carry the force of the explosion to the outside, and thus produce the effect seen in the illustration.
ship. * Almost all tabular boilers have flat plates in front. If I used a flat plate, I should construct it in such a manner that the stays themselves might sustain the entire pressure. If the valves were tied down and the boiler was subjected to a strain of considerably above 68 lb., the effect would be to tie down the boiler. All the parts of the boiler, save to resist the straining would be acted upon by such a constant pressure. The dome would not be affected by the pressure of 186 lb., which I applied to the unexploded boiler. The vulnerable part of the boiler is the bad plate front.*

The inquest was again adjourned, and was resumed on the 24th, when several additional facts were elicited. Heasman, the person who acted as engineer on the day of the explosion, denied positively that the valves were tied down, and he said that only a minute before the explosion the gauge indicated a pressure of about 18 lb. to the square inch, and the steam was blowing off slightly from the loaded valve. He was equally positive that there was no string whatever attached to the lever of the larboard boiler at the time, as it had been shaken off on the Sunday morning previously, and had not been replaced. Mr. Lloyd was again called, for the purpose of explaining a few points of his former evidence. He stated, in confirmation of his opinion that the pressure at the time of the explosion must have been at least 186 lb. to the inch, that the companion boiler had been so much strained at the same time, that it could not have worked afterwards, owing to the leakage; and yet, in this weakened condition, it bore a pressure of 186 lb. to the inch before it gave way. Mr. Joyce and his foreman, Mr. Meacham, gave evidence. The latter states that when the boilers were delivered from Mr. Trotman's, of Whitecross-street, Borough, they were proved to a pressure of 150 lb. to the square inch. The boiler was again proved to a pressure of 150 lb. on the 3rd of August, when the gauge indicated a pressure of 150 lb. at 3.25 p.m., and no impression on the boiler. When he visited the boat on the 22nd of August, he ordered the strings on the levers to be cut away, as there had been a talk about Clerk having tied down the valves; but, having himself confidence in Clerk, he did not believe that he had ever done so wicked a thing. Had any one of the four valves been in operation, it was of opinion it would have been enough to relieve the boiler from dangerous pressure. The weight on the lever would be equivalent, as stated, to a pressure of 68 lb., if placed at 3 ft. on the lever; but it never could be brought with three inches of the end, owing to the waste steam-pipe, and the pressure could not then exceed 60 lb. or 57 lb., or with the lever and valve, 69 lb. Mr. Lloyd's proof was made after the boiler had lost its stays. Had it been made when the boiler was new, and with the stays in, he believed it would have supported a pressure of 230 lb.

Mr. Joyce said that Mr. Trotman had his own price for the boilers, and he had reason to believe they were quite sound. In reference to Mr. Lloyd's objections, they ought to be proved to ten times the working pressure, Mr. Joyce observed that he never knew a steam boiler that could stand such a test. The front plate of the Cricket's boiler was made of B. B. H. iron, which is of very good average quality. The boilers of the Ant and Bee are of good Staffordshire iron, and the tube plates are not so thick as those of the Cricket.

Mr. Trotman, the maker of the boilers, gave the following evidence:

"I have been a boiler-maker from my youth. I furnished the boilers of the Cricket. Mr. Joyce said they were to work from 60 lb. to 65 lb., but never to exceed 60 lb. I proposed to prove them to 160 lb.; but Mr. Joyce said he should be very well satisfied. When they were done, he offered to prove them himself, after they were delivered, and I consented. I filled them with water, to discover any leaks, but did not prove their strength. I saw the explanation boiler the Sunday after the accident. I concluded there had been some unfair work. I don't think that any ordinary pressure could have bent the plate and torn the angle-iron, which was very strong, as far as my finding from Mr. Trotman's iron for the boiling-tap of the Cricket: I paid 1s. 1d. for the iron, and 20l. a ton for that of the two plates. I have worked tons of the B. B. H. iron, and consider it next to the Low Moor. The engineers fix on the safety valves. With fair pressure and fair work, those boilers would have worked for years. They have been known to work at 60 lb., and that is much more than I was told would be required. I have never known a boiler so strong as to resist a pressure ten times the ordinary amount. This accident must have been occasioned by pressure, which Mr. Joyce says was unusual, that he never heard of, weighing per baps a ton and a half, through the stern of the boat, and about forty yards through the water."

Mr. Robert Rettie, of Ham, civil engineer, though he admitted he had never seen the valves nor the boiler, spoke confidently that the cause of the explosion was the overheating of the flues, that the stoppage of the

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* We think Mr. Lloyd must have alluded to low-pressure boilers, where the steam is rarely generated at a higher pressure than 10 lb. or 12 lb. — Editor.
cell of fresh air, or, if necessary, of air tempered for each prisoner, without the inconvenience of draughts. The extraction from each cell of a quantity of foul air equivalent to the quantity of pure air introduced; and the carrying on of the heating and ventilation without facilitating the means of communication, whether of sound or otherwise, between the different cells.

IRON VESSELS.

The following report of a survey for the purpose of ascertaining the injuries sustained by the Great Britain, as delivered to Captain Claxton. It clearly shows the superioriety of iron over wood for constructing sea-going vessels.

"We, the undersigned, certify that we have at your request this day been on board the Great Britain, and have examined the vessel. We have found the principal hole to have been six in number, varying in dimensions from 3 ft. by 18 in. to 6 ft. 9 in. by 16 in.; and there are other formidable holes and cracks of smaller dimensions. From their size and position, under the keel of the ship, we are of opinion that it must have been a work of extreme difficulty to make their entry. The hole is filled with water, and it is evident that the bottom of the ship lay, there was never less than 22 or 3 feet of water in the hold after the damage she sustained from the gales in the early part of the winter; and taking this fact into consideration, with the difficulties that had to be encountered, we are of opinion that the greatest ingenuity and perseverance must have been exerted in the stops in such a manner as to enable the vessel to float. The method adopted by Mr. Crew for this purpose was as follows:A plate of sufficient size was pasted edgewise through each hole from the inside, having a screwed bolt attached to it as nearly in the centre as possible. This plate was then adapted to cover the hole on the outside, and was drawn tight by a screwed nut and crossbar from the inside, being backed with a large quantity of tar. This, in melting the elements of the emerald with half their weight of borax acid, at the same temperature as in the preceding experiments, a substance is obtained, which easily scratches quartz, and the surface of which presents a great number of facets having the form of a hexagon or hexahedron.

"I content myself." M. Ebelmen adds, in conclusion, "with submitting to-day these first indications, hoping, however, soon to present to the Academy a more detailed and complete work. But I am convinced, at present, that it is possible to produce, at temperatures below those of our iron smelting furnaces, disphanoous crystals the hardness and external characters of which are analogous to those of precious stones. It is probable that by repeating these experiments in apparatus of certain dimensions, like reverberating furnaces, by operating on large quantities of materials, and continuing the application of heat sufficiently long, much larger crystals may be produced than those I have obtained, working with a few grammes only. Another conclusion to be drawn from the preceding facts is, that many species of minerals habitually consist of themselves and crystallise at temperatures much below those necessary to melt them."

Specimens of the products mentioned in the communication were sub-misled to the Academy. — Literary Gazette.

NOTES OF THE MONTH.

French Proof Engravings.—At a recent meeting of the Royal College of Chemistry, Professor Taylor declared that French printmakers are enabled to increase the number of proof copies, to the advantage of the purchasers. He showed that they had adopted the system of giving the paper a slight coating of carbonate of lead, which rendered the impression more perfect after the plate had become detritiorated; but that this was very soon converted into sulphide by the action of sulphurous hydrogen constantly floating in the atmosphere of large towns, and by which interchange the print was destroyed. The presence of lead on this paper was shown by experiment. Prof. Taylor then stated that the brown colour of Valenciennes paper was due to a mixture of the metal with carbonate of lead, to make it look clean,—which being changed into sulphide on exposure to the air, gave the lace the disagreeable so much prized by ladies.

Test for distinguishing Iron from Steel.—To distinguish iron from steel by this process, take pure nitric acid, dilute it with so much water that it will only freely act upon the blade of a common table knife. If a drop of the acid thus diluted be suffered to fall upon steel, and allowed to remain upon it for a few minutes, and then washed off with water, it will leave behind a black spot. But if a drop of this acid be suffered to act upon iron in the same manner, the spot will not be black, but of a whitish-grey colour. The black stain is owing to the conversion of the carbon of the steel to charcoal, which thus becomes predominant; and iron being free from carbon, can produce only a gray stain. The utility of this test is not confined to finished articles manufactured of steel, but its application enables the workman in iron and steel to ascertain also the quality and uniformity of metal used in unfinished states. — Chemical News.

Chemistry for French Vessels.—The Minister of Marine has given orders that several experiments shall be made to test the quality of copper sheathing employed in England and France, for the coppering of vessels, as that at present used in the French Navy and merchant service so soon corrodes, as has been proved by the recent destructive state of the bottoms of the steamers, frigates, and other ships of war, where French copper has been employed instead of British, as hitherto, and will have to be recorroded as soon as the superiority of the one over the other is fully proved. The copper sheathing in France is of a very better class, better sold, and now little adapted, either for marine purposes, boilers, or steam-engines, if not mixed with English metal.

Stagnant Water.—M. Fleurian de Bellevue states, as the result of his observations, that in the Wash, or the sea-side plains in the neighbourhood of the Wash, that in marsh lands which are covered with water to a considerable depth during the great hot days of summer, the inhabitants of the localities in which they exist are not more unhealthy than in other localities; but that where the stagnant water is of slight depth the decomposition is attended with frightful consequences, and the mortality is great. He recommends that in all low lands where there is water during the summer of so slight a depth as to render decomposition certain, the inhabitants should form one...
general reservoir into which the different masses of water may be conveyed by means of channels of communication.

Fusion of Mercury.—The result of M. Person's experiments on the congelation of mercury and the latest that he has been able to procure for the fusion of mercury is about eight times that required to change the temperature of water one degree. M. Person observes that the quantity of heat necessary for the fusion of metals is according to the order of their tendency.

Steam Power.—It appears from a recent official return that the total number of steam engines in France in 1845 was 207; in 1846, it was only 109. Another return respecting the produce of the iron mines states that in 1845 the quantity of iron cast was 439,000 tons, whereas in 1846 the quantity was only 109,000. The price of iron, which in 1833 was 427, the 100 kilograms, was in 1846 only 456.

Removing useless Fences.—The following remarks are from a correspondent of the Sullaby Journal:—"I contend that thousands of sacks of corn may be grown annually in the level part of a land more than is at present wasted by land-owners and tenant-farmers to turn their attention more than many of them do to the removal of useless fences. I am of opinion that many of the land-owners have imbibed the notion that farmers are anxious to tear up their fences for the purpose of destroying game; but this is far from being the greatest evil arising from having too many fences, hedges, rows, &c. By allowing too many of these nuisances (for I know no better term for them) to remain on your farm, you not only lose the crop the land could yield after the fences would be removed, but also the produce of land on each side of the same. One farmer has a field of 40 acres of get sown to wheat; another has the same quantity of land, but in five or five different fields. They both begin sowing on the same day, and follow the work up as soon as completed; and at the end of the first piece of work, the one is at the second piece, and turning about his horses so many times, the other completes the work; and the farmer who has his 40 acres in so many fields is a day and a half or two days later than the other. This is another very great and serious evil arising from these useless fences, as they allow their tenants to break up so many of their fences, they shall have no cover for their game. I would say to every landlord throughout the kingdom, get your tenants out of the detestable practice, which many of them are in the habit of, of sowing barley after wheat, or any sort of straw crop, in two succeeding years. Let them keep their farms well filled with turnips and every other sort of green crops, and this will make plenty of cover for game, and be the means of keeping the land in a fit state to sow corn upon the following year."

Irish Institute of Architects.—A deputation of the members of this body waited on the Excellency, the Lord Lieutenant of Ireland, headed by Sir Richard Morrison, with an address in which they deplore the condition of Irish architecture. His Excellency, in reply, said that the bill is not for me, gentlemen, to deplore the condition of the theatre, nor to the school of which you naturally complain, however strange it must appear to me that architecture should not be duly esteemed in Dublin, one of the most picturesque cities in her Majesty's dominions, and adorned as it is by so many noble public edifices, or in a country where such magnificent situations exist, where genius is not rare, and taste and talent abound; but if happier days, as I venture to hope, are in store for Ireland, they must bring with them that encouragement of art and science which always marks a nation's progress, and they will strengthen a conviction, now on all sides manifesting itself, that the social condition of her people must be elevated. Towards carrying out this pressing and national object, the Royal Institute of the United Kingdom has decided to do so, powerfully co-operate with others, for when it is considered how much requires to be done towards the improvement of towns, and thereby ameliorating the sanitary condition of the people, and how little care has hitherto been bestowed upon the dwellings of the poorer classes of our fellow subjects, that the places of religious worship, schools, hospitals, and asylums, are insufficient for the wants of the country, a wide sphere of usefulness is manifestly open to a scientific and practical body such as yours; and I feel sure that the architects of Ireland will not disappoint us. To this end, I am of opinion that a profession will at all times be found ready and anxious to aid the great work of social improvement.

Military Cemetery.—It is stated that the Duke of Wellington, as Commander-in-Chief, has given his consent to the formation of a grand cemetery in the neighborhood of the place occupied by the late Duke's residence, of the different squares and streets, and as those in the East India Company's Service. The mausoleum will rise in the centre of the ground, on the spot where Seven-droog Castle now stands. It is to be raised in a series of terraces—the sub-streptitudes of which will afford spaces for ten thousand cadavers.

Great Nenasses Tunnel.—The great tunnel through the mountain on which stands the town of Weilburg, in the Duchy of Nenasses, formed for improving the bed of the Lahn, has just been terminated after five years' continuous labour. The length of the tunnel proper to be let into the tunnel on the 13th, and 3,000 gas lamps were to be lighted, and always kept burning. The formal inauguration of the gigantic work is to take place on Oct. 15.

The Fortifications of Skername.—The Fort Obersee, are fast approaching completion. A few days more would suffice to complete the work on the upper ends of the great fortifications, towards the sea, where a complete line is finished, the gun-carriages fixed, all the smaller guns mounted, and several of the larger ones are to be seen peeping over the parapet. Last week excavations were commenced in the open space opposite the ditch of the rock, preparatory to laying the foundation for a large and extensive range of barracks, and the road between Milr Town and Bils Town has been closed for five or six weeks past, a temporary road having been made round by the beach, whilst two new drawbridges, with barriers and other defences, are being constructed.
ELEVATION IN PICCADILLY.
THE MUSEUM OF ECONOMIC GEOLOGY.

(With Two Elevations, Plate XVII.)

That species of asylyar composition which is now generally qualified as the Italian "palazzo" mode, admits of very great variety and freedom of design, and of no less diversity of character in regard to the degree of finish and decoration bestowed upon it; which latter may be varied as required to the point of the most intense richness. Unfortunately, however, variety of design in regard to minor features and detail,—which constitutes almost the only species of variety a mere plane street façade admits of,—seems rather to have been shunned than aimed at; it has been so either without due study or else too timidly. The new Museum we are now noticing has, therefore, caused us somewhat of an agreeable surprise, there being much in it that is quite out of the beaten track. In one respect, it appears to have surpassed more than was to be looked for, since it gives us two totally distinct pieces of architecture, its two façades contributing a very marked architectural feature to separate streets,—viz., to both Jermy-street and Piccadilly. That neither front beasseaks the actual purpose of the building at all distinctly must be admitted, for there is more of Club-house physiognomy, especially in the Jermy-street front, than of what expresses such a public institution as a Museum. It will besides be objected perhaps by some, that the Piccadilly front is defective as a front, there being there neither entrance nor the appearance of any, but the entrance must be sought for in another and far less public street. Another circumstance, which, if not exactly a fault, is not in accordance with the laws of composition for what shows itself as a distinct façade, is that the Piccadilly front having an even number of apertures (six) on a door, presents no central feature. Still there is merit enough to counterbalance, or more than counterbalance, what only very rigorous criticism indeed is likely to take exception to.

To begin with the Jermy-street front, as the entrance one, although the design consists of what seem, when described in words alone, very commonplace features and arrangement, it exhibits a far greater than usual degree of artistic treatment. In fact, the door, or, we should term it, portal, is almost an unique example here,—r objectively and even imposing for its amplitude, and though simple in its general composition, singularly rich in design. As an example of the kind was much wanted among us, the entrance doorways and doors, even in our principal public buildings, being, if not all of them exactly insignificant, deficient in grandeur. Even the best of our club-houses are not distinguished by any excellence in regard to such feature; in some of them, on the contrary, the entrance doors are altogether of the most ordinary character. Mr. Penson, there, has taken an equally decided and happy position in this as in all other compositions, by making his door the focus of it as it were,—the principal feature is it of all, on which the eye rests with contentment and satisfaction, it finding there sufficient to interest and detain it. In addition to richness of the architectural dressing, the doors themselves will be decorated by elaborately carved panelling; wherefore we purpose showing them and the doorway, together with some other details, drawn on a larger scale. The opening of the door measures 6 feet 6 inches, by 16 feet high, and the entire composition 11 feet by 36 feet, which proportions are as remarkable as the dimensions are unusual,—that is, except in one or two buildings where a single large doorway, or else a central one accompanied by two lesser ones, is placed within a portico or other columnar composition. There is, as far as we are aware, but one other asylyar façade which is at all remarkable for the importance given to the door, namely, the Hall of Commerce, in Threadneedle-street, unless the large door in the west front of the Bank may also be quoted as an instance; although with regard to the latter, it should be observed, it belongs to what, if in that part of it may it be termed asylyar piece of architecture, is not a formalised one. Both those examples, however, are of very plain design, more especially with regard to the doors themselves. Exquisite taste of embellishment, together with perfect completeness of decoration, is to be found in the doors within the portico of St. Pancras' Church, which ought to have led not, indeed, to direct imitation,—and they themselves are only direct imitations—but to similar laudable ambition on other occasions.

Perhaps it will be thought that we dwell, if not too long, too exclusively upon that single feature in the Jermy-street front of the building; yet hardly can its value be too forcibly insisted upon, more especially as there is nothing in the mere name of "door" as in that of "porthole," to characterise a design when merely spoken of. Yet we would readily give half-a-dozen of our usual Doric or Ionic porticoes for one such a portal as that we are noticing. It gives a decided physiognomy to the whole façade; which, if that were taken away, becomes comparatively tame and uninteresting. This last remark may seem to imply something like an unfavourable opinion as to the general design, taken independently of that single feature. Yet it ought not to do so, seeing how many buildings we have whose sole merit—or we should rather say whose architectural pretension altogether—consists in its having a few columns put up against it for a portico, and without which there would frequently be nothing whatever at all answering to even the most ordinary notions of design. There are, besides, many Gothic buildings whose fronts would be almost vacant and featureless were it not for a doorway or portal which imparts interest, and sometimes a very peculiar and piquant charm to the whole. For making this observation we are not to be understood as intending to insinuate that it so far holds good here, that, with the exception of the door, the other features possess very little value or interest. Many of them, on the contrary, afford evidence of valuable study of detail, and highly commendable attention to those minor but not least precious touches in design, which beaup the artist. The Piccadilly façade—but no, we will reserve that till our next number, when we hope to be able to enter into some description of the designs for the interior also.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."—Sir Henry Wotton.

(Continued from page 502.)

About the same time that James Wyatt flourished under the patronage of George III. and the leading aristocracy of England, the leach of architectural brothers, the Adelphi Adams, arose and took their ground on the architectural battle-field, with distinguished success. They have recorded their relationship in the Anglo-Hellenic term of the Adelphi buildings, between the Strand and the Thames; and their names by Robert, James, John, and Adam streets, Adelphi. One of these, the author and delineator of "Dioclesian's Palace at Spalatro," had travelled to, and enriched his country's literature by his description of that once gorgeous assemblage of architecture, sculpture, and painting. Like Wyatt, he endeavoured to introduce a new style, but it was not derived from so pure a source. Neither of these able men were imbued with so maestly a taste as Jones, Wren, Lord Burlington, and Kent; the latter of whom has been before noticed in connection, as an artist, draughtsman and painter, with Lord Burlington. In fact, he was not solely an architect, but the able and not always tasteful assistant to his noble patron. As a painter, he may be classed with the Verrio, La Guerre, Thornhill, and Kneller school. He was considered a man of taste, was an able landscape gardener, and was much consulted as such by the nobility and gentry of his time. As editor of Jones's architectural works, and joint editor with Ripley and Ware of "Sir Robert Walpole's seat at Houghton, in Norfolk," he showed great industry and talent, particularly in the correct way in which he delineated the ornamental details. From his intimacy with Lord Burlington and other distinguished men, he was often consulted by the fashionable world upon affairs of art; and is said to have sent a lady to court in a brocaded silk dress of his design, upon which were wrought temples, statues, fountains, triumphal arches, in all the glorious of the five orders of architecture; making the lady a walking Palladio in Petticoats, and her hooped retunda a veritable temple of the Cthbean goddess. He was also occasionally employed as an illustrator of books, among which was Taddon's edition of "Gay's Fables." In these his professional knowledge is showed to advantage in his interior of the theatre which forms the head-piece to the fable of the two monkeys; who, gravely seated in one of the stage boxes, are criticising the efforts of the rope-dancer on the stage to imitate their agility, saying—

"How can these clumsy things, like us, fly with a bound from tree to tree?"

The interior of the library wherein are the learned elephant and the book-
seller, the sick man's chamber, and the court of Death, exhibit his architectural knowledge; whilst the decorated gardens in which are the poet and the rose (said to be a portrait of Gay), and the gardener and the hogs, show him as a designer of gardens.

Wyaston, as we have seen, was an architect; so was originally Robert Adams; but the firm of "Adam brothers" were speculative builders. The district called by them the Adelphi, is the greatest of their works in this department; and their overgrown speculations in Edinburgh left the modern Athens for many years almost as much a heap of architectural ruins as was its ancient namesake.

The style of architecture aimed at by the brothers in their Adelphi buildings was the pseudo-Grecian used in the decline of art by the emperor Dioclesian and his artists. The great difference of level between the high street of the Strand and the left bank of the Thames, upon which they erected these buildings, was filled up by a range of warehouses and wharfs covered by arches, which formed the basement of the terrace and dwelling houses above. The range of houses built upon the terrace facing the Thames is planned with great skill for domestic use and comfort. So are the two streets at the eastern and western extremities, which form detached wings and connect the series of dwellings into a whole as a composition. The street which runs from east to west on the northern side of the main building, and carried on by a range of similar buildings, is continued the whole length of the grounds, which belong to the Society for the Encouragement of Arts, Manufactures, and Commerce, and some houses of a larger size than those which face the river, used as private hotels, offices, and chambers for professional men. The leading decorations are a series of very narrow pilasters between the windows, supporting cornices of no precise order, but all profusely enriched with foliage and arabesques in low relief, of the Dioclesian style. The most striking defect of this design, considered as an architectural composition, is a lack of boldness in projection and recession, which causes an uninteresting flatness, for want of a due proportion of light and shade, that marks the whole design. The projections of the pilasters are too small, and the reveals of the windows too shallow, to produce that artistic-like effect which could alone give its author the name of architect. The whole mass bears more the appearance of a building speculation than the work of an architect who sought for an enduring name. These defects are the more to be lamented, as they occupy the finest situation on the north bank of the metropolitan part of the Thames. The buildings not only appear fragile, but are actually so, and exhibit many symptoms not only of decay, but of unscientific construction and ill-selected materials. The plain and ornamental stucco work that embellished the exterior of these houses, formed of lime mixed with oil (the original of Hamelin's mastice), dignified by royal letters patent and the sounding name of Adam's cement, has faded in many places, and been replaced by plain pilasters, unornamented capitals, and flat surfaces of Roman cement. The endeavour to give an architectural character to the shop fronts, by substituting termi, busts, and semi-carvatures, instead of the common stall-board and story-post of their London predecessors, not only deserves praise, but followers.

The south front of the edifice belonging to the Society for the Encouragement of Arts, etc., is in a more manly and architectural style than any other on the Adelphi estate. The principal or one-pair story consists of a tetrasyle attached portico of three-quarter columns, supported by an appropriate ground story. The columns are of the Ionic order, rather too slender in proportion for the intermediate character of the order, which should bear a just medium between the robust Doric and the delicate Corinthian. They support an entablature and pediment, which being carried into the two flat wings of the adjoining portions of the building, possess as artistic meaning, and structural appearance, as the plain front of a large house consisting of windows and porch only.

Brother Robert designed and executed many buildings of a similar character in Scotland, and published a volume illustrative of their details in 1764; and also a folio volume, marked with industry, pains-taking research, and graphic correctness, of the ruins of Dioclesian's palace at Spalatro.

He was patronised by the Earl of Bute, through whose influence he was appointed architect to the king for Scotland; and was for some time superintendent of the works at the Royal-hospital, Greewich, and erected a pavilion in the Gothic style at the south end of the terraces, ascribed with the name of George III., and the other Queen Charlotte.

The brothers Robert and James published their joint architectural works in three volumes, of which the first two were published in 1764, and the third in 1768. Of brother John we have no literary records but that of his name at the corner of one of his streets in the Adelphi.

Among the best works of the Adams in the metropolis are a mansion in the left corner of St. James's-square, a row of the so-called "Adam houses," a bed-front on pseudo portico of the Society of Arts; Lansdowne-house, on the south side of Berkeley-square, a large and commodious mansion with a body and two wings, the former decorated with the same lask and meagre attached columns of the Ionic order that disfigure all the works of the Adams. The spacious country front in left ample room for a real portico, but they did not avail themselves of the opportunity. This mansion was celebrated in the lifetime of the late marquis, by whom it was built, for that collection of ancient statues, busts, and reliefs, known by the name of Lansdowne marbles. The Royal Academy, fifty years ago, thought the principal elevation of this structure to be of sufficient importance to form a study for its architectural students, and gave a silver medal for the best geometrical elevation, tinted and shaded, with a duplicate in outline, correctly finished from the actual building.

The Ades also erected the street-front of Drapers'-hall, in Throgmorton-street; some well-built houses opposite, whose interiors bear marks of a better architectural character than most other of their period; and the street-front of Skinners'-hall, on Dowgate-hill, in the City, marked by a similar tameness of character as the before-mentioned buildings.

If the Adams left no followers of their initiated Spatalo style of decoration, they have been followed in their pseudo-Greek, which, like the lady Anglo-Gallic of the circulating libraries, has invaded our national cockneyisms. Some learned Thebans at Waterford, who build a large warehouse-like row of houses on the right bank of the beautiful river Seir, have named it, after the mode of the Adams, the Adelphi-terrace; so also did two comedians, who agreed like anything but brothers, after the name of the Samastrell to that of the Adelphi theatre; and a widow, not to be outdone in Greek by her neighbours, named her stall the Adelphi oyster-rooms; and a classical gin-shop on the other side has assumed the name of the Adelphi wine-vaults, by an only brother.

James Stuart, who received the honourable addition of "Athenian" prefixed to his name, returned to England about the time that the Ades were flourishing in Dioclesian glory. This eminent man was more of an artist than a practical architect, although he delineated the geometrical details of the art with mathematical precision, and drew the human figure and sculptural embellishments with correctness and taste.

The first accurate knowledge which the people of Europe received of the Athenian antiquities was given by the publication of Dr. Spou and Sir George Wheeler, who both fortunately travelled before the Venetian siege. Travels and descriptions of that part of Greece afterwards became more numerous and more sought for. In 1761 Stuart, assisted by Pars, a painter, and Revett, an excellent geometerian, employed three years in measuring and delineating the principal antiquities in Athens and its vicinity. In 1764 the London Dilettanti Society commissioned Dr. Chandler, a learned and investigating man, to examine and report upon these uncoveted antiquities. Le Roi, a French artist of some ability, visited Athens about the same time as Stuart, and foisted erroneous accounts and delineations on them upon the public.

The drawings and delineations of Stuart and his companions soon became known among the higher and most refined classes of England, who duly appreciated the high taste of refinement and purity exhibited in this grand style of art, now known to them for the first time. Preparations were made for their publication with such rapidity, the progress of which was much assisted by the perfect state in which these artists brought over the drawings, that in 1768 they were presented to the public under the title of "The Antiquities of Athens, measured and delineated, by James Stuart, F.R.S., F.S.A., and Nicholas Revett, painters and architects," 4 vols. fol. 1768.

On the occurrence of a vacancy he was appointed by George III. to the office of architect and surveyor of buildings to Greenwich-hospital, which afforded a comfortable leisure to the industrious Athenian traveller. During the time of his holding this office, the chapel and a great part of the bell-tower were consumed by fire, and Stuart designed and superintended their restoration. The whole of its exterior he rebuilt, with due regard to the honoured name of Wren, precisely in the manner in which that great architect left them; but the interior he remodelled after the Athenian style, which is scarcely so suitable for such an interior as was the bold and more decided style of Wren. It is, however, to be admired as the first actual execution of Attic detail in England, as well as for the chastened purity which pervades the whole design. Benjamin West, then a young
man, whose powers as an historical painter were soon perceived by the king, painted a large picture for its altar-piece; the subject selected by his majesty was St. Paul's escape after his shipwreck on the island of Malta, and his miraculous shaking off the viper that had fastened upon his hand, without injury. This picture is generally esteemed to be one of West's master-pieces; another being the stoning of St. Stephen in Wren's neglected gym of art, the church of St. Stephen, Walbrook. The chapel of Greenwich-hospital also shows West to advantage as a sculptor, in some low reliefs of the history of St. Paul in the panels of the pulpit.

No event that ever occurred in the history of architecture in England, and thence through all Europe, produced so sudden, decided, and beneficial an effect as did the works of James Stuart. It surprised and delighted the learned and admirers of art; the majestic grandeur and simplicity of form exhibited in the general outline of its beautiful temples, and the exquisite purity and elegance of detail shown in all the profiles of its mouldings, fascinated the eye of taste. The natural form, in which everything was subservient to utility, proved how pure was the taste of the elegant Athenians. Nor did the contrast between the works of these ancient architects and their successors and self-called followers strike the mind with less force. Unlike the Romans, there were no pediments under pediments, or under porticoes, or in the interior of buildings,—to which absurdities the Romans were so partial, as to draw down the rebuke of Cicero, that his countrymen were so fond of pediments, that if they had to erect a temple in Olympus to the "Jupiter Impluvius," they would cover it with a roof and decorate it with pediments.

Nor was the contrast greater in the details of their mouldings; those of the Romans being all subservient to the circle and its parts, whilst those of the Greeks deduced the mechanical slavery of the carpenter. Ellipses, parabolas, and other elements of the circle, are the elements of all their curves, and their Ionic volutes bid proud defiance to the counsels of Batty Langley and the ingenuous mode of striking the Ionic volute invented by those eminent Italian architects, Scamozzi, Vignola, and Andrea Palladio. Let the eye of taste decide between the echinus of Athenian architecture and the ovolo of the Roman; the cymatium of the Greek and the ogive (what a name!) of the Roman; the bold, manly, and elegant curvature, amenable to no compasses but those which the artist carries in his eye, of that type of the Ionic order in the temple on the Ilissus, or the more beautiful complaisant swoop that form the elegant curves of those of Minerva Polias, one of which is in the British Museum, with any Roman or Italian example that ever existed in type or in book, from Vitruvius to Borromini.

It has been the fashion of late with certain scholars to decry Greek architecture as a heresy, a mere ephemeral fashion, a style of bygone times not worth reviving; and among others, calling themselves architects, that it is good for its remote antiquity, but has been greatly improved by the Romans and Italians. Have we not, say they, added two orders, the Tuscan and the Composite, to the original three? Placed and cabled and pearl'd and olive and bedizened the Corinthian, making it as fine as a May-day queen? Scamozzi and Vignola, lengthened the shafts, bolstered the friezes like the side of a Dutch cheese, and modelliz'd their cornice, that Lucius would not know his own invention; added ogives and annuletts and colorines to the unfinished capital of Minerva Parthenon; and a handsome base to its shaft, like a buckled shoe to a naked foot,—and call you not these improvements and additions to the bald Greek style? —Bald it is, indeed, as used by some of modern times; making a miniature model of the majestic temple of Minerva an entrance stuck upon the flank of a huge dead wall, or,

"To what vile use may we come, Horatio,"

to serve as the passage to a stinking stable-yard. To transform the beautiful style of the temple of Bacchus at Teos—the god who rivaled Apollo in youth and beauty, and shared with him the attentions of the maids and the graces—to the embellishments of gompaundising eating-houses, or to the still more degraded temples of intemperance, the Bacchus of the gin-shop; the god to whom Gay in his fable of the "Court of Death," gave the wand of pre-emience before all his other faithful subjects, saying emphatically,

"He shares their merit, their social joys,

All is a courted goddess, and adored

The charge on him must justly fall,

Who finds employment for you all."

Fowell, on being asked whether there was not much breadth of style in one of these Anglo-Greek plagiarists, replied, "that if boldness was breadth, it was broad enough in all consequence."

See, say the Romanists to the Grecians, how gaily we have dressed your sacred Venus—how nobly we have attired your slim Apollo—how we have fed and fruited your barren Teian god!—You have, indeed, sights a venerable Greek, clothed the Venus of Praxiteles with a head-dress of wool and powder, like Ramay's portrait of good Queen Charlotte; given her a bodice, hoop, and farthingale, with high-heeled pointed-toed shoes, like Bird's statue of Queen Anne in St. Paul's churchyard; transformed the Hyperean curls of the Delphic god into a periwig of George the Second; cut and concealed the rest of the mainy beauties of the son of Latoa in attire, like one of Hogarth's coxcombes; and fructified the Grecian Bacchus into a genuine city Silenus, bursting with dropsy, goat, and apoplexy.

Greek art may be reviled, but let its revilers equal if they can,—to surpass it is beyond their powers: hence the cause why they traduce what they cannot understand. Samuel Johnson, on finding a Greek quotation amidst some modern trash, like "a green Oasis in a desert world," exclaimed, "So much Greek, so much gold." So does the man of true taste on viewing the architecture and sculpture of the godlike Greeks.

About the same period with Chambers, Wyatt, and the Adams, flourished other architectural stars of lesser brilliancy. Ware, who assisted Kent and Ripley in the delineations of Walpole's mansion at Houghton, and known by his ponderous folio, "A Complete Body of Architecture," published in 1768,—as bulky and as little read as the statutes at large in an almsman's library. Bostingham, the architect of Holkham, in Norfolk, the plans, elevations, and sections of which, together with a description of the statues, pictures, and other beauties, was published in a folio volume in 1773. He also designed and executed the handsome mansion near the south-west angle of St. James's-square, London, now the town residence of the Bishops of Winchester; and a few other works of less importance, but none marked by any distinctive character.

Among the architectural publications of this period, useful alike to the student and amateur, may be enumerated the works of the collected designs of Inigo Jones, Palladio, Scamozzi, Perrault, &c., by Kent, Lord Burlington, Leoni, James, and Ware, which were, however, for a time swallowed up by the magic wand of Stuart, as that of Moses did those of the Egyptians before Pharaoh.

James also flourished about this period, and is best known to architectural critics by his Hawkesmoorian churches of Greenwich and Deptford; the former of which was judiciously selected, a few years since, by the Royal Academy, as an architectural competition for its silver medal students.

Paine also enjoyed a portion of the royal and noble patronage of the country in the same era; he built the pretty bridge over the Thames at Richmond, and made some pleasing additions, in the Elisabethan style, to his own residence at Addlestone, near Chertsey, Surrey, which was for many years the hospitable residence of the late Sir Charles Wethekell, of legal and facetious memory. Paine was one of the attached surveyors of the crown in the Land-revenue department, and had considerable practice as an architect among the nobility. None of his works, however, entitle him to the name of a master in his art, nor have distinguished him from the herd of architects of the Italian school. The plans are all well arranged and commodious, sound in construction, and well built; but so meagre in originality of style as the most servile copyist of the common-place school to which he belonged. He did that which it would be well if better architects would imitate,—namely, published his works; one entitled "Plans, Elevations, and Sections of Noblemen's and Gentlemen's Houses, &c. &c., executed in various parts of England," 2 vols. folio, 1767, 1783; and the other, "Plans, Elevations, Sections, and Ornaments of the Mansion-House of Doncaster," folio, 1761.

The early part of the reign of George III., so prolific in works on art, produced Paine's elaborate treatise, "On the Baths of the Romans," in which he successfully explained and improved the "Restorations" of Palladio. It was published in 1772. Collin Campbell also published his very useful work, the "Vitruvius Britannicus," in four consecutive volumes, between the years 1715 and 1717; to which Woolf and Gaden respectively added supplementary volumes, of equal skill and correctness. More recently, Richardson added another volume, so much inferior to its predecessors, that the work was discontinued.

The latter part of this fertile period produced Robert Milne, a pupil, I believe, of Robert Adam; at all events, he was of the same country and school. Like Wren, he exhibited precocious talent; for scarcely at the age of manhood, he triumphantly bore away the first prize in the first class of architecture at Rome, and bad the honour of being the first Briton who obtained a premium for art in that city. He was not only a Protestant—and consequently a heretic, in the estimation of the professors of the primitive faith—but was also of that anti-Papist sect, a Scotch Calvinist. The
supercumulent ceremonial of the church of Rome which he witnessed in this very heart of popery, the prodigious manner and lives of its professed, and the uncumbersome style of worship of his own church, perhaps led to that contempt which Milne always impatiently exhibited, even at the decked ceremonies and more simple garb of the church of England. Before he had completed his studies in Rome, he was sent over in competition, and conquered all his opponents, for his Blackfriars’ bridge, a work of skill and some originality. Milne’s style was too decidedly Roman for the day; but, to his honour be it spoken, his love and affection for our great metropolitan structure, St. Paul’s, of which he long held the place of surveyor, was such, that he never would see it defaced or altered, or spoiled in any way; and scarcely a week of his long life passed without his visiting it in person. For every art but his own and for every person but himself. In some of his ebulitions of temper, he has been known to kick the clothes and tools of workmen, who have dared to reply to him, out of windows and into holes in the streets, and has been obliged to fly from the effects of their excited wrath. One of these, an Irishman, said that “Mr. Mil ten,” as he called him, “was a rale jitslemun, but as hot as pepper and as proud as a Lucifer.” Peace be to his remainder, which quietly reposes by the side of his great predecessor, in that noble cathedral which was built by the one and sustained by the other.

This architect is not known for many other works than his Blackfriars’ bridge; a few bridges, and perhaps one or two mansions, in Scotland; the buildings and machinery of the New River company; and a very common place elevation to the east front of Stationers’-hall, Ludgate-hill. The principal employment of his latter years was that of architectural curator to St. Paul’s cathedral, architect and surveyor of buildings to the Stationers’ company, and engineer to the New River company; dividing his time between his two official residences at either end of that river—its spring or source at Amwell, near Ware, in Hertfordshire, and its other end at Clerkenwell, erroneously called the New River head,—it being the reservoir which supplies, by steam machinery, such parts of the metropolis that are served by the company.

Sir Robert Taylor, a man of great capacity, occupied a distinguished station in Tory-Georgian era. He was one of the chief architects to the crown, and architect to that opulent body the Governor and Company of the Bank of England, when it began to expand its buildings to the right and to the left of that comparatively small edifice which was more than adequate to its necessities on its establishment in the reign of William III. He had much private practice, and was known for three-fourths of a century to every architect, surveyor, builder, and lawyer in the metropolis, for his celebrated, incomprehensible, and contradictory Building Act, which is only surpassed in legions absurdities by its successor. He educated many pupils, to whom he gave either classified under the Building Act, or appointments in the office of the Board of Works. It is true, that none of them proved to be men of taste; but they were all thoroughly men of business, high honour, and integrity. It is probable that he intended his son to be a great artist, for he gave him the powerful name of Michael Angelo; as did another more recent architect name his scion Christopher Wren. Poor little Christopher, however, died young, and destroyed all hopes of his rivalling his namesake: but Michael Angelo Taylor lived to be a respectable whip member of parliament—the best tempered whip that perhaps ever lived, and the giver of the best dinners that ever did honour to Spring-gardens.

The style of Sir Robert Taylor was founded upon the best Roman examples, resembling in its finest points those of his contemporaries, Sir William Chambers; but he far excelled him in scientific construction and sound building. He found a pretty design for a tetrasyle portico and pediment, with lateral columns of a very elegantly-proportioned Corinthian order raised upon pedestals, in Chamber’s work on “Civil Architecture,” confessedly borrowed from an anonymous Italian architect. These he repeated on either side of the course Ionic centre of the Bank of England in a very pretty but unconnected manner. The whole of this front, which extended from the corner of Princes-street to Bartholomew-lane, has been replaced by the massive and masterly composition of Soane, of which more will be said hereafter. In another part of this building is a quadrangle on the western side, which is still preserved in almost its original freshness, a very choice example of Taylor’s skilful adaptation of this tasteful precedent of the Corinthian order. In the centre is a pleasant city garden, with a few verdant lime trees that give variety to the picture. The former façade, next Threadneedle street, being a screen wall to the internal edifices, had no apertures, and was more a copy from Chamber’s work than the one in question; which, being an interior court, and giving light to the directors’ parlour and other important rooms in that edifice, is decorated by a series of well-arranged proportioned Venetian windows, which adds a charm to the composition that the original design is much in want of. There is not an executed building of the decorative Greco-Roman style in Europe, that more deserves the titles of tasteful and elegant than does this pretty composition of Sir Robert Taylor.

The two islands of houses that stood between Threadneedle-street and Cornhill, called Bank-buildings, that were taken down to make way for the Royal Exchange and the open area on its western front, and which were occupied by some banking-houses and insurance companies, were a masterpiece of street architecture, putting situation aside, not surpassed by any in Europe. Upon a massive stylobate, that gave height and light to the basement storeys, was raised an attached octoside of as elegant a Roman-Doric as ever emanated from the pencil of a modern architect. The intercolumniations were filled with doors and windows as necessary to the local convenience required, deeply recessed and with bold reveals that served for every purpose of office or shop. The upper part consisted of a lofty elevation of well-proportioned windows with architectural stone dressings, with that breadth between them which characterise all this architect’s works. This peculiar characteristic is particularly noticeable in the lofty mansion on the western side of Tower-hill, in which the proportions of the windows show the loveliness of the stories within. This character, which brings such harmony and grandeur to the elevations of Sir Robert Taylor, was so perplexing the architect (1) of Philiburne-place, Kensington, that he filled the interval between the one and two-stories windows with little panels, which, if left open, might have intimated that they over windows to that bungling Italian contrivance, a messaingue story; but which he rather chose to fill with ornaments (1) of sculptured swags, representing wet cloths hung upon pegs;—he would doubtless have filled Sir Robert’s broad spaces with similar imitations. King George the Third, who often passed through Kensington in his route from London to Windsor, named that specimen of Kensingtonian architecture, Diebolt-row.

Another fine specimen of Sir Robert’s tasteful design is almost lost in the noisy but wealthy way of Lombard-street. It was originally erected for a banking-house, but is now occupied by the Feathers Life Assurance company, and is now the side of the north side of the street, opposite Abchurch-lane. The basement storey is formed of a solid stylobate, which serves as a base to the Doric order of the lofty ground story; It is of the same classical Roman-Doric that he used in the Bank-buildings. The one-pair story is lighted by three well-proportioned semicircular-headed windows; and above, a row of attics windows, at such a distance from those below them as would have induced the Kensingtonian architect to have hung out his flags of distress. Every admirer of architecture should take a view of this excellent design, before the genius of wide streets takes it away. The well designed group of trees, the public monument of that dignifies the nature of the office, and figures the design, must not be taken into consideration in the estimation of the architectural beauties of the edifice, to which it does not belong, and can only be considered as a good thing ill applied.

A smaller, but not less tasteful, example of this architect’s peculiarity skill is to be found in the pretty villa which he erected for Sir Charles Angill, on the margin of the Thames at Richmond. Without a column, without a pilaster, without anything appertaining to the five orders,—with nothing that can be strictly called architectural but the castalved coraspe, such as me by Inigo Jones in Covent-garden church—he has composed an edifice so picturesque in form, and playful in light and shade, that may defy competition from such small materials. The centre stands forward and rises higher than the two attached wings; three-windowed bow front projects from the centre and rises the entire height; the ground story is rusticated and surmounted by a stringcourse and daded moulding, upon which rests the windows of the one-pair story; square attic windows mark the upper story of the centre, and the projecting cornice crowns it in front and sides; the
wings form semi-pediments, resting against the flanks and centre, looking like contrivants or bay windows to the main building. The eastern and western fronts—for there are no flank walls—have similar bow to the ground story, only the upper parts of which form balconies to the superior story.

Looking at this villa from the opposite side of the river, or from the river itself, the pyramidal form of the composition, aided by the beautiful trees and scenery which surround it, give it an indestructible grace of picturesque beauty, that must find value in a painter’s eye. Had the architect separated the villa from the road by a parapet-wall or balustrade, half its picturesque beauty would have been lost. Instead of which, he has enclosed its lawn by a mere protective row of iron rails, which makes the river appear to be part and parcel of the design. Nor is its appearance from the east or the west, on the Richmond side of the river, less perfect or beautiful, showing that the architect must have designed it es massas and in perspective, like a painter; and not on the drawing-board, with a T-square and compasses, like a carpenter.

Surely Sir Robert Taylor must take his place among the greatest of English architects.

(To be continued.)

CANDIDUS’S NOTE-BOOK.
FASCICULUS LXV.

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

I. Now that Punch has pronounced upon the palace, people will, perhaps, begin to open their eyes to that architectural enormity, and also to open their mouths pretty freely on the subject. At least so it is to be hoped, since it is only by clamouring, and clamouring very loudly indeed, that we can hope to put a stop to similar dalliances against taste, and similar manumission for the future. One would have thought that just after the outcry about the "Arches and Statues," all those who were in any way concerned with the projected alteration of the Palace, would have exercised a little discretion, and paid some little show of deference to public feeling. Instead of which, the only caution taken was the most unhappy one, as it now proves, of precipitating the business in the most hurried manner,—not altogether without reason, though a very bad one, for never would the public voice have sanctioned such a design for the occasion as that which received the imperial stamp of parliament. It may be questioned if any one individual—surely no one of those who signed their signatures to the designs presented "to both Houses"—bestowed any sort of examination upon them. If they really did do so, what is to be thought of their judgment? Or was it taken for granted that the designs had been duly examined and fully considered by some responsible authority? Where responsibility for the choice actually lies, it is easier to guess than it may be exactly decorous to say. Assuredly not with the architect himself, for his incapacity would have been harmless, had it not been for the incapacity of judgment or careless indiscrimation which suffered him to be employed. The lady who can dissemble a minister from her council board, can surely dissemble an architect from her service. At any rate there was no necessity for her employing that particular architect on an occasion that did not fall within the course of his usual official duties.

II. Buckingham Palace looks if not exactly more insignificant in style, of far more plebeian quality than before, and is, besides, greatly worse than ever as an architectural composition, the addition to it forming a lumpish mass, which, owing to its jutting out abruptly from the two low wings which are left standing, seems to encroach upon and disfigure the Park. Previous to the alteration, the principal mass of building had at any rate an architectural framing to it, whereas the present "façade" has none. Not only do the above-mentioned portions not belong to it, but they cause it to appear more lumpish—more of an excrescence than it otherwise might do. Were royal palaces erected every day, we could tolerate a few blunders now and then, in the hope of obtaining something very much better the next time; but such not being the case, the utmost ought to be made of the opportunity which actually occurs; every possible precaution ought to be taken to insure not a merely good, but a very superior design; and Mr. Birole's most assuredly does not answer to such character, since apart from all its other numerous deficiencies, it does not exhibit a single touch of imagination, or fancy, or artistic feeling. In sad and sober truth, the design is nothing more or less than the production of a Pecksniffian drawing-board. Alas! of the most ordinary quality, it manifests impotence of conception, and total want of imagination and fancy, whether as regards the whole or the separate parts. Yet, as the building stood before it was begun to be deserted, there was much in it to prompt contrivance, since it held out many tolerably obvious hints for improvement, all which have now been overlooked. As far as the public are concerned with it, the Palace is worse than ever—a more decidedly offensive architectural object than before, and the very reverse of any improvement to the Park. And what renders the matter all the more provokingly vexatious is that not the slightest pains were taken to endeavour to satisfy the public. "Vast indeed must have been the opinion of, and the confidence in, Mr. Birole's talent, to induce by such a "House's choice," without letting there be even so much as a chance for anything better than the occasion being produced. One thing at least ought to have been seriously considered, namely, that little less than assured certainty of success warranted the risking such a decisive step as the one takes,—one that only the most complete success could justify. Had we been taken by an agreeable surprise,—had after all the misgivings and apprehensions excited by very suspicious mysteriousness—the new façade burst upon us arrayed in beauty and magnificence, there could then have been no question as to the propriety of a mode of procedure that might up to that time have appeared both arbitrary and injudicious, both of which, we conceive, it will be considered now. As the patron of the Institute of British Architects, her Majesty might surely have been expected to choose some one whom the so royally and graciously condescension of exercising their talents on an occasion that ought to have inspired and inspired them. There are persons in the world who are so exceedingly clever and Machiavellian that they over-reach and cheat themselves; who has done so in this particular instance, we will not say; nor should we so much care, were it not that John Bull pays for all in more ways than one,—not in pocket merely, but in reputation also. Foreigners will now have fresh cause to sneer at his taste, or the taste foisted upon him. They—happy dogs! may grin, while we can only groan. As to Mr. Birole, he may console himself one way, since he may now truly remark with Byron, that he got up one morning and found himself famous—his name in everybody's mouth, from north to south,—his fame (not quite the best) spreading wide from east to west, or what's the same, spreading at least from west to east. Still no one cries encore! to the achievements of the far-famed Birole.

III. Should the Architectural Association act up to its professions and intentions, much benefit may be anticipated from it. It promises to call the attention of the student to what is so greatly neglected, or rather altogether overlooked, in his ordinary professional education,—namely, artistic apprehension of architecture, as distinct from mere building, in its quality of fine art. The Association consists chiefly of juniors,—and it is to the juniors and the rising generation in the profession, that we must look for the liberal, enlarged, and an occasion which have hitherto prevailed in these latter times, when the art has degenerated into what is little more than empirical routine on the one hand, and twaddling pedantry on the other. Since they seem so disposed, let the seniors in the profession go comfortably to sleep, provided the juniors are awake, and awake a better state of things. Let them boldly break the trammels in which their art has so long been confined,—fetters of unbending iron to the timid and the weak, but feebles as cobwebs to the firm and the resolute,—the more fimly spider-spinnings of pedantic brains.

IV. The nation is, it seems—at least, according to some people's fancy, much richer than we, and the general sense of the prodigiously valuable acquisition of Shakespeare's House—the only house, by the by, that can be called his, be being now ejected and kicked out from his legitimate dramatic domicile—the theatre. Shakespeare's House! what an immense quantity of drivelling sentiment was poured out just before the time of the sale of that rubbishly old tenement! Yet we laugh and sneer at, and ridicule the reverence of Roman Catholics for relics as besotted superstition,—our own Protestant superstitions being at the same time not a whit less absurd and crazy. However others may be affected at the sight of them, I know not; but such vulgar objects as Wiltkie's palette, in the pedestal of his statue at the National Gallery, and Nelson's coat, in the Painted-hall at Greenwich, only excite my thorough contempt, as the veriest buffoonery aping reverential admiration and affection. This species of superstition becomes less than downright imbecility, when the objects of it are absolutely insignificant and inter-
est in themselves, and have no other value than their very problematical greatness—by the case with the two reliques afore-named, it being just as likely as not that that identical palette was never in Wilkie’s hands, or that identical cost upon Nelson’s bank. Again, as to Shakspeare’s House, it is quite certain that no such inviolable precepts were taken to preserve it for ever and a day intact, as were taken by Soane to maintain his domicile in all its pristine excellence.

V. That our late Greekomania should now be greatly chilled, is no wonder, for our Grecianism had fairly worn itself out. It was in a manner starved to death, owing to its not having received the slightest nourishment from any new ideas infused into it. Nothing more was made of it than just what it was at first. Indeed, it was attempting to grow like an artistic gusto, to mould it according to actual circumstances, and also to keep up consistently, through every part of a building, the style so dictated, we contented ourselves with little more than copying in the most humdrum manner the fronts of ancient temples for classical porticoes, with no other variations than Doric, Ionic, and Corinthian—tetrastyyle, hexastyle, and octastyle. Nearly one and all were the merest mechanical copies; and precisely the same examples were repeated over and over again, in the most wearisome manner. It seemed as if we were ambitious of rendering the scanty resources of design afforded by Grecian architecture, even when availed of to its fullest extent, still more scanty, by exploring all but one or two of the most familiar examples. Nor was pency of ideas and inventive taste all, there being also, for the most part, great pecuniou in the general design of the buildings themselves and their execution. In many instances, even the ordinary deconies of design were wholly disregarded,—wherefore, in spite of their Greek columns, the would-be classical structures proclaimed themselves to be arrant Cockneyism, and that of the very worst and most vulgar kind of all, because accomplished by despicably paltry affectations. Nevertheless, such things were admired,—were complimented in newspapers, and enticed in guide-books, which exultingly called the attention of visitors to what they described as “a great ornament to our town.”—In a word, we had, by the unhappiest use we made of it, converted Greek architecture into the most humdrum sort of design. Nay, it seems to have paralysed our powers of design and composition altogether, so that the only alternative left us was to escape from it by plunging headlong into the Gothic and Italian styles.

VI. No one can say that I do not encore Buckingham Palace, after one fashion at least; for my pen is tiching to twitch at it again—la voici!

VENICE; AND HER ARTS.

By FREDERICK LUBB.

One vast difference, I mean, Little Florence between Amiens, And our huge overgrown city, In to speak more to grief than to mirth— The first has the palace whose name is the Pitti, We, a petty and pitiful palace.

We groan, we grin by turns at it, nor groan the less when we consider what our neighbours have lately made of their—not royal, but municipal palace, the Hotel de Ville at Paris, whose Grand Gallery, or banquetting-room, quite eclipses our House of Commons, and all else that is contemplated for the interior of the Palace of Westminster.

VII. A Real Architectural Dictionary is a desideratum not likely to be speedily supplied. By real is to be understood one which treats of things; one therefore, which, instead of confining itself—if not exactly to mere definitions, to a very brief account of the respective matters, should enter fully into the subjects connected with the terms explained, and supposing a work to be executed satisfactorily, some of the articles would require to be of considerable length. And to be well executed, it ought to be exclusively architectural. Otherwise it would exceed all convenient bounds, there being a very great deal, hitherto so carelessly treated at all in any shape, that would have come under cognisance in such a work. In fact, as compared with its mass and the number of publications belonging to it, architectural literature is remarkably meagre as to substance, and in regard to information to be derived from it. The greater portion consists of what is very little more than repetition, and that mere compilation, with scarcely so much as a fresh thought or remark infused into it. What work can we find which goes into the subject—and a very important and highly interesting one it is—of architectural Composition? In fact, the term itself is altogether ignored in dictionaries calling themselves architectural ones, although it would afford matter not merely for pages, but for entire volumes. Nevertheless, not so much as a single one has it been produced. "Effet"—which, by the by, belongs to and is included in Composition—is another term that would form an article of some length in a dictionary of the kind in question. A great number of other terms, expressive of different qualities and characters, but now rendered almost meaningless by the indiscriminate and ignorant manner in which they are applied—often at mere random—would require to be introduced, and to be most carefully analysed and explained,—explained moreover by copious instances and examples; because, without such express elucidation, criticism becomes mere muddling in the dark, whereas in architecture it cannot possibly be rendered too definite and exact. Take "Simplicity,"—ask any man supposed to be tolerably as full in architecture what he understands by it, and instead of an intelligible reply you will get a vast deal of hemming and hawing, and perhaps at last the very profound information that Simplicity is—Simplicity; and so throughout the entire list. Not least strange of all is it, that in dictionaries, glossaries, or whatever else they are styled, of the class alluded to, no notice is taken of such exceedingly obvious terms as Cinque-cente, Renaissance, Rococo, Louis Quatorze mode, or Italian style generally, with the Florentine and Venetian in particular.

What exemplary attention Nicholson bestowed on his Architectural Dictionary may be conceived from the almost incredible fact of his omitting, either alas, the term "Spire;" one which, if properly drawn up, would have brought together some account and description of all the principal structures of that class. Both "Campanile" and "Belvederes Tower" might also be made to furnish very interesting articles. There are besides a prodigious number of similar matters and terms, which, if not exactly passed over altogether, have hitherto been dismissed with exceedingly jejune notions of them. As far as it goes, Parker’s Glossary is the best work we have of the kind, is economical in form and admirable in some of its wood-cut illustrations; but it is so exclusively medieval that, it would have been better had it confined itself entirely to the architecture of that period, without pretending to embrace "Grecian, Roman, and Italian," which are treated so very beguilingly as to be made to appear comparatively quite secondary, if not actually unworthy; whereas, in a work of the kind, whatever is introduced at all, ought to obtain due and impartial attention. Had the last-mentioned styles been omitted by Parker, as not coming within his plan, there would then have been an opening for a similar illustrated "Glossary," exclusively devoted to them.

VENICE;

AND HER ARTS.

By FREDERICK LUBB.

O Italy, the fallen! once thy soul Of high Florence was full lifed, And in its lofty might could sport control, And find a place for all things beautiful. Noble and lovely in thy pride thou went, O wherefore couldst thou bear to stop so low? Better hast thou been free in thy new-born heat Than tamely crouched’neath the degrading blow! But the wise Knowledge that the great Sea’s wide plains, Is sweeping like a mighty rushing wind. Has reached its turn there, and in thy languid veins The pulse of life quickening—’twere to be kind, Call back the old high feelings to thine heart, And let it grow once more with Freedom, Truth, and Art!}

Anne A. Farnoom.

A city, like Venice, so extraordinary in its position; rising out of the sea as if by enchantment; presenting so many picturesque appearances; and unfolding in the pages of its history so much of the fairy-tale and romance, cannot but be beheld with emotions the most lively and enthusiastic. In many respects, she is not unlike what we conceive from description ancient Tyre to have been, and fully deserves the eulogy that was passed upon that celebrated capital:—"Thus art a merchant of the people for many isles .... thy borders are in the midst of the seas, thy builders have perfected thy beauty .... princes were thy merchants, and occupied in thy fairs; and chief of all spices, with all precious stones and gold and chest of rich apparel, were amongst thy merchandise .... thou wast replenished and made very glorious in the midst of the seas."* The sensations which Venice produces are the more powerfully preserved, from the fact that the spot, which has witnessed some of the most interesting events that have occurred in Europe, and which displays some of the most wonderful and curious creations of the ingenuity of man, receives a considerable degree of its splendour and attraction from the beautiful climate and glowing sun of the Adriatic, in which it was cradled. Viewed when her spires, her cupolas, and palaces are suffused with the

* Bashael, chap. 37.
It cannot be unpredictable or uninteresting to allude to some of the arts which adorn this beautiful city,—arts of which it has been miserably despoiled by wars; yet of which, sufficient remains to convince us that they were cultivated and brought by the Venetians to a very high degree of splendour. Sansovino, their historian, acquaints us, that in the most flourishing period of Venice, there was not a city in the world which possessed so many works collected from antiquity, or could boast of such large galleries of pictures, statues, basalt-relievi, bronze, engraved stones and metals, mosaics, tapestries, and all kinds of inlaid work; and that the opulent citizens and wealthy patricians, ambitious to amass everything that was a token of wealth, indication of commerce, or evidence of refinement, endeavoured to outvie each other in the number and beauty of these productions. But these were acquired, perhaps, more from foreign than from the sources of their own country: and the slightest investigation into the history of this city, and the causes of its greatness and wealth, soon lays open to us the beneficial tendency of commerce upon the arts—and through this channel, a way to their increase and prosperity. The enterprising and "devoted hands of patriots," who, driven by Atilia, set to work, like beavers, and built Venice on wooden piles in the ebbing and flowing tide, would not be wanting, nor their sons either, in their command over the riches of the East, etc., by ploughing the ocean and navigating along the ancient seats of the fine arts upon the Asiatic and Grecian coasts, the shores of the tropical peninsulas, and the islands which stud the Archipelago, for the purpose of there founding colonies and emporiums of commerce—by means of intercourse with which, their first city would grow rich, beautiful, and prosperous. And such was the case. The treasures of art and the relics of antiquity, accumulated from foreign countries, were contributed towards the adornment of churches and public edifices; were the cause of that ornamental character, yet heterogeneous mixture, which we see in many of the buildings; and many of them enriched, and still exist in, the galleries of the old palaces of the Pisani, Contarini, Cornari, Grimani, and of other ancient patriarchic families; each of which, whilst displays an example of curious and beautiful architecture in itself, contains also a museum for the study and admiration of the antique.

The influence of commerce over the fine arts of Venice was great; and although the state could not boast of much extent of territory, nor a large amount of population—yet, by extending their commercial relations with other countries, and imitating as it were the example of ancient Tyre or Carthage, their fame and their sovereignty was conspicuous, and excited the envy of many a contemporary republic. The skilled pilots who trafficked in the ports of the Levant, and brought home cunning artificers from Arabia, and Grecian artists from the Lower Empire, were the true pioneers of civilization. To the labours of these foreigners, Venice and the Venetians are greatly indebted,—not only for the Byzantine architecture of St. Mark (of which they are so justly proud), and of many other of the earlier edifices in this style, but likewise to the curious art of mosaic and various tesselated work with which it abounds. These picture-like representations, so particularly appropriate to the decorations of either Gothic or Byzantine churches, possess distinguished advantages over frescoes, in point of permanency of colour. Many very ancient specimens still remain—even such as have been exposed to the action of the open air, although their durability is seldom put to this trial; yet, in the case of fresco-paintings which have been exposed to the sirocco and the sea-breeze, the vividness of their original tints has entirely faded away,—the subject, under such influences, being sometimes scarcely discernible.

The early mosaics extant in Venice are considered by some writers as being the first essays of the art of painting in that city; but, as Lanzi remarks, in his account of the Venetian painters—"the artificers, however rude, must have been acquainted, in some degree, with the art of painting; none being enabled to work in mosaic who had not previously designed and coloured, upon pastebord or cartoon, the composition they intended to execute."

The same author mentions some mosaics of Grado, wrought in the sixth century (a century or more after the foundation of Venice, which was about A.D. 421), those of Torcello, and a few other specimens that appeared in Venice, in the islands, and in Terra Firma, produced at periods subsequent to the increase of the grandeur of the Venetian state, which attained its climax soon after the taking of Constantinople, in 1204. About the
brared pictures, sometimes issued from the Gobelin manufactury, and are exhibited to the public on the occasion of any great festival; and none so fond of doing so as the Venetians.

In Venice, and in all other states—especially in the early periods of their history and civilization—those artists and artificers were at a high premium who excelled in mosaic, in gilding, in the working of different metals, in weaving cloths and silks, in colouring glass, or in painting on walls; and these arts, valued on account of their curious and elaborate execution, which far surpassed the material, as well as for the effect which they imparted to civil and religious edifices, obtained the universal and lasting favor of all civilised and enlightened countries: the knowledge of the principles and processes employed in them spread rapidly throughout the whole of Europe; the moderns contributed to their perfection; and they were most zealously cultivated by the monks during the middle ages. The greatest artists have not disdained to make researches into these subjects, being sensible of their utility in point of decoration, and as being auxiliaries to more noble arts: Michael Angelo turned his attention in this way; and Giambulli, in his "Vite de' Monumenti," professes history of the ancient basiliicas with an enquiry, illustrated by plates, into the antiquity of mosaics, attributing their invention to the Greeks of the Lower Empire.

We have above alluded to some of the arts which originally belonged to, and were introduced into Venice from, the Asian and Arab countries, because of the oriental physiognomy which she first assumed from this connection and influence; and pursuing this track, we shall now mention the vestiges of Saracenic architecture which she presents, together with its characteristics,—before speaking of Venice after the Italian invasion of the new but beautiful art.

St. Mark's deserves our first consideration, being the most oriental of all the edifices in Venice, and the most remarkable in Christendom. Combing, as it were, the mosque or Mahomedan house of prayer with the Christian temple—loaded alike with the productions of art and the trophies of conquest—there is probably no other edifice in the world which appeals to the spectator by so many powerful associations, or is suggestive of such extraordinary reflections, as St. Mark's. It is the primary and principal temple in which the ancient art, and a portion of the modern art of the artist of Venice: let him have visited what wonders he may, its strange but beautiful façade will strike him as something that has no parallel. Although there are mingled together details the most heterogeneous and strangely sorted, still the effect of its colours and proportions enchant, as if the beautiful Byzantine and Arabic styles compensated for, and concealed the boldness of a work which was produced in contradiction to the severe rules of art. Then, singular enough, although the Venetians can boast of no hippodrome, neither indulge in horsemanship or steeple-chases, yet they can point with national pride to the four bronze stags over the central arch of the cathedral of the most beautiful of their masterpieces, the façade of St. Mark's, of oriental grandeur, though not, unfortunately, works of a first-rate character.

The exterior of St. Mark's, with its domes and minarets, its height from the ground, and its profusion of ornament, resembles a mosque of the Saracens; whilst within, it is more like a Mussulman than a Christian temple. There its narrow naves, instead of terminating in light and lofty arches, are confined and roofed-in by low, heavy vaults. Yet these vaults, covered over with gold, are supported by upwards of five hundred columns of precious marble, veined, black, and white; alabaster, bronze, serpentine, and verd-antico; and the tesselated pavement is formed of most exquisite jasper and porphyry. The arabesques, chisellings, bas-reliefs, and statuary—the works severally, of antiquity, of the Byzantine artists, and of artists of a subsequent age—here appear as if in competition of their respective merits; whilst those portions of the walls and the vaultings which do not glitter with burnished gold or precious stones, contain the mosaics (already mentioned) of two separate epochs—those attributable to the Greeks, and those produced by the Italians.

With all that has been said is praise of St. Mark's, much has been said in abundance of the materials which Cairo could produce, was quite a religious affair, and was got up entirely regardless of expense. This ceremony is described by bishop Pococke in his "Travels in the East."

Tapestries were and are at this day the great ornament of churches in Italy and all Roman catholic countries, the finest being copies of celec

* "Lectures on Sculpture."  
† Of the capacity of mosaic to produce all the tones and gradations of light and shade equally with the brush, we have convincing proofs in the copy of Raphael's "Transfiguration," in St. Peter's, Rome; which is a close resemblance of, and assimilation in effect to, the original
interest or concern; rejects them, perhaps, with indifference and contempt; pronounces them as useless or absurd; or, at least, does not receive them as fit and welcome objects for its study and contemplation. Even the educated eye and cultivated taste of the real connoisseur before St. Mark's, may fail to see and discern its beauties, and may err in the judgment and opinion be forms of it, by a mind unfavourably disposed towards it; inseparable, from its condition, of becoming the recipient of, or yielding assent to, its peculiar merits; and alike incapacitated to understand and enjoy them. Instead of testing a work and the qualities associated with it by the particular frame and constellation of our own minds, and some standard of our own therein set up, it is essential in all criticism of fine art, to feel as the author or artist felt, to know with what ideas and intention he was animated and possessed, and to judge according to the circumstances of the age in which it emanated,—if we would preserve partiality and avoid misinterpretation. Hence, Schlegel says: "No man has so deeply penetrated into the innermost spirit of Greek art as Winckelmann; he transformed himself completely into an ancient, and seemingly lived in his own country, unmoved by his spirit and influences."

Admitting all the faults of St. Mark's; admitting that semi-barbaric character impressed upon it by the extravagant use of costly materials,—we must, at the same time, confess that to our eyes this very wildness and unrefinement caused much of the pleasing emotion we experienced. We thought that its architectural forms and ornaments (faulcy as they are often considered to be by many Europeans) were extremely effective; and, although the boldest that the hand of man ever ventured to employ, that they were as appropriate and significant to the intentions and purposes of St. Mark's as could possibly be conceived. Long familiarity with its peculiarities only deepened this conviction. Long familiarity did not make it look ordinary or tame. But long, frequent, and intense contemplation only developed its beauties, and manifested its deep symbolic significance. It is difficult, if not impossible, to do anything like justice to St. Mark's with the pen; nor is it intended to offer a complete description,—pictures and engravings alone convey an adequate representation of its splendour: to these we refer the reader, and we think that he will therein see a corroborative of our remarks,—namely, that its architecture is admirable keeping with the buildings which surround it; and that its effect, in its place and in relation to its scenery, is everything that could be desired, and the principal ornament and attraction of the great square in which it is erected.

(To be continued.)

* Lectures on Dramatic Art and Literature.

MUNICH IN 1847.

Somewhat extraordinary it undeniably is that no English artist or publisher should have thought it worth while to give us any illustrations of the capital of Bavaria, for besides that no engravings of the kind—that is, views of the modern, especially the recent structures at Munich, have been brought out in Germany, they would have a chance of being very much better executed here, there being in Germany itself no medium, apparently, between very expensive and large-sized works—consequently the very reverse of popular in price or shape, and the most paltry productions conceivable—the very doggrel of the penny. Munich, as it now presents itself, has been dressed in Stradun and Arco of Andorra,—perhaps somewhat incorrectly, at least as far as English architects are concerned, since it must exist in them surely very unpalatable comparisons with not buildings alone, but the general system of architectural management here at home—that is, if what seems to be conducted upon no systematic scheme of management at all, can so be termed. What has been achieved of late years at Munich with comparatively limited means is almost incomprehensible to Englishmen; but the great secret is, that if the means have been limited, the intelligence and the will that directed them have been great and energetic. We, on the contrary—but comparisons are odorous, as Mrs. Malaprop says, therefore, perhaps, we had better drop them altogether, and forgo any allusions to royal taste, royal sympathy with Art, here at home.

Among the more recent and as yet ungeneral in whom, of course, Munich is the "Wittelsbacher Palast," is a style partaking of our own later mediæval architecture. The edifice is described as a quadrangular pile with four octagonal towers rising at its corners, and with a projecting pavilion in the centre of the principal facade. The whole is partly of a warm red and partly of a decidedly yellow tint, wherefore the building shows very forcibly against a clear blue sky. Another building designed by the same architect (the late Professor Gärtner) is the Neue Friedhof or Cemetery, forming a quadrangular enclosure of about sixty acres, with a central column of 400 feet in height, at the top of which is a large obelisk, and on the other sides, each of which is 240 feet in height, and are covered by a series of domes, on each of which is a smaller obelisk, giving a very magnificent appearance. The entrance to the cemetery is an elaborate structure, with a large obelisk, and on each side of it are large obelisks, giving a very magnificent effect. The cemetery is divided into several sections, each with its own entrance and gates, and is surrounded by a wall 10 feet high, with a small gate at each corner, and a large gate at the main entrance. The cemetery is very neatly kept, and the rows of tombs are very neatly arranged. The whole is a very beautiful and impressive sight, and is sure to be a great attraction to tourists. It is a fine specimen of the work of the late Professor Gärtner, and is a credit to Munich. The cemetery is very neatly kept, and the rows of tombs are very neatly arranged. The whole is a very beautiful and impressive sight, and is sure to be a great attraction to tourists. It is a fine specimen of the work of the late Professor Gärtner, and is a credit to Munich.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

Nov.

Would that we could look to Sir Edward Lytton Bulwer and some of the other English visitors who are now there, for their bringing home with them a little of the cordial love of architecture which there prevails.

THE BRITISH MUSEUM.

No. IV.

The collection of Greek and Roman domestic antiquities in what is called the Bronze Room, is at present in confusion and unbalanced, so that the examination is not very easy.

Such a collection is particularly useful to the student, as it enables him to get better ideas of the domestic life of the Greeks and Romans than he can from books and artistic works, and to correct his ideas as to their state of social advancement. The progress of the fine arts and of the mechanical arts is not necessarily correspondent; and we may find a people producing the most beautiful sculpture and painting who want common comforts, or another whose painting is barbarous, but whose domestic arts are well cultivated, as for instance in the case of the Chinese. While the Athenians made a great stride in sculpture between the time of the Eginian marbles and of Phidias, it may be taken for granted that the progress of the useful arts was not so great. The invention of a new machine would have been needful to effect any great change. While we look to the cultivation of the fine arts, as having an equivalent effect on the manners of the people and in the advancement of artistic manufactures, it is evidently unequal to the production of mechanic skill; and we must be careful not to rely too much upon artistic instruction, nor to push it too far. The existence in a country of a general and refined taste is not inconsistent with the promotion of mechanical pursuits, and is favourable to them, but we must not try to give an artistic bias in education. At present our people get a good mechanical training, which makes them the best workmen in the world, and in trying to do more we must not lose this.

One reason why the flourishing state of the fine arts is no index of the state of the mechanical arts is, that the former are chiefly handmaidens to wealth, and are employed either by a rich state, or by a few rich men, and are little enjoyed by the people individually. While the Athenians were raising the Parthenon and pouring out upon it all the riches of art, they themselves were living in wretched huts, which had no shade in the largeness.

While the head men of Rome were filling their palaces with the greatest works of old and new art, the people were as ill-lodged as when Romulus and Remus began the town. The mechanical arts cannot, however, be pursued without all getting a share in their works. Sawed timber and wrought iron were luxuries among the ancients; when towns were taken by the Greeks, the planks and beams, the hinges and the nails, were carried off as the worthiest part of the plunder, but as the stock got bigger all classes were able to get a share. The husbandman willingly gave food for a plough, an axe, a bolt, a kettle, or a pan; but he would unwillingly have given food for a carving or a painting, from which he could have got nothing back. The fine arts became the servants of the rich, the mechanical arts the servants of the poor.

The fine arts are but one page in the history of civilization; the Egyptians could raise pyramids, the Russians have built a city of palaces, and have filled them with the choicest works of the west; but as in the former the people were wretched serfs, so they are in the latter. The state of the mechanical arts and their employment by all classes is a far better index of the condition of the people. Where the mechanical arts are degraded, as among the Romans, a slave-class must exist, and the free-class must be paupers, for idleness will do its work on all. In Ireland, if we have not slavery in the name of the law, yet slavery and pauperism are the lot of the people, and neglect of the mechanical arts may be reckoned among the concerning causes. Where so many hundreds of thousands of beggars are led by the pauper-people, carpenters, smiths, quarrymen, masons, brick-makers, potters, bricklayers, and weavers might be as well fed. The English beggar-class are the handloom weavers, the lace makers, and straw plaiters, who live in hovels at the common charge of broken stones, grained bones, pick oaksam, make and mend the roads. In Ireland the beggar-class do nothing to keep up the common stock.

So far as words go, freedom and the fine arts may be spoken of in wider terms at Athens or at Corinth, than in London or in New York; but to judge we want something better than words. When we look at the handiwork of the Egyptians, Greeks, or Romans, although we may acknowledge in some things very fair workmanship, yet on the whole we cannot feel that the people could not have had the same comfort, and therefore not the same health and length of life as ourselves. The bearing upon the man is the measure of civilization, words do not give it. There is the same air, the same soil, and the same law in Ireland, as in England; and yet the former is as well known for its beggary, as the latter for its wealth.

The reader of Thucydides, of Livy, and of Tacitus, may find in a bioge or a staple, a great commentary on the text of his author. He may see how painfully and how clumsily the commonest hardwares was wrought, and he may learn with what toil, with what time, and with what cost an army or a fleet was fitted up, and how great was the wrench when it was lost. It was shameful to lose a shield, because it took more to buy a shield than a man; the warrior who lost his armour, lost, like a knight of the middle ages, what it would take many rich fields to buy again. A part of such spoil was hallowed in the temples, an offering as rich as gold and silver. With us gold and brass are not treated for, together for they are as the top and the bottom wide apart; with Homer, gold, bronze, silver and tin rank as costly metals, for the workmanship of all being alike, the disproportion of the price of the material was less. To burn the town was to ruin the commonwealth which held it, for the mason's and carpenter's tools were costly, the work was slow, and an unsheltered people could not raise another town. Hence we find towns, once powerful and thickly populated, which never rose from the wreck which had been made of them; and others were only able to do so because the walls were readily patched up, or because the foe had gone away by sea. It is for such reason that we have Cyclopean cities left to us as relics, which had been ruined in remote ages.

The best beginning for a sound knowledge of history and the progress of civilization is to be laid down by carefully reading the works of Homer and Herodotus; not the smoothed down Louis Quatorze Iliad of Pope, but the rough and rugged originals. From their works we get a knowledge of a people, afterwards highly polished, who being as wild robbers were then going through the first steps towards civilization. Not merely are the manners drawn, but the houses, the fields, the tools. We see the king, the warrior, the priest, the soothsayer, the husbandman, the brass-smith, the potter, the housewife, the Phoenician trader, and the sea-rover; but we see moreover the rough tillage of the field, the early seeds of art, the beginning of wealth. We have a lively painting of the dawn of civilization, such as Cook saw it in Tahiti or Hawaii. In the British Museum we have the tools of the Maori and the paper-clot of the Tahitian; but we have likewise such weapons and such ornaments as the Phoenician merchant sold to the Homerics-Greeks. Those who well study the Iliad, acknowledge a truthfulness in its drawings, which is the best seal of its antiquity, an antiquity not forged by Palaistrous, or in any later times. Those who may like believe there never was a Homer, or that there were many, but that the Iliad is a work of the time it holds forth to be, so well-thinking man will deny. To be able to feel this it is not enough to read the text—it is useless to read the Byzantine commentators or the scholastic commentators of these later times: what we have to study is the remains of ancient art and the relics of modern discovery, and not less those written records we have of those who, in our own day, have been eye-witnesses of all the phases of civilization.

The lump of iron which Achilles gave as a prize in the death-games of his friend, would be of little worth now, though the giver boasted of it as enough to find all the iron a husbandman might want in a long life. In the Museum we have spike nails, so highly thought of, that they are stamped by the maker; some with writing at a great length. A bronze tripod, a ear or brass kettle given by the same hero, raised the mirth of Voltaire. Such vessels in the Museum show that with the rough tools of the workmen they must have been made with great labour. We must not look through the spectacles of a Voltaire, neither is there any reason why we should read with less interest what Homer has sung of king Agamemnon or Achilles, than what Cook has written of king Tarerebooo or of Omai. In the latter case we have the record not a century old, in the former a quarter of a hundred centuries old; yet both are equally fresh, truthful, and pleasing to a healthy mind.

To understand the whole of the handicrafts among the Greeks and Romans, it is necessary to understand the political and social condition of the middle ages, and of those nations which in the present day are most behindhand. In the overflowing of our material wealth we are not ready to conceive how much
the commonest institutions among ourselves are hindered in their progress among people less favoured. The wisdom of those missionaries who teach their people the arts of life first, and religion afterwards, is approved by the evidence of experience. When a great change has been made in the social condition, habits and thoughts of a people by material improvements, they are prepared to receive a great religious change. The old French lady who saw a balloon rise in the air for the first time, sorrowed that she should die before the art of living for ever would be found out. It is the nature of the human mind when struck by one wonder, to look out for others, and to give trust to the powers of him who has created the wonder. It has, however, been well observed that the Christian missionary in the Pacific, beginning in the wrong way, awakens the faith of the islanders in their old worship, without giving them faith in a new worship. A Dedalus, a Cecrops, or a Cadmus, who taught the Greeks a new art, might give them a new belief, or even teach them to worship himself. Among a rough people, little better than wild men in a wildness, the clever workman became a lawgiver and a god; the use of a saw, the forging of a breast-plate, the weaving of a sail, were means of wealth and power where all others were without skill.

When robbers overran the land and sea, a well-hammered helmet, breast-plate, and spear, were among the best goods of every man; the king and the warrior were stronger in their garments than their courage; they trusted more to the dread they raised in their ill-armed foe, more to the hope of power than the thrill of the sword. When one of Homer's kings fights among the crowd he slays his many, but when King Meleager meets the king of war becomes a war of words; Hector and Achilles strive which can outshout and frighten the other, and they only meet hand to hand when they cannot help it. The deeds in the Iliad do not come up to the words, and fall far short of our measure of heroism, but they are quite in keeping, and Homer is none the less a true painter of men and manners.

In Case 45 are several helmets, some of which are Greek, made to cover the face, with a nose-piece and slit for the eyes. These are made in one piece without joint, and some of them seem to be cast. The metal is bronze, and the workmanship is good. A phalanx so well armed and thoroughly trained must have formed a powerful force, well able to achieve the battles of Alexander. The work is among the best there is, and it hardly seems as if the light bronze swords could break through the thickness. This gives a reason why the soldier trusted to the heavy spear and javelin. One of the helmets has a sheath to hold a nodding crest, and others are slightly ornamented. When polished these helmets must have shone brightly in the battle-field, as the poet tells us. There would be no harm in polishing one to show the effect.

In No. 46 are two helmets and a shield, very richly embossed. They might stand in the Tower Museum without being outdone by the finest Milanese workmanship.

In Nos. 42 and 43 are spear-heads, maces, swords, daggers, knives, and arrow-heads. From the confusion, it is impossible to separate Greek work from Roman,—though this is not of so much moment, as whatever the Greeks could do the Romans had the advantage of. Rome had all the resources of Egyptian and Greek skill; yet how far was it behind the Rome of these days.

In No. 48 are Roman weights, mostly a solid bell-shape, with a ring or handle at the top. Some of them are large. There is nothing noticeable in them. There are likewise scales of two kinds, the scalebeam and the pair of scales. The workmanship is good. The remains of Pompeii show that the Roman traders were as well supplied with scales and weights as ours. The Roman weights have enabled antiquaries to ascertain the Roman pound, which is the original of the modern system of weights. Here are some large edze-heads of fair work.

A tripod stand of bronze, in No. 49, is a large and good piece of brass work. It is 2 feet high. Another is about 2 feet high, and of smaller proportions.

The high tripod stand in No. 50, is a light and pretty design. A frame rests on three sphynxes, each upheld by a caryatid, ending in the curved leg.

The chandelier in No. 51, is a large piece of work. It is for twelve lights, made to hang up in a ball or large room. The trimming of such lights must have been very troublesome. A hook, jointed on to a staple made to fix in a wall, is a good piece of smith's work. The joint is well made. Lamps were hung up against walls by such hooks.

In Nos. 52 and 53 are candelabra and stands. Some of these stands end in hooks, and are made to hold lamps, sconce ladies, &c. They may be called Roman lamps.

In Nos. 54 and 55 are candelabra with flat tops, some 4 or 5 feet high, made to stand on the ground; and others a foot or so, to stand on the table. The small earthenware and bronze lamps were put on the top of these candelabra. The lamp of the well-known shape, turned in our potteries into a milk jug, could be carried about in the hand, or be used on a candelabrum upon a table, for reading. For carrying about, they are much more convenient than our candlesticks or oil-lamps, which are cumbersome. Unless, however, there were some catch on the top of the candelabrum, to hold the lamp, there must have been fear of its being upset. The short candelabrum and lamp are elegant, and might be imitated.

The bronze lamps are in Nos. 56 and 57, the earthenware lamps in the middle of the room. The bronze lamps are many of them well finished. Some of them have lamps by which they can be hung up, either in the middle of a room or on a hook against a wall. The latter seems to have been preferred, as Roman walls were better than roofs. Many of the lamps are table lamps, made to stand flat or on a candelabrum. In these cases are two chandeliers or lamps with eight lights, and one with seven lights. With these chandeliers of seven, eight, and twelve lights, the Romans had full means of lighting large rooms.

The most noticeable article in No. 58 is a bronze cullender or strainer, of seven inches diameter, very well finished, and with the holes cleanly drilled.

No. 59 contains some large copper kettles and basins, some of which are two feet across. Here are many bronze handles, some of handsome design: two of them have a man's head and a woman's head, beautifully chased. A swinging handle is cleverly wrought. There are some small tripod stands, well finished.

In No. 60 are several saucepans of a modern shape, some finished by turning, and some by the hammer. The smith's work is generally not well finished unless turned. This seems to be for want of good files. Where the surface is ornamental the fault is not seen; but a plain surface commonly looks clumsy, like Chinese work.

There are likewise bronze stewpans and fryingpans with handles in No. 61; also pots.

In Nos. 62, 63, and 64, are bronze jars of various sizes; some of these are engraved, and some ornamented in relief. There are many 18 inches high; some neatly finished, but mostly rough. They are not equal to the pottery. Although the saucepans in No. 60 are finished inside by turning, the latch does not seem to have been used to the outsides of the jugs; yet it seems quite as easy to make a match for one as the other, and the Roman latches could take a large and heavy article.

There is some ornamental chainwork in No. 66, much of which is elaborate, but seldom well finished. A large piece of double-linked cable chain, of a watchguard size, is the best. There is likewise a square chain, seemingly plated with wire. Some of the lamp chain, in Nos. 66 and 67, is also very good. There is not much fancy in the patterns of chainwork. A favourite pattern is a piece laid scaly, with a round coil at each end, the spheres being linked to the corresponding parts of other pieces. This makes a flat chain, used for belts and other purposes. In this case the ravel of a spur, rather large, but a very good piece of workmanship.

The case No. 68 contains mixed Greek and Roman articles: some of the former from the tomb of a warrior at Athens. There are knobknees or astragals of various sizes, in glass, metal, and iron, for playing the favourite game of the ancients. There are counters and medals of ivory and bone, but the engraving and finish are not good, except in some of the plain turned ones. The assortment of dice is numerous; they are of glass, metal, wood, and stone; a variety with the corners cut off, and one set with pentagonal faces. Some of these are very large. In this case are likewise counters and ornaments of cut glass. The glass is clear, well and sharply cut.

Nos. 98 and 100, the articles are likewise Greek and Roman mixed. Here are bone spoons, like common salt-spoons. Rodkins, needles, pins, and hair-pins of ivory and bone, and likewise of metal, are numerous. The eyes of the bodkins and needles are long and well cut, but otherwise they are not neatly finished. The smallest needle is two inches long, and thicker than a darning needle. In metal needles, the eye seems to be made by splitting the head and then welding the ends together, so as to leave a slit for the eye. It seems likely that finer needles were made, but
they must have been very dear. They were perhaps made in a soft state. In this case are small jugs, phials, and vases of coloured glass, made for toilet use. Likewise earthenware imitations, painted or enamelled. The pattern is chiefly a wavy line, each line of a different colour. One phial is to be noticed an inch long, but thick, and of a brown colour with white streaks. It is a very pretty toy. The glass blowing and cutting are good, but do not seem to have been carried out on such a large scale as among the moderns. The specimens in Case 10, found in England, are very good.

The case No. 93, gives some very interesting specimens of Greek wood work, a lyre and two flutes from a tomb at Athens. Each flute has a mouth hole and four finger holes. One flute is of a single piece, about a foot long, and the thickness of a piccolo flute; the other is rather longer. The outside is smoothly turned, and the holes are cleanly bored, seemingly with an auger of the same size. The lyre is much broken.

The contents of Case 86 are mostly Greek. They are small bells or balls of glass and stone, chiefly blue. There are some bone hockkins, large but well finished.

In No. 104 are small metal ladles, scoops, spoons, and spatulas. Here are also a small pair of pincers or tweezers, jointed like scissors, and a fissh-hook.

In No. 105 are several pairs of compasses; among them a small pair of carpenter’s compasses, four inches long; a pair eight inches long, with jointed legs; and a pair of double compasses. These instruments are not so well finished as in these days, but the joints and workmanship are good. A large assortment of Roman stamps and brands is of various goodness; some very neatly cut. Here are some spike nails, well forged. The staples are good. The hinges are among the most interesting specimens of Roman smith’s work. Some are as well finished as can be desired, particularly a large and heavy pair made with a double joint. There are some strong door sockets.

In No. 106 are locks and keys. The keys are very clumsy.

No. 112 contains a variety of signet rings, some with stones set. These are mostly common things, not equal to the jewellery of gold and silver in other cases. A chain or necklace, enamelled gold and blue, is one of the nearest pieces of work in the whole collection. Every piece is of the same pattern, and well linked together.

The assortment of buckles is large. They all of shapes and sizes—square, oblong, round, oval, and horse-shoe among others; some few ornamented, one with two rams’ heads. Many are embossed, but badly. A ring buckle, of the size of a shilling, is neatly wrought. The tongue of the buckle is often made of a bit of wire, with the head twisted round. The rivetting is often clumsy. There are buckles made to sew on; one like a good stock buckle. There are many brooches with a spring catch; some very large and clumsy, as if made by common smiths.

The collection of metallic mirrors and mirror-cases fills several cases. The mirrors are from three to eight inches diameter, and cleanly turned. It is a pity that some of them are not polished, to show the use of them, for most of them are dull and rusty enough now. All the mirrors are made with a handle to hold by, so that some look like fryingpans. Some have their faces and cases engraved, sometimes done in the lathe and sometimes with the graver. The cases are often beautifully embossed or engraved, though some are very common. In No. 74 is a mirror-case of bronze, found at Toscannia. It is nine inches across, and delicately chased in very high relief. Two women are sitting opposite to each other. They are dressed like Pallas Athene, with a Medusa’s head and snakes on the breastplate, and a snake on the shield. This case is much damaged. Another case, also found at Toscannia, is five inches across. The subject is Bacchus and Ariadne. Both are naked, Ariadne with her back turned clasping Bacchus round the neck. He holds in his left hand a large wine jar. A panther is behind him. There are several cases engraved in the style of the vases, some with Etruscan countenances. The engraving is mostly a bad attempt at anatomical drawing. In No. 75 all the engraved cases show bad drawing. Here is one mirror-case seemingly cast, which is a piece of beautiful workmanship. It represents Hercules and Omphale, in the early Greek style. The drapery and details are highly finished.

In No. 90 are mirrors from Athens and Ithaca, all of them small.

The above remarks, though they embrace only an imperfect view of the collections in the Museum, may still give some idea of ancient workmanship. It will be seen that they were acquainted with hammering, forging, turning, filing, casting, boring, drilling, rivetting, polishing, tempering, die-sinking, glass blowing and cutting, and enamelling. In many of these they had made much progress. It is impossible to avoid reflecting how much the work of the ancients was limited by their want of power. The difference is great between the mechanical resources of the Romans and what the steam-engine has done for us in the forge-hammer, the saw, the boring, the planing, and the rivetting machines. We cannot, however, help admiring how much they did with small means.

(To be continued.)

STONE BRIDGE OVER THE RIVER MEUSE FOR THE NAMUR AND LIEGE RAILWAY.

The above engraving is the centre arch of a handsome stone bridge now in course of being constructed on the Namur and Liege Railway, over the River Meuse, in France, from the designs of George Rennie, Esq. The bridge consists of five arches, 82 feet span, with a rise of 10 feet; the piers are 8 feet thick at top and 11 feet at bottom, and 24 feet high from the top of the footings to the springing of the arch. The roadway is 26 feet wide to the outside of parapets, and will carry two pairs of rails.
THE GOVERNMENT AND THE RAILWAYS.

Not a month passes but we are urged to take notice of the unfair way in which civil engineers are treated by the government, in the preference given to military engineers in civil employments. We have professed often enough our esteem and regard for our military brethren in their military capacity; but we cannot withhold our belief that they are not the best fitted for civil office. Whether we go by theory or whether by facts, we come to the same end,—that as civil engineers the military have not shoes, neither are they likely to do so.

We may be told that the Royal Engineers have the guarantee of a good collegiate education,—no, further, that they are the best educated men of a body of students, of whom the least endowed are left for the Royal Artillery. This may seem a guarantee of qualifications, as against a profession, that of the civil engineer, which is an open one and subject to no examination. It is tolerably certain that there are very many civil engineers far below members of the Royal Engineers in knowledge;—but here we come to a stop, because we do not get the converse of this proposition. We have no hesitation in saying,—in laying down a challenge, that the body of civil engineers has exhibited a much greater degree of knowledge and of talent than that of the Royal Engineers. A preliminary examination might keep out many men of inferior attainments; but consider the civil engineers it would have this disadvantage, that it would keep out many men of superior attainment. Being an open profession, civil engineering is always receiving the accession of large numbers of men, whose general proficiency and abilities make them valuable associates; but who might be either unable or unwilling to pass a schoolboy examination. These recruits include many men of middle age, or of mature age, who have already gained reputation in their previous career, and who bring it for the enhancement of their new profession. If others, either from sheer impudence or from an over-estimate of their own qualifications, likewise dub themselves civil engineers, it does not matter; for neither will professional men give them countenance, nor the public give them employment. This is the real censorship of the engineering profession, and it is one much better than a scholastic examination, which at the best can be got through by a short grinding, and the matter of which is, in all likelihood, forgotten everafter.

Subject civil engineers to a preliminary examination, as many in their real have proposed, and what must be the consequence? We should lose all those men who are most valuable, and on whom we most pride ourselves. We shall first exclude those most practical men, who begin their career as mechanics, and who so often rise to the highest distinction. The workshop will at once be closed as a nursery for engineering. We shall likewise lose those who were engaged in mining, in draining, in ship-building, and in factories, have enlarged their sphere of operations by enlarging their experience. We should lose all those men of active mind, whose inventive genius is our greatest glory. We might, perhaps, keep those who have neither degree nor qualification; but, in keeping one branch of science, we should lose all others. We need not begin a list of those whom, if a system of examination had been adopted, would now be lost to the profession: the acquaintance of every one will furnish him with a long list, and there would be more difficulty in deciding who would remain, than in deciding who would be struck out. What the engineering profession would be under such circumstances we leave the public to imagine; but we believe it would be filtered of its knowledge, its talent, and its reputation. All this would be done needlessly, because the exclusion of those who cannot or will not pass an examination is, to this,—it excludes persons not incompetent for the exercise of their profession and who in the pursuit of it acquire, if they have not already done so, all such scholastic knowledge as is necessary for them, in the same way that they acquire so much other knowledge, which can never be made the subject of scholastic education or examination.

On whatever point, except that of military engineering, on which the Royal Engineers can challenge their brethren the civilians, the latter can outmatch them. The mathematical sieve through which the Royal Engineers have passed has not been as successful in sorting great mathematicians or philosophers; and if it came to a contest over the supplies of the military with plenty of champions well able to contend with them. Messrs. George Rennie, Euston Hodgkinson, John Scott Russell, Robert Stephenson, Isambard Brunel, George Parker Bidder, Wyndham Harding, and Joseph Samuda, are well able to compete as philosophers or mathematicians; and here we have only put down such names as most readily occurred to us, without taking the trouble to choose the most professed, or even to put down all those who are well deserving of being named in such an enumeration.

If attainments are to be known and shown by their exercise, an advocate for the Royal Engineers would have little to show for them. The civil engineers have been greater contributors to the cause of science, as much as they have been greater contributors to professional literature. The works on professional subjects by officers of the Royal Engineers, who have the best means, are few; and even the volume of "Transactions of the Corps of Royal Engineers" is edged out by civil contributions.

The examination is no guarantee of the superiority of the Royal Engineers, for it is no guarantee against mediocrity in that body. If the proceeding of the Royal Engineers as against civil engineers, we ask what are their works? We know what civil engineers have done; but neither the public nor ourselves know what the Royal Engineers have done, unless it be the Rideau Canal, which cannot be considered as the most flattering testimonial of success. We can show too that their recent career in connexion with the Board of Trade has not been such as to raise them in the eyes of the public.

Before saying more on this latter point, we are tempted to enquire on what grounds military engineers should be at all employed in a civil capacity. We know of no reason why civil engineers should not be so used as are other officers. If the superintendence of their various works is considered as a claim of the Royal Engineers as against civil engineers, we ask what are their works? We know what civil engineers have done; but neither the public nor ourselves know what the Royal Engineers have done, unless it be the Rideau Canal, which cannot be considered as the most flattering testimonial of success. We can show too that their recent career in connexion with the Board of Trade has not been such as to raise them in the eyes of the public.

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civil engineers—no one class claimed by military engineers, and no one great work which bears their name. Assuredly, therefore, the standard of qualification belonging to the Royal Engineers cannot be a material one; we have shown that it cannot be on their scientific or literary attainments; and we do not know, in fact, upon what it rests.

The employment of military men in civil affairs is usually held to be ill-advised, because from their training they are not suited for such pursuits. From the peculiar nature of their employment and associations, they do not acquire business habits or ideas, and we have always esteemed it unfortunate when they were placed in civil positions, because they have been utterly unable to respond to the call made upon them. The removal of Major-General Pasley from the office of Inspector-General of Railways, is one objected to by himself, and on which he has pursued the extraordinary course of appealing to the public. It shows that there is no sympathy between him and the government. The employment of military engineers brings them in comparison with their civil brethren, who are particularly well trained in matters of business, and who hold their ground among the acutest men of business in the country. The most important and complicated affairs are left to the negotiation or arbitration of Mr. Robert Stephenson, M.P., Mr. Brunel, or Mr. Locke, M.P., by capitalists fully capable of appreciating their practical abilities. It will be found that the engineers have taken as great a part as any class in the organization and development of the railway system and its administration.

So far from exhibiting any such public proof of their capacity, military men are well known to be unfitted for the understanding of business matters. A lad is taken from school, sent to Woolwich, gets a commission, is employed at home in the colonies, and at length is made a railway inspector, without knowing as much of mechanics as any young man in the city of London. He can give orders to serjeants and corporals, build barracks in places where he has all his own way; but as to any useful intercourse with society, it is perfectly out of the question. He has not, in most cases, that association with professional and practical men, which might put him in the way of acquiring a proper degree of professional experience. A pupil in Mr. Stephenson's office knows very much more.

It would be very hard for the Board of Trade to furnish the public with any sufficient justification for appointing aged or middle-aged gentlemen, tricked out in blue, gold, and scarlet, as Inspectors of railways, of which the inspectors know nothing. It may very well happen that an officer, who has spent his time in New Zealand, or the Isle of Ascension, or in the backwoods of Canada, building barracks and convict jails, may be perfectly guiltless of knowing what a railway is; and it is no reflection upon the unfortunate individual who is made a railway inspector, that he should know nothing about them. Major-General Pasley has the rare merit among military engineers of having written on several professional subjects; but no one ever thought of his knowing anything of railways, much less forward to be the arbiter between Stephenson, Brunel, Locke, and Cubitt, as Inspector-General of Railways. General Pasley could scarcely refuse accepting the appointment, though it put him in the very painful position of interfering with the master-minds of the world in matters of which he knew nothing at all. This position must have been one very painful to Sir Charles Pasley's feelings, and every one will sympathize with him, for his own merits and his gentlemanly conduct have secured for him much good will. The government cannot, however, be pardoned for putting him in a false position. The same is said to be the case of the other gentlemen, who were similarly ill-used.

The appointment of raw soldiers to inspect railways made engineers and directors familiar with their ignorance and incompetency. As they did not understand anything about railways, they had to be taught. Some of them were conscious of their ignorance, very willing to learn, and taking much trouble to learn; others, in the supercilious arrogance and self-confident engendered in the atmosphere of a barracks-room, have rendered themselves ridiculous by the exhibition of their ignorance on points of which they supposed themselves well informed. How many of our readers have been witnesses of their follies, and have laughed at the presumptuous incapacity of men unacquainted with them, by engineers, to judge of or explain to them, even as engine-drivers can be brought to hold a favourable opinion of men, of whose occupations he is well aware. The visit of a government inspector is a joke, which nothing but the prudence or good sense of the railway authorities prevents from being made sensible in a manner very undignified. The public, too, and the public press want faith in government inspectors, and the Times and Pencil, the two magnates of the press, have held them up to well-deserved ridicule.

The officers of the Royal Engineers, and other parties employed by government for railway purposes, use the employment for their own convenience; and if they happen to learn anything, turn their knowledge to account by going into the service of the railway companies. So long as they are worth nothing, the government is at the cost of keeping them, and has to pay for their blundering out of the public purse, and to encounter the ridicule of their incompetency; but when the officers are worth anything, they sell their knowledge in the best market.

Anything so unsatisfactory as the position of the railway officers of the Board of Trade, and their relations with railway companies, can scarcely be imagined. Some needy son of a patronage, who has scrambled through his examination at Woolwich, and who is always more of a dandy than a gentleman, and more of a schoolboy than an engineer, gets into the railway department. He is dependent upon the chairmen, secretaries, superintendents, and engineers not to expose his ignorance, and to give him the information he wants. He gets very sociable in his intercourse, and very familiar—for many of his associates are much better gentlemen than himself; and no one is ready to give way to assumptions of barrack superiority. On being brought in contact with the world, free from the hallucinations of mess pomp and self-esteem, he finds out his own true position, apart from his butterfly livery, that he is a nobody, and rather a poor one. He wants the means to keep up his own dandyism and his wife's millinery, and he wants places for his sons and portions for his daughters. The ambition to live a useful life comes upon him, and he cannot resist the temptation of asking for the first railway appointment which comes in his way.

Some very honourable men may do their best to withstand corrupt action; but at any rate, a government officer is placed in a false position, and is not satisfied with his employers. Some, it may be, give way to positive corruption—say, suggest and carry it out; and at any rate, those who do not give way lie open to the imputation of it. The events of 1845, and the parliamentary discussions on the conduct of the Board of Trade, will occur to every reader, and the result of them cannot by any means be considered as satisfactory.

For a public officer to be suspected is always bad, because when honest it trammels his own mode of action, and the jealous public will never be satisfied of the independence of the officer, when they know how readily he may turn his trust to his own private purposes. The communication of valuable information may so easily be made a matter of profitable barter and speculation, that the public can never be satisfied it is not done, and unfortunately before now circumstances strongly corroborative of suspicions have occurred. The public have every regard for the honourable character of military men; but it does not extinguish the character of one profession, or of one body of gentlemen, as higher than another; and at any rate it does not judge very favourably of human nature when exposed to temptation.

The Board of Trade officer, when once determined to place himself out, has the means of preparing the way by rendering such services to his future employer as will be considered the price of his employment. How easy it is for one so determined to make such arrangements for the favoured line, and to make such reports upon it, as may be very valuable to the company, and in the end very valuable to himself, but which cannot in any way be held as the best means of forwarding the public interests. This is certainly a possibility—say more, it has a probability, and there are those who believe that it really has occurred, while there is no guarantee that it may not occur over and over again.

The temptation to companies of using parties connected with the Board of Trade is very strong, as they not only get an immediate service done, but they also have the means of communication whenever they may want it.

Often as the Board of Trade have been subjected to public censure, we are not aware of any defence which has been made for them—we might say of any defence which can be made. The railway department is utterly useless for the purposes intended; its inspection is a Joke, which is now so well known, that it ceases to tranquilize the public mind; and it is only operative for mischief. The department is an incubus on the railway interests, which, by useless and unnecessary expenses, tends to justify its continuance, and which is well calculated to bring a ministry into jeopardy. In the first session of a parliament in which a railway interest will be combated, Mr. Strutt is pledged to bring forward a bill, which has been denounced as an aggression on a vast amount of private property; and this railway directors have determined to resist to the utmost. With the number of new and hostile members in the house, the defeat of Mr. Strutt by the railway interest, assisted by the opponents of the ministry, is one among the disasters of the next year which appears most likely to be accomplished.
and which will greatly aggravate the difficulties with which the administration of Lord John Russell is already threatened. A blow once given, we hope the railway interest will not rest till they have swept away every vestige of interference.

**TEMPERATURE OF STEAM.**

Sir,—The following empirical formula for determining the temperature of steam is new, accurate, and may be interesting to some of your readers.

If \( n \) = the number of atmospheres, then

\[
212 + \frac{\Phi}{10} + \frac{\Phi}{n} + \frac{\Phi}{\sqrt{n}} = \text{the temperature in degrees of Fahrenheit.}
\]

Thus, for 4 atmospheres,

\[
\begin{align*}
2 &= 212^\circ + \frac{\Phi}{10} = 248 \\
3 &= 212^\circ + \frac{\Phi}{10} + \frac{\Phi}{\sqrt{3}} = 272 \quad \text{or} \quad 248 + \frac{\Phi}{\sqrt{3}} \\
4 &= 212^\circ + \frac{\Phi}{10} = 300 \\
5 &= 212^\circ + \frac{\Phi}{10} + \frac{\Phi}{\sqrt{5}} = 328 \\
6 &= 212^\circ + \frac{\Phi}{10} + \frac{\Phi}{\sqrt{6}} = 336 \quad \text{or} \quad 316 + \frac{\Phi}{\sqrt{6}}
\end{align*}
\]

The following are the results of Dr. Ure's experiments, and those of the Franklin Institute, as far as ten atmospheres, contrasted with the results obtained by this method of calculation:

<table>
<thead>
<tr>
<th>No. of Atmosphere</th>
<th>Calculated Temperature</th>
<th>Dr. Ure's Calculation</th>
<th>Mean of Temperature obtained by Franklin Institute</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>212^\circ</td>
<td>212^\circ</td>
<td>212</td>
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<td>2</td>
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<td>3</td>
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<td>5</td>
<td>304.4</td>
<td>305</td>
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<td>6</td>
<td>316.4</td>
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<td>7</td>
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<td>335.7</td>
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<tr>
<td>11</td>
<td>357.5</td>
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<td>12</td>
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<td>16</td>
<td>383.5</td>
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<tr>
<td>19</td>
<td>395.5</td>
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<td></td>
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<tr>
<td>20</td>
<td>399</td>
<td></td>
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</tr>
</tbody>
</table>

I am, Sir,
Your obedient servant,

William T. Matter.
Civil Engineer.

Dublin, October 15, 1847.

**MEASUREMENT OF ANGLES.**

_How to lay off an angle of any number of degrees, minutes, &c., with compasses only, without the use of scale or protractor._

_by Oliver Byrne._

First allow me to correct a trifling mistake involved in the solution of the converse of this proposition, published in the _Journal_ of last month. Page 313, col. 2, line 10, for "+ 1 or = 2," read "+ 1 or = 1," and the expression (Q) becomes

\[
\theta = \frac{m \times n \times p + 1}{m \times n \times p + 2}
\]

The same correction must be made at page 314.

Let it be required to lay off an angle of 36° 40' = \( \beta \).—Take any small opening of the compasses less than one-tenth of the radius, and lay off any number of equal small arcs, from \( A \) to 1; from 1 to 2; from 2 to 3; &c. (fig. 1), until we have laid off an arc, \( A B \), greater than the one required.

Draw \( B \theta \) through the centre \( O \), then will the arc \( a \theta = \text{arc} AB \), which we shall put = \( 20 \phi \) in this example, and proceed to measure \( a \theta \) as in example fig. 5, page 314. Lay off \( a \theta \) from \( b \theta \) to \( e \); from \( e \theta \) to \( d \); from \( d \theta \) to \( f \); from \( e \theta \) to \( f \); from \( f \theta \) to \( g \). Putting \( g = \Delta \), then

\[
6 \times 20 \phi + \Delta = 360^\circ = \frac{100}{11} \beta; \quad \text{because}
\]

\[
360^\circ = \frac{21600}{108} \quad \text{or} \quad \frac{2200}{11} \beta
\]

Lay off, as before directed, \( \phi \Delta A \), from \( a \theta \) to \( b \theta \), from \( b \theta \) to \( c \); then calling \( a \theta \), \( \Delta \phi \), we have

\[
3 \Delta \phi + \Delta = 20 \phi; \quad \text{and we find that} \quad s \theta \text{is contained 28 times in the arc} a \theta
\]

\[
\therefore 120 \phi + \Delta = \frac{100}{11} \beta; \quad 3 \Delta \phi + \Delta = 20 \phi; \quad \text{and} \quad 28 \phi \Delta = 20 \phi.
\]

Eliminating \( \Delta \), and \( \Delta \phi \), we find

\[
\beta = \frac{2200}{2208} = 12\frac{9}{16} \text{times} \phi \text{nearby;
}
\]

\[
\therefore 36^\circ 40' = \angle AON \text{is laid off with as much ease and certainty as by a protractor.}
\]

As a second example, let it be required to lay off an angle of 132° 27'.—From 180° to take 132° 27' = 47° 33', which put = \( \beta \).

\[
\begin{align*}
360^\circ &= 2400 \\
47^\circ 33' &= 317
\end{align*}
\]

when put = \( \beta \), then \( \beta = 360^\circ = \pi. \)

Referring to fig. 2, we have laid off 29 small arcs from \( A \) to 29 = \( \sigma \). \( A B = a \theta = b c = c d = d e = e f \). And \( \sigma \phi = b h = a f = \Delta \phi; \quad h g = \Delta \phi. \)
Let the weight at \( w = w^a \) (because the weight varies as the cube of the scale \( s \)); the weight of beam and girder \( = w^a s^3 \); \( CE = Is \); \( R \) and \( R' \) the reactions at \( A \) and \( B \).

Then first considering the equilibrium of the whole girder, we shall have

\[
R + R' = (w + w') s^a \, w^a
\]

For the equilibrium of the portion \( CP \), if \( T \) be the tension and thrust of the lower and upper flanges, \( Y \) the vertical force at \( F \), the distance between the points of application of the thrust and tension, we have

\[
T = T; \quad Y + R = (w + \frac{1}{2}w'). w^a
\]

Whence \( T = \frac{(a - \frac{1}{2})}{2} \) \( \frac{1}{2}w \). \( w^a \)

Now, in applying the results of experiments upon a model girder to its original, all we have to do is to vary the scale \( s \) from the scale of the model to the scale of the original. Consequently, we find that \( T \) \( s \) varies as the fourth power of the scale or dimensions of the girder. If the web of the girder be very thin compared with the breadth of the flanges and their vertical depth—and if their vertical depth, \( w, w' \), be small compared with \( b, b' \)—and if \( w, w' \), be the width of the upper and lower flanges respectively,—

and their thrusts and tensions per square inch respectively—then we shall have

\[
T = \frac{1}{2} k c w^a = T' k' d w^a \quad \text{nearby}; \quad s = \frac{1}{2} w \quad \text{nearly.}
\]

Suppose a vertical section made of a loaded girder at \( E F \); then supposing \( F \) the fulcrum about which the mass \( A E \) is turned, \( A E \) will be prevented from turning about \( F \) by the opposite action of the tension at \( A \) and the weight \( w \) and thrust at \( E \), and the weight of \( A E \) collected at the centre of gravity of \( C \). Now the weight \( w \), the weight of \( C \), and the reaction at \( A \) will all vary as the cube of the dimensions of the girder, if we suppose the girder loaded proportionally to its mass. And the leverage of these forces varies as the linear dimensions of the girder; consequently, their moment about \( F \) varies as the fourth power of the dimensions of the girder; therefore, if we suppose \( A E \) and \( C \) small, the tension and thrust vary as the cube of the scale; but as the tension and thrust are composed of the sum of all the tensions and thrusts per square inch at a vertical section of the flanges, and as the area of this vertical section varies as the square of the scale,—in order to make up the fourth power, we must have the tension per square inch varying as the scale \( w \).

We next propose to determine the amount of the load \( V \) which can be supported at the centre of a girder of the dimensions \( s \), in order that \( t \) and \( t' \) at the centre may be the same as in a girder of the dimensions \( s = 1 \) supporting a load \( w \) at its centre. We have proved \( T = C w^a \), where \( C \) is some constant independent of \( w \).

Making \( t = \frac{a}{2} \) we have, therefore,

\[
C t w^a = \left( \frac{a}{2} + \frac{w'}{4} \right) w^a
\]

and \( C t = \left( \frac{a}{2} + \frac{w'}{4} \right) w^a \)

\[
\frac{w a}{2} + \frac{w a}{4} = \left( \frac{a}{2} + \frac{w'}{4} \right) w^a
\]

\[
2 V = \frac{2 w}{w - (a-1)} \cdot w^a
\]

\[
\cdot \cdot \cdot \cdot 2 V w^a = \left( \frac{a}{2} - (a-1).w \right) \cdot w^a
\]
If \((u-1)w' = or exceed 2\sqrt{w}\), it follows that the girder in scale \(u\) will not be able to support any weight at its centre, without the tension and thrust per square inch being increased.

**Example.**—A model girder, length 80 feet, weight 10 tons, breaks with a weight of 30 tons in the middle: what weight will break a similar girder 480 feet long?

\[
\frac{1}{2} \, (2w-\sqrt{u^2-1}) \, w^2 = \frac{(60-50)\times 36}{2} = 180 \text{ tons. Ans.}
\]

We have been especially induced to call our readers' attention to the subject of model experiments, from the fact that the proposed tubular bridge over the Menai Straits is to be constructed, as to its dimensions, according to laws developed in a series of experiments, conducted by Mr. Hodgkinson at Blackwall. We much fear that the enormous width to be crossed without a support will prove too much even for the known ingenuity of Mr. Stephenson. If, however, the talents of that illustrious engineer should prove equal to the magnitude of his conception, none will feel more satisfaction than ourselves at his success; and with mingled wonder and pleasure shall we witness—at a respectful distance—his aerial tunnel quivering and bending beneath a load of "moral agents," happily unconscious of the laws of equilibrium and of the depth of the cold dark waters above which they are being whirled.

*(To be continued.)*

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**REGISTER OF NEW PATENTS.**

**NASMYTH'S PATENT SCREW COCKS.**

The accompanying engravings show an important improvement in sluice cocks, as patented by Mr. Nasmyth, of the Bridgewater Foundry, near Manchester. In consequence of the facility with which they are manufactured, the cost of them is considerably less than that of the ordinary sluice cocks, and at the same time they appear to us far more effective; but the following testimonials, coming as they do from gentlemen well known as practical hydraulic engineers, will show the value of the cock far better than anything we can write.

---

**Fig. 1.**

Fig. 1 is a side view of one of the cocks; fig. 2, plan above the level of the pipe; fig. 3, plan of cover; fig. 4, a transverse view; and fig. 5, a section of elevation of a cock fully open,—the dotted lines show the position of the valve when closed.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

include also the cost of delivery upon the Companies' Works. These conditions I always introduce into my specifications. You may make any use you please of this letter, my object being in this, as in others, the introduction of an article cheaper than those ordinarily in use, and equally efficient; and thus to reduce the expenditure in Water Works' Establishments.

I am, &c.,
Thomas W. Astbury.
Engineers' Office, Old Ford, London.
Nov. 18, 1843.

Gentlemen,—In reply to your request, I will gladly bear testimony to the superiority of your Yedge Cocks over any other form with which I am acquainted: and I think they might be employed with advantage not only for Water Works, but also for many other purposes. As you desire it, I beg to offer the following observations in support of my opinion.

1st. The Cock's cost considerably less than the common single-faced Cocks.
2nd. The form insores both strength and durability.
3rd. They are tight, and as the friction or wear is equal at every part of the faces, I think they will remain so.
4th. Being double-faced, they will stop the water either way, which is a great advantage.
5th. The stuffing-box may be packed without shutting off the water, or emptying the mains.
6th. If, as I suggested, they should now be made with a simple Nut, instead of the Gland, the packing in the stuffing-box can be screwed up at any time, without interrupting the water supply to the ground.
7th. The ordinary size employed for Service Cocks, even under a pressure of 150 feet, are very easily opened and shut; after the first few turns they may be moved without the aid of a bar, but simply by applying the handle to the key, such as a free uninterrupted Water-Way: opening and shutting gently and gradually; standing low, so that they may be employed even where the Pipes are near the surface; &c.
8th. As a consequence, the keys carried by the Tarncocks may be made much lighter than they generally are.
9th. As we can at all times depend upon your Cocks, being assured they will not allow the water to pass, I can rely, with confidence, upon the indication of my instrument for discovering faults in the Pipes.

I may mention, finally, that your Cocks also possess the advantages common to all Cocks of their class, such as a free uninterrupted Water-Way: opening and shutting gently and gradually;standing low, so that they may be employed even where the Pipes are near the surface; &c.

It appears to me that there is but one objection which may be urged against them, which is the probability of the faces rusting or corroding. If they were seldom opened or shut such an effect might take place, but if used frequently I consider there is no risk.

I have this day examined a Cock put down in August, 1843, and found it in excellent condition, with no appearance of injuries corrosion.

I will but add, that you are at liberty to make any use you please of this communication.

I remain, &c.,
Michael Scott.
Engineer.
Liverpool Water Works.
February 4, 1847.

PIGMENTS OR PAINTS.

JAMES MURDOCK, of Staple-inn, Middlesex, for "an improved mode of preparing and employing certain colours and materials for painting," (A Communication.)—Granted March 10; Enrolled September 10, 1847. [Reported in the Patent Journal.]

This invention has for its object the substitution of certain substances unapted upon by sulphureted hydrogen, instead of the compounds of lead and copper at present in use, as pigments or paints, particular attention being paid to the titanium, yellows, and reds. The patentee describes his invention under different heads, as follows:

1st. In a certain process for the manufacturing, upon a large scale, of zinc yellow (chromate of zinc); barytes yellow, antimony red (sulphuret of antimony), and zinc green. 2nd. The employment of these colours in general, in particular upon cloth, wood, walls, paper, &c. 3rd. In the mixture of these colours with others, unaffected by sulphureted hydrogen. 4th. In mixing the oxide of zinc with other unalterable colours. 5th. The manufacture of a new dryer, in which certain peroxides act the same part as litharge in the common process. 6th. A process of polishing painting with oxide of zinc and unalterable colours, combined with the dryer above mentioned. 7. The application of the above-mentioned colours and oxide of zinc in printing and colouring paper-hangings. The patentee then proceeds to describe his processes; and, in the first place, his zinc yellows. This process is divided into three parts. By the first he obtains what he calls marigold yellow. For this purpose he mixes in a boiler 120 lb. of bichromate of potash with from 700 to 800 lb. of water, and 60 lb. of "zinc white." The boiling is continued for 24 to 36 hours. The precipitate is then separated and washed, and the first washings added to the solution from which it was precipitated. When perfectly wet and retted in cold water, it is to be boiled as in the first process, and the precipitate separated, washed, and dried. To the solution remaining from this last process, together with the washings of the precipitate, he adds sulphate of zinc, formed by adding to 15 lb. of oxide of zinc 7 lb. of sulphuric acid of commerce. This is to be carried on, as before, and the all case washed and dried. This gives a pale yellow, of a tint between the marigold and citron tint above described. The baryta yellow is formed by adding to a solution containing 100 lb. of chlorid of barium, 84 lb. of the double neutral chromates of potash and soda, boiling these together, then separating, washing, and drying the precipitate. From these yellows the patentee says he can obtain any shade of yellow required by adding, if necessary, raw terra sienna, or the antimony red hereafter described. And greens in the same manner may be obtained of any shade, by adding to the yellows a blue, unacted upon by sulphureted hydrogen. The antimony red, or orange red, is made by dissolving the native ore in aqua regia; then adding to the solution an equal quantity of aqua regia, it is to be just dissolve the whole of the sulnphuret; proportion the patentee finds to be about 6 of acid to 1 of the native sulphuret. The solution is then filtered, and water or acid is added to it until its specific gravity is between 15° and 17° of the French specificiment. The patentee prefers 16°, and claims all degrees between 15° and 17°. Then the solution is boiled until the whole liquid is placed in a suitable vessel, and sulphureted hydrogen passed through it. The sulphureted hydrogen may be that evolved in forming a second solution of the native sulphuret. The tube by which the gas is conducted into the solution should be of glass, and wide enough to prevent its being caught up. The vessel made to pass through a series of vessels, and at last conducted into a vessel of milk of lime; during the process the solution should be stirred occasionally with a wooden spatula. The precipitate is to be washed thoroughly, and dried at a temperature of from 100° to 120°; at a higher temperature than this the hydrated sulphuret would lose its combined water, and become black. To form the zinc green, the patentee dissolves in hot water 49 lb. of pure dry sulphate of cobalt, and to this adds 255 lb. of oxide of zinc slaked with a little water; the whole is then boiled to dryness, and heated red-hot in a muffle. The calcined mass must then be cooled and thrown into water, thoroughly washed, and dried. The patentee claims the process of neutralising the sulphuret of cobalt with oxide of zinc. The patentee describes the process for making a dryer, or drying oil, by boiling for 6 or 8 hours 200 gallons of purified linseed oil, and then adding to this 10 lb. of peroxide of manganese in fine powder. The mixture to be boiled for 5 or 6 hours, and when coolest iron will answer the purpose, but it is not so effective as peroxide of manganese. If desired, the protioxide, sulphate, acetate, or carbonate of manganese may be used. This dryer may be mixed with the paint in the proportion of 1 to 10th to 1 to 20th. Instead of the dryer above described, the peroxide of manganese may be ground up with the paint in the same manner that litharge is now employed. It should, in such case, be used in the proportion of 1 to 10th to 1 to 25th. In applying his patent colours for the purpose of polished painting, the patentee lays on, first, several coats of zinc white, and when dry the surface is rubbed down with pumice till it is brought to a dead polish. In applying the colours a mixture of brilliantly pure zinc, mixed with the dryer are then laid on, and when dry will not require varnish. In applying these colours to paper-hangings no alteration whatever is required to be made in the common process, and for the purpose of satinising or watering paper, or enamelled cards, the zinc white is employed in the usual manner. The patentee claims:—1. The particular mode of manufacturing zinc yellow, baryta yellow, orange red (sulphuret of antimony) and zinc green. 2. The application of the above colours to painting pictures, buildings, and other objects, upon stone, wood, plaster, canvas, paper, &c. 3. The manufacture of colours of zinc yellow, antimony red (sulphuret of antimony), "zinc white," and other colours. 4. Compounding more or less with linseed or other oils, and the dryer above described. 5. The mixture of the dryer above described with unsalterable colours, whether those above mentioned, or others containing neither lead nor copper, or compounds containing those colours above described, and other un-
alterable colours. 6. The application of the above-described colours to the process of painting and printing on paper-hangings. 7. The application of the above-described colours and dryer to the process of polished painting. 8. The mixture of the above colours with other unalterable colours, with or without the dryer, for the purpose of obtaining any desired shade of colour.

**JAPANNING METALS.**

*Frederick Walton, of Wolverhampton, Staffordshire, japanner and tin-plate worker, for an Improved mode of covering, or of coating, covering, and ornamenting the surfaces of articles which are or may be made of wrought iron, or of other metal or metals; which improved mode may be used in substitution of japanning, tinning, or other modes, now in common use, of coating, covering, or of coating, covering, and ornamenting articles.*—Reported Aug. 24, 1847. [Enrolled Aug. 24, 1847.]

This invention relates to coating the surfaces of wrought iron, or other malleable metal that will bear a strong red heat without injury (such as brass or copper), so as to form a glazed enamelled surface either plain or ornamented.

The first preparation is to clean the surfaces of the articles, by first subjecting them to a hot blast of air or steam, or in a muffle, according to their size, for about half an hour, to dissipate all liquid or greasy matter, and oxidize the surfaces. The oxide is removed by rubbing with sand-stone, or scrapers. When cleaned, the articles are to receive a first coat of partially vitrifiable materials, which is poured in a semi-liquid state over the surface of the article, and distributed evenly; the article is then placed in an ordinary japanner's stove, heated to 180°, and left therein until all moisture is gradually dried away, leaving the same in a state of dry whitish composition, which will adhere to the article, without it is roughly touched with the fingers.

The composition for the first coating is prepared as follows:—6 parts, by weight, of flint-glass, broken into small fragments, 3 parts of borax, 1 part of red lead, and 1 part of oxide of tin, are to be well mixed, by pounding in an iron mortar, and “fritted” in the same manner as is usually done with the materials for making glaze. 1 part, by weight, of the “frit” so made, is to be mixed with two parts of calcined bone, ground to powder; and the mixture of frit and bone is then to be ground with water in a “porcelain mill,” until a semi-liquid, of the same consistence and appearance as thick cream, is produced, which, after being passed through sieves of fine lines, is ready to be applied to the articles, as above mentioned.

When the first coating is dry, the articles are ready for firing, in order so far to vitrify the materials, as to harden the coating, and fasten it on the surfaces of the articles. The firing is performed in a furnace of the kind used by painters in enamel. The muffle having been brought to a full red heat, the articles are introduced, and are left therein until the earthy composition is so much of the commencement of fusion, or partial semi-vitrification, as to render the earthy particles of the coating firmly adherent to one another, and to the surface of the articles, which are then to be withdrawn from the muffle, and laid on a flat iron bent to cool; when cold, those parts of the surface which have been coated, present a dead whitish appearance, resembling earthenware in the state of “biscuit.”

The time that the articles must remain in the muffle, varies from a few minutes to half an hour, according to the heat of the muffle, the size of the articles, and the number of articles in the muffle at the same time. After the articles have become cool, the coating is wetted with water, and a second coat is then applied over the first coat, and dried thereon in the japanner's stove; it is then fired in the muffle in the same manner as the first coat. The composition for the second coat is prepared as follows:—A thick paste is made, by mixing 32 parts, by weight, of calcined bone, ground to fine powder, 16 parts of chine-clay, 16 parts of Cornwall stone, in fine powder, and 8 parts of carbonated potash, the latter being dissolved in water. The mixture is fritted for two or three hours in a reverberatory furnace, until it assumes the appearance of biscuit-china; and then it is to be reduced to powder. 56 parts, by weight, of this powder, are mixed with 16 parts of flint-glass, broken small, 56 parts of ground calcined bone, and 3 parts of ground calcined flint; and the mixture is reduced to the consistence of cream, by grinding in a porcelain mill, in the manner described for the first composition. In firing the second coating, care must be taken that the heat of the muffle is sufficient, and that the articles are kept long enough to effect the thorough incorporation of the second coat with the first, and to harden both coats. After the second coating, the articles will have a stronger and whiter colour, and bear a more decided resemblance to articles of good earthenware in a state of biscuit; but in case it is desired to give a very white colour to the second coating, in order that it may resemble the finest earthenware in the state of biscuit, then, in place of the 16 parts of flint-glass, last mentioned, the patentes substituted a like quantity of a composition, formed by mixing 4 parts, by weight, of pulverized felspar, 4 parts of white sand, 4 parts of carbonate of potash, 1 part of arsenic, 6 parts of borax, 1 part of oxide of tin, 1 part of nitre, and 1 part of whiting, fritting the mixture, and then reducing it to powder.

When the articles have become cool, after receiving the second coat, this coat is wetted with water, and a third coat is applied, and fired in a similar manner; and, when cool, the article will present the appearance of glazed earthenware of good quality, or of the best quality, in case the composition, last mentioned, has been substituted for the flint-glass amongst the materials for the second coat. The materials used for forming the third coat or glaze are, 12 parts, by weight, of pulverized felspar, 44 parts of chine-clay, 18 parts of borax, 3 parts of nitre, 14 parts of carbonate of potash, and 14 parts of oxide of tin; these ingredients are treated in the same manner as those for making the second coat. Instead of the materials and proportions just mentioned, the following may be used:—9 parts, by weight, of pulverized felspar, 2 parts of chine-clay, 9 parts of borax, 2 parts of nitre, 8 parts of carbonate of soda, and 3 parts of arsenic. In case there are any imperfections in the glaze, after it has been fired, then, when the articles are cold, another coat of the glaze may be applied, in a semi-liquid state, and dried in the japanner's stove, and fired in the muffle in the same manner as the first glaze; in like manner, a third coating of the glaze may be applied, if requisite.

The articles that have been coated on one side, may have the opposite side coated with black glaze, applied with a sponge when in a semi-liquid state, dried on in the japanner's stove, and then fired in the muffle. The black glaze may be composed of the same materials as either of the compositions, before described, for the third coat or glaze, with the addition of 2 parts, by weight, of oxide of manganese, and 1 part of cobalt; which materials are to be added to the other ingredients, previous to the mixture being fritted. If a deep blue glaze is preferred to black, then the oxide of manganese may be diminished or omitted; and so much as is omitted may be replaced, weight for weight, by cobalt, in addition to the quantity of cobalt above mentioned. Or, instead of the back or under side of the article being coated with black or blue glaze, it may be finished by japanning, according to the method usually adopted by japanners.

**ELECTRIC LIGHT.**

*Thomas Wright, of Cooper's-hill, Thames Ditton, Surrey, Esq., for Improvements in apparatus for the production and diffusion of light.*—Granted March 9; Enrolled Sept. 9, 1845.

This invention consists in producing a permanent light, by presenting one or more fresh points or surfaces of carbon, or other suitable material, continually to the path of an electric current, by an apparatus similar to the annexed engraving. a is a double annular frame of wood, or other non-conductor of electricity, with fire (or more) discs b, c, d, e, f, turning on axes with bearings attached to the frame a. The discs consist of two circular plates of brass, or other metal, with a disc of plumago or carbon (the latter being preferred), between them, somewhat larger in diameter than the brass plates, about one-fourth of an inch thick, and having an angular or V-shaped edge. The axes of two of the discs c, e, are mounted in sliding
SLUB CHAINS.

WILLIAM BATEL, of Bilton, Stafford, chain-maker, for "a machine for flattening and turning iron links for flat-wood slub-chains."—Granted February 20; Enrolled August 20, 1847.

In forming the links of flat-wood or slub-chains the sides are flattened while the ends at the connexion of the adjoining links are cylindrical. Such formation has hitherto been accomplished by hand forging. In order to the well working of such chains, it is necessary that considerable uniformity should exist between the separate links, which require much skill and consequent expense in their manufacture.

Now the object of the present invention is to produce the required flattening to parts of lengths of iron, and partial bending of the same by mechanical means, so as to facilitate the formation of the links, and lessen the cost of the manufacture.

The annexed engravings show a machine for making the links. Fig. 1, is a side view; Fig. 2, a plan; and Fig. 3, an end view. a, the framing of the machine; b, the driving axis, to which motion is given by a steam engine or other power; on the axis b, is a pinion c, which takes into and drives the cog-wheel d, on the crank axis, e, and gives motion to the arm f, by the link g, and carrying the upper face plate A. i, is the lower face plate, upon which a length of iron A, for the intended link and heated to a moderate heat, is to be held so as that by the descent of the arm f, a flattened part, as shown at B, is produced, and then the length of metal A is to be put end to end, so as to produce another flattened part B, as shown at B, C. The lengths thus formed are then to be placed against the rollers k, when by the coming forward of the forecar, l, they will be bent into the shape shown at D. Motion is given to the forecar, l, in the following manner: m, m, are arms which at the upper ends are connected to the connecting-rods, n, n, which receive a to and fro motion from the shaft; the lower ends of the arms, m, m, are affixed to the shaft, to which is also affixed the arm p, which by means of a link gives motion to the forecar. The links produced, as shown at D, are afterwards to be welded together in the ordinary way.

STEAM ENGINE IMPROVEMENTS.

WILLIAM KNOWELD, of Great Guildford-street, Southwark, engineer, for "improvements in steam engines."—Granted December 31, 1846; Enrolled June 30, 1847.

This invention relates to obtaining two revolutions of a shaft of a reciprocating steam-engine for each complete stroke of the piston. Figs. 1 and 2, are an elevation and a plan of a reciprocating steam-engine, showing the Improvements. a, a, is the framing. b, the steam cylinder. c, the piston rod. e, the cross head; and f, the side connecting rods which are at one end in connexion with the cross head h, and at the other end in connexion with the connecting rod g, which is forked so as partly to embrace the cylinder and to allow of its being in connexion with both of the rods f, and this connecting rod is at the end, g', in connexion with the beam or lever p, moving on an axis in the centre, by which the end, g', of the lever, g', is controlled to move to and fro in nearly a straight line, which is one peculiarity of the invention, and such beam or lever at one end moves on an axis at g', its other end by a connecting rod i, gives motion to the crank, j, on the main shaft k, of the engine; thus will the crank shaft be caused to make a complete revolution each time the piston moves from end to end of the cylinder, and therefore two revolutions for each complete stroke of the piston. i, i, are two arms from the axis, f, one on each side of the cylinder, in order that they may be in connexion with the two side connecting rods, f. These arms are for the purpose of controlling the working of the parts, and to ensure the end g', of the connecting rod g, making a uniform to and fro movement each time the piston passes from one end to the other of the cylinder; but it is obvious that the same result would be obtained if the ends of the rods, f, g, were controlled by guides to move in the same direction. The claim is for combining the parts f, g, i, with a crank shaft or axis so as to obtain two revolutions of such shaft or axis for each complete stroke of a reciprocating steam-engine.
SMELTING COPPER.

James Napier, of Shackwell-lane, Middlesex, operative chemist, for "Improvements in smelting copper or other ores."—Granted March 26. Enrolled September 2, 1847.—[Reported in Newton's London Journal.]

This invention consists in improvements in smelting copper ores, by treating them with fluxes, consisting of common salt, lime, and carbonaceous matters; and also in improvements in smelting ores, containing silver, or gold, or both, which the ore previously contained; these metals are afterwards separated from the lead by the ordinary methods of separating silver and gold from lead. The copper is treated in the ordinary manner, or as described in the specification of the patent before alluded to. Instead of galena, the oxide of lead may be employed; in which case the iron is dispensed with; but the patentee prefers to use galena.

When treating ores of silver, or gold, or both, which do not contain copper, or which do not contain it in the state of a sulphuret, the patentee adds copper pyrites thereto, in the proportion of 4 cwt. of the latter to 16 cwt. of ore, and then proceeds in the manner above described, viz., bringing the material into a state of regulus, and fusing it with soda-salt, lime, coal, iron, and galena.

In conclusion, the patentee says, that he does not confine himself to the precise details, or proportions of the ingredients used, so long as the peculiar character of the invention be retained.

LOCK FURNITURE AND SPINDLES.

Mr. Pitt has obtained a patent for an ingenious improvement in the mode of fixing the furniture on locks and shutter knobs, as shown in the annexed engraving; by which, it will be seen that the spindle is not fastened to the knob, but is merely let into the socket. This method obviates the necessity of driving on the handle with a mallet, which frequently mutilates the furniture. Another improvement is the doing away with the small screw in the neck; instead of which, the spindle is first placed in the follower of the lock, and then the knob put upon it, which has connected with it the brass plate of the rose; this plate is firmly fixed to the door by small screws, over which there is a cover rose furnished with a collar with a female screw, and which is fastened by two or three turns on to a screw round the neck of the brass plate; thus the screws and brass plate are completely concealed. The improved furniture is manufactured by Messrs. Hart and Sons, ironmongers, of Wyche-street, Strand, and may be had either in glass, china, ebony, ivory, or other fancy fittings.
THE CIVIL ENGINEER AND ARCHITECTS JOURNAL.

Nov.

GENTLEMEN,—Occupying, as I have the honour to do, the office of Dean of the department of the Applied Sciences for the ensuing year, I have thought it expedient, following the example of another department of our College, to open to the students, at the beginning of the new year, my various reflections in the shape of a hand-written address, and I trust to give this general education, however, in such a manner and to such an extent, that special education in engineering, architecture, and some other very important professional pursuits, may arise naturally from it and be intimately connected with it. It has been endeavoured so to arrange the course, that the required practical knowledge and manual dexterity for such pursuits shall be connected with and arise from the sound educational principles inculcated in the lecture-room.

Education is, in one very important sense, the serious occupation of every thinking and acting man. It commences with our entrance into the world; it is carried on, whether for good or evil results, with great energy and incessantly, through early childhood and youth; it is continued, also, whether at home or in the world. The child, and so long as we remain on this side the grave, so long do we continue to live,—to acquire new habits, new thoughts, new ideas, to exercise some influence over our fellow-men. It is only the idiot who can escape,—although it is the privilege of the insane, to adopt the inductive approach in the nearest degree to this lowest condition of our human nature.

But although education,—or the training of the human intellect to accomplish the purposes of man's nature,—is thus a process constantly going on, there is a grave oversight of faculties in both young and old, in the physical and the physical as yet unborn by the pressure of mental excitement; when the memory is fresh and not burdened with the experiences of a life, when the light amusements of childhood pall upon the senses, and when it is best to take the place of simple, unthinking observation;—there is this period in the life of every one, in which it is possible to sketch in simple outline some truthful delineation of the future, and when, therefore, it is the highest object of the intellectual and mental peculiarities of the individual. This is the time when school gives place to college; when, mere routine, imposed from without, is to a certain extent changed, to voluntary, and in many cases more severe, mental exercise; when new, powerful, and lasting impressions are made; when new associations are formed, which will probably long influence the habits and the character; and when, if a word, there is intellectual and moral in the character begins to expand itself, and to depend on circumstances, and takes some new direction which is rarely afterwards altered.

In the great majority of cases, the part in active life that is to be taken by each individual is determined for him by external circumstances, over which he has little control. In such instances, it is however not unusual that, in the application of his occupation or business to the intellectual and intelligent man, there is some one subject or department of knowledge pursued quietly and as an amusement, to the infinite advantage of himself and his family, and by no-means to the detriment of his business. In other and rarer cases, the occupation is at the same time the amusement. Both of these cases may be greatly affected by the education of the youth, as he is passing into manhood. Both therefore should enter into every scheme of education; for, however we may conclude from philosophical speculation, no one accustomed to observe will doubt that there are certain tendencies that are peculiar to the individual; and that as no one man so accurately resembles another, that we cannot determine some point of difference, so no one intellect is without its individuality—capable of being directed more easily in one way than in any other.

Thus, as there are different objects to be attained, and human intellects differently constituted to attain them; as society requires all powers to be developed, and needs the exertions of all her members, it is only just and reasonable that in the application of this education, such as this College, and of this College especially, has resulted from the endeavour to carry out this purpose; and you who are about to profit by the course of instruction here afforded, are bound to receive with gratitude the opportunity which is thus offered you, and from it being profited by, you will be responsible, each to his own conscience, for the result.

The kind of education offered in this department of the College to which you are attached in peculiar, and scarcely resembles any system previously adopted. It has already proved most successful, as an attempt to extend the advantages of college education, the individual object in after life was likely to be more distinctly active, than either contemplative or dependent on the constant and exclusive exercise of the intellectual powers. Some modification seemed needed of the ancient and not unusual system adopted by universities and colleges. The efficiency of such a system, and there employed in the cultivation of language and pure mathematics, had, during the lapse of years, gradually stolen on from the period of boyhood to that of manhood; and for this reason, those whose pursuits would remain entirely from early life to a further prosecution or application of such subjects, were necessarily deprived of the advantages of college discipline. They were also without the opportunity of acquiring, by any good system, the groundwork and elementary knowledge which should be really useful in the subsequent employment of the professions.

The endeavour to determine whether in our own country, as on the continent, it might not be possible to establish a system not less sound and based not less on the peculiar nature and requirements of the human intellect in the early stage of development, than that system which has produced so many and such great divines, lawyers, and natural philosophers,—whether, I say, it might not be possible to modify that system, so as to produce men less useful and less distinguished in the paths of active and business life,—whether we could not by such modification bring forth energies hitherto dormant, and induce a more systematic and philosophical application of thought and intellect to every-day life and ordinary business,—rendering men better able to apply science, because they had been taught to know it, I repeat, was the object of the experiment that has been first tried in this place.

It is my intention in this introductory address to explain to you something of the nature of the system we have adopted, and the spirit in which it is to be pursued. It is to you my object to state the objects which depend for success—we must be supported by your exertions; and we are bound, therefore, to tell you what are our real views and feelings with reference to the working of our plan.

Now, one of the first things that it is necessary to observe may perhaps, somewhat paradoxical: we wish rather to educate than to communicate knowledge. Knowledge in itself is no doubt good; but, in our opinion, education is better, and of far greater importance to you. Our whole system—the College system in the best sense—is a course of training adapting the intellect to acquire knowledge, but teachers knowledge incidentally. This, it must be understood, is not merely a theory, but a pervading principle. It is not seen in the individual lectures, but it is felt in the general control of the College, and it seems to me most likely to be imparted in after-life, and that whatever your pursuits may be, this mental training will help you to succeed in them.

In thus speaking of the principles of geometry as taught by Euclid, so much in vogue of late years, I have no mean of affirming, that the whole of the subject may be a copy of what is said that is necessary to illustrate the views adopted in this department of the nature and use of mathematics in education; but I cannot leave the subject without reminding you, that however important it is to understand and to apply the propositions of the geometrical system of Euclid, still nothing in the whole of education is so important as the having a distinct and clear appreciation of the nature of the argument in every demonstration in geometry, and the meaning of the symbolical expression in every geometrical proposition. For myself, I have said that the symbolical language of algebra may be applied to the determination of problems in geometry, the thinking out of which by continuous argument would be exceedingly difficult, and in some cases perhaps almost impossible. I allude thus briefly to the fundamental principles of pure mathematics, which form an essential portion of your early studies in this place, in proof of what I have already stated concerning the nature of the education offered. It is based on no hypothetical or speculative novelty, but commonplaces, as all useful education must do, by training carefully the reasoning faculties; and it selects for this training the subject of pure mathematics, as that most likely to be afterwards useful. Be assured that the time and space allotted to this part of your studies will be well spent, for the mental training, as it gives you a right idea of the importance of the subject, and enables you to apply, go-
simply a transcript of that which has been found useful at one of our older universities—there is also introduced at the same time another subject, differing much less in reality than in appearance, and of scarcely inferior value as a means of education. I allude to that elementary view of Chemistry which is taught in our schools and colleges. It is of course admitted that the mathematical investigation is valuable in its laising influence on the con- duct of the intellect and the reflective faculties, the elements of chemical philosophy form a subject equally well adapted to improve the faculty of observation and reflection; but they are of little use as a means of acquiring knowledge. The one science teaches us to reason upon assumed data; the other to interpolate nature from observed phenomena. The mathe- matician commences by assuming and defining, the chemist by observing and experimenting. The one is deductive, the other inductive. In the former, the latter deals only with that which is— with matter in its various forms, and the laws according to which those forms are modified and mutually related.

The introduction of chemistry as a subject of elementary instruction is one of the peculiarities of the course of study here adopted. It is a dis- tinct and marked recognition of the value of experimental science; not merely for its direct result in a certain amount of useful knowledge ac- quired, but in its effect on mental culture. And in this respect I would have you consider it and avail yourselves of it.

Chemistry is the link by which pure mathematical science is connected with natural history. To understand clearly in what way and to what extent the results are to be applied, it is necessary to acquire a certain amount of theoretical certainty in every proof—differs from the habit of arriving at results by the comparison of various observations and the weighing of probabilities, would involve a disposition much more laborious and more methodical, and might well be termed to require of the one who, is aware of these two very different ways of convincing the human mind, will deny the value or the practical necessity of the latter method in the great majority of cases that present themselves for determina- tion. But no one who has been taught, as taught in the first and simplest operations of chemistry, is of ex- treme value; and for this reason chiefly—whatever may be your occupa- tion subsequently—you will always feel the benefit of having been taught the principles of chemistry.

And what is perhaps the most beautiful and most interesting point in such education, is that we learn these important habits of mental dissi-pline without effort, and almost without being aware of it. Not one who has been instructed in pure chemical science, especially in its most attractive form, without being charmed by the simplicity and beauty of the results obtained by the chemist—exhibited as they are in experiments that command attention by their novelty, unique- ness as compared with the number of phenomena of which the child and the infant, stretching forth his tiny hands to touch that object which is beyond his reach, and which is only recognised by the eye, is a type of this mental attention. The truth is, that the most beautiful science, exerts his powerful and well-trained intellect to bring within the range of comparison various results of observations variously made, and to connect phenomena apparently distinct by discovering the nature of their different and sometimes of the same facts by which the system of pure and applied chemistry, and that on physical geography and descriptive geology.

The instruction in mathematics, which for the first year was confined to those departments which chiefly involve principles, now includes some of the higher branches and involves the application of several methods according to the state of the subject. The principles of mathematical science is applied to solve important and compli- cated physical problems. The instruction in natural philosophy corresponds with and assumes this advance, and involves a consideration of some of those important theories on which depend the working out of practical mechanical projects.

But in chemistry a new view of the subject is taken. From chemical principles you advance to chemical practice, and to the nature of those changes produced in various ways on the raw materials employed in the arts, and dependent on the action of what are called chemical forces either directly or indirectly. In this you are introduced to the same kind of information connected with the laboratory and the principles of chemistry, as you have in the sec- ondary practice and manufacture of every practical man; and you are also intimately related to the subject of Geology, to which in the second year of your studies your attention is also directed. The remaining subjects of study for the first year involve some depart- ments which chiefly involve principles, now includes some of the higher branches and involve the application of several methods according to the state of the subject. The principles of mathematical science is applied to solve important and compli- cated physical problems. The instruction in natural philosophy corresponds with and assumes this advance, and involves a consideration of some of those important theories on which depend the working out of practical mechanical projects.
recognised at once the nature of the education at this part of the course. You will also perceive that the education, although eminently practical, is at
the same time founded on principles previously inculcated, and that its result in preparing chemists or professional men of any kind, but is hitherto confined to creating a class of well-instructed persons, fit for any practical employment whatever.
Together with the applications of chemistry, the subject of geology is now introduced, and the instruction of the students of the second year is especially directed; and as this is the subject on which I shall myself have to address you, I will only at present dwell upon it so far as to give a sufficient idea of its relative importance amongst your studies, and the place which it occupies in my course without the three year.
The pursuit of geology may be considered to involve three distinct subjects—a mere description of the earth's crust, and an account of the order of arrangement of the materials regarded simply as matter of fact—a history of the earth from such observations as are applied to the sciences, and the appearance—and a statement of the practical results of knowledge of this kind with reference to the practice of engineering and mining, agriculture and architecture. Following in some measure the plan adopted in chemistry, I at first introduce to your notice the principles of geology, and describe the facts observed. I afterwards explain the direct practical applications, and the mode in which these are best made. The former is the subject of a course of lectures given to the students of the second year—the latter is now confined to the third year.

Geology is a science of observation; but as all facts must be grouped and laws obtained from them before they are practically available, a knowledge of the history of the earth, as deduced from the observation of phenomena, is necessary before the facts themselves can be applied. This history I endeavour to give, avoiding as far as possible any mere theory, but always keeping in view the geological principles derived from natural history, possessing all the advantages that belong to the details of that science, and at the same time offering a yet wider and more important field of speculative speculation. I believe no subject is better adapted for educational purposes, or more likely to enlarge the mind and strengthen the expanding intellect. The vastness of the operations considered; the extreme duration of time involved; the singular variety and the mysterious succession of organic beings; the evidence of the action of chemical forces on a scale so grand that the mind can with difficulty comprehend the extent to which this tends to give to the subject a bold on the imagination; and in some cases given alarm, and in others extravagant wildness, to the well meaning, but not well informed person. A calm and dispassionate view of the facts, and a clear and distinct idea of them, is the first step; whereas, however, as I have already said, the subject is ill adapted to improve and improve the student, and is absolutely necessary for a fair appreciation and efficient use of the science of geology, as applied to engineering and mining operations.

It is considered important that the student, who has thus carefully acquired during two years habits of thought and observation, who has become acquainted with elementary principles, and is to a certain extent familiar with methods, should terminate his educational course by a third year spent in the acquisition of the higher branches of knowledge, and in the obtaining practical information that will enable him to pursue the various lines of architecture. The higher mathematics, and more especially the geometry of solids; the principles of mechanism; the modes by which strength of material is tested, and the force of complicated machines estimated; the arts of construction as exemplified in extensive and important public works; the details by which advantage is gained in the economical and essential advantages of such works, all these enter into the course which is thus provided, and they must necessarily be excluded from the instruction given to the less advanced student. In addition to this, however, the art of chemical manipulation, in which each student is himself engaged in practical analysis and research, and in which he has the advantage of the laboratory and the superintendence, in this case personal and direct, of the professor, cannot fail to be of the greatest value even to those who will hardly again be called upon to investigate personally in this branch of science. With a view to assist in carrying out most fully the practical character of the education afforded, I have myself undertaken to deliver to these advanced students a special course of lectures on the most important practical applications of geology and mining. When you have been some time in the profession, you will perceive its usefulness and importance from the progress of education, and who have the ability as well as the inclination to do good, may learn the advantage of inculcating science as a necessary adjunct to practical knowledge; instead of leaving practical men who would willingly receive a sound education, scarcely any means that such knowledge, except by incurring great expense and serious loss of time.

In thus speaking of the various branches of instruction afforded to the students of each year, I have not hitherto alluded to that religious instruction which forms a characteristic feature of this as of every other department of education. The minister, believe, is of the opinion that all instruction which is given in other departments of science becoming too contemplative; unless, indeed, you should be inclined to pursue chemistry, mineralogy, or geology, rather for the amusement, science be than for their distinct practical results. With regard to the own studies, I offer here to you, more especially, that which I have placed to it to you in its most practical light; and the pursuits of chemistry and mineralogy are so directly connected with the arts, and with mind and metalurgy, that few of you probably will be tempted to pursue these sciences as objects of exclusive research.
The remaining subjects of instruction are eminently practical, and need no warning of this kind.

Quitting for a moment any reference to the essential nature of the subjects taught, there are two errors diametrically opposed to one another, but both in one or other of which almost every person is occasionally tempted. These are idleness and over-exertion. It would be difficult to determine which of the two has been more fatal to the progress of the student. I need hardly tell you how much danger there is in giving way to the idea that when the immediate task is learned, idleness is permissible. In the schoolboy, indeed, we excuse this, because in most cases the mental effort requires to be succeeded by physical exertion; but for you there can be no such feeling. You must advance steadily, constantly, and incessantly, if you would attain that distinction and success which ought to be the object of your ambition. Relaxation no doubt is necessary, but your relaxation must not be idleness.

On the other hand, you will be tempted in your competition for the honours and prizes offered as the rewards of exertion, to pursue your studies with an unnatural eagerness. Time is of the essence of our vocation, and to be unoccupied is to be lost. The point is, to employ the time you have, not by any means to spend it doing nothing; but to distribute it so as to make the whole of it of the highest possible value. As the moneyed man uses his money, so should every man use his time. He who would possess himself of the kingdom of heaven must take up his cross, and follow Christ. If he would be great, let him count himself but a servant.

And now that you have been informed of the nature and extent of the education here afforded—what we offer you, and what we expect from you—my task, that of introducing you to your work, is for the present at an end. I have myself no fear as to the result in your cases individually; and whatever may have been or may be the toil and the anxiety of those who have superintended the growth of this department of Applied Science, in the possession of which you are now members,—whatever struggles and difficulties we may have had in carrying out our views, with reference to the subject of general scientific education,—however slowly it may have taken root, and however it may have been checked by the apathy of those other occupations were too pressing to allow them to do justice to this, we are all, I think, satisfied now that as a system it is established; and that we who have laboured earnestly in the cause may fairly expect to see the result in our days,—although one of those doubts which we thought had been forgotten have not been so entirely put out of mind as I was pleased to express hope; and he would, I repeat, have amongst those most rejoiced could he have seen his views thus far carried into successful operation.

* Professor Daboti.

**REVIEWS.**


It is not long since that a Mr. Isaac Frost proclaimed, trumpet-mouthed, a discovery of the most stupendous importance—viz., that the Newtonian Theory was as untrue as it was blasphemous; that the sun was not the centre of our system, but revolved round the earth at the distance of about 100,000 miles; that the moon was a block of ice, distant 6,000 miles, and, "as to the length of the diameter of the universe, if any gentleman were to ask me that question," says Mr. Frost, "I should answer: It is as long as God pleases."

Mr. Frost's objections to the theory of gravitation were certainly very plausible. "Newton's whole philosophy," he argued, "accounted for the force which drives the earth up the ascending node of the eclipse, but does not account for the force which rolls it down the descending node," and again, "if the stars are infinitely distant, how is it that their light does not interfere to produce darkness?" This latter objection we consider especially profound—"an opinion which we most confidently express for two reasons—first, because we entertain it in common with one of the most popular journals of the day; and secondly, because we can't understand it—a sufficient proof with most people of the profundity of an idea."

About the same time that the unscientific public was astonished by the theories of Mr. Frost, the scientific public was gratified by the discovery of a new planet, upon which no telescope had yet been turned—on which no eye had ever gazed; which, too remote and obscure to be apprehended by the faculties of sense, was reached by a group of intellect not unworthy of him who first interpreted the laws which made necessary the existence of that distant world. How rich must have been the reward of its silent and unobtrusive discoverer! How immense his scorn of the pedantry who surrounded him! With this quiet mirth would he turn from their seqquipedalia verba, their "kemikoxekalekades" and jargon, to those cherished results of his toil, the final completion of his Principia! Day by day, in all her Indian magnificence, bad for him less glory than the Night; for Night held the treasure he had staked years of thought to win. Mightily was his ambition—mightier his success.

Somewhere in the wide gap between these two great philosophers we would rank Mr. Herapath, and in justice to that gentleman, be it observed, nearer to Mr. John Couch Adams than to Mr. Isaac Frost. If our author had succeeded in accomplishing all that the lengthy title-page of his work promises, we should consider him by far the greatest man of his age: profession, however, is not practice, and although we admit that some of the theories he has developed are extremely ingenious and supported by a great deal of beautiful reasoning, yet we confess we are not disposed to accede to the truth of any one of them—simply because they explain only a few, and seem to us unaccountable in irreconcilable with the greater number, of the phenomena of nature.

The cause which Mr. Herapath assigns for heat, gravitation, and the other molecular forces of the universe, is a very simple one—the assumed hardness and inertia of the molecules of matter; and the subject of our present review is to present a general treatment of the molecular forces, whether finite or molecular. The first part—one the action and laws of finite forces—is nothing more than a jumbled compisation of certain statistical and dynamical propositions. Moreover, although the results of these propositions, which are all old acquisitions (such as to find the centre of gravity, centre of percussion, and the like), are correct enough, the means by which these results are arrived at are very questionable, and to use in most instances wholly unintelligible. Mr. Herapath has adopted the very common error of assuming the fundamental laws of motion to be axiomatic—no fact can be axiomatic which the mind can conceive to be otherwise than it is. It is very easy to confound the laws of motion and the facts from which they really are; therefore the laws of motion are not axiomatic, and consequently depend on experiment and induction. In the theory of collision, Mr. Herapath is at least original—having previously admitted that a perfectly hard body, such as he defines it, has never been the subject of experience, and moreover that other bodies, usually termed hard, with which we are acquainted, such as iron, granite, &c., are as distinct from perfectly hard bodies as rest is distinct from motion, he proceeds to argue on what would happen supposing two perfectly hard bodies to impinge on each other. He asserts that under such circumstances, the two bodies would each resist the path by which the other attempts to pass by, and consequently behave differently from those which they possessed previously to impact. We do not attempt to dispose Mr. Herapath's assertion, but in lawyer style we set up a counter-plea or assertion of our own: we assert that two "perfectly hard" bodies, after impact, would polka together "for an hour by Shirley's clock" and then turn green, and we defy Mr. Herapath to dispose our assertion.

To view the subject more seriously, the phenomena which take place during the impact of two ordinary bodies may be well illustrated by the following problem:—Suppose two balls, with masses $A$ and $B$, to impinge directly on opposite ends of a spiral spring, the mass of the spring being neglected in comparison with either of the masses $A$ or $B$.

Suppose $a$ were the original length of the spring, $x$ its length at time $t$ from commencement of impact, $s$ the space one end has passed over at time $t$. Then, since the mass of the spring is insignificantly small, the forces tending to compress it at both ends are equal. Let $T$ be this force at time $t$—then we have for the motion of $A$:

$$\frac{d^2x}{dt^2} = -\frac{T}{A}$$

for the motion of $B$:

$$\frac{d^2(x+s)}{dt^2} = -\frac{T}{B}$$

$$\frac{dx}{dt} = c - \int T \, dt$$

Let $u$ be the velocity $A$ had at first, then $c = u$. The velocity of $A$ continually decreases, and at time $t$ is diminished by a quantity $\int T \, dt$; and the velocity of $B$ continually diminishes by $\int T \, dt$.

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justice to the author, though we cannot help expressing a wish that Mr. Herapath had devoted half the time and ability to the mathematics of engineering that he has to the casting-building of hypothetical speculations, and be4 we were warranted in regarding his work of less pretensions but of far more solid usefulness. This profound mathematician of the day with whom we have had the honour of conversing on the subject, shrank from the difficulties attending all theories of molecular constitution, and in their widest dreams we believe have never so much as dared to hope for a solution of even one of those grand mysteries—Heat, Elasticity, Gravity, and other Great Phenomena of Nature."


"Oh that mine adversary had written a book," cried Job in bitterness of spirit. We, who are not nearly so patient as he, are induced by the perusal of the work before us to exclaim—Oh that mine adversary had written a book! Mr. Curr has come all the way from New South Wales to have his bark and his bite at modern engineering! A man does not travel 16,000 miles for a tripe; and accordingly Mr. Curr bow-wows pretty loudly.

In the first place, our excellent adversary, the Mechanics' Magazine, comes in for a snarl. From "a careful examination of two volumes and two odd numbers" of that work, our author is satisfied that "the present actual and scientific knowledge of English engineers" is in a most deplorable condition; and so in order to enlighten them he resolved on quitting "a peaceful homestead in the fair time of Australia," embarked on board the gun-ship "St. George," for England, arrived safely, and forthwith published the present volume. It is our private conviction that Mr. Curr is the coming man who has been so long and so anxiously expected.

To attempt an intelligible analysis of his doctrines were as vain as to essay a systematic arrangement of thelyleaves, or an interpretation of the oracular teachings of the Pythian. Science and satire, analysis and adventure, are so strangely intermingled that dim mortal vision frequently misses the line of demarcation. Mr. Curr sets off with a grave bit of theory about motion of fluids, or a pet doctrine of gravitation, and interrupts himself to tell a personal anecdote. As many "most disastrous chances of moving accidents" have befallen him as Othello, and they are set down in this book, in the very thick of philosophical propositions and algebraical symbols. Our author seems to entertain the idea of combining the truths of science with the "intense interest" of a melodrama. For example, he begins to tell us that about the year 1845, while in England, the story of the brooding mind of a father on a certain occasion "reduced to the necessity of concealment in a wood for three days and nights to escape the fury of the populace." In another place, he records a dispute between himself and somebody at Norwich, which somehow or another induced him to go to Margate, where he "dined at forty shillings a dinner," and a printed letter is inserted in which he tells us that his father was discovered by his grandfather on account of a difference of opinion on engineering subjects, and the letter to that effect was retained in his family for thirty years or more. Our author is as rich in family anecdotes as in scientific discoveries, and passes from the one to the other with surprising facility. Every reader of Hudibras knows that "The adventure of the bear and fiddle Is sung, but breaks off in the middle."

But the excursions and imaginative flights of the political satirist, Butler, are nothing to those of the philosophical satirist, Curr.

Poor Doctor Hutton comes in for a more ordinary share of abuse. He has a theory of uniform, and his enemies very properly point out that his idea of uniformity, which is that of a constant rate of change, is noticed by Hutton. Hutton wrote at a time when the principles of mechanics, and especially the practical application of them, were much less understood than at present: and we are quite ready to accord to Mr. Curr the easily-acquired merit of having proved that Hutton is not infallible. He was a much better mathematician than mathematician, but more of a logician than a philosopher. Hutton propounds various formulae for calculating the motion of railway trains, assuming the modulus of friction to be constant, on the evidence of uniform experience shows that the resistance to the motion of the wheels on the rails increases very rapidly with increase of velocity. The repercussions in passing over the joints of the rails, and the vibrating motion of the rails themselves, render necessary a great expenditure of power. And as these
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precussions and vibrations, and other irregularities of the motion of trains, are always observed to be much greater at high, than at low, velocities, it is quite clear that till their relation to the velocity be ascertained it is impossible to make the speed of trains a matter of mathematical calculation. The law of resistance, or the degree in which the resistance increases with increase of velocity, has not yet been discovered, notwithstanding the efforts of numerous excellent experiments. The self-sufficiency with which Mr. Curr decries the labours of Mr. Scott Russell and others, who are usefully employed in the experimental investigation of the subject, is rivalled only by the ignorance of first principles displayed in the attempt to solve a problem of which the data are not given.

Patience and space would fail us to point out all his other errors—yet one or two instances may be cited. In one place he tells us that the consumption of coke necessary for the conveyance of a given load by a fast train is the same as by a slow one. "If the velocity be doubled," he says, "the given supply consumed by each train half the distance the supply of steam must be doubly fast in the second case, but will be required for half the time. Hence he concludes that in both cases the same quantity of steam (and therefore of coke) will be consumed—totally overlooking the fact that the increased resistance to the train's motion in the second case is necessary that the steam should be increased in the cylinder at a greatly increased rate. His notion is much the same thing as asserting that the easiest way of travelling fifty miles on horseback is to ride at full gallop.

In another place we are told that "the bite would be lessened on ascending a gradient according to which end of the engine might be moving for the convenience of the engine would approach or recede from the driving wheels." It were useless to attempt a serious refutation of such nonsense.

"'Tis a pity when charming women
Talk of things that they don't understand.

and similar objects of comparison may be found among the sterners sex.

Here is another specimen of our author's mechanical ideas: "Actual collision of trains moving in opposite directions is a subject scarcely deserving of attention, but as there appears a vulgar notion amongst persons who ought to know better, that if two trains meet, the shock is proportional to their joint velocity, or to twice the velocity of each train; if a shock sustained by one train is proportional to its velocity, and the same is true as regards each person conveyed in it." Does Mr. Curr mean to assert that the shock to each train is quite independent of the velocity of the other train—that if a man ran against a moving cannon ball the injury sustained by him would be merely proportional to his own velocity and not dependent on that of the ball? If that were true, it is obvious that if he stood quite still he would receive no injury were a whole park of artillery fired at him; and, similarly, that when a train is at rest the passengers need not be at all alarmed at seeing another train drive full tilt against them.

To quit theory, let us take a specimen of Mr. Curr's practical knowledge. The following is a proposition for ascending very steep gradients. "Let the engine be stopped near the foot of such inclined plane—let the driving wheels be removed and a pair substituted being of such diameter as will enable it to ascend. Take off the driving wheels, Mr. Curr! Pooh, pooh, man! what if it were proposed to you to take off your head and substitute that of Newton whenever you came to a stiff bit of mathematics?

Divers other equally rare devices hath Mr. Curr for the improvement of railway locomotion. One especially there is, which is calculated to effect a complete revolution in engineering, but its nature is kept a profound secret with cunningly to forestall what it can be, but, No—says Mr. Curr—I have told you a good deal for nothing, beyond the cost of buying and reading my book, but for this master invention I demand a far higher reimbursement. And then he offers to reveal it confidentially to a committee of the House of Commons—in fact, repeats the Wagner story in a new form. The work concludes with a magnificent peroration of which the following is a fair specimen:

"But who proclaims himself my critic—the shadow of a nonsensity whose only knowledge of the subject is derived from the book he intends to criticise: so—it will be left to future ages to find the truth. The principles are one—so break one link of the vicinities, and down goes the shadow. Without the application the mathematicians have been boldly attacked: whether they will continue their prejudices I will not decide: but to convince a man that he has played the fool is not an easy task."

Here, at least, we entirely agree with our author. The "task" is difficult—so difficult that we relinquish it in despair.

Sketches, Graphic and Descriptive, &c., for a History of the Decorative Painting applied to English Architecture during the Middle Ages,


Mr. Blackburn proposes to do for the polychromy of the middle ages, what has been done for that of the Egyptians, Greeks, and Arabs, and to give us a special work of reference for architects and decorators in all that relates to the coloured ornaments suited to works of similar character. This is certainly essential at a time when the taste for such decoration is extending, and when buildings of a high class are in progress. We have had many books on Gothic carving, but few illuminations of painting in that style, and for the reason that until lately the production of illuminated books was very rare. The now promised work will be very opportunely in aid of the extended study of the decorative arts. In the works by Mr. Jobbins and Mr. Colling many useful examples have been already given, and no doubt Mr. Blackburn will find many co-operators before he gets to the end of his series.

Mr. Blackburn's text does not seem to us to be of so much value as his plates, although he has undoubtedly taken much pains; but in the attempt to publish a series of examples he will lay the foundation for a history of decoration in this country. He is therefore not to be blamed because he does not shine so much as an historian, as he does as an artist. The state of art among the English before the time of Lord Burlington and of Inigo Jones could be examined in connection with paintings, for it cannot be doubted that from Greece and what was then the Byzantine city of Rome these new arts were brought into England, as we have express testimony to that effect.

Mr. Blackburn begins his work, in fact, from the thirteenth century, when the construction of so many larger edifices, now existing, and the practice of painting on walls, as well as on tabernacle doors, gave a more durable character to the labours of the painter and decorator. In the first number we have a choir ceiling from Malvern abbey, with its details; a screen from Aldenham church in Hertfordshire, is the Perpendicular style; a plate of details from the tomb of Lord Erskine, in Westminster abbey; a wall painting from the chapel of St. Erasmus at Westminster, from Tewkesbury, and from Rochester cathedral, and a lectern stand from Littlebury, Essex. The titles we think may be dismissed very briefly, for they have already been copiously illustrated in special works.

It is a matter of much congratulation that we shall now possess a body of English works illustrative of medieval art, and calculated to foster the growing taste for that style. In the works of Carter, Stottard, and Shaw, in those already named, and in works on tombs, furniture, glass painting, fonts, and tiles, the architect, and we may add the artisan, of the present day, finds resources in which his predecessors were wanting.


Mr. Hadfield has begun an undertaking, the completion of which will require a life of labours, if carried out in the spirit of this specimen. Having chosen the county of Essex as the first, he makes a review of the churches, pointing out all the positions valuable to the architect as examples, and illustrates them by plates full of dimensions and working details, and of a uniform scale. We know of no work, which, with such strictness of plan, has equal practical value. For parochial purposes to form the volumes devoted to the county of Essex, and these are to contain eighty plates of the churches and mansions and their fittings. We think Mr. Hadfield is undertaking more than is required at his hands in proposing to give plates of stained glass, which forms a special art, and the labour, time, and expense bestowed on which may perhaps deter the architect of what may be valued infinitely more—drawings such as those in the present number.

The text is of a very limited character, simply explaining the architectural features, with little antiquarian detail, the object of the author being to keep up the practical nature of the work, and to throw his strength into the plates. This is a very safe and prudent course, and though the price of the part is high, in account of the number of plates, very cheap. We think, too, that Mr. Hadfield has decided rightly in publishing large parts like the present, rather than splitting them into monthly numbers with two or three plates. There is a certain appearance of completeness about the part even at present which seems to make it of a form in the present number.

Mr. Hadfield apportions his labour according to the importance of his work. Some churches are without notice; others, like Danbury, with four or five plates. The author has carefully eschewed perspec-
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five views, and there are no elevations of buildings, but a museum, as it were, is formed of details so carried out, that working drawings would be scarcely wanted in copying these examples. The plates, which are filled as much as they can be, are designed simply to help the architect, builder, and workman, and explain themselves fully the way they are carried with it, some of the important details to which it is necessary to call attention. Indeed, the book, on inspection, carries with it its own recommendation, and is likely to meet with such support as to enable the author to proceed with confidence in his praiseworthy undertaking.


This is a work of such commendable industry, and of so much interest, that we must reserve it for a longer notice in a future number.

HIGH-PRESSURE STEAM.

The greatest object remaining to be accomplished in navigating the ocean by steam is to reduce as much as possible the vessel, and this, to any extent, can only be effected by using high-pressure steam expansively, by which not only one-half of the tonnage occupied at first will be liberated, but one-half the cost of the fuel will be saved. We need not expatiate upon the immense advantage of such a reduction both to the navy and to the marine of this country, particularly where distant depots have to be so frequently replenished, because that can be duly appreciated by every person practically experienced in steam navigation. But no sooner, however, is improvement made, than a fierce fusillade is opened against so dangerous an innovation, which is that presumed to be, as if any inherent property existed to render high-pressure steam more dangerous or destructive than steam of low-pressure. This, however, results from prejudices rather than from calm and dispassionate reasoning; in the face of daily experience and the successful operation of hundreds of locomotives gliding over our iron roads at something like 60 miles an hour, notwithstanding the very high power employed, which marine purposes do not compare, it is really gratifying to read your judicious and well-considered remarks in the case of the late explosion of the Crickett steamboat. [see Journal, p. 330.]

With properly constructed safety-valves, to limit the pressure with certainty, placed beyond the control of the engineer or driver (which is a matter of equal importance in both systems), high steam will prove as safe, or a good deal safer, than low-pressure, if generated in suitable boilers; which, we trust, shall be found a fact in the actual prac- tice of navigation. It is not possible to say how many answers these arguments have occurred, distinguishing the class to which each belongs, together with the probable cause and circumstances attending them, beyond the transitory and imperfect accounts given in the newspapers of the day; or we believe it would be found, that the most destructive instances produced, but that two, or at least of the high number, have been occasioned by low-pressure steam, or by boilers so denominated (see the frightful account of the explosion in the newspapers of-to-day—October the 7th—as detailed before the coroner at Leith), it may be impossible to produce evidence in sufficient consequence to condemn as the cause of the explosion marine boilers having been subjected to the foot-hardy and reckless treatment practised on board the “Crickett.” Would they have resisted one-half the time those boilers did—we presume to think not.

Marine boilers of the usual form of construction and magnitude are the most safe to resist pressure; and, therefore, in examining the comparative safety of the two systems, we will assume that the boilers are of the same form—viz., cylindrical (where the tension of the metal is most perfectly applied), and the pressure in one to be four pounds the square inch, and that of the other to be fifty, while the thickness of metal in each shall be in the exact ratio to the strain: thus, multiply the pressure by the radius, and divide by 2400 (to find the stress on an inch of the radius), and you will find the proportion of safety in eighths of an inch. The proportion will express the thickness in inches which the planes of each of the boilers should contain.

Thus, we have two boilers whose power of resistance in relation to their contents are exactly equal; hence, if the fifty pounds steam were to be doubled, the pressure would not be one iota more dangerous than the four pounds steam being increased to eight, and vice versa; consequently, in relation to strength, one boiler is as likely to explode as the other; but as neither is likely to take a flight if duly supplied with water, and their safety-valves be in good order, we will proceed to consider the result in case of neglect—first, with regard to a deficiency of water, and next to the valves becoming fixed. With respect to a deficient supply of water, the chance of it is in favor of the higher pressure, inasmuch as this little leak would probably be the force, from the larger volume necessarily kept up in low-pressure boilers; indeed, we are not aware that there is any distinction observed in this particular, but in effect the low steam may be assumed to be more disastrous from its scaling property, as you very properly remark, than high-pressure. In respect to the safety-valves, we have shown that each boiler is capable of resisting the doubling of the working pressure of its contents, or any other extent in the same ratio as an equal degree. Now, it is quite possible for a low-pressure valve to adhere to its seat so firmly as to resist the additional four pounds per inch, and even a much greater increase; whereas, in high-pressure boilers, the valves are required to be capable of an addition of fifty pounds per inch without being upset, is scarcely within the bounds of probability. All boilers require careful and efficient supervision most unquestionably, and casualties from neglect will not soon disappear. Under an equal degree of supervision and skill in construction, we think we are justified in the conclusion that high-pressure steam in regard to safety has the advantage.

The quantity of fuel saved depends upon the just application of the expansive principle: the usual practice is for the pressure in the boiler to be constant, and the amount of expansion varied by expansive gear, according to the exigencies of the service. To prove that this is an error, we need only imagine a cylinder, a few inches long and one in diameter, with steam of four pounds cut off at one quarter its length and allowed to expand to four times its volume, which will exert a mean force of two pounds and a fraction; thus we will assume to be the minimum working power of the engine. Now, if circumstances of power be applied to the four pounds during the whole stroke, it is manifest that a fourfold amount of steam will be required, and expansion must be abandoned altogether to effect it when its saving effect is most requisite, as the largest amount of fuel is being consumed. Now, in these cases, the function of these functions, by making the amount of expansion constant, and work with a variable pressure, it will be found that the steam required will be exactly in the ratio of the work done; thus, if we raise the pressure to eight pounds, and cut off the steam of four pounds at one quarter, we shall have the same effect if the maximum pressure were sixty-five pounds above vacuum, and the minimum one-half that amount, working with a constant expansion of eight or ten times its original volume.

Now that competition has raised the speed, every degree of pressure is employed and steam generated in all kinds of boilers, suitable or unsuitable; the temptation is so great to run dangerous risks for the sake of economy, that some power of control is become absolutely necessary—a matter that has, however, of being difficult accomplishment through it might be opposed by the proprietors, possibly, as exposing the secret of the designs in the engine-room, with regard to the real working pressure; but that is a matter of so weight, nor can it be honestly objected to or denied. We would refer the reader to the statements in another part of the Journal, as to the necessity of inspecting all steam-boats periodically, as to the fitness and condition of the boilers in relation to their working pressure, and to see the following precautions observed. One safety-valve, at least, on each boiler, placed beyond the control of the engineer, except as to having the power of lifting it occasionally, to insure its duty operating; or by a slight easement effected at regular intervals by the engine itself, but not of adding weight. Next, that two graduated gages be fixed in one case above deck; and also showing the pressure of steam in the boilers, and the other the level of the water and the excess or deficiency in either case from the fixed working points on the scale. These gages to be open at all times for inspection by every person on board, and minutes made in the log at regular intervals. Lastly, to ensure the taking of this precaution during the night, stating the height of the water and pressure of steam. The sound working condition of these gages to be maintained at all times, and cases of neglect, or tampering with them in any manner, to be visited by a severe penalty, together with the fine. The greatest and innumerable danger, which would at once put an end to the reckless tampering with the pressure, and insure careful attention to the supply of water, and consequently safety to all on board.

C.

London, October 7, 1847.

FULGURITUS AND FULMINARY TUBES.

We have found in a French periodical some remarks on the action of the electric fluid when striking the earth, which has attracted much attention here, and which we have used to look into the subject. It is observed that in the beginning of the last century, a hollow tube was discovered, which formed branches, in the sandy plains of Silesia. This tube was cut into slices, and it was found to contain a mass of the most curious nature. Some-what later, similar tubes were found in the neighbourhood of Paderborn, Dresden, and Munster, likewise in Cumberland, in Hungary, on the plains near Bordeaux, and on the plains of Bahia in Brazil. We do not remember regarding these tubes as being of much importance, and there is an extensive collection of meteoric stones in the mineralogical department. This suggests the propriety of a separate collection, which should include meteorites, fulgurites, minerals and vegetables affected by electric action, volcanic substances, &c. These would exhibit our knowledge of new branches of science, those of meteorites, geological action, and geological design. All the localities in which fulgurites are found, although far apart,
have a similarity of character in the soil in which the fulgurites are found, having a fine sand, containing a large proportion of silex. In this sand the tubes are always sunk vertically. Their diameter varies from 4/5 of an inch to 3/4 inches, and the thickness of the coating or wall of the tube from 1/32 of an inch upward. The larger fulgurites usually indicate the depth of tube, particularly when the tube ramifies; and these ramifications are sometimes very numerous, giving the fulgurine tube all the appearance of the root of a tree.

Some fulgurites have been found six yards long. The external surface of the tubes is composed of grains of sand cemented together; in the inside these grains are melted, vitrified, and mixed with little bubbles, forming a sort of pearl-grey enamel, with which the inner part of the hollow cylinder is lined.

In the Brazil, fulgurites have been found with facets and completely vitrified, and in Cumberland a vertical fulgurite was found cemented to a porphyritic boulder, at a depth of eight yards. At this point the fulgurite deviated, going off at an angle of 45° and being about 4/5 of an inch in diameter.

Though several hypotheses as to fulgurites have been formed, that of Dr. Richler seems best to meet the case. He has shown that these tubes are caused by the calorific action of lightning, which passing through silicious sand, melts, and forms a tube. This melted part becomes the inner wall or core of the tubes, and the outer wall is formed by the cementation of grains of quartz imperfectly melted, and joined by water in a state of vapour arising from the great heat developed by the lightning in its passage through the soil. This action of lightning has been determined on several occasions. On the 3rd of September, 1789, lightning struck an oak in the Earl of Aylesford's park, and killed a man who had taken shelter in the tree. On digging up the ground to erect a monument on the spot, a quantity of melted sand was unearthed. The man's bones were incorporated in a vertical tube of melted sand. Some seamen having noticed lightning fall on the sandy isle of Arran, off the Danish coast, found, on looking there, a fulgurine tube. On the 13th of June, 1841, Dr. Richler found a similar tube in a vineyard near Dresden. This tube divided into three branches, each of which, in turn, divided into others, so that the number of branches of fulgurites have been formed by passing the electric fluid through silicious sand. It may be observed that there are authenticated cases of rocks even being melted by lightning.

DRAINAGE OF LANDS.

Hydraulic engineering connected with the drainage of land becoming daily of such vast importance, induces us to present to our readers the very interesting discussion that took place last month, at a meeting of several highly intelligent and practical farmers and scientific gentlemen collected together at Drayton Manor, at the invitation of Sir Robert Peel. For the report we are indebted to the Agricultural Gazette.

Mr. Woodward said that in his opinion thorough drainage was the foundation of all good horticulture, without which many valuable skills would be thrown away. Some undrained land had been occupied, heavy land, which only produced 10½ bushels of wheat per acre; he immediately drained it 8 feet deep, subsoiled it, dressed it with burnt clay, and the first year obtained 19 acres, not a single straw being lost. He considered burnt clay land as a most important practice. It rendered the soil so much more friable and conformable, and enabled the farmer to work it with much less horse labour. The effects of burnt clay upon all green crops was wonderful, a most important fact which could not be too strongly impressed upon the mind, as being very essential to the growth of corn, especially when consumed upon the land by sheep, eating at the same time a little oil-cake or refuse corn. He had not, however, found advantage in the use of Italian ryegrass, which he thought otherwise the prize it had received. The treading of sheep was highly advantageous to the wheat crop, provided the land was thoroughly drained and subsoiled. In order to secure the requisite amount of pressure, he had not only employed sheep, but horses, oxen, and even men, who had been employed to tread it, c. 6d. an acre. He had also found advantage under some circumstances in the use of an instrument which he called a prow roller. This was formed of an elm-wood cylinder, stuffed with oak pegs about four inches apart; it proved to be a most effectual implement when drawn over the land, imitating as it did the consolidating power exercised by the feet of a flock of sheep. He regarded pressing down the land as opposed to an invincible obstacle to the operations of grubs and wireworms. As to dead fallows, he entirely objected to these as wafters, and he attributed much of the evil to his manure as necessary. He confessed to several for fallow, e. potted vetches, and on his gravel, ryce, and rye and vetches. For clearing the stubbles after harvest he employed the implement called a two-edged "skim," which he strongly recommended to a cheap and ready weapon. Mr. Woodward then pointed out what he regarded as the best manner of breaking up inferior pastures and converting them into arable; and concluded a very instructive speech by forcibly pointing out the absolute necessity of sending back to the land whatever is removed by a crop, and by expressing his entire agreement in opinion with Mr. Woolryche Whitmore, Mr. Huxtable, and others, that farming, properly and efficiently carried out, with capital and skill, may be made as profitable as ironworks or any other branch of commerce. Being asked whether he held his land on lease, Mr. Woodward replied that he did. He even if he had not, he would have had no reason of opinion that the expenditure of his improvements would be incurred in the improvement of his land. He expressed the pleasure of having a tenant who, by going tenant the whole unenhanced value of the improvements he had made; whether this was to be paid by landlord or incoming tenant was, he thought, of no importance. He trusted that the legislature would see the advantage of passing some law that right might be right; otherwise it was not to be expected that tenants would expend their capital on land. Mr. Woodward having expressed a desire that Mr. Mechi would bring under the notice of the meeting the result of his high farming in the neighborhood in the last twenty years. Mr. Mechi, a tenant on the estate of Mr. Wood, also present, responded to the call. His practice in agriculture coincided so nearly with Mr. Woodward's, that it was only necessary to say that he grew alternately grain and root or leguminous crops, endeavouring as much as possible to show how, although his land was 2 feet 8 inches deep, with pipes and stones, at a considerable expense; but since he had had the good fortune to meet with Mr. Parkes he had amended his errors, and was reaping more deeply and effectually with pipes alone at one-third the cost. He rented some land adjoining his own; although he held but a seven years' lease, he drained it 5 feet deep with 1 inch pipes, at a cost of from 35. to 60. per acence. He could not afford to deprive himself of the benefit of drainage. He found it very unprofitable to drain land without proper drainage. He had been entrained as a tenant in the fens. He had been enticed to farm in the place, and paid 1 l. per acre for the whole cost. The result of his improvements at Tiptree had been to double the produce of his farm and of his labour. A portion of it was formerly a swamp, not producing 8s. per acre. He had been enticed away by the prospect of the land, and leased it at 1 shilling per acre, at an annual rental of 6s. per acre. He had removed 35 miles of unnecessary banks and fences. Taking the arable acreage of the united kingdom, he thought they might safely dispense with 500,000 miles of unnecessary banks and fences, and with many more millions; each ton of produce or manure costing an average carriage of 6d. per mile, renders the position of the buildings an important national consideration. Wagons were a most philosophical contrivance. It was quite clear that a long, light, low cart on two wheels, having a space of capacity equal to a wagon, and only costing half as much, was a much more sensible and profitable mode of conveyance. The question was not now an open one, having been thoroughly discussed and decided upon at the London Farmers' Club; therefore, the sooner the wagons were got rid of the better. With regard to the quantity of seed, his experiments (conducted now for three years and publicly recorded) had uniformly been in favor of the saving, say from the saving of two years of this time.

Mr. Wood had found salt tended to a similar result. He salted his wheats at the rate of 6 to 8 bushels per acre, and was determined to use much more. He knew a gentleman in Norfolkshire, whose wheat crops could scarcely be kept from being down. He attributed this to the want of sufficient depth of native production, costing only about 20s. to 30s. per ton, whilst all other alkalis were nearly eight times as dear. He strongly recommended the abundant use of bones, with and without acid, for root and green crops. Not that he was going to appeal to the peculiar character of our soil in the produce of the farm, cost us 65. per pound, or 45s. per ton. Now, if we could replace these, as we can do by bone-dust, at 7l. per ton, it was clearly good policy to use them. He considered the waste of the common bones, and the amount of those which are annually put to the refuse of this manure, as a great evil. He was a mistake great ever to allow water to fall on manure. Water was a very heavy article. A thousand gallons weighed 10,000 lb. and were expensive to cart. He had heard farmers say when rain was falling, that it would soon hand out our lots, and take the place of our own sea water. He found in practice that animals did well on their own excreta and straw under cover; that they consolidated the manure until it was four feet thick, when it would cut out like a good dungheap, and be fit to cart on the land. But if rain water was allowed to wash this mass, an injurious effect resulted both to the animal and to the manure. The
could not afford to allow his measure to be well washed in the yards by drainage from the buildings, and afterwards to be washed, dried, and milled. He always kept them clean, and the sawdust or other hardships on the doors. He had found that his crops grew better with unwashed manure. A farm-yard should be like a railway station—covered in, but only ventilated. There was comfort and profit in keeping everything dry.

For Hay-making, there were several important points. The hay should be cut and cured as soon as possible. The hay-making season was long, and the money was better spent on a good hay, than on a poor one. As a rule, the hay should be cured for one to two months, and then be stored in the barns. The hay should be kept dry, and the barns should be closed tightly to prevent dampness. The hay should be turned regularly, to allow the air to circulate and the moisture to escape. If the hay was not turned, it would become moldy, and the quality would be damaged.

When the hay was cut, it should be allowed to wilt for a few days. This would allow the moisture to escape, and the hay would become drier. The hay should be cut when the plants were dry, and not too wet. The hay should be cut when the plants were about 15 to 20 inches high, and the moisture content should be between 30 to 40%.

The hay should be cured in the barns, and not left out in the field. The hay should be stored in a dry place, and the barns should be closed tightly to prevent dampness. The hay should be turned regularly, to allow the air to circulate and the moisture to escape.

The hay should be turned regularly, to allow the air to circulate and the moisture to escape. If the hay was not turned, it would become moldy, and the quality would be damaged. The hay should be kept dry, and the barns should be closed tightly to prevent dampness. The hay should be turned regularly, to allow the air to circulate and the moisture to escape. If the hay was not turned, it would become moldy, and the quality would be damaged.
THE RECENT EXCAVATIONS AT POMPEII.

NAPLES, Oct. 2.—In the magnificent street leading from the ancient seashore to the theatre, the road was covered by a thin layer of untrodden earth, and there the excavations have been conducted. The street was constructed of stone and tufa, and the foundation lines are clearly visible. No buildings remain, but the remains of the walls and columns are still visible. The street was lined with shops and taverns, and the side streets were narrow and winding. The remains of the street are well preserved, and the excavations have been conducted with great care and attention to detail.

Mechanical Equilibrium of Heat.—M. Segur's experiments on the distribution of heat indicate that the temperature of the body is not constant, but varies with the environment. The experiments were conducted in a room with a temperature of 20° C, and the results showed that the temperature of the body varied between 37° C and 38° C. The experiments also showed that the temperature of the body is not evenly distributed, but that the brain and heart are cooler than the rest of the body.

Metal for Glasses.—M. Laugier communicated to the Academy of Sciences, Paris, the results of a series of experiments with a new type of glass. The new glass is more resistant to heat and more durable than the previous types. The experiments were conducted in a furnace with a temperature of 1500° C, and the results showed that the new glass is more resistant to heat and more durable than the previous types.

Atmospheric Rays.—The colour of the horizons.—The colour of the horizon is determined by the scattering of light by the atmosphere. The scattering of light is greatest at the horizon, and this results in a reddish or orange colour. The colour of the horizon is also affected by the presence of aerosols, such as dust and smoke, which scatter light in all directions. The colour of the horizon is also affected by the atmosphere, which is dependent on the temperature and humidity. The colour of the horizon is also affected by the time of day, with the colour being most intense at sunrise and sunset.

Value of Land reclaimed from the Sea.—A few days ago, farmers, by the Nene Outfall commissioners, at Witham, 900 acres of land, in 27 lots, being their portion of between 3,000 and 4,000 acres gained from the sea, by the completion of their great work. The lots varied from 7 acres to 180; and the reserved bid varied from about 45l to 50l per acre; and though none of the lots were actually sold at these prices, above 60l per acre was bid for one lot, containing 100 acres, and for some of the others the prices were given, but not sold. It is hoped that the whole of this valuable land formed the bed of the Witham river, and from the rapid deposits now going on beyond the barrier bank, another portion of from 3,000 to 4,000 acres may be added to ferme in the course of the next month of March.
The Eclipse.—The meteorological observations made at the Cambridge observatory during the eclipse on the 9th October have been published, as follows:—Air-pressure, 29.40, and by thermometers, very high, but sufficiently considerable to show there to have been in some measure affected by the phenomenon. The observations were taken at intervals of from 10 to 15 minutes. At 8h. 0m., the barometer read 29.833 in., and until the commencement of the eclipse showed an inclination to fall. At the time of the greatest obscuration, it remained stationary, and immediately after it continued to ascend; finally, at 8h. 45m., it read 29.963 in., having thus ascended 0.030 in. in 8h. 45m. With three common thermometers, one in air, another in the shade, and the third in the sun's light, another with plain bulb in same position, and the third in the shade, the readings were plainly affected, though to a small amount, remaining mostly stationary as the sun became obscured, and varying rapidly as the phenomenon passed. The temperature of air, sun's light, and shade, the differences were uniform, following the same range as the common thermometers. Owing to the moisture in the atmosphere, the wet and dry bulb readings were nearly the same, the differences being at commencement 2.6 degrees; below dry, 0.5 degree; at greatest obscuration, 0.4 degree; and at termination, 1.0 degree.

New Railway Carriages.—Messrs. Adams, of Fairfield Works, Bow, have just constructed some improved carriages for the North Woolwich branch of the East Counties railway. They are 40 feet in length, and 9 feet in width; the extra width being gained by building the carriage frames to the width of the ordinary step-boards. More is thus accomplished on the narrow than has yet been on the broad gauge, where the carriages are only 8 ft. 6 in. in width, by 25 feet in length. The extreme axles are 8 feet 9 inches apart, and the side carriages are 6 feet 3 inches above those on six wheels or on four. Notwithstanding their length, they will pass a curve of 200 feet radius by means of the flexibility and arrangement of the springs, which permit the wheels to traverse laterally. The buffer heads are free to turn to adjust themselves accordingly. On the whole, they press firmly under all circumstances. The carriages are fitted up in four compartments; one first-class with couches all around, and a table in the centre; the other three second-class. They will carry about 100 passengers.

Obituary.—Mr. Cottingham, the architect of several cathedral restorations and other public works, died on the 10th ult., at his residence in the Waterloo-bridge road.

Death of Vasques.—Benor R. Vasques, member of the order of the Jesuists, and of the Academy of Fine Arts, one of the most able architects and engineer in the Peninsula, has just died in Spain. He entered the order of St. Ignatius, but continued ardently to pursue his profession, in which he was extremely successful. He was engaged in the immense undertaking of opening a tunnel in the mountains of Guadarrama, a much more difficult task than even the most celebrated tunnel of Europe, when he was suddenly attacked by an illness which carried him off.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM SEPTEMBER 24, TO OCTOBER 21, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Charles Bancroft, of Brompton, Middlesex, gentleman, for "Improvements in the preparation of grape parchs, and in the application thereof, same, and in combination with other materials, to various manufacturing purposes."—Granted September 24.

Charles de la Salle, of Paris, gentleman, for "Improvements in looms for weaving."—Granted September 24.

William Edward Newton, of Chancery-lane, Middlesex, gentleman, for "Improvements in machinery for the manufacture of ota and netting." (A communication.)—Granted September 24.

Richard Johnson, of Manchester, wire manufacturer, for "certain improvements in the manufacture of wire cloth."—Granted September 24.

Charles Jay, of Bathurst-street, gentleman, for "Improvements in machinery for making the braiding and brocuring of the surface of steel, iron, zinc, lead, and tin."—Granted September 24.

Robert Hawkins Nicholls, of Thornby Grange, Burscough, Lincoln, gentleman, for "Improvements in plating, galvanizing, and electroplating other metals and in the making of electrical and other machinery."—Granted September 24.

James R. Baylis, of Red Lion-street, gentleman, for "Improvements in machinery for making laces for boots and shoes, boots or stockings for eiderdowns, and other irregular forms."—Granted September 25.

Charles Adley, of Addlestone-street, gentleman, for "certain improvements in apparatus for evaporating and concentrating macaroni and salting vinegar, and which will also be applicable to the evaporation and concentration of vegetable and other extracts."—Granted September 30.

Pierre Auguste Bessaneau, of No. 11, Rue de Cretemont, in the City of Paris, gentleman, for "a new process for the preparation and engraving of prints, adapted to the printing of cotton stuffs, paper, and other substances."—Granted October 7.

Nathaniel Fortescue Taylor, of Vanessa Walk, Lambeth, engineer, for "Improvements in machinery for the manufacture of oana, and in the making of certain substances, and in the application thereof, to musical instruments,"—Granted October 7.

Joseph Wye, of Alfred Place, Saint George's, Southwark, engineer, for "Improvements in machinery for driving pins and raising and lowering the tube and bolts."—Granted October 7.

James Read, of Montague Terrace, N.W., and the engineer, for "certain improvements in locomotive engines and carriages."—Granted October 7.

Alexander Birt, of the Wilderness, Hampton Wick, gentleman, for "Improvements in certain apparatus for manufacturing musical instruments,"—October 7.

Sir Samuel Brown, knight, of Vanbrugh Lodge, Blackheath, Kent, in Her Majesty's Navy, for "Improvements in propelling and steering vessels, and improvements in the mariner's compass."—Granted October 7.

George M. Dodge, of Attleborough, in the State of Massachusetts, of the United States of America, for "certain new and useful improvements in machinery for spinning and weaving yarn."—October 7.

Thomas Hunt Barber, of King-street, Chapeltown, gentleman, for "Improvements in machinery for propelling vessels." (A communication.)—October 7.

Richard Fell, of Witcher-street, London, engineer, and James Fell, of Ot万多, gentleman, for "certain improvements in the manufacture of glass, and certain substances."—A communication.—October 7.

James Hartley, of Dresden, glass manufacturer, for "Improvements in the manufacture of glass."—October 7.

Jean Joseph Martin de Ligne, of Portland-street, in the County of Middlesex, gentleman, for "Improvements in machinery for propelling vessels, and other machinery for various purposes."—October 7.

Matthew Townsend, of the borough of Leicester, framework-knitter, for "Improvements in the manufacture of machine-woven blankets."—A communication.—October 7.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "certain improvements applicable to the construction of buildings and other parts of buildings, and also in certain modes of furnishing and fittings for buildings."—October 7.

Pierre Antoine Joseph Dujaudoin, of Lilla, in the kingdom of France, doctor of medicine, for "Improvements in electro-magnetic telegraphic apparatus."—October 7.

John Tysall, of North Avenue, Queen-square, Middlesex, gentleman, for "Improvements in machinery applicable to the printing of newspapers and for the purposes of telegraphic communication."—October 7.

John Hoole, of Kidderminster, Worcestershire, gentleman, for "Improvements in machinery applicable to the printing of maps, charts, and other subjeets."—October 7.

David Fisher, of Clerkenwell Green, Middlesex, for "certain improvements in the manufacture of boots and shoes."—October 7.

Matthew Curtis, of Manchester, gentleman, for "Improvements in machinery used for preparing, preparing, and polishing other substances, and also in preparing the same for the same purposes."—October 7.

Joseph Munday, of Lambeth, Surrey, for "certain improvements in the manufacture of wool, and in the manufacture of certain substances."—October 7.


Arthur Wall, of India-row, East India-road, Middlesex, for "a new or improved apparatus for a method of separating ceizes from their compounds and each other."—October 7.

Robert String and Newall, of Gateshead, Durham, for "certain improvements in machinery for preparing and finishing goods and substances on railroads, and other machinery and apparatus for working or driving other descriptions of machinery."—October 7.

Robert Bashford, of God's Brow, Stafford, railway bar finished, for "Improvements in the manufacture of wrought-iron railway bars and railway rails."—October 7.

Edward Tattriss, of Newmarket, land surveyor, for "Improvements in making communications from one part of a railway train to another."—October 7.

Brooke Smith, of Birmingham, manufacturer, and Richard Ford Burgess, of the same place, for "certain improvement or improvements in apparatus for clearing,"—October 7.

Charles Adley, of Addlestone-street, gentleman, for "certain improvements in machinery for propelling and steam-engines,"—October 7.

Patrick Elsdon, merchant, and Laurence Hill, junior, civil engineer, for "Improvements in the manufacture of sugar."—October 7.

John Ridgway, of Calderdale, gentleman, manufacturer, for "certain improvements in the manufacture of paste boxes, and of other similar articles, in textiles and earthenware, or other plastic materials."—October 7.

Charles E. Redfern, of Red Cross-street, gentleman, for "certain improvements in machinery and implements for boring and shaping."—October 7.

Robert Richardson Banks, of Great George-street, Westcheap, gentleman, for "a new method of artificially currying and preserving the hides of cattle by drying apparatus."—October 7.

Edward Tattriss, of Newmarket, land surveyor, for "Improvements in making communications from one part of a railway train to another."—October 7.

A QUERY.—Suppose (P) pounds raised one foot high per minute represented the power required to roll a certain cylinder over a certain uniform inflexible road at a given rate. Also suppose (p) pounds raised one foot high per minute represented the power required to carry a certain unattached substance (of the same density) along an inflexible road. [That is, the power required to travel just so much of that substance in any given time as the cylinder came in contact with during that time].—Question. Would (however great the diameter of the said cylinder, and however great the said substance (of the same density) as necessary to raise one foot high per minute be required to move the said cylinder on the said road over the said substance at the given rate, that substance being crushed thereby?}

J. W.
RAILWAY SUSPENSION BRIDGE.

(With an Engraving, Plate XVIII.)

At the last meeting of the Institution of Mechanical Engineers a paper on a peculiar form of bridge, I ought, perhaps, to apologise for introducing matter which may be of some interest to belong more strictly to our civil brethren; but possibly before the conclusion of the paper, I shall have anticipated any objection which might have been made on that score by showing, in point of fact, that I have only been explaining a piece of boiler-maker's work, and which may certainly be considered to be far enough removed from civil engineering. The object of the present paper is to call the attention of engineers, and railway directors generally, to a mode which I have invested of constructing suspension bridges in such a way that they shall not be thrown out of shape, or in any way distorted, by the weight of a passing load, whether it consists of a railway train or only of the ordinary traffic of a common road. It is well known that suspension bridges are decidedly less costly than any stone bridges, and we may add that most iron bridges, unless they are all along the length of an ordinary girders; and although many persons have turned their attentions to them, particularly with regard to their use on railways, I am not aware that any suspension bridge has ever been made, or proposed, that was at all competent to carry the weight of a railway train in motion, or, in other words, that should be safe as a railway bridge. My attention was particularly called to suspension bridges by the proposal of carrying a railway over the Hungerford-bridge, or over a bridge placed alongside of it; and it appeared to me that the weight of a passing train would so move and distort the chains as to cause the road very soon to get out of order, if not actually to give way; and I then conceived the plan of making a chain of such depth as to include any alteration in the curve of the strands that might take place.

The curve which the chains of an ordinary suspension bridge takes is well known to be a catenary, or rather a curve between a catenary and a parabola; it would be a true parabola if all the weight were in the platform, and a true catenary if all the weight were in the chains. As, however, the difference between a true catenary and the parabola is very slight indeed in that portion which would be used for a bridge, we may assume it to be a catenary for all practical purposes. Now, on loading an ordinary suspension bridge with an even small weight, it at once assumes a different curve (unless the weight be equally distributed over the bridge), and if the weight be large, it will assume a very different curve; but, soon, indeed, will the form be altered so as to injure or strain the material of which the platform or road is composed. Now, it is evident that, if the road has to distribute the weight, it must be a very strong and stiff beam, or, in fact, a girder of the full length of the bridge; and the strength of this girder would very nearly be equal to carrying a quarter of the weight of the road in the centre; it is, therefore, evident that the plan of forming a stiff platform or road for a railway suspension bridge, although by no means impossible, must be at least half abandoning the suspension principle, and be the cause of greater outlay. The plan of keeping the road in shape, by distributing any weight that might come upon it, by means of strong diagonal ties, was the first idea that I had; but it will be found by calculation that these diagonals would have to be very strong, and of considerable height, thereby causing the total depth of the bridge to be much greater. But the plan on which I propose to construct suspension bridges capable of carrying railway trains without being in any way injured thereby, is simply to construct the chain of such depth as to include the curve of strain when the weight is placed on the bridge in the most unfavourable positions. With this object I construct the chains of boiler plate of considerable depth—say three or four feet, or more—and rivet the whole well together without any movable joints, or separate links, and at the top and bottom edges of the chain (I still mean chains, that may be tried between) I rivet or otherwise attach bars, either flat, half-round, or angle iron, so as to give an accumulator of metal at those parts, and at the same time to render the edges of the chains perfectly secure against any tendency to rise or tear.

In the engraving, fig. 4, it will be observed that there are two chains, each 4 feet deep, which support the ends of cross wrought-iron girders, in the position of sleepers, each chain being composed of four boiler-plates, riveted together in pairs, each plate being three-eighths thick, and at the top and bottom edges there are securely riveted strong angle irons. The suspension bars hang between the two pairs of plates forming the chain, and are supported by a small saddle, which bears on the top edges of them. The ends of the cross wrought-iron girders are firmly secured to a light rib of boiler-plate, which runs along each side of the bridge, as shown in the section of the bridge; the lower ends of the suspension-bars are secured to the ends of the girders, with means of adjustment, so that the road may be trimmed perfectly level when the bridge is fixed. There are also light diagonal ties shown in fig. 5, for more perfectly staying the road to the chains, particularly in case of the bridge being applied whilst the train is passing over the bridge. The rails, either of the ordinary for places of chairs, or of that form commonly called the bridge-rail, are supported on balls of timber, scarped together, which run longitudinally throughout the bridge, and these are supported by short balks of timber running from girder to girder, immediately under the first. There are a series of diagonal ties placed in the platform, as shown in plan, fig. 3. These act as a means of stiffening the platform, and preventing any vibration or shaking of the parts. There are also diagonal ties or stay-rods, by which the bridge is prevented from swaying or swinging sideways. They are attached to the piers, and are very similar to some used by Mr. Brunel, senior, in a bridge at the Isle of Bourdon.

The engraving shows a bridge 200 feet span, having the cross girders eight feet from centre to centre, and the chains four feet deep, which depth has been arrived at by actual experiment; the weight of the road from one line of rails and the train is one ton per foot run, and this is allowing some margin for the continued growth of locomotives; I have taken as a proof load, two tons per foot run; thus the weight of the load, or disturbing causes, will be just double the weight of the bridge. I find the greatest distortion of the curve strain takes place when the bridge is only half loaded,—i.e., from one end to the centre the curve then approaches the bottom of the chain, very nearly in the centre of the unloaded half, and approaches the top of the chain in the centre of the unloaded half. If the piers it approaches the top at the loaded end, and the bottom at the unloaded end, as shown by the dotted lines in fig. 2. Again, if the same load be placed in the centre of the bridge (covering one-half of the length), the curve of strain will approach the bottom of the chain in the centre, and will approach the top of the chain at very nearly one-fifth from each pier, whilst at the piers it will be near the centre of the chain, but rather above it. Take one more case, and we shall have disposed of all the heavy disturbing tendencies—the last of the ends loaded, and the centre left unloaded; the curve of strain will then approach the top of the chain in the centre, and the bottom of the chain at about one-sixth from each pier, whilst at the piers the strain will be slightly above the centre. I may add that, when the bridge is fully loaded throughout, the curve of strain is in the centre of the chain, throughout its length. I propose to call bridges made on this plan, "Inverted-Arch Bridges."

Photogenic Experiments.—M. Claudet, in a paper lately read at the Académie des Sciences, Paris, containing an account of various photogenic experiments, states that the solar spectrum is endowed with three different photogenic actions, which correspond with three groups susceptible of being attributed to the three groups of red, yellow, and blue rays. These three actions have distinct characters; each of the radiations has the effect of fixing the vapours of mercury in Daguerreotype plates, but they are in other respects so different that they cannot mingle or assist each other; on the contrary, they destroy each other. The effect commences by the blue rays is destroyed by the yellow and red rays, and that which is produced by the red rays is destroyed by the yellow. The effect of the yellow rays is destroyed by the red, and that of the last two is destroyed by the blue rays. These changes appear to indicate that the chemical compound which covers the plate remains always the same under the various influences, and that there is no separation or isolation of the constituent principles. By a proper application of this theory, it will be possible to efface any image upon a plate, and yet leave it in such a state as to receive a new impression.

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WORKING STEAM EXPANSIIVELY.

When a steam-engine is working at any given speed, the pressure on the
 crank-pin is equal to the pressure on the piston resolved into the direction
 of the length of the connecting-rod, minus the force of inertia of the re-
 ciprocating parts when their velocity is increasing, or plus the "vis inertiae" of
 those parts when their velocity is decreasing;—it is required to ascertain
 the amount of this ± pressure.

If the square of the velocity of any mass of matter increases in an ele-
 mentary space n times as much as it would increase by falling through that
 space,—then the force for that point or elementary space must be n times
 the force of gravity, or n times the weight of the mass; that is, putting
 $v = \text{the velocity due to falling a given space}$, and $V = \text{the actual velocity},$

\[
\frac{V \cdot dV}{ds} = n \quad \text{and differentiating} \quad v \cdot dv = gds.
\]

Let $x = \text{the angle passed through by the crank};$
 $r = \text{the length of the crank};$
 $s = \text{the space travelled by the piston};$
 $V = \text{the velocity of the piston} = \frac{dx}{dt};$
 $v = \text{the velocity of the crank-pin in the arc} x = \frac{r dx}{dt};$
 $C = \text{the length of the connecting-rod};$
 $C = \frac{C}{r}, \text{ or the value of C in terms of the length of the crank};$
 $n = \text{the force of inertia or inertia in terms of the weight};$
 $p = \text{the pressure on the crank-pin caused by the inertia or inertia, or the}$
 $\text{value of n reduced to the mechanical conditions.}$

For the beam, let $g$ be a fraction expressing the distance of the centre
 of gyration from the centre gudgeon when the length of the radius of the beam
 is 1. Let $n'$ represent the force of inertia of the beam at the point $g$: then

\[
\frac{g \cdot dV}{g' \cdot ds} = \frac{g \cdot dV}{g' \cdot ds} = n';
\]

but of this force, a portion $1 - n'$ will be sustained by the centre gudgeon;
the remainder, or $n' - n'$, will be sustained by the top of the connecting-
rod, which, multiplied by \( \frac{c}{(c^2 - \sin^2 x)^{\frac{n}{2}}} \), gives the pressure on the crank-pin
due to the inertia of the beam, which we will call $P'$; therefore

\[ P' = \frac{g' \cdot dV}{g' \cdot ds}, \quad \text{or} \quad P' = g' P, \]

on the supposition that the end of the beam describes a straight line instead of an arc, which
supposition has been made by all writers on the theory of the crank.

The connecting-rod has a compound motion—namely, vertical at the top
(neglecting the arc), and circular at the bottom; these two motions may be
resolved into vertical and horizontal. The sum of the inertia in the vertical
and horizontal directions, resolved in the direction of the length of the rod,
will give the value of $P'$. Let the centre of inertia, in the vertical sense,
be supposed to be concentrated in an undetermined point $p$: this point,
when the upper end is moving vertically with greater velocity than the lower
end, will be between the two, and of the centre of gravity; and when the lower
end is moving vertically with greater velocity than the upper end, it will be
between the bottom and the centre of gravity—practically, it may be con-
sidered to be in the centre of gravity.

The upper end will have passed the space $s$, and the lower end the vertical
space $v \cdot vs$, the point $p$ will have passed a vertical space $v$s', and

\[ s' = s - p (v \cdot vs) = (1 - p) s + v \cdot vs - v s', \]

when $p$ is a fraction expressing the distance of the aforesaid point from
the top, the length of the connecting-rod being unity; inserting the value of $v$, and

differentiating

\[
\frac{ds'}{d i} = r \sin x ds + \frac{(1 - p) \sin x \cos x}{(c^2 - \sin^2 x)^\frac{n}{2}} ds;
\]

and the vertical velocity of the point $p$ will be

\[ \frac{dV}{dt} = \frac{dV}{dt} \times \frac{(c^2 - \sin^2 x)^\frac{n}{2}}{v \sin x \cos x} \circ \sin x + \frac{(1 - p) \sin x \cos x}{(c^2 - \sin^2 x)^\frac{n}{2}} \circ \sin x. \]

Substituting for $\frac{dV}{dt}$, differentiating and reducing by the "triangle of
forces," we have

\[ P = \frac{c^2 \cdot dV}{c^2 \cdot ds} = \frac{c^2 \cdot cs}{c^2 \cdot (c^2 - \sin^2 x)^\frac{n}{2}} = \frac{32 r (c^2 - \sin^2 x)^\frac{n}{2} + c^2 \sin x \cos x}{32 r (c^2 - \sin^2 x)^\frac{n}{2}}, \]

which needs no further reduction, inasmuch as there is no vertical support
to the top end of the connecting-rod; consequently, the whole of the in-
ertia or inertia concentrated in the point $p$ is sustained by the crank-pin.

For the horizontal motion of the connecting-rod, the inertia is con-
centrated in the centre of gyration, and the space described horizontally by
that point will be $g \cdot r \sin x$; differentiating and substituting, we have

\[ V'' = - g \cdot r \cos x - \text{and ultimately we obtain} \]

\[ \frac{dV}{dt} = \frac{dV}{dt} \times \frac{(c^2 - \sin^2 x)^\frac{n}{2}}{v \sin x \cos x} \circ \sin x + \frac{(1 - p) \sin x \cos x}{(c^2 - \sin^2 x)^\frac{n}{2}} \circ \sin x. \]

which will need reducing, because $(1 - p) \cdot n'$ will be supported by the end
of the beam laterally; the remainder, $g \cdot r$, reduced into the direction of the
length of the connecting-rod, by multiplying by $\frac{\sin x}{c}$

\[ \frac{(r \cdot \sin x)}{c} = P \quad \text{therefore, for the connecting-rod we have} \]

\[ P = \frac{c^2 \cdot cs}{c^2 \cdot (c^2 - \sin^2 x)^\frac{n}{2}} + c^2 \sin x \cos x. \]

Let $W$ = the weight of the piston and rod and appendages; $W'$ that of the beam; and $W''$ that of the connecting-rod;—then collecting the above
results, we have

\[ P = \left( W + W' + W'' \right) \times \frac{c^2 \cdot cs}{c^2 \cdot (c^2 - \sin^2 x)^\frac{n}{2}} + \left( W + W' + (1 - p) W'' \right) \times \frac{c^2 \sin x \cos x}{c^2 \cdot (c^2 - \sin^2 x)^\frac{n}{2}}. \]
In the next month's Journal, I intend to give a table of the value of $P$
for different angles of the crank, when $W = 1, r = 1, r = 1, \text{and} c = 4$, which
will be about a medium value of $c$. This will reduce the above to the fol-
lowing form:

\[ P = (W + 2W + W^2) \times \frac{T^2}{r} \],

$T$ being the tabular number.

The practical inferences will also be attempted to be shown.

Bochdale, Nov. 15, 1847.

M. N.

CANDIDUS'S NOTE-BOOK.

FASCICULUS LXXVI.

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

I. It is an ill wind indeed that blows nobody good. Penny-a-liners, thrive upon accidents, "awful occurrences," and disasters: a famine helps to keep them from starvation, and "a most terrible murder" from cutting their own throats. In like manner, the "Arch and Statue" was a windfall to the critics—especially the small-fry gent, who having got their cue, roared out as lustily as sucking doves. To that enormity, however, we seem to be now reconciled,—perhaps, by the irresistible argument advanced for suffering the Statue to remain, although the reason assigned was such as to cause some people to quote Johnson, and exclaim—

"From Marlborough's eyes the tears of dosage flow."

It is now the Palace which is the general butt of criticism, or rather is beginning to become so; for although it has been censured severely, carefull is not at ye so universally expressed,—many preferring, for reasons tolerably obvious, to be silent, and take no notice of it at all. Their very silence, however, is most significantly condemnatory of the Palace, since they would be foolishly loud with their praise, were it possible in any way to commend it. Their silence, moreover, betrays what sort of solicitude it is with which they so busily interest themselves, and affect to watch over the interests of Art. Criticism,—honest and genuine criticism— is no respecter of persons: it makes no distinction between Prince or Pecksniff; or if it made distinction at all, it would be to admixture with most severity on bad taste and paltriness of taste in the former, as being decidedly influential for mischief to Art.

II. One presumption strongly in favour of those who betake themselves to the practice of any art to which they were not at first educated in their youth, is that they have been impelled to do so by a natural irresistible impulse towards it and a sincere affection for it. Accordingly, when Mr. Blome abandoned his original profession of engraver for that of architect, there was no reason for suddenly supposing he was instigated to do so by the consciousness of possessing not only a preference, but superior talent for the art which he thought proper to make his new calling. It was not, indeed, to be supposed that he would distinguish himself by any particular ability in construction and other mechanical and technical matters, or in what comes under the general term of business, yet it was rather to be expected that he would display some touches at least of genius and imagination—some of those felicities unbidden ideas that not all the professional training in the world will enable any one to produce. Nevertheless, it is precisely in the artisitic and imaginative that Blome fails, and fails most egregiously; wherefor he may, so far, be said to signalize himself egregiously also. Reversing what the satirist says of Ferraioli, he has turned from a good draughtsman and engraver, a wretchedly bad architect.

Pondness for architecture he may have; although even that may be questioned, since con amore feeling never impels him to exhibit at the Royal Academy,—a piece of forbearance in which he emulates another shining glory of the British school of architecture. He will not, it may be presumed, break through his rule of non-exhibiting, even out of compliment to the Palace, and yet he might take the opportunity of showing his "new building" to very great advantage in a drawing, by representing it just as it shows itself through a very dense fog.

III. An article in the New Monthly, purporting to be a "Secret History of the Court and Times of George IV.," contains the following interesting contribution to architectural history. "During the time the unhappy man

[Cashman, the sailor, was suffering the sentence of the law, the Prince [Regent] was occupied in the inspection of a surveyor's [ ] estimate and plans for the erection of a house for the Duke of Wellington. 'A palace it shall be,' exclaimed his royal highness. Lord Burghersh detailed to the Prince all its proportions, it occupying four fronts. The architect of this design is young Cockrell, and he estimates five hundred thousand pounds, every farthing of which, the Prince says, shall be expended upon it. How the money is to be raised is another question." It is still a question, perhaps if this same piquant anecdote be little better than one of those random bits of gossip which the congenitors of "secret histories" so greedily swallow and so complacently divulge. At any rate, "young Cockrell" must know something of the matter, yet be seems disposed to keep the secret, notwithstanding that a design which would have required half-a-million to execute must have been something magnificent,—the more fame of which ought to have overawed the author of it with commissions. It did not however, help him to the patronage of George himself, for when Buckingham House was to be metamorphosed into Buckingham Palace, he gave the job to Nash. While as to the Duke, he, perhaps, finding that the intention of building him 'a palace' had clean evaporated, betook himself for building for himself a snug little house, for which he employed Ben Wyatt as his Virius, and which, if not an architectural "lion," deserves very well to pass for an architectural sheep.

"I am always showing after what fashion the writer understood what he was speaking of."—New Improvements! Waterloo Place, opposite Carlton House, is beginning to assume something like an uniform feature with (the) façades of Carlton House. The columns are composed of brick supporting a scagliolising pole (!), and the latter supports the entablature (I). Now, when the pole rots, down will come the whole structure. So much for the economy of the architect." And so much, also, for the sense of the critic who discerned scagliolising poles supported by the columns, and supporting the entablature.

"V. Without corresponding worthlessness of design, value and goodness of material only increases dissatisfaction—that is, of intelligent; for the uneducated in art—and who are so far the vulgar, the uninstructed profanum vulgus, let them belong to what class of society they may—have no other standard of excellence than size and cost. Ask such persons their opinion of a building, and they will perhaps tell you it is a very grand one, because it is very large and all of stone, although it may nevertheless be in itself a complete absurdity, considered as a production of architecture, and hardly worth half a shilling. So far from affecting any satisfaction, it is truly mortifying and vexations to find, as is frequently the case, superior material employed for what is exceedingly poor, if not positively bad in point of design. More than one structure might be mentioned that, owing to the unfortunate durability of its materials, will last to disgrace its author, unless it should have the good luck to be metamorphosed,—of which there have lately been one or two instances,—into something quite different. More market-value is the criterion by which most persons steer their criticism. Tell them that a picture cost a thousand guineas, and—Oh, the hypocrisy!—and it will instantly be acknowledged as a masterpiece. If it have expensive and beautiful paintings in it, although, in all probability, they had actually turned up their noses at the very same performance had they heard that it cost only two pounds, or that it was painted by some Mr. Smith. Almost the very first question or remark of all which people ask concerning what ought to be estimated by its artistic value, relates to cost and price,—which is both exceedingly vulgar, and exceedingly English. It is the ordinary reverence for mere cost and sumptuousness that has obtained so much fame for Verailles, that monument of a taste at once frivolous and prosaic,—poetic only in the wasteful prodigality that stumps it, showing what reckless pro-

In the following article, purporting to be a "Secret History of the Court and Times of George IV.," contains the following interesting contribution to architectural history. "During the time the unhappy man
the divers excess which he sometimes did. Verily the great
civilizer's love of action must have been quite overwhelming, when he directed
Mr. Hay to paint him shams frames to pictures—a species of deception so
inartistic—or rather a mere attempt at deception, which instantly betray
itself to the eye, that almost any one would, on seeing it, exclaim with
Macbeth: "Unreal mockery, hence!" Let me myself be fancied to be
here reminiscing, by imparting the strange freak in question to Sir
Wallace, I will quote Mr. Hay's own words concerning it. After stating
that Scott had directed him where to place the two small pictures—two small ones
(one of Malvoisie Abbey by moonlight) being to be placed 
over doors,—a most unmitigated farce for paintings of small dimensions,—
he proceeds to state that: "these, after being fixed to the wall by a
narrow moulding of oak, were to be surrounded with an imitation of a 
carved frame of the same material, painted in light and shade upon the flat plaster." 

Now, however ably executed—by how admirable so ever bromans of 
relief the appearance of actual carving projecting from the wall might be rendered,
the eye could not fail to detect the deception upon almost the
very first change of position; and if they happened to be viewed sideways,
it would at once be perceived that these frames were only flat painted
frames, without any projection at all, while the real "narrow moulding
of oak" would by its projection on the wall show itself very awkwardly.
Such a mixture of the imitative and the real must have been in very bad
and parnasoire taste—both execrable and to be accounted for only as a mere
whim on the part of Sir Walter, for the fun of "taking it" his guests after
that fashion, making them stare, and enjoying their surprise. Painted frames to
to decorate an imaginary wall are just as preposterous as real 
frames would have been for paintings executed upon the walls,

Institute of the building on the real material would do.
Every one knows, for instance, that gilded ornaments are not of the solid metal, but merely covered
with gold of almost incredible thinness—the two hundred and eighty-thousand of an inch!—what then? the appearance is produced, and it
is with appearance, and appearance only, the embellishment which
at first sight at first sight, on first sight, makes one at once think, if one

Granting that the bloom of her complexion may be artificial—and you only
suspect it,—I take the beauty of it to be just the same as if it was real: a
difference of course there is; but that is her affair, therefore a truce to your
preaching."—Value of material adds nothing to the merit of design—
of the architect's own share in the work, who, if he be an artist, will
display talent and produce effect with the cheapest and cheapest materials,
—with merely fictitious ones—alias "sham," while he is not, will
show the very best pictures to disadvantage, and render them less valuable
than they were before being used, or we may say abused, by being applied

VII. Hay has had a hit at Sang's decorations in the Royal Exchange,
which he has the delicacy, however, not to mention by name, contenting
himself with alluding to it so very politely that no one can possibly mistake
"Our general knowledge," he observes, "even of the propriety
necessary to be observed in decorations, is so far below the requisite
standard that the grossest absurdities are often committed. For instance,
we find the most finery and most luxurious in the palace itself,
and in the decoration of a building devoted to the private luxury of an
ancient Roman, adapted as a suitable style for the interior of an house

species of public business of such a grave nature, etc., etc."
"It is
scarcely possible," he continues, "to conceive a greater degree of decorat-
ive incongruity than this, yet it has been committed in one of our greatest
national edifices, amidst all the agitations that exists in regard to national
advancement in the art of ornamental design." The measure is perfectly
just: the mistake these commissioners have, however, committed, is so obvious a palpable one
that it is extraordinary it should have been allowed to be perpetuated.
Were it possible to entertain so strange a suspicion, we might imagine
that this specimen was intended to satisfy the public most effectually one way,
by making them gape and scan the real and the real for the first glance, and proclaiming
it to the whole world in the fairest manner, that there was Lord
Somebody-else is reported to have said in the House, he thought the public
would be satisfied with Buckingham Palace—the unlucky Palace again! but it can't be helped—after Mr. Blere's alterations—his lordship was too
conscientious to make use of the word "improvements." But what a
mean opinion then must be entertained of the public taste, and how very
little regard must he have for its "advancement,"—that is, supposing him
not to be himself an utter novice in matters of art, and to have had no sus-
ception of what a balsam design he was recommending to the "House,
pre bases publics; a design which now makes the Palace look almost twin-
brother to the Barreeaks just by, in the Birdges walk, with which Blere
or somebody else must have been so smitten, as to take the leading idea
from it.—Verily, it is a proof of an innocence that some one lately quoted, or
pretended to quote, the following distich:

"Unhappy Britons! I aforesaid to be disguised
By Pecunia palaces, and Royal taste!"

VIII. Errors of the press are, if generally provoking, sometimes ex-
ceedingly diverting, as, for instance, that of a certain "print" which has
transformed the "Army and Navy Clubhouse" into that of the "Army
and Knavey," than which Mrs. Malaprop herself never uttered so amus-
ing a blunder. There has been an error of some magnitude in the matter,
we are bound not to suspect; nevertheless, there is much which looks like
manoeuvring. Most assuredly it looks like anything but fair play on the part
of the Club to attempt to measure the public building, without
allowing the first competitors—those who had tasked their ingenuity to provide
the required accommodation within a space which the Club them-

selfs have since virtually declared to have been insufficient—to take their
chance in a second competition. Well, the refusal may have been mercy,
although, apparently, it does not say much for the liberality of the "Army
and Knavey." And as to their clever scheming—why, a piracy from Sassovisco for their exterior, and for their interior, a
most humdrum, merely-pamby plan, devoid of all inventiveness, contrivances,
and study of effect—merits which the "Army and Knavey" people have perhaps no conception, much less any appreciation of.
For Clubhouses at least, if not for private houses, it might be supposed that something
more than mere routine plan would begin to be thought of, for in that
direction, if no other, there is room for advance, and great scope for
improvement. Admitting that composed forms of rooms are more expensive
than the usual four-sided ones, and that they also occasion some loss of space,
consequently are out of the question for houses in general where economy
is to both cost and space must be chieflly attended to, so far from being
an argument against, it is a relief de plus for such forms and picturesque
effects being purposely introduced in Clubhouses and other houses of
a superior grade, instead of four walls with a flat ceiling, and perhaps one
core to it, being, as the Athenaeum remarks, all the elements out of
which their apartments are constituted. Surely, says the writer in that
Journal, if it be worth while to expend so much as is sometimes done upon
superficial and accessory embellishment, it would be equally so to expend

V. So very little study is given to matters of plan in rooms, either as re-
gards ensemble or individual parts and detail, that the eye is frequently
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offended by the most unpardonable negligence, and sometimes by the most arrest bungling, in point of design, even in large and expensively fitted-up and furnished apartments, where, just in order to save a little exertion of ingenuity and coyness, and symmetry, and balance have been more or less disregarded. Thus that consideration of the subject and actual circumstances, which would almost of necessity prompt fresh ideas expressly adapted to the occasion, is altogether evaded, and the most ordinary routine is submitted for artistic composition and artistic effect. In fact, the majority of those who call themselves architects, appear to have no more in mind, as any conception of what artistic effect is, - not even so much as to suspect that it can have anything to do with their own art. The truth — and a sad truth it is, architects are not educated artistically: artists they may eventually become, but it must be entirely by the promptings of their own mind, for by others they are not even so much as put into the way of becoming such — which is the utmost that can be done by the very best artistic education. Well, therefore, was it said by one who valued his art, and being asked to take a lad as his artistic apprentice: "I can engage to make your son a good practical builder, but as for architecture, you might as well ask me to make him an archbishop!" — To dismiss remarks of this kind, I return to what occasioned them, by affirming that effect—generally artistic and other effects of a less artistic kind — is through the medium of interiors, planning. It will, no doubt, be urged very urgently that effect adds nothing to convenience. Most assuredly not; but so neither does embellishment, which is only for the sake of that species and degree of effect — certainly not the most valuable of all, that is to be so obtained; it being, on the contrary, that which is most easily of all assured. Consequently, effect be not worth the study required for producing it, so neither is decoration worth its cost, and the latter may be, by very far, the more costly of the two, because the other may sometimes be produced by the simplest means, without other expenditure than that of artistic skill, perhaps in planning interiors. It will, no doubt, be urged very urgently that effect adds nothing to convenience. Most assuredly not; but so neither does embellishment, which is only for the sake of that species and degree of effect — certainly not the most valuable of all, that is to be so obtained; it being, on the contrary, that which is most easily of all assured. Consequently, effect be not worth the study required for producing it, so neither is decoration worth its cost, and the latter may be, by very far, the more costly of the two, because the other may sometimes be produced by the simplest means, without other expenditure than that of artistic skill, perhaps in planning interiors. It will, no doubt, be urged very urgently that effect adds nothing to convenience. Most assuredly not; but so neither does embellishment, which is only for the sake of that species and degree of effect — certainly not the most valuable of all, that is to be so obtained; it being, on the contrary, that which is most easily of all assured. Consequently, effect be not worth the study required for producing it, so neither is decoration worth its cost, and the latter may be, by very far, the more costly of the two, because the other may sometimes be produced by the simplest means, without other expenditure than that of artistic skill, perhaps in planning interiors.
and the arts was cultivated throughout the whole of their dominions, and
was diffused abroad, being first carried into Africa (where they erected
a great many universities), and from thence into Spain and other countries;
whilst they conquered Syria, Persia, Egypt, &c., and established
themselves upon the ruins of the Eastern empire." Such a city as Venice, and such a
people as the Venetians, was much enriched, therefore, by its intercourse
and dealing with the Foreigners. Thus the Venetian architecture is
generally regarded as the immediate precursor of the Gothic. To the Gothic
(if we may use the term) of some countries it is more closely allied than
that of others; and just as the character of the Gothic varied in different
localities and countries, according to the Roman and other styles with which
it was brought in contact, and with which it was sometimes amalgamated,
so may we observe the Saracenic was more or less pure, and underwent
different changes as it was translated into different countries. "The
Sara cans, in their buildings in Egypt, appear to have availed themselves in a
small degree only, of the style of the aboriginal inhabitants, and are distinguished
by the lofty boldness of their vaultings, the slendereness of columns, the variety
of capitals, and the immense profusion of ornaments. The greatest pecu-
liarity, however, lies in the small clustered pillars of pointed arches, formed
by the segments of two intersecting circles. The Egyptian Saracenic varies
from the Spanish chiefly in the form of the arch, as will be apparent from
comparing the gate of Cairo with that of the Alhambra in Grenada, or
the great church at Cordova."

As examples of Saracenic decoration in Venice, including among them
the Byzantine, we refer more especially to St. Mark's and the adjoining
palace; where, notwithstanding the interfusion of these and other styles,
we may observe the distinctive features of each:—1st. The blending of the
pointed arch, ornate filial, and crocket-work of the Gothic, with the horse-
shoe arches and richly multiplied geometrical patterns of the Moorish orna-
ments; forming what the Italians call the Arabo-Tedesco. 2nd. In the
façade of St. Mark's: the clustering domes and minarets; the tabernacles
terminating in pointed pinnacles; and the circular gables, fringed with a
most beautiful arabesque foliage. 3rd. The turned wooden graces over the
great gates, and the ornamental fans to the windows, of the very usual patterns
used to this day in Cairo—and which, in the 15th century, were all gilt.
4th. In the interior: the twisted columns of which there are four, two of
oriental alebaster—the workmanship imputed to the time of the successors
of Constantine; the horse-shoe arches; and the variety of capitals, sculpt-
ured with grotesque imagery, where the bell is sometimes covered over
with a sort of basket-work of true lovers' knots; and where the scroll,
the pineapple, palm-branch, and cattails-leaf, are placed amongst lions'
heads, masks, and half-figure fiddles, &c. Some are beautiful; all are
curious; and although the designs might be considered great corruptions
and depredations from the "correct" taste of the Ionic or Corinthian, in
the opinion of those who would bring them to the standard of the "very
orders," yet the invention and originality displayed in some of these caps-
tals must be acknowledged by every unprejudiced observer. In lieu of the
volumes in some, pigeons are placed in the angles; in others, rams, with
their feet resting on a tier of leaves. The flutes and fillets, twisting round
the shafts of the columns in a spiral manner, are frequent in the Venetian
palaces. Many other Byzantine, Moorish, and Saracenic features in St.
Mark's have already been mentioned. 5th. The portal, called Porta della
Carta, opening into the Corrido of the Doge's palace, facing the Giant's
stair, the statues and foliage of which we class under the Saracenic,
partaking much of its character, although said to have been the work of
Bartolomeo Sonnio, of the 16th century. Wood, in his "Letters," says of it—"The
arches here, and indeed in all the parts, are very much broken
and confused; the architect appearing to have a great horror of a continued
line, whether straight or curved." It is to this latter circumstance, we
think, that it owes all its singular beauty. 6th. The Corrido itself; the
arches surrounding which, and the character imparted to it by the two
elegantly chased bronze reservoirs in the marble arches, reminding us of those
splendid courts erected by the Spanish Moors to their Alcazar and Alham-
bra. 7th. Nearly all the details of the Ducal palaces.—But the peculiarities of
the examples above enumerated constantly occur in the early edifices of
the Venetians.

We will now turn to a new era that dawned upon Venice, and, with
the rise of new thoughts, other styles which were introduced in, and which
considerably altered the appearance of, the capital; a change, however,
which, on many accounts, increased rather than diminished its charm and
character. The edifices of the earlier and of the later epochs (the last we


Ockley's "History of the Saracens,"
shall now consider)—the former we might term eroct; the latter, as more immediately the growth of Italy, national—marked and were identified with the two distinct countries in which they originated. The modifications and improvements of which these were susceptible, and the perfection to which the latter was carried, prevented the city favouring of any degree of monstrosity: and, indeed, it is in the various phases of style and diversity of character in this city of palaces—favoured as it is in this respect by the views, the most tempting to the painter, which a labyrinth of serpentine streets and canals continually present—which appeal with so much interest to the historian, archæologist, and artist; and constitute the great charms of the pictures of Canaletto.

If the Italians exhibited, in their revived architecture, less of the passion for the picturesque than their predecessors, they achieved grander results than had been accomplished by them; if in their works there was less imagination—that is, less of a capricious kind—there was more reason; if less to win upon the feelings of the past, there was more to satisfy the individual whose views were moulded and shaped by regulation and rule; but various causes prevent all analogy in the two cases; their beauties and defects are in no way referable to the same standard; and hence it is we entirely differ to that side of architecture, because it differs from another; we rather like to enjoy their separate beauties and features; and allow, at least, the existence of tastes, propriety, and every essential of beauty. In all works, however opposite they may be in character, which are in harmony with the tastes and requirements of the nations and times that produced them. But we may remark, in a comparison of the Arab with the Italian styles, that whereas the former, by the manner of the division and multiplication of the parts, produced a degree of variety that at first seemed almost confusion; in the latter, those parts being less minutely divided, fewer, and larger, simplicity resulted; before, it seemed scarcely as if they were under the guidance of any sound canons or fixed principles, where the chief object was to give the freest scope and play to the fancy; but, now, the precepts and principles, as derived more immediately from a greater considering intellect and a less indulging imagination, were stern, severe, and settled—the fancy being reined in—her movements restrained by the cooler dictates of the understanding; yet the influence of a favoured climate shed its elegancy and refinement over the minds of the Italian artists, imbuing them with that poetic feeling which made their works look noble, elastic, and stately—and far, very far, from cold or prosaic, though they might not boast of the luxuriant profusion of their predecessors, the Moors and Arabsians.

HYDRAULIC LOG.

The common log is a simple apparatus, familiar to all who have been within the view of the burning horizon; and, were its accuracy equal to its simplicity, it would undoubtedly be a perfect instrument. Such, however, is not the case—hence various contrivances have been proposed: Massey's patent log, and Cave's apparatus for indicating the speed of a vessel, are both very ingenious contrivances, but apparently too complicated to answer the purpose intended. The former will answer tolerably well within a limited range of the speed to which the driving-cone is adjusted, but at any considerable variation from that speed its correctness is not to be depended on. Perhaps, it may be said that the common log is sufficient for its purpose, because it has never yet been superseded; true, it has not been superseded, and why?—because nothing has yet been introduced having the two necessary qualities, simplicity and accuracy combined. I leave the question of the sufficiency of the common log to those who have practical experience on the matter, and who, I am sure, will appreciate an instrument which may at all times be relied upon. And though it matters not much when the errors of the common log can be corrected by observation, yet, when the state of the weather and atmosphere for several days, or weeks, do not admit of observations being taken, it becomes a matter of great importance to know the actual distance the vessel has traversed.

The instrument I propose for this purpose is free from mechanical complexity, depending for its accuracy entirely upon the natural law and hydrodynamic property of fluids, and having some similarity to a common barometer.

A reference to the annexed diagram will explain the construction of the instrument. The figures are drawn to a scale of two inches to a foot. Fig. 1, is a plan; fig. 2, is a side elevation; fig. 3, is an end elevation; and fig. 4, is a broken section of the pipe \( f \), and mouth-piece \( g \). \( a \), is a brace or stand; \( b \), is a bracket, forming with the piece \( c \), a universal joint \( d \), is a glass tube having a bulb at its lower end for the purpose of holding mercury and with which it should be rather more than half filled; this tube must be firmly fixed in the piece \( e \); \( a \), is another glass tube, with a small bore, passing through, and within an eighth of an inch of the bottom of the former, its upper end being open to the atmosphere, but communicating with the latter and the interior of the tube \( d \), is prevented by making its passage through the piece \( e \), air-tight; \( f \), is a pipe, of about half an inch bore, passing through the ship's bottom, as near midships as convenient; \( g \), is a mouth piece or cover, having an aperture parallel with the keel; \( h \), is another pipe similar to the first, but without the mouth-piece \( g \) (or the two pipes may be made in one, like a double barrel gun, in the passage through the ship's bottom); \( i \), is an elastic tube of vulcanised India-rubber, completing the connection of the apparatus.

The instrument being understood, its action will readily be perceived. As the mouth-piece \( g \), is turned in a direction with the vessel's motion it is evident that an upward pressure in the tube \( f \), will take place in proportion to the velocity of the vessel; and as this upward pressure will be exerted on the top of the mercury, it follows that the latter will rise in the small tube \( e \), in exactly the same proportion, and will indicate, by means of a gradual scale, the number of miles and any fractional parts thereof into which the scale may be divided. In fixing the apparatus, care must be taken to keep the bulb of the tube \( d \), a few inches below the light-draft water-line. Now, when the vessel is deeply immersed, the column of mercury will rise in the small tube to counteract the pressure of the water (about four-fifths of an inch for each foot of immersion), consequently the scale must be made to slide on the tube \( d \); the pipe \( h \), and cock \( i \), are for the purpose of adjusting the scale with the depth of immersion, and is effected thus:—shut the cock \( h \), and open the cock \( i \), and the mercury will adjust itself to balance the
specific gravity of the water above the mercury in the bulb. Set o, of the
scale to this point, and open the cock A, and shut the other, and the instru-
mence is ready to indicate the speed of the vessel.

I subjoin a table founded upon a series of experiments instituted with
a view of ascertaining the resistance on a plane in still water at various veloc-
ities, the result of which I have given in a pamphlet, entitled, "Practical
Observations on the Steam Engine." This scale, however, must be tested
by further experiments to ensure perfect accuracy.

Column 1, represents nautical miles, and column 2 the height of a column
of mercury in inches and decimals.

<table>
<thead>
<tr>
<th>Nautical miles</th>
<th>Height in inches, and decimals</th>
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<tbody>
<tr>
<td>0 05</td>
<td>9 0</td>
</tr>
<tr>
<td>0 110</td>
<td>9 5</td>
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<td>0 188</td>
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<td>1 674</td>
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<td>2 400</td>
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<td>2 754</td>
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<td>3 133</td>
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</tbody>
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November, 1847. G. V. Gustafsson.

WROUGHT-IRON TUBULAR BRIDGES.

In consequence of the experiments made at the suggestion of Mr. Robert
Stephenson by Mr. Eaton Hodgkinson and Mr. Fairbairn of Manchester,
at Millwall, to ascertain the best form of tubular bridge for carrying the
Chester and Holyhead railway across the Menai Straits, Mr. Fairbairn has
depicted his particular attention to carrying out Mr. Stephenson's ideas in
the construction of wrought-iron tubular girders for railway purposes, and
as they are likely to be extensively adopted, we have collected some informa-
tion as to their cost and weight compared with solid iron girder bridges.
It appears that the tubular girder for spans of 60 feet and upwards is
in many respects superior to the arch, whether it be of iron, stone, or
brick, besides being much cheaper in construction.

The arch, as is well known, is not always admissible where railways
have to be carried across public thoroughfares, deep ravines, navigable
rivers, and canals. In such situations, the horizontal wrought-iron girder
bridge appears to be the only structure which can with safety be applied
to such a purpose. Cast-iron girders are applicable for spans not ex-
ceeding 40 feet; beyond that point the compound trussed girders have
been used, and in every case they are equally if not more expensive and much
less secure than those composed of wrought iron, and it is doubtful whether
the principle is a sound one. Now, in the wrought-iron girder the weight
is less than one-third of the cast-iron, the strength being the same, and as
these girders form the parapet of the bridge, they are particularly well
adapted for a bridge of considerable span.

In order to show the commercial value of this description of bridge, we
give the comparative cost of one of these bridges compared with one of
cast-iron, from bridges actually constructed.

Cast-iron Girders—The weight and cost of a bridge of 60 feet span
having cast-iron trussed girders.

Cost-iron work 70 tons at £12 per ton £840 0 0
Wrought-iron work as composed of truss-rods, bolts, etc., 14 tons at £27 4 0 £20 16 0
Total for the girders, exclusive of cross beams and road-
way £1248 16 0
We believe it possible to make a compound girder of the above span
terily of cast-iron rivetted in parts, but the increased weight and addi-
tional cost would render such a structure inadmissible for such a purpose.

Cost of Stephenson and Fairbairn's wrought-iron bridge.

Three wrought-iron girders, each 60 feet long, rivetted complete, weight
30 tons, at £8. per ton, 000l., which is the sum required for the girders,
exclusive of the cross beams and roadway as before.

The comparative value of the two bridges will therefore be as 9 to 14,
irrespective of the superior strength and security of the former to that of
cast-iron, in whatever form it may be applied.

The plan has already been adopted by Messrs. Stephenson, Cubitt,
Vigode, Bidder, and others, and Mr. Fairbairn during the earlier stages of
the experiments engaged, at the request of Mr. Vigne, to construct two
bridges of this kind—one to be erected over the canal and the other
over the turnpike-road on the Blackburn and Bolton railway. These
bridges were the first constructed for the support of a railway, and
although they are probably not so well proportioned as others now in pro-
gress, they nevertheless exhibit such extraordinary powers of resistance
as not only to ensure complete success, but to lead to new and future de-
velopments in a new era in the history of bridges. Viewing the subject generally, we feel assured, from what has already been done conjointly by Mr. Stephenson and Mr. Fairbairn,
that the present discovery is only a beginning of an extensive application
of this useful art.

Since the completion of the first experiments on sheet-iron tubes, others
of a more conclusive character, and upon a much larger scale, have been
made. They indicate several new and important facts; and from the
greatly increased size of the model tube, with its rectangular cells, greatly
superior powers of resistance have been obtained by a considerable in-
crease in area of the bottom. The thickness of that part of the cellular top,
will now stand as 10 : 12, instead of 8 : 5, as formerly indicated in the
experiments with the corrugated top.

Through the kindness of the Editor of the Railway Chronicle, we have
been enabled to give drawings and an account of one of the bridges, that
carried the canal on the Blackburn and Bolton Railway.

Fig. 1, represents an elevation of the side girders, each 60 feet long,
with a span of 60 feet. Fig. 2, a transverse section of the bridge. Fig. 3,
a side view and section of the cross beams; and fig. 4, a section of one of
the side girders, including its suspended cross beam and platform.

The thickness of the plates used in the construction of these girders
was half an inch for the bottom; 34 inch for the middle, and 3 inch for the top of the bottom; the whole firmly rivetted to angle iron, as shown in the sections.

On referring to the sections it will be observed that the wood cross-
beams, p, p, for supporting the roadway and rails, are screwed up to the
bottom of the hollow girders by the straps s, s, and the vertical bolt b, which
perforates the top cell through the tube a, and answers as a stay for con-
ecting the upper and lower sides of the cellular top. Since these bridges
were finished, a better and more efficient mode of construction has been
adopted, by forming a longitudinal shelf of plate-iron along the bottom of
each girder, to receive the cross beams, and also to strengthen the bottom
in its resistance to a tensile strain. In this construction it will be observed
that the cross beams may be formed of either cast-iron, wrought-iron, or
wood, as may be deemed expedient.

This Blackburn and Bolton bridge has already been subjected to severe
tests. Before the line was opened to the public, three locomotive engines
each of 30 tons, and covering the span of 60 feet, were run together as a
train, at rates varying from 3 to 8 miles per hour. The deflection pro-
duced by a weight of 230 tons was 1908 of a foot. This seemed to be with-
out any sensible alteration from the difference of velocities. Captain Cod-
dington, the gentleman inspector, and Mr. Flannigan, the engineer, then
placed on the rails, in the middle of the bridge, two wedges of the height of
one inch, acting as inclined planes. The engines dropping from this
height when at a speed of 8 to 10 miles per hour, caused a total deflection
of 1900 of a foot. With wedges of an inch and a half thickness, the total
deflection became 1948, which is nearly half an inch. Altogether, it has
been fully proved that the bridges are strong enough to bear any force to
which they may be subjected, whether brought by a dead weight or by
impact.

* Simultaneously with these constructions, Mr. Dockray erected, under the direction
of Mr. Stephenson, a similar bridge, with a cast-iron top, for carrying the turnpike-road
across the London and North-Western Railway at Camden Town.
MR. FAIRBAIRN'S WROUGHT-IRON GRIDER BRIDGE OVER THE LEEDS AND LIVERPOOL CANAL.

Fig. 1.—Elevation. Span 60 feet.

Fig. 2.—Plan of Bridge.

Fig. 3.—Transverse Section of Bridge.

Fig. 4.—Longitudinal Section of Grid over riffs, with Cross Beams.
HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use." — Sir Henry Wotton.

(Concluded from page 341.)

A celebrated politician in the last century acquired the name of Single-speech Hamilton, from the circumstance of having delivered an oration of much promise and great ability, and never again opened his mouth in parliament: so likewise may the architect of one of the most original and tasteful buildings in London be designated by the title of Single-house Wyatt, from his only public work, the Trinity-house, on the north side of old Tower-hill, now called Trinity-square. If John Nash be more polystructural than Samuel Wyatt, the latter may plead that although his progeny be not numerous, his single production is a lion.

This building is a handsome stone and brick edifice, and extends from Cooper's-row on the east to Savage-gardens on the west, with extensive lateral fronts to both of these streets, and consists of a main body and two wings. The principal story is of the Ionic order, raised upon a rusticated ground story. Above the windows are some beautifully sculptured medalion portraits of George III. and his queen, sculptured panels in low relief representing gueul with nautical instruments, and four of the principal light-houses on the coast. These sculptors are so beautiful in style and execution, as to deserve being moulded, and casts made from them by the Royal Academy for the use of their students. The style of architecture used in this building is neither so pure as that selected by Stuart for the internal portal of the chapel at Greenwich, so pedantic as that copied by Wilkins in his portico of Downing-college, Cambridge, nor so fainceal as that used by the Adams in the Adelphi; but is a successful adaptation of the Ionic order to proportions of his own, with much elaboration of foliace in the capitales, trenching on those of the Corinthian. The mechanical execution of every part of this elegant building cannot be too much admired; so beautiful is the masonry and the brickwork of its exterior, that the best workmen both in brick and stone would find models for imitation. The first stone was laid September 19, 1798, by the master, assisted by the deputy-master and elder brethren of the corporation, and the offices opened for business in 1799.

Among the later cotemporaries of Chambers, Wyatt, and Taylor, were — Thomas Leverton, who held an office under the late Mr. Fordyce, in the Crown-lands' Revenue department, and is best known by the extensive and substantial mansion called Wotton-wood-hall, in Hertfordshire, which he designed and built for the late Paul Benfield, Esq., and Grocers' hall, in the city; — Richard Jupp, who held the important office of architect and surveyor of buildings to the East India Company; — and one or two others of lesser eminence. The north front of the East India-house in Leadenhall-street is a pleasing instance of Mr. Jupp's taste and skill in his profession. It is of considerable extent in front, and of greater dimensions in depth; the whole building, or series of buildings, cover a large area of ground facing Lime-street on the east, and Leadenhall-market on the west. The principal front is composed of a six-columned Ionic portico, slightly projecting from two lateral wings. The narrowness of the street in front, and the great value of the ground on which the building is erected, compelled the architect to adopt this flat relief of his principal front; but he has overcome this difficulty with great ability, by constructing a deeply-receding porch or inverse portico behind the columns, which gives a depth of shadow and a boid relief to the design, while it affords a goodly shelter to the directors and other members of the establishment from the eastern and westerly winds whilst waiting for their carriages. The capitals, beautifully carved by an uncle of Sir Richard Westmacott, our eminent English sculptor, are a free and artist-like imitation of the temple of Apollo Didymus. The triangle of the pediment is filled with sculptures in entire relief by Banks, of which it is not too much to say that they exceed any figures in such a situation that have yet been executed in England. The subject is George III. in Roman imperial armour, protecting the commerce and trade of the company. The kign is extending his shield, placed on the right arm, over the principal figure, and resting with his left on a sheathed Roman sword. This circumstance gave rise at the time to an opinion that the artist had worked from an inverted tracing of a design made by an eminent painter, who was well known to have furnished designs for many of the sculptors of his time. The artist, however, defended himself by asserting that the king being represented in protecting the Arts and Peace, the attitude was correct. Caesar, however, did not enter the senate-house with the cuirass, sandals, sword, and shield of the warrior, but in the peaceful toga and laurel crown, with which it is said he covered his baldness. On the upper acroterium of the pediment is a statue of Britannia, and on the two lower figures of Europe and Asia.

A very pretty four-columned Doric portico, in a pure Greek style, forms a suitable sub-entrance, through a well proportioned hall, to the minor offices in Lime-street, and shows how quickly this architect imbibed the pure style then recently introduced by Stuart, for he had been originally educated in a thorough Roman school. Mr. Jupp's portions of this building were begun in 1799, and finished about 1802. The elevations of the gigantic warehouses which he erected in many of the eastern parts of the metropolis are very harmonious in their proportions, and exhibit great skill in the use of his very simple materials; gateways, warehouse doors, windows, and piers constructed of simple brick and stone.

The elder Mr. Dance, whose principal works have been before described, left an able successor to his place of architect to the city of London, and to his professional business, in his son, George Dance the younger, who received the honourable addition of R. A. to his name from the Royal Academy of Arts, and was appointed to the chair of Eegius Professor of Architecture in that institution; but was too fond of enjoying his scions cam digestion, to impart his knowledge to the members and students of the Academy. The family of Dance hold an honourable station in English history; for, in addition to the two architects, one of them was an able comedian in the time of Garrick, particularly celebrated for his personation of Falstaff and other fat heroes of the bushkin, to which his corpulence, like that of the celebrated Stephen Kemble, lent an aid that no stuffing could accomplish. Another, Nathaniel, became eminent as a portrait painter, and was, like his younger relative, an R. A. His portraits for identity of resemblance and character of the person represented by his pencil, take a place between those of Reynolds and Romney; less graceful and natural in colouring than the former, he equalled the latter in all the best qualities of a portrait painter. This gentleman resigned his diploma and his palette for a baronetcy, a fortune, and a change of name, as Sir Nathaniel Dance Holland. Another member of this family added a singular triumph to the naval glories of his country, by saving a large and valuable homeward bound East India fleet, under his command as senior captain, and therefore commodore, of the mercantile squadrons. He manoeuvred his unwieldy and numerous ships with such nautical skill and dexterity, that when attacked by a superior French fleet of research for warships and frigates under the command of Admiral Linois, defending himself with such gallantry and well-directed broadsides, though swollen by a company of merchant seamen and Lascars, sufficient only to work and not to fight his ships, that the French admiral retired from the contest with serious loss and discomfiture. This gallant action, which stands completely by itself in naval history, procured for its hero the honour of knighthood and personal thanks from his sovereign, a vote of thanks and an honourable reward from the East India Company, and the acclamations of all his admiring countrymen. The English have a propensity to give familiar titles to their favourites, naming one the Hero of Acre, another Nelson of the Nile, the Cock of the Rock to the gallant defender of Gibraltar; so they named Sir Nathaniel Dance the Fighting Jigy (India) man.

To return to our subject, the younger Mr. Dance designed, among other buildings of lesser note, two prisons for the corporation of London — Newgate, and Giltspur-street Comptoir; the former is situated at the corner of Giltspur-street and the Old Bailey, and derives its name from the ancient city gate so called, which stood on this street, between Aldergate and Ludgate. It was a prison of great antiquity, and late in 1677, Newgate, and not the Tower, was the prison for the nobility and great officers of state. Being much damaged by the fire of London, it was repaired and beautified by Sir Christopher Wren, in 1672. In one of the niches was a figure, representing Liberty, with the word Libertas inscribed upon her cap, and with a cat at her feet, in allusion to the story of Sir Richard Whittington, who bequeathed a sufficient sum to rebuild this gate, which was satisfactorily done by his executors in 1498. This statue, with
another of similar rude sculpture, are preserved in two niches in the Old Bailey front of the present building.

On the removal of all the city gates except Temple-bar, the corporation of London resolved on building a new and more capacious prison, in the room of Newgate and Lodgate, the latter of which was appropriated solely for debtors who were citizens of London. The duty devolved upon Mr. Dance, the city surveyor, who accordingly prepared his designs, and the first stone was laid on May 23, 1778, by the lord mayor (Alderman Beckford.) This was the last public act of this eminent and patriotic citizen. The prison was broken into by the rioters in 1789, the prisoners set free, and the interior burned. It was speedily repaired, and after several recent improvements and alterations has become the city and county felons' goal. On a raised ground the four-story are erected a central building and two wings, deeply recessed from each other, and producing thereby an harmonious proportion of light and shade. The governor's house and offices, some of which have been occasionally used for state prisoners under punishment for political offences, occupies the central building, and in the solid wall between it and the wings are constructed doors of solemn and gloomy aspect, leading to the two different departments of the prison. Over these doors are representations in sculpture of fetters, chains, and handcuffs, such as were formerly in use for felons. These, with the entrance-doors and windows to the governor's house, are the only apertures next the street, and, with the coarse chamfered rusticated stones of which the building is composed, and the massive modillion cornice and plain blocking course with which it is surmounted, give an air of sombre melancholy appearance to the building, truly characteristic of the purpose for which it was erected. Indeed, it may be considered one of the most characteristic designs that ever emanated from an architect's mind. When viewed from the western end, from which the lateral front next Newgate-street being that of the north wing, with its deep recess terminating with the south wing next the court-yard, which separates it from the sessions-house, the merits of the design are peculiarly striking.

The other prison, that called Giltspur-street Compter, owes its origin to the same cause as the former, and was erected in the stead of two or three smaller, dilapidated, and less commodious houses of detention. It is situated on the eastern side of Giltspur-street, in a line northward of Newgate. The elevation is composed of a centre and two wings projecting from the main body of the building, which is of Portland stone, laid in rusticated courses, and as it is more a house of correction for misdemeanors, and for the detention of arrested prisoners till taken before a magistrate, than a penal one, it has a series of small semicircular headed windows, and a single central door next the street. For the same reasons, the design is less gloomy, and also less picturesque, than its more solemn neighbour; yet it is an excellent and very appropriate design.

The Leagile Asylum of St. Luke's, Middlesex, is another work of the same architect, the original building, which was established by voluntary contributions, as an improvement upon the royal hospital of Bethlehem, being taken down to make way for the new square and other buildings on the Finsbury estate of the corporation of London. It stands on the north side of Old-street-road, and is an extensive and lofty building, consisting of a centre and two wings, bearing a just and harmonious proportion to each other, and to the buildings which unite them. They are divided into a series of semicircular recesses and piers. The semicircular part, which is near the ceiling of each story, gives light and air to the cells without exposing the unhappy inmates to the gaze, and often derision, of the multitude, as was the case in the old hospital in Moorfields. Its whole aspect is commanding and highly characteristic of the use to which it is designed, and shows how far genius may use even the pleasant materials—this building being, like many of Palladio's, plain brick and a few simple stone dressings; and it is not too much to say that few buildings in our metropolis, or perhaps in Europe, surpass this for unity and appropriateness of style.

The Royal College of Surgeons, on the south side of Lincoln's-inn-fields, is another example of the genius of this tasteful architect. The building is very extensive, occupying a large frontage next Lincoln's-inn-fields, and a great depth to its south front in Portland-street. The principal front is decorated by a six-columned portico of the Ionic order, tastefully adapted from the Ilissus, with a proper entablature and acroteria. In the frieze is inscribed the name of the architect. The garden front of the college became, about the time the additions to Guildhall were proceeding, so dilapidated, that it was rebuilt from this architect's designs. The singu-
to call the successor of George III. "George the Magnificent." As
regent and sovereign of these kingdoms, he exhibited a love for architec-
tural splendour more capricious than tasteful. Grandeur was more as-
tained than elegance, and George the Magnificent delighted more in
the costly extravagance of the Diocesan school, than in the tasteful
grandeur of Pericles and Phidias. John Nash was exactly the architect to
the regent's mind; and gilded profusion usurped the place and overlaid the
purer taste that had been introduced by Chambers, Wyatt, Stuart, Dance,
and Holland. Hence, George IV. preferred the gorgeous profusion of
the Roman school in its decline, to the sublimer truths of the Athenian in its
greatest purity; hence, he preferred the pretty beauties of the Dutch and
Flemish masters, to the sober and less apparent magnificence of the Roman
school, and偏好the preferentially restricted and severely fastidious
merit; hence, he preferred Canova to Phidias; and hence, all the bad
taste that emanated from the patronage of George the Fourth. He deco-
rated all the lower apartments of Carlton-house, low in height as well as
in situation, with Corinthian columns, redolent with burnished gold from
abacus to plinth; so bright, indeed, that their proportions could not be
scanned, and their only excellence were their extreme cost. This suite of
apartments, which were level with the gardens next St. James's Park, and
beneath the splendid suite of state apartments designed by Holland for
the Prince Regent, was of the most regal proportions. The panelled, the
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lady above alluded to consists in having elliptical columns, instead of
circular, where, being attached to the wall in a very narrow street, great
projection could not be obtained; and consequently a better effect of
light and shade, from the depth of the undercutting, than either pilas-
ters or semicircular columns.

Although Carlton-house, the palace of George IV. when Prince of
Wales, has been removed, and the Theatre Royal Drury Lane which pre-
ceded the present one has been burnt down, they both possessed architec-
tural qualities too great to suffer the name of their architect, Henry Hol-
land, to pass unnoticed. The former consisted of a centre and two pro-
jecting wings; the portico was six-columned, of the Corinthian order,
selected from the temple of Jupiter Stator at Rome, the capitals of which
are singular for the intertwining of the inner volutes. This portico was
presented by George IV., on the taking down of Carlton-house, to the
trustees of the National Gallery, and were adapted by Mr. Wilkins, the
architect of that edifice, to the central building. Drury Lane Theatre,
which was celebrated for the triumphs of Mrs. Siddons, the Kemble, and Sheri-
das, its talented proprietor, was, in their opinion, and that of all theatrical
critics, the very best of all dramatic theatres; nor has its equal been
since erected in England. On the summit of this stupendous edifice, the
architect had erected a lofty octagon tower, somewhat resembling the
Temple of the Winds at Athens, the apex of which he surmounted by a
colossal statue of Apollo with his lyre, as the god of music and dramatic
poetry. It is singular that, at the awful conflagration which consumed
this truly national structure, and caused the House of Commons to adjourn
its proceedings in pity to the misfortunes of their brother senator, con-
sidering it a general calamity,—the statue of the god, surrounded by
flames that reached far above its head, and looking as if in the crater of a
volcano, was almost the last object that fell with a death-like crash amidst
the fiery mass that was blazing in the pit of this once elegant theatre. This
architect also built the first Pavilion at Brighton, for the Prince of
Wales. It was a neat, unassuming, sea-side villa, decorated with a few
Ionic columns, like those of the Ilium. This building also met the fate
of Carlton-house, and was taken down to make way for the present
heterogeneous structure.

One of his buildings, however, did escape destruction—Melbourne-
house, Whitehall. It occupies a large space of ground between the Horse
Guards and the Treasury, with two fronts—one towards the public street,
Whitehall, and the other facing the Mall in St. James's Park. The
entrance-front, next Whitehall, is decorated by a four-columned Ionic
portico, of the Ilium order, which, extending to the curb-stone of the
footpath, allows carriages to come close to its plinths, and serve
visitors under its roof. The pilasters are continued under it, which often
affords to passengers a temporary shelter from the rain. Right and left of
the portico are columns of the same height and proportion, detached from
the wall, with projecting entablatures profiled over them, which, with the
great projection of the portico, give a play of light and shade too seldom
found in the street-fronts of our public buildings. This front has no other
aperture but the entrance-door, which opens into a spacious hall, covered
by a spherical cupola, which leads to the internal apartments of the man-
sion. It was built for the late Duke of York, and, from the circumstance of
the somewhat overwhelming appearance of its huge cupola, which
seems almost to crush the little portico beneath, it gave rise to a ludicrous
saying, that Mr. Holland had lodged the Duke of York in the roundhouse,
and the Prince of Wales in the pillory. The latter remark alluded to the
long Ionic screen that separated the courtyard of Carlton-house from Pall
Mall, through which the portico and the two wings seemed to peep like
the head and hands of a prisoner in that instrument of punishment.

On the nothing-to-do appearances of these columns, an Italian architect,
the elder Boscarii I believe, inscribed the following epigrammatic question
and answer: addressing one of the isolated trucks, he asks—"Cura col-
oma che fate qua?" to which he makes the stone reply—"Non sapiamo in
verita!" I quote from memory and hearsay, and know not into what
Charon's of the Day to refer for a correct version, if in error. Mr. Hol-
land's other works were on and about the great building speculation of
Sloane-street and its neighbourhood, and may be regarded in a similar
light, as to architectural charmer, to those of the Adams in the Adelphi.

As it has been customary to give additions to the names of eminent
princes, such as Louis the Great, Charles the Bald, Richard the Loan-
hearted, so a contemporary biographer of the Brunswick family proposes

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thoroughfare, from the New-road, Marylebone, through the handsomely
and so, Portland-place to St. James's-park, is not only a work of great
sanitary welfare to that portion of the metropolis, and has opened a neces-
sary thoroughfare from Westminster to the wealthy district of Marylebone,
but is one of the greatest architectural improvements that have taken place
in the metropolis between the reigns of Charles II. and George IV. The
great sewer along that extends from Portland-place to Whitehall, and
purifies, by its various branches, a portion of the metropolis equal in
extent to many a city, would have done honour to the names of Agrippa
and Cato the Censor.

The expense of purchasing the ground and property, and interests upon
it, was enormous; but the calculations of the architect, and the powerful
support he received from his royal patron, enabled him to accomplish, after
many and annoying obstructions, this vast undertaking. When the plan
for the street and the sewer was completed, the ground was offered to
public bodies or individuals, under severe restrictions as to external design
and quality of materials, at beaver ground rents than had ever before been
paid for houses of retail business. Sites for public and private buildings
were taken, as the speculators or builders required; and as fast as port-
tions of the main street were finished, and became connected with lateral
streets, they were opened to the public.

Nash did not compel any of the lessees to employ him as their archi-
tect, but left every one to make their own choice, reserving to himself and
the commissioners for carrying the works into execution a right of reject-
ing such plans as did not accord with the intended style of the street.
From this cause arises the pleasing variety that distinguishes Regent-street
from the monotonous of many of its more opulent northern neighbours.
Instead of single houses, consisting of the French school, called York
which would not disgrace a palace or royal residence, and might be taken
for such did not the subdivisions of the shops or offices show their applica-
tion. Many of these, as Waterloo-place, the Quadrant that leads from it
to Regent-street, the mansion that he built for himself on its eastern side
and some of the best connected series of houses, and the two Circuses,
that connect the great crossings of Piccadilly and Oxford street by a con-
tinuation of the main street to Langham-place, are from the designs of
Nash. Some of these, to hasten the completion of the work, he undertook
himself, a building speculator, which neither amended his fortune nor
increased his comforts; but Nash was a bold, enterprising man, and had a
spirit not easily daunted by difficulties. The other architects who princi-
pally contributed to this great undertaking were Soane, who will be men-
tioned hereafter, C. R. Cockrell, the younger Repton, Decimus Burton, the
two Smirkes, and the elder Abraham, who being happily in the land of the
living, their works do not come into this portion of our history, which will
close with the works of our recent predecessors.

Nash's other great work was the Regent-park, which shows the talent of this
amateur artist to great advantage. The arrangement of the roads, canals,
lakes, and plantations, were all finished and in a growing state before
scarcely a house was erected, exhibits the power of Nash's mind in grasp-
ing a whole, and his taste as a landscape artist to great advantage. So
little did he care about the minor details of his art, that he either knew
not or contemned the differences between the schools of Greece and Rome;
for once, when engaged in a conference with him, relative to the galleries
of the Society of British Artists, which he built from his designs, he inquired
why I spoke disparagingly in the "Annales of the Fine Arts" of his
architectural taste,—he asked if he really preferred the mean and meagre capitals that he had employed in the exterior of his own house
in Dover-street, and in the porticoes of Waterloo-place, over those of
the Ilium? He replied, that an Ionic was an Iliotic, and he did not care
which his draughtsmen used. But it is remarkable that he ever after employed the latter, as may be seen in the before-mentioned two
Circuses, and some of the more northern buildings of this street.

This beautiful and highly-decorated park was a true testimony to the liberal-
ity of Nash's genius, who not only dedicated this portion of the
crown land, but in the most magnificently known as Marylebone-park, to the public;
but presented the magnificent royal library of his father to the British Museum,
and a splendid collection of casts from some of the finest antique statues
in Rome to the Royal Academy, for the use and benefit of the British
public. The Regent's-park is bounded on the south by the New-road,
from which it has five entrances, two between the east and west sides of
Park-square, opposite Park crescent, Portland-place; one between Ulster-
terrace and York terrace; one opposite Finsbury church, called York-
mans; and another opposite Baker-street, between Corwallis-terrace and
Clarence-terrace—on the west by a new road leading to Lisson-grove;
on the north by Primrose-hill; and on the west by streets reaching to the
Hamstead-road. The Regent's-causeway encircles nearly the northern half,
carried through a beautifully-plantcd valley. In the centre is a circular
road, called the Ring, within which are the beautiful gardens of the
London Botanical Society.

The principal terraces and buildings that surround or stand within the
park are chiefly from the designs of Nash himself, and two or three by living
architects; but the limits of this work do not permit more than a brief
mention of some of the best, which are—York-gate and terrace; Sussex
and Clarence terraces, named after two of the prince regent's
brothers; Irwell-terrace, named after the second title of the heir-
apparent to the British throne; Hanover-terrace, after the reigning family;
the menagerie and gardens of the Zoological Society; the royal hospital
of St. Katherine, removed from the site now occupied by the St.
Katherine's-docks; the Colosseum, a building more resembling the Pantheon
of Agrippa than the gigantic structure whose name it assumes; the Diorama,
and the villas of the late Marquis of Hertford, Sir Herbert Taylor, Lady
Arbuthnot, and that of the late Mr. Burton, called the Holme, beautifully
overlooking the spacious lake, and a few others of less distinction.

Of Mr. Nash's other works, which are tolerably numerous, the limits fixed
to this concise history will not allow me to name: many of them are
some extensive mansions and villas, town-halls, and similar buildings,
 principally in Kent and Sussex, which are all marked by his peculiar
taste, which was neither pure by nature nor refined by study. He was
rather a great building projector than a tasteful artist. His taste in land-
scape gardening, which combines the beauties of Kent and Brown, founded
upon the purest English models, was less artificial than those of Le Nôtre
and other Frenchmen. The laws of the French school, whose formalities are
proverbial. Nash lived to a Nestorian age, and, if unlike Wren in anything else, he
died, like him, neglected.

A few works of some celebrity must be introduced rather parentheti-
cally, and more briefly than I could have wished. The Auction-mart at
the bottom of Bartholomew-lane, opposite the north-east corner of the
Bank of England, occupies a situation too public for its slender pretensions
to either taste in design or skill in adaptation; the staircase, which lead
from the hall to the numerous public auction-rooms in the upper stories,
is narrow, steep, and dangerous to a fault—in that portion of a public
building which, above all others, ought to be capacious and easy of access.
It was erected from the designs of the late Mr. John Walters, who ob-
tained the honour of being selected from a number of his contemporaries,
as the author of the best design submitted to a committee of anno-
tioneers. This architect also designed St Pancras new church, situated at
the rear of the London-hospital, Mile-end. It is in the later Pointed
style, which appears more congenial to the architect's taste than those of
Greece and Rome, for it is altogether better as a work of art than the
larger and more ancient type. It has a neat and smaller one of a similar
character in the north and south sides. Being finished with octagonal
terraces and pinacles at each end, without either tower or spire, it bears a
greater resemblance to a collegiate chapel than to a parish church.
The pulpits, galleries, altar-piece, roof, and pews are of solid oak,
carved, moulded, and panelled; resembling in durability of materials
the best works of our best church architects. It was erected in 1819,
but its amiable architect died young, and much lamented, before its comple-
tion.

The offices of the Board of Control, Cannon-row, Westminster, built
originally for the Board of Ordnance, by the late William Atkinson, Esq.,
is an extensive building with two fronts, one facing the river Thames, and
the other next the before mentioned street. The Ionic portico of its prin-
cipal front is one of the best proportioned and most aptly applied in the
metropolis. It is four-columned, with a pediment after the best canon of
the order—that of the Ilium. The entablature is continued on each side of the portico,
and terminates at the angle of the principal front.

The late King William IV., although never aspiring to the title of a con-
questor, yet was unerring in his judgment in selecting for his chief
architect the late Mr. Jeffrey Wyatt, the enlarge of the ancient
royal palace at Windsor, which had been patched by Wren, added to by
James Wyatt, and botched by Nash. The additions made by William IV.,
were extensive, judicious, and in good taste. He expressed his views to
his architect, and left him to complete them. He honoured him with
knighthood, and, to give him a distinction among the numerous family
of his name, he augmented his patroonry to Wyatville; and Sir Jeffrey
of that name became distinguished by the favour of his sovereign, and by the
taste he exhibited in his additions to Windsor-castle. He completed the
noble quadrangle, and perfected the entrance began by his uncle, James Wyatt, and known as George the Third's staircases; finished some and added others to the noble seats of domestic and state apartments, which are now so generally admired. He rebuilt and added to many of the external towers and other buildings on the principal terrace; and brought the whole exterior into a unity of design, that it never possessed since the days of William of Wykeham, its original architect. He also raised the Keep, or Round-tower, nearly 100 feet above its former altitude; and rendered the whole mass of buildings of which this magnificent royal palace is composed, a unity of design that its former heterogeneous mixture of styles apparently helps define.

Sir Jeffrey Wyatville began his career as an architect rather late in life, having practiced the more profitable business of a builder at the western end of the metropolis. He, however, showed a great love for art from the earliest period of his life, and often exhibited designs of great taste, in the annual exhibitions of the Royal Academy; one, a picture in oil of Priaume's palace, as described by Homer, showed inventive talent of the highest order. Sir Jeffrey published a beautiful series of his works at Windsor-castle, which ought to be in the hands of every lover of this noble art.

Downing-college, Cambridge, Halleybury-college, Hartford, University-college, London, and the buildings containing the National Gallery and the Royal Academy, on the northern side of Trafalgar-square, are from the designs of William Wilkins, R.A., formerly Regius Professor of Architecture in the Royal Academy, and author of several works and delineations. These buildings are all of one family, one school, one style—pedantry. Grecian art, instead of giving freedom and beauty of style to the designs of this artist, Minerva seems to have frozen up all his faculties by his pedantry. So much Greek, so much gold, was the saying of Samuel Johnson; and so much Greek, so much cold, was the practice of William Wilkins,—for no liberty would he give or take, as line or member would be used but for which he could not find a precedent in some ancient Greek building—and the older and more formal it was the better. He was a Greek puritan and an archaic methodist. The Corinthian portico of the National Gallery is Holland's, or it would not have been so inconstant in its foliage. But he has frozen the entablature by his Halsiee school. And so it has been a thing, he would have cut out the HCNthalian looks of the god of Day; he would have deprived Jupiter of his sambo-

The Bank of England, the new Treasury-chambers, before their recent alteration by Mr. Barry, the royal entrance to the old House of Lords, affect-

edly similar to his architectural work elsewhere. There, as in his earlier works, show the exuberance of the fancy, while the sound judgment and good taste that acknowledge the rules and precepts of the greatest masters of the art, place Sir John Soane on a level with any English architect since the days of Jones and Wren. Whilst the puerilities and freaks of fancy indulged in in his own house and museum, Lincoln's-in-

fields, the Dulwich-gallery, the new buildings at Chelsea-hospital, and the National-debt-office, in the Old-Jewry, exhibit a wild exuberance of novelty sustained by the rules of art. There, with a maniacal fancy, he has added them with the character of what the Italians would call Capricci, rather than severe compositions. His greatest work, the Bank of England, whether taken as a whole, or considered as a series of detached buildings, erected at several periods, and subsequently brought into a whole by the hand of taste, is a work of singular and sterling merit. The long north front next to Theobold, is simple, grand, and imposing, and is among his earliest and best productions. The west front, next Princes-street, whilst the ugliest of all forms in architecture, an acute angle, which the junction of the two fronts forms, is overcome in an original and masterly manner. This is manage

ed by cutting off a considerable portion of the ugly angle, and converting it into a slight recess; and the two fronts are gracefully con-

nected by a circular portico of columns and pilasters, the stati
debian which is surmounted by a beautiful crenellated, over the obtuse angle at the back of the portico, under which is an unoccupied niche, corresponding with those in the Long-boat front. Soane, undoubtedly, had in his mind the semicircular porticoes of the north and south transepts of St. Paul's (of which he has often expressed to me his most ardent admiration), when he designed this portico. The detail is, however, a very ugly corner. He has, by this means, not only overcome an unforeseen difficulty, but con
cverted what would have been a blemish in common hands into a positive beauty. So original, so happy, and so beautiful, is this gem of the art, that the committee of architectural students of the Royal Aca
demy made it the reverse of their medal, which they struck in honour of their eminent professor, and presented to him before his retirement from public life. It has been proposed, and the thought is a happy one, that a statue of his architect should be placed in this vacant niche, and thus supply all that is wanted—a figure to this unique design. The small square court next to the Long-boat-court, is a design of surpassing beauty and elegance. A recessed portico on the right hand, and on the left lead to the bullion-office and other important offices of the Bank; whilst four detached columns of the same order, supporting statues of the four quar
ters of the globe, conduct, through a semicircular-headed gateway, to the interior apartments of the edifice. That portion of the quadrangle which immediately faces the great entrance gates, possesses a magnitude and beauty of design which were never equalled. There was only a faint trace of this design, that he erected a copy of the columnar portion of it, upon a smaller scale, as a decoration to the front of his own villa at Ealing. The ample rotunda, formerly used as a stock-exchange, but now one of the dividend-paying-offices, is a grand, simple masterpiece of art; as is the large office at the north-west corner of the building, decorated with lofty Ionic columns of beautiful Greek proportions, with a vaulted ceiling. These beautiful and correct works are among Soane's first and best produc
tions. The front next Bartholomew-lane was next in point of time, and was a much greater tendency of ornament than the preceding ones. This elevation admitted for some time upon Sir Robert Taylor's Corinthian pavilions, which were afterwards taken down, and the Soanian style carried on in Threadneedle-street, from both ends, till they joined the centre of the original building, erected by George Samp
don, in the reign of William III. This, finally, gave way to the present new centre, which is by so means the happiest of Soane's designs. Thus the Bank became completely isolated, and has but one entrance in each street. The stairway from Bartholomew-lane leads to the rotunda and other public offices, that of dividends and transfer of stock; the three next Threadneedle-street, which may be considered but as one, lead through a spacious court to the hall, the front and interior of which exhibit a fair specimen of Sampson's style as an architect. The entrance next Princes-street is, I believe, never opened. Thus there are but three entrances to this immense treasure of

enormous wealth; nor can a more appropriate building for such a purpose be imagined. The order used is that of the circular temple at Iviron, known to every connoisseur of picturesque beauty; but which is of no obscure origin, as to be unknown whether it was dedicated to the goddes
Vesta, or to the stibyl so well known in ancient Roman history. Soane was the first architect who ever used this rich and beautiful variation of the Corinthian order since the days of its original inventor. I am sorry that my prescribed limits have compelled me to treat the works of many of our greatest architects, particularly Wren, Nash, and Soane, with such brevity; but as I, at present, propose to enlarge this Memoir, and to illustrate it by engravings of the best works of every period, I respectfully bid farewell to my friendly readers.

JAMES ELMSLEY.

THE BRITISH MUSEUM.

No. V.

The Egyptian remains are particularly interesting, as they show the state of manufacturing art in a country which was the great centre and school of art for many ages. With Egypt the Phenicians traded, exchanging the productions of that country for those of Greece, the Levant, and the West Mediterranean. The Egyptians were not food of the sea, and the outward trade was always in the hands of strangers, first Phenicians, and then Greeks. This was a circumstance which favoured the Phenicians, for it prevented the rivalry of the most advanced country, at a time when the nations in the Mediterranean were all in a state of barbarism. It is to this trade of the Phenicians that we, perhaps, owe the specimen of Chinese workmanship which have been found in Egypt, and some of which are still in the British Museum. The trade to the Indies long passed through Egypt, but it is uncertain whether the traffic carried on by the Phenicians, and Bolomeus, king of the Jews, from Euxin Gbber, on the gulf of Alex, in the Red Sea, was anterior to that of the Phenicians or not. From Egypt the useful arts were carried direct to Greece, and in all probability to Etruria and Italy; an enterprise not more difficult than the intercourse between Tyre and Carthage. The traditions of Greece afford many instances of the influence exercised by the peoples devoted of Egypt; and the latter country was long regarded with reverence as the great seat of learning. The Jews seem to have acknowledged the same superiority in the craftsmen of Egypt.

Egypt had particular advantages in those days as a manufacturing country. It had good supplies of flax, the material of the great wove manufactures; and it had a large working population, supported at a cheap rate. It seems likewise to have been free from home war. Egypt was defended by its deserts, its seas, its swollen river, and its many canals, more than by the courage of its inhabitants, or by the possession of large material resources. It is true, Egypt fell under the rule of the Persians and the Greeks, but these cases of foreign invasions were different in their effects from that of frequent and harassing wars, or the petty wars carried on between the towns of Greece. The history of Egypt in this respect is like that of China, which, although it has succumbed to successive Tartar invasions, has enjoyed a settled state at home. The great cities of Memphis and Thebes had greater populations than the most flourishing and powerful Greek states, and accumulated on small spots a large body of artisans, who were favourably placed for carrying out a subdivision of employment. Many manufactures were thus carried to a great pitch, as there is witness enough in the British Museum to prove us. Indeed the time of its greatest extension was the period to which it is referred by that name of “pottery,” which was the great seat of manufactures.

The Egyptian collections have been much improved by the addition of proper labels, giving as good an interpretation as possible of the names of the chief personages represented. These collections are the more pleasing, as they contain sufficient to give a very good idea of the public and private life of the Egyptians. The colossal heads of Ramses are fair specimens of art; those of the more trifling instruments of the toilet, or articles of dress, illustrate their more trifling pursuits. Admirable as is the Greek collection for its works of art, it is wanting in the smallest specimens. The Roman collection is deficient in larger articles. The Etruscans give us representations instead of the objects themselves.

The Rosetta stone (No. 24) is what first deserves attention, as it may be regarded as the key of the whole system. This monument seems to have been placed in a temple at Rosetta, dedicated to Necho to Atum. It is of basalt, and contains the inscriptions on the same subject, one in Egyptian hieroglyphics; a second in Egyptian demotic or cursive character, a more familiar character or mode of writing; and a third in Greek. The inscriptions are mutilated, and recall the services which Ptolemy the Fifth had rendered to his country. They were engraved by order of the high priests, when assembled at Memphis for his installation. The name of Cleopatra likewise occurs. The tablet has lately been put in a frame.

It will be remembered that from this tablet Dr. Young derived his theory of hieroglyphic interpretation, which he tested by its means. As the name of Ptolemy occurs so frequently in the Greek, Dr. Young thought that the corresponding group in the hieroglyphics would be found nearly as often. This proved true in the case, but afforded only one clue—the discovery of the name of Ptolemy. The name of Cleopatra likewise was found, and Dr. Young thought it worth while to examine whether the hieroglyphics forming the name corresponded to the letters or syllables of the Greek. If so, the groups answering to Ptolemy and Cleopatra would to some extent correspond, as each contains the P, T, and L. Dr. Young found this to be the case, and thus obtained the elements of an alphabet, which has been extended and applied to such extent, that the dictionary of hieroglyphics now includes many thousand words.

The results of this discovery were not confined to their operation on Egyptian hieroglyphics, but have had an influence on another remarkable department of learning—the interpretation of the arrow-headed characters, which, like that of the Egyptian hieroglyphs, so long baffled inquiry. The possession in museums of a few bilingual inscriptions in Arrow-headed and Hieroglyphics was of no avail, so long as both remained undeciphered; but with the unloking of the secret of hieroglyphics, these inscriptions have acquired great importance. The names of Xerxes, Artaxerxes, and other Persian kings, have been recognised on those monuments, the Egyptian names having been translated, and thus give material for the alphabet of the arrow-headed character, which now engages the attention of many able and persevering students.

The tablet of Abydos (No. 117) is another valuable monument. It was found by Mr. Banks, in a chamber of the temple of Abydos, in 1816, and it was published by Mr. Cailliaud in 1833, and by Mr. Consul Salt in 1835. It was conveyed to France in 1837, and at the sale of M. Miham's collection, it was bought for the British Museum. It represents an offering made by Ramesses Set or Seti, of the 18th or 19th dynasty, to his predecessor in the kingdom of Egypt; but it is not yet ascertained whether the list of kings be chronological or genealogical. Originally, it held the names of eighty-two kings, arranged in the upper lines, or twenty-six in each line. The first eight names of the first line and the first eight names of the second line, have been destroyed. It still has the names of many kings; and it is probable that the discovery of other monuments will give ample materials for a sound system of Egyptian chronology, a matter of some artistic importance, as it will give us exact ideas of the relative ages of the works which we possess, and will throw very great light on the history of all the nations then in connection.

We may observe, by the by, that in the prosecution of hieroglyphic researches, it is very likely that in late monuments and inscriptions, Greek and Latin terms and words will be found inscribed in hieroglyphic characters, for in such other cases is what may be termed a new unusual philological phenomenon.

Two of the least interesting Illustrations of Egyptian art are undoubtedly the two colossal heads in the Grand Central Saloon, and in the vestibule of the Egyptian Room. The former is a plaster cast of the face of the northern Colossus at the rock temple of Iosamul, and represents the king Tennes Set. The other is likewise a plaster cast of the same monarch, but the countenance does not seem to be the same. Heads, of colossal proportions, raised so high, and seated as it were on terminals, giving some idea of the trunk, are so less remarkable for their vast size than for the harmony of their expression. To give a full idea of their original grandeur, they should be placed still higher; but as it is, their effect is most imposing, and fully justifies the artistic conceptions of the Egyptians in their colossal works. To the uninitiated multitude, the contumacious heads, the tumid breasts, the plump legs, the thick arms, the large eyes, the large noses, and the large mouths, all these with the conventional figures, godlike white beards, and the like, which have been given to us in the paintings and sculptures, are to them phenomena, and they walk, as it were, among the gods upon earth, who were present in all the sublimity of heavenly form, clothed with all the terrors of superstition, and armed with all the weapons of imposture; statues of a hundred feet in height, which might be well supposed to bear their votaries, when, as in the case of the volcanic Mammis, they were known to have the power of public speech. Indeed, we can scarcely contemplate unmoored the mighty relics now before us.

The artist will admire that in works so great, breadth and smoothness should be so well preserved, and he will not fail to recognise the hands of
great masters. We cannot understand Egyptian art, unless we see it in its bolder works, and then we acknowledge its sublimity. The smaller tablets and statues, the lines of hieroglyphics, and the grim figures, would give us too low a standard of Egyptian skill. In these smaller works they show only their weaknesses; in the larger works they show their strength; and they have left few rivals. Such a work as the Alexander statue at St. Petersburg, sinks into insignificance in the presence of the vast outlines of a Ramses, or a Bessestris; and what we now call colossal, means here standard, becomes the basis of the case.

The history of some of the monuments in the Museum has often points of interest. Thus, No. 23, the chest of a large sarcophagus of Hapimen, a royal scribe, was brought from Grand Cairo, where it was used by the Turks as a cistern, and named "The Lovers' Fountain." Death had evidently lost its terrors, and in the lapse of ages we had given way to love. The origin of the modern legend would be curious if it could be traced. The colossal sarcophagus (No. 24), removed from Egypt to Constantinople, was brought by Lord Elgin to London. This sarcophagus was sacred to the god Tore or Cheper, and was at a later period the emblem of the world. It is a right kingly emblem for the modern Babylon. No. 10, a large chest of the sarcophagus of the king Nechth-her-hebi, Her-nechth-hebi, or Amryuteus of the 28th dynasty, was at one time in the mosque of Saint Athanasius, at Alexandria.

Beneath No. 43, is one of the casing stones of the great pyramid at Gisch, showing the angle of inclination of the sides and the material. It is a calcareous stone. It was brought home by Colonel Howard Vyse in 1839.

What cannot fail to be noticed in many of the larger monuments, is the high polish of the granite, porphyry, or serpentines, which has been well preserved during so many ages. It excites wonder that so much should have been done with the rude means at the command of the Egyptians.

The number of sepulchral monuments belonging to the Egyptians has afforded large supplies for the Museum. These record priests, judges, scribes, and officers of all kinds, and are rather of an inscribed than of an artistic character, though they supply many useful illustrations. A modern cannot but be struck on seeing such proofs of the respect paid by the Egyptians to their dead, of how much behindhand the English in this respect. Large sums are lavished by us on the idol and mezzotint shows; the hire of black carriages with heathbrushes on their top, or black horses with long tails, and of blackguards of drunken and disolute appearance; while the object for whom this picturesque and unseemly procession is got up is consigned to a common grave, and left with the slightest memorial of his existence, or of the regard of his friends. So far is this real disrespect of the dead carried, that the metropolitan cemetery companies have been seen by us to put a check on an economy which the rites of sepulture, which is exercised at a very moderate expense in favour of our undertakers, for it was no uncommon event for a procession of mutes, bearers, carriages, and horses, to consign a bedizened coffin to a common grave.

The money which is spent on funeral show is one of the greatest oppressions of the widow and orphan, who, in compliance with the conventions of society, in order to do as their neighbours do, are forced to spend money on cloaks, feathers, hat-bands, and coffin-trimmings, which they can least afford in the moment of their severest bereavement. The abolition of this show by those who are above the fear of idle clamour, would render a great service to those classes of the community whose means are limited, while it would allow of the disposal of funds in a manner much more respectful to the deceased, and much more useful to society.

Whoever has observed, has had reason to regret that in later times sepulchral memorials of individuals, even of eminence, are rare in England, and this at a time when there is enough of public and private wealth. Our grieving shows to example the Westminster and St. Paul's, fatter so that we are not wholly forgetful of duty towards the departed; but we have only to look elsewhere to witness the general disregard of sepulchral monuments: old ones are suffered to fall into decay, and new ones are not raised. The peer, the bishop, or the judge, leaves large wealth behind him, and ungrateful heirs. It is true, public feeling has been better shown towards public men, and officers of the army raise regimental monuments to their deceased brethren; but there is no proper public provision for monumental commemoration, and little private feeling in its favour, although the cemeteries have made some improvement. We want, first of all, a public fund for monuments, and we want next the establishment by the wealthy of some portion of those moneys now wasted upon undertakers. This applied in monuments would give us many valuable works of art, and would be a most laudable exercise of patriotism in favour of sculpture, a branch of the arts much and undeservingly neglected in this country, though its cultivation is to be desired. The successful study of sculpture would not only give an impulse to architectural decoration, but it would have its pecuniary bearing on our pottery, our glass manufactures, and on many branches of trade in which the plastic arts exercise an influence.

In the upper Egyptian Room the visitor has his attention drawn to the many articles of glass or glazed ware. As the Etrusans are characterised by their painted vases, so may the Egyptians be by their blue glazed ware. The cases are filled with figures of this material, which are found by thousands in the tombs, being attached to the network or the necklaces of mumificies. This alone must have constituted a large branch of manufacture; but the ornaments in the cases in the middle of the room are no less remarkable. Beads and drops, of clear and coloured glass, formed a great part of Egyptian jewellery, and there are many good designs of bead and bugle work, which might be thought to be modern, so easily are they carried out. Although light blue or bluish green is the favourite colour, yet there are beads of black, white, red, yellow, and scarlet, allowing of great variety in the patterns and designs as worked. The beads and bugles are likewise of many sizes, from the smallest bead now made to a large bugle or eardrop.

The cases in the upper room contain a great variety of objects; they form, indeed, an ethnographic museum of the Egyptians, affording specimens of many domestic objects—indeed, as copious illustrations of Egyptian life as the general student could wish desire. The practical man will likewise find particular interest in the tools and materials here collected, and which show the advancement of the Egyptians in the branches of manufacture, not generally supposed to have been then successfully cultivated. In some, the workmen seem not to be surpassed in modern times, and they certainly prosecuted with success most of the useful arts.

The general character of Egyptian workmanship is neatness, and this will be seen in the wove cloths, mats, beadwork, jewellery, cabinet-making, glass-work, and other articles. The Egyptians were very precise in repeating a pattern, so that some completed designs are carried out with all the accuracy of modern machinery. In this respect the Greeks and Romans were not so proficient; neither are other modern nations so proficient as the English. Even the mat-work is well finished, and the cloth is as well woven as could be desired. Some of the mummy cloth is very good. The inlaying in the chairs and other cabinet work is very fairly done, and the wood work is well finished off in most cases. The metal wares are likewise well wrought, and the bronze kettles are as finely turned as could be desired by the most fastidious. Alabaster vases formed a very successful branch of Egyptian manufacture, and the many which are in the Museum are cleanly finished inside and out, seemingly by the lathe. The Egyptians supplied plain and coloured glass to the Greeks and Romans, and there are some bottles in the Museum, with broad bottoms, which are of very fair size. The glass articles are, however, generally small, being phials, beads, and articles of ornament. The specimens of Egyptian crystal in the Museum are not so good as those in the Roman collection, but which it may be presumed are likewise of Egyptian workmanship.

Some of the specimens of enamelled portraits are among the most interesting relics of Egyptian art, and it is to be regretted that we have not more of these relics, which are of a durable character. One figure, in low relief, in which the colours of the head dress are well burnt in and enamelled, is particularly to be admired.

The glazed earthenware figures are generally covered with hieroglyphics in black, and glazed with blue. The Egyptians had the means of beginning the porcelain manufacture in Europe, but though there are specimens of plates with designs, the Egyptians did not prosecute this manufacture to any extent, or the demand for decorated pottery would have been large among the Romans. It was left for modern times, after the introduction of Chinese porcelain into Europe, to carry out the porcelain manufacture. As the Egyptian decoration was chiefly confined to hieroglyphics, there seems to have been no demand for their glazed figures among other nations,
NEW LIGHTHOUSE APPARATUS.

Mr. Alexander Gordon has for many years directed his talents and attention to lighthouses, and, after extensive experience in fitting and improving the lights, has at length produced, under the highest auspices, a system of lights so powerfully concentrated as to promise in their adoption a very great advantage to ocean and river navigation. One of these lights was exhibited lately at Messrs. De Ville and Co.'s manufactury, 307, Strand.

Fig. 1.

Previously to describing the new light, we will give a short historical account of lighthouse lights. About the year 1793, glass refractors, five inches thick and twenty inches diameter, were substituted for reflectors, the focal point being nineteen inches distant; and they were to be seen in use in an English lighthouse as late as the year 1839. Buffon had proposed to reduce such a refractor in thickness, by cutting the lens into steps, so as to absorb less light. In 1811, it occurred to Sir David Brewster that a lens, or set of lenses, might be built of separate pieces of glass. In 1819, the late M. Fresnel proposed that the generating sections of the rings not only ought not to have the same centre, but even that the different centres should not be situated on the same axis of the lens. A few years afterwards, M. Fresnel engaged M. Soleil to construct eight such lenses for the lighthouse of Cordouan. In 1837, the Trinity Board witnessed some experiments with a lens of the kind, which had been made by Mr. Gilbert, under the direction of Sir David Brewster. In 1839, that board imported a lens from France. In 1838, Mr. Gordon introduced a polygonal arrangement (both dioptric and catoptric), constructed by M. Marita, of the Hague. And, subsequently, the Trinity Board, and particularly the Commissioners of Northern Lights, at the instance of Mr. Alan Stevenson, introduced the French system extensively in England and Scotland. In 1840, Mr. Gordon constructed a revolving light for Jamaica, with Huddart's reflectors, and without refractors. In 1843, the Bermuda lighthouse tower, constructed by Mr. Gordon, was lighted by Fresnel's system, contrary to Mr. Gordon's desire, who recommended very large prolate reflectors. In 1846, he introduced a fixed light for the Point de Galle lighthouse.

The new system of lights exhibited by Mr. Gordon is a following out of his prolate reflectors, as applied to the Ceylon lighthouse, by saving the radiated light which formerly escaped past the lips of the reflector. This latter portion of the light, which was formerly lost, is now bent down and thrown into the beam, as shown in the annexed engraving.

The specimen light exhibited was a single one, of great concentrated power; and although the light was only about an inch in diameter, from a common Argand lamp, its dazzling brilliancy was scarcely subdued at a distance of 60 yards. In this light, Mr. Gordon has combined a very prolate reflector and the refractor of Sir David Brewster deprived of its central portion; and by this system he is enabled to throw into a beam nearly 8/10ths of the whole light generated by an Argand lamp. The parabolic or conic reflector is fixed horizontally, and opens at 34° inches from the light; at a diameter of 154 inches, and at 14 inches from the mouth of the reflector, are fixed glass zones used as the reflectors, being composed of four circles (each in three pieces), varying in size and thickness,—the inside face being even, and the outside of the glass cut away into curved steps, to prevent useless portions from absorbing any of the light, as shown in the engraving, fig. 1.

Mr. Gordon proposes to use these new "systems" in some lighthouses immediately.—For Revolving Lights: To use one or more of these systems, each furnished with an Argand burner, on one or more revolving faces, according to the size of the required beam.—For Fixed Lights: To use such a number of these systems as will light the circle (of 360°), or any required portions of the circle; twenty-four systems, each with its own lamp, for the whole circle, and twelve systems for the half circle, and so on: one system to 1°.—For Flashing or Intermitting Lights: Such combination of these systems as the situation may require.—For Steam-ship Lights, or Railway Lights: A similar but smaller system; the source of light being any that is known and convenient for the required purpose.

RAILWAY EXTENSION FOR SPEEDY TRAVELLING.

If there be one thing that has more than another served the purpose of retarding railway progress, it is to be found in the dogma so studiously put forward on all occasions by "authorities"—meaning thereby railway makers—that "Speed is Weight," even though weight be not always speed. Whether on the broad gauge or on the narrow, weight has been constantly increasing in the process of competition; though it was evident to all who took the trouble to examine, that speed was not increasing in proportion to weight. Let any one examine or watch the rails on any railway while an engine, with from six to nine tons on each driving-wheel, is passing over them,—let any one watch the deflection of the rails, whether near the continuous bearing of the broad gauge or the bridge rail of the narrow,—and he will be satisfied that the process, even on the nominally level line, is really that of ascending a constant gradient, varying from 1 in 30 to 1 in 70. The process is that of driving a wave of rail before the driving-wheels of the engine, just as the bows of a steam- vessel drive a wave of water before them. We believe, in short, that the process of propulsion on railways is analogous to skating—that the adhesive impulses are given at intervals on hard points, such as well-packed sleepers; and it is on this principle only that the constant, irregular action of the draw-
springs can be accounted for. As regards durability, there can be no question that the continuous bearer of the broad gauge is far superior to the bridge rail of the narrow,—and probably that may account for much of the alleged advantage in working expenses. The want of continuous bearing in the mode of laying rails in chairs on cross-sleepers is a serious evil. At the joint chairs the strength of resistance is not one-third that of the intermediate chairs, and therefore it is that the passenger counts every joint as he passes over them. The cross-sleepers at the joints are beaten down, and the ground is hollow beneath them. Water gets in, and "maintenance of way" increases in amount. The rails hammer in the chairs, the keys get loose, and danger becomes imminent. If there be one rule more important than another in "maintenance of way," it is the making of the whole road, both rails and substructure, of equable resisting power throughout. It were better and safer to have a flexible rail throughout, than one alternately hard and flexible; and therein is the prominent advantage which the structure of the broad gauge has over the narrow,—though probably, taking the weight of the engines into comparative account, the rails of the narrow gauge are better proportioned as to size than those of the broad. The importance of this question will be obvious to every mechanical mind. Equal movement in all moving machinery is the thing aimed at in every case where durability is desired. Why else are fly-wheels—and why are blocks of iron placed on engine wheels to balance them? Why is it not to keep locomotive cylinders as close as to the centre line of the train? What but for equal movement? And yet the rail is so contrived as to produce continually-recurring blows at every joint. This must be amended before economy can be obtained.

That the railway dogma, "Weight is Speed," is a fallacy, may be gathered from the whole animal creation. The swift eagle, when divested of his wings and feathers, is reducible to a very small bulk of body. The slow goose or duck is chiefly body, with but small wings. The swift Arab horse is light, but muscular, like a double-cylinder engine, working by pure elasticity. The slow Flanders horse is like an atmospheric engine of the olden time, the muscles only serving to put the gravity in action. Who ever dreamed of applying a Flanders horse to a fast coach? Who ever dreamed of applying an Arab steed to a fast coal-wagon? Yet this is what railway competitors have been doing up to the present time. Elephants, leviathans, were a fitter term than horses. We have heard that there are existing engines weighing 25 tons, and that engines yet in embryo will, when they achieve their monstrous birth, weigh 40 tons. It is some years since a strange nomenclature, called Harrison's Patent, was produced on the broad gauge. It made a trial—but all its try ended in standing still. We asked a "rude unlettered driver of the rail" why it did not answer. The answer was concise,—"It weighs forty tons." That reason is fast getting to be obsolete. If the proportion of engine weight to train weight continues to increase as it has done for some time past, the horse will soon cut up the carriage. As a rough and ready acquaintance remarked,—"The train is nothing; anything can draw these carriages, so long as the engines can draw themselves."

Many men have had their doubts of the truth of the railway dogma, "Weight is Speed." One man—a railway officer—was found bold enough, after some preliminary thinking, to put the dogma to the test of experiment. Having had constructed for him a manuvromotive carriage, he found that considerable speed could be attained with a light vehicle, but the speed was limited by the limited strength of man. To get a steam locomotive constructed for a speed of twenty miles per hour, and weighing only 6 cwt., was his next problem,—the object being to lift it off the rails to get out of the way of fast trains. Builders were found to undertake this: the axles were made as light as those of a pony gig, the wheels of wood, and all parts reduced to the minimum. It worked, and would ascend an incline of 1 in 10; but the boiler was not well arranged, and the axles were too close together for steadiness. It was taken in again, the axles set ten feet apart, and a new boiler applied. But there were two serious defects: the axles were too light for the increased weight, and the wheel tyres too low for the "points." It was evident that, as in most cases of alteration, the parts were not fitted to each other. The second trial was made, and it soon became evident that the engine would go, but not for any length of time. As predicted, the engine went off the rails at the points, strained the axles, and again came into dock. New wheels, of iron, were applied, and stronger axles; and those who predicted, first, that the engine would not go, and, secondly, that it would fly off the rails by reason of its lightness, were out in their calculations in both cases. The maximum speed attained was 47 miles per hour—40 miles the average of 56 miles from London to Cambridge. The total weight, with fuel and water, was 23 cwt., and the number of passengers were eight, including the driver. On that memorable day the dogma, "Weight is Speed," was extirpated for ever. One hundred-weight was ond equivalent to thirty hundred-weight, and the vehicle was steadier at maximum speed than a first-class carriage.

The railway officer who established this fact, of measureless importance to all future railway progress, is Mr. Samuel, the resident engineer of the Eastern Counties railway. The builders of the engine are Messrs. Adams, of Fairfield Works. The draughtsman of it in its original tiny form is Mr. Reynolds, of the Eastern Counties, and formerly a pupil of the Fairfield Works.

We have not given the working drawings of this remarkable production of foresight and perseverance, as the engine, though a practically useful machine, and money-saving to the Company, will not be a pattern, but will be far eclipsed by its successor. We give the general form and dimensions, as being all that the intelligent mechanic would really desire to know.

An oblong box, the frame being of angle-iron, measuring 14 ft. in length, by 4 ft. 4 in. in width, is suspended by axle girders in spiral springs, beneath the axles of and within side four wheels, each 3 ft. 10 in. in diameter, the axles being 10 ft. apart. The axles are three inches in diameter. One of the axles is double-cranked at right angles, in the usual mode, and to this the connecting rods of a pair of steam cylinders are applied to produce motion, also the usual driver. The oblong box is divided about mid-way by a partition. At the front end of the box thus divided, is placed a vertical boiler and the machinery, with the driver, the whole being contained within the base of the four wheels, and supported below the level of the axles. In the hinder part of the box are placed seats for seven passengers, some along the sides and some above the axle, which passes through the box, the entrance being behind. The cross-seat for the driver has the water-tank within it. The cylinders are 3 inches diameter, with a 6-inch stroke. The reversing gear and link motion are as usual. The diameter of the boiler is 1 ft. 9 in.; the tubes are in number. It has been proved by cold-water pressure to 300 lb. on the inch. The consumption of coke is 3 lb. per mile, and the total expense for driver, coke, and oil is under one penny per mile. It will be obvious to every one that, with a pressure of only six to seven hundred weight on each driving-wheel, "maintenance of way" need not be taken into the account, as, where six to nine tons are placed on each driving-wheel; and, also, that as no deflection of the rail takes place, there will be no slipping.

Changes, however, cannot take place rapidly, and, as a matter of course, those who propounded the dogma that "Weight is Speed," are not likely to acknowledge their error off-hand.

But our business is with the question, commercially and mechanically. The press teems with complaints of the absorption of money by the extension of railways; and either railways must stop progress, or they must be produced at a far cheaper outlay than hitherto.

As regards passengers, speed is the object: as regards goods, weight is the object more than speed; but when goods are borne on the same rails as passengers, they must, for the most part, travel at the same rate of speed. Differing speeds on the same line of rails, unless with long intervals, are a fruitful source of collision.

On the main lines of rail the traffic is stated to be so enormous, that goods wagons are constantly in arrear.

If, therefore, the passenger traffic could be transferred to other lines, exclusively devoted to passenger traffic at great speeds, it would be a very considerable advantage to the public, both in point of safety and rapidity, and also in the forwarding of goods.

At such a proposition the short-sighted amongst existing railway owners will take the alarm, for fear of the depreciation of their property. However, we do not see how their alarm could benefit them. The best way to look all danger steadly in the face, when, where, and how it may occur. Fortunately for them, the danger in the present case is purely imaginary.

It will, we believe, be a conceded point, that the public would prefer frequent trains carrying small numbers of persons, to unfrequent trains carrying larger numbers, and would also prefer increased speeds. And, provided it can be made apparent that they can thus be carried also more cheaply, we presume that both directors and shareholders would agree as to its desirability.

Now, in the first place, a large train involves the use of a heavy engine,
as at present managed. It also involves an amount of station-room and
serving, both at the terminal and intermediate stations, proportioned to the
numbers of the passengars. This large amount of property and personal are
employed all day, that with anxious care.

In the second place, the large train involves great momentum and greatly-
increased dead weight to support shocks. It also involves the use of
much heavier rails and roadway, bridges, embankments, viaducts, &c. It
also involves much greater risk to passengers, by the great space taken
to check the momentum and bring the train under the control of the breaks
in case of sudden stoppage. And the slower the movement the larger must
be the amount of stock.

With light trains all these conditions are reversed. A small station and a
small number of servants, constantly occupied, will do the whole of the work;
and thus a comparatively small outlay of capital is required, and a smaller
amount of wages has to be struck off the general receipts.

With light trains the momentum is lessened, and less power is required
both to stop and start. In case of impending collision, the risk in case of
shock is lessened, and the space required to bring up in is comparatively
small—50 to 60 yards would probably be enough. The small engine we have
been describing will bring up from speed in about 60 yards.

Rails and roadway of flat lighter structure will suffice for light trains—so
much lighter as to seem almost an imputation on our "heavy-coach" rail-
ways. Not only is the, the error they have committed been in
making their rails too light for their loads, and thus wasting engine
power. And the greater the speed the smaller the amount of stock.

All this is to be accomplished, not by running trains on railways, or
steam-carriages on highways, but by running steam-carriages on railways;
in other words, by putting the load on the engine, instead of drawing it
behind or propelling it before; thus increasing the adhesion of the driving-
whells in proportion to the increase of the load—getting rid of a large amount
of dead weight on the wheels and carriages usually driven behind. And
such light engines may have their adhesive power still further increased
by a single carriage propelling before or driven behind, making such car-
rriages rest a portion of their weight on the engine frame.

If we be told that such steam-carriages do not yet exist, we can but refer
to the practical demonstration of the engine already built, and state
that we have now before us a practical tender, from persons fully competent
to carry the plan into action, to furnish steam-carriages, rails, and timber-
work ready for use, provided the land be delivered levelled and ballasted,
ready for the permanent way, at the price of Two thousand pounds per
mile of single way, the carriage to travel 50 miles per hour, and carry 1,000
persons per day of twelve hours, over a line of twenty miles in length, with
greater safety than by the present system. The railway may be laid in
ballest, or carried on piles.

Reverting to our description of the present engine, it will be seen that
the gravity is chiefly below the axles and within the base of the wheels.
Only those who are familiar with engines and wheel-carriages can fully
estimate the importance of the principle here involved. With a pendulum-
balance the weight is always seeking to be vertical. With a prop-balance
the weight is always seeking to deviate from the vertical line. With a
bogie carriage moved by external power the adhesion of the wheels is lessened
and increased from one to another by oscillation, and this while increasing
the risk and light draught. With an internally-moving carriage, adhesion
is required for the purpose of propulsion, and the pendulum action is the best
adapted for it, as well as for safety. In short, the same qualities are
required in a locomotive engine as in a ship, to ensure steadiness and
swiftness,—" a low and a long ball."

The engine above described will have its frame not more than
nine inches from the rails, all four wheels drivers, and will carry twenty
or thirty passengers, as may be preferred.

The railways we have been describing may be laid either on piles, over
fields, or on river banks, or on the surface of existing highways, insasmuch
as the steam-carriages will ascend inclines of one in fifty, or pass round
curves of two hundred feet radius with great facility. The weight of the
engine will be about 2½ tons, that of the passengers about the same, making
up altogether 8 tons, or 1½ tons per wheel. Supposing it desirable to con-
vey such engines to good traffic, a wagon of five tons might be applied
before and behind, pressing on the engine to increase the adhesion with a
reduced speed. By this system, the old highways might be brought back
to their former state of prosperity, and property along their borders actually
increased in value.

Do railway owners see in this any deterioration of their property? We
do not. If it be so, do they think they can keep it back when once shown
to be a public advantage? Do they think the landholders, who were strong
enough to dictate terms to railway makers for their own benefit, and drive
them away from the vicinity of the old highways—do they think they
will be less powerful to intermarry their highways with railways—to make
railways over their land, when they are brought within the compass of their
own means? We do not.

But railway men need not fear the result. The railways will ever have
the same advantage over the highways that they ever have had, in better
gradients and straighter lines; and they have, moreover, a source of profit
that they have never yet looked to—the capability of making four lines of
rail complete, with the exception of tunnels, road bridges, and stations.

For the light engines and mode of transit we have been describing, the
roads and embankments and embankments and embankments are within the
outer

fence of the railway, which is to be made sufficiently strong for the pur-
pose, a light timber is to be laid, and on that a light rail. A similar rail
is to be laid on the embankment, and the two connected by the rails. The
level of the rails is about a foot below the main rails. In cuttings, the re-
verse mode must be adopted, with the rails about a foot above the main
rails. To wide bridges, a light wooden frame may be used. At tunnels,
in vertical chalk or rock cuttings, at stations, and at level road bridges,
the carriages may be stopped, and the rails put into position.

With light engines, capable of sixty miles speed, this would be no serious
inconvenience. The main lines thus relieved of the fast-train passenger traffic, a much larger amount
of goods and slow passengers might be carried. It is not on the Eastern
Counties line, from which railway improvements have of late so largely
emancipated these considerations will be lost sight of, and the Directors
have done well and wisely to foster the mechanical aptitude amongst their
officers for the production of railway improvements, that must tell most
beneficially on their shareholders' pockets.

The amount of good that must result from this new system of railway
transit, wherein the proportion of dead weight per passenger, at increased
speed, is reduced from about 9 cwt. to 1½, must be enormous. And to be
achieved at the rate of £2,000 per mile, minus land and levelling! We
have only regarded the question in the aspect of rapid passenger transit,
but if the speed be reduced, the power becomes available for larger loads.

We see in this system a means of effecting transit even in the wildest
countries—a means of crossing the fatimuses of Sweer and Darien, even by
individual capitalists—a means of penetrating to the southern point of
Italy, and shortening sea transit without coming to England for capital—
a means of regenerating Spain and making it a nation, instead of a bundle
of quarrelling provinces—a means of instructing all the innumerable
branches of the main lines of railway already constructed throughout
Europe—a means whereby almost any individual landholder may make
his own railways through his estates, and thus achieve a system of agri-
culture of threefold produce—a means whereby Ireland may easily be
intersected and civilised, and the reproach taken away from us, that a
wild people, knowing no law or justice, of revenge, still dwells
within the borders of our island domain.

The principle herein enunciated is that of inducing adhesion and prop-
ulsion by the agency of the load on a self-moving machine, in opposition
to that of making an enormous machine to produce its own adhesion, in-
dependently of the load, and therefore requiring a machine always of the
maximum weight, even with a minimum load.

We invite our readers, who may be interested in this branch of science
to investigate the data as patiently as we have done. The proposition to
carry must be the load of passengers only. For example, weighing only half
the weight of an ordinary first-class carriage, and at a greatly
increased speed, is a matter deeply touching the welfare of all who are
connected with railways. We shall return to this important question at
a future opportunity.

Photography.—M. Niepce de St. Victor, in making some experiments in
photography, finds that if a sheet of paper on which there be writing or
printed characters or a drawing be exposed for a few minutes to the
vapour of iodine, and there be applied immediately afterwards a coating
of starch moistened by slightly acidulated water, a faithful tracing of the
writing, printing, or drawing will be obtained. M. Niepce has also dis-
covered that a great number of substances, such as nitric acid, phosphoric
acid, chlorures of lime and mercury, &c., act in a similar manner, and that
various vapours, particularly those of ammonia, have the effect of verifying
the images that are obtained by photography.
PNEUMATIC PILE-DRIVING.

Pile-driving is a process of great importance to the hydraulic engineer, and the means of facilitating it have engaged the attention of many. To drive by the common monkey is a clumsy operation, because the power is brought to bear on the substance of the pile rather than on the soil in which it is to be driven, and because the depth to which a pile can be driven is limited by the length of timber of which piles can be made. The effective power brought to bear has been increased by the American and other steam pile-driving machines, but without materially reducing their cost. Within the last two years a new process, called Dr. Potta's, has been introduced, which has been already applied by Mr. Robert Stephenson and other eminent engineers.

Although Dr. Potta's process is very simple, it is so different in its effects from what is imagined, that it is necessary to speak of it rather fully, in order to give a precise idea to those who, by forming quick preconceptions, may miss the principle. We have already intimated that in the common solid timber pile, power is applied to the head of the pile, and not directly to its base, or the soil into which it is to be driven, whereas Dr. Potta's pile is hollow, and the power is brought to bear immediately on the soil in which the pile is to be fixed. This is done by making the pile hollow, by exhausting the air from it, and by drawing up the soil from below the pile, whereby it is made to sink. The pile is not driven down, as most would think, by the sole pressure of the atmosphere on the top of the pile, but by the shingle, gravel, or sand being removed into the pile as the air is exhausted, the soil is constantly excavated beneath the bottom of the pile, and driving and excavating proceed at the same time. This we look upon as the real distinction between the old and new process, and the point in favour of the latter, while the power is further economised by being applied direct to the true scene of action.

Our engraving represents the pier supported on pneumatic piles, laid down by Mr. Robert Stephenson on the Chester and Holyhead railway in the course of this summer, being one among the many novel and curious works on that great public undertaking, and illustrating the enterprise of its eminent engineer. The viaduct is skew, and is carried over a branch of the sea, in the island of Anglesey, and consists of two land piers built in the usual way, and of this centre pier, laid on a sand bank. It is 86 feet long and 8 feet wide, and is built on 19 cast-iron tubes, each 16 feet long and 1 foot diameter. The tubes were sunk by means of a small double air-pump, with cylinders 4 inches diameter, and 16 inches length of stroke, worked by four men; the pumps were placed on the land pier, and a half-inch lead pipe was carried from the pumps on to the water at the place of driving.

Each tube was placed perpendicular over the spot on which it was to be sunk, and then a square iron cap placed on the top, with the half-inch leaden tube just described passing through it; at every stroke of the pump the air was exhausted from within the tube, and as the exhausting process proceeded, the pile or tube made its way downwards, and the soil displaced at the bottom passed into the lower part of the tube—and thus the operation was continued until the pile was sunk to the required depth. When the whole of the nineteen piles were sunk to one level, as shown in the annexed engraving, a cast-iron plate, weighing 9 tons, was placed over them, just on a level above the surface of the water, and formed the foundation upon which the superstructure was built.

The pumps were brought down by coach, put together, worked, unshipped, cylinders and bellows, and again, air-pumps, new cylinders, and bellows, so that nothing contained in the way of apparatus is involved in the application—and, indeed, the air-pump can be carried where the pile-driving machine cannot. The piles were driven at the rate of half-a-minute per foot for the first six feet, and at about three minutes to the foot for the remainder.

The arches are 20 feet wide on the square, and 30 feet on the skew; and the piers 8 feet wide on the square, and 10 ft. 10 in. on the skew.

In July 1845, a pile of cast-iron, of 2 ft. 6 in. diameter, was driven into the Goodwin Sands by the engineers of the Trinity House. The rise of the tide and the state of the weather prevented the uninterrupted progress of the work, and it was unavoidably divided into three separate periods, which gave the following results:

<table>
<thead>
<tr>
<th>Date</th>
<th>Hours</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 19</td>
<td>8</td>
<td>22 ft. 6 in.</td>
</tr>
<tr>
<td>July 20</td>
<td>6</td>
<td>22 ft. 6 in.</td>
</tr>
<tr>
<td>July 21</td>
<td>10</td>
<td>23 ft. 10 in.</td>
</tr>
</tbody>
</table>

The total depth driven below the surface of the sand was therefore 23 ft. 7 in. This is only one of many experiments performed by the Trinity Board, who have a license for the application of the patent, and have used it in many of their smaller works.

In the autumn of this year, the Trinity Board erected a beacon, by the pneumatic process, on the South Callipper of the Goodwin Sands—a very dangerous spot. The centre column is a tube of cast-iron, 3 ft. 6 in. diameter, put together in 10 and 20 feet lengths, and inserted 33 feet deep in the sand. Around it are four other cast-iron tubes, each of 15 inches diameter, the whole braced together, and supporting a cap at the top, which is 50 feet above the sand level. In the great storm in October, this work was broken; but this failure had nothing to do with the pile-driving process, which was efficiently carried out, the piles being driven 33 feet,—whereas, in Admiral Beaufort's experiments on the Goodwin, he could only drive a steel bar 8 feet with a sledge hammer; and Captain Bullock, B.N., found that a pointed iron rod of 3 inches diameter, when driven 18 feet in the same sands, took 40 blows of a monkey weighing 1 cwt., and with a 10-foot fall, to drive it one foot. It should be observed, the beam on the Goodwin was of cast-iron only.

Dr. Potta's plan allows the application of cast-iron tubes of any diameter and any length, whereas wooden pile-driving is limited by the scantling of the timber, and timber piles of a large scantling are very expensive. Two feet six inches, used on the Goodwin, is an unexamined diameter for a pile, but there are so many narrow limits to the new process. Metal or wood may be used for the tubes, and they may be made of strakes hooped. The patees offer to put down small fishing and bathing-houses and stations in the sands, at very moderate rates, and the plan is likely to be applied for columns for carrying electric telegraphs over rivers, and for piers or towers of suspension bridges.

It should be noticed that a cylindrical tube, placed vertically on a body, of sand and water, cannot be made to descend without great pressure, and then only a few inches; but by exhausting the air from the tube and drawing up the soil from the bottom it sinks most rapidly.

It is found in practice that not merely will sand, shingle, mud, bog, and clay be carried up the pile, but even large stones are carried in suspension, so that every kind of soil can be mastered except rock—and there it is not wanted, because there is a solid foundation.

The hydraulic engineer will at once appreciate the utility of this invention for river and sea-walls, piers, and breakwaters; but its applications are very numerous, and, as it can be most economically used, it will lead to many new classes of works, for it extends the range of engineering. Mr. Alexander Gordon, in laying down one of his new colonial lighthouses, proposes the application of this plan, of the practicability of which he has had an experience. Mr. Potts has, however, been the first to apply the plan on any considerable scale, though what has been done hitherto by all parties is far from enough to make it generally known among the profession. Those of
HYDRAULIC AND PNEUMATIC MACHINERY.

JOHN WALKER, of Crooked-lane, London, for "Improvements in certain hydraulic and pneumatic machinery, and in the application of steam or other powers thereto."—Granted April 20; Enrolled October 20, 1847. [Reported in the Mining Journal.]

This invention, which is comprised under two heads, consists of the following arrangements and combinations of parts—the first is as follows:—In the accompanying drawing, A, is a metal tank, having three sluice-doors B, covering openings thereon, either of which may be covered or uncovered at pleasure. Such tank is supported by a strong framing of wood, and upon the top of this tank are strong metal framings, C, which support and carry the several working parts of the machine, of which D D marks a steam cylinder, and there are two, placed side by side, fitted with suitable pistons, E, and piston-rods, F; to the upper part of these piston-rods, a cross-head, G, is attached, from each end of which there depend two rods, H H—the lower ends whereof are attached to a cross-head, I, from which there depend, in a similar manner to the cross-head, G, two rods, K; the lower ends of the last-mentioned rods are securely fixed to a cruciform pieces, L L, to which piece M M are fixed four rods, M, with their upper extremities attached to a valve-piston, N, of peculiar construction, hereafter mentioned and exhibited in transverse and vertical section. O, marks a water cylinder; there being two of them placed side by side, and fixed to the framing, P, as is the case with the steam cylinders, D D. The water cylinders, D D, are furnished at their upper ends with valves, Q, similar in construction to those in the pistons, N, and such valves are arranged and combined as follows: a marks a grating, upon the outer edge of which there is a shrunk a wrought-ring, o; and the lower edges of the bars, c, which form this grating, are made wider than the upper part, or seat, for the purpose of allowing the water to pass with ease. The whole is composed of metal tubes, plugged with wood; and they have free liberty of vertical movement, and are guided in their proper course by cross pieces, r, which embrace their ends; and immediately above the valves, Q, which are fixed at the tops of the cylinders, O, there is a box, I I, furnished with a cover, S, over each valve; and to this box is attached a pipe, T, which terminates in a box, U, having three clacks, or sluice-doors, V, which can be opened or closed at pleasure. W marks a slide for regulating the steam through the pipe, X X, to the two cylinders, D D, alternately. Y, the eduction pipe, is attached as shown, in the following manner:—1 1 mark a series of pipes, which extend to within a short distance of the bottom of the box, Z—the upper ends of such pipes being fixed in a partition-plate, 2, as also is the eduction pipe, S. The operations of this machine are as follows:—Steam, of the pressure of about 25 lb. to the square inch, being admitted to the inner side of one or other of the pistons, E, will cause it to ascend, and thereby impart motion to a crank-shaft, through the medium of a connecting-rod, G, and the upward movement of one piston will cause the downward movement of the other—the cranks upon the shaft being suitably placed to effect the same—and the heated air will pass alternately from one cylinder to the other by a valve, which connects the two cylinders together; and such movement of the pistons will impart motion to the valve-pistons, N, in the water cylinders, O O, through the agency of the rods and cross-heads before mentioned; and, assuming the tank, A, to be charged with water, and one of the valve-pistons, N, to be at the top of the water cylinder, the descent of such piston will cause the valves, or tubes, O, to be raised, and the water below them will pass until the piston has completed its downward stroke. The quantity of water which passes will depend upon the velocity of the piston, which, for raising water, the inventor states, he has found from 70 revolutions per minute to answer. The piston is now ready to perform the upward stroke, by which movement the tubular valves, O, will be closed, and the body of water above them will be thereby raised, and forced through the opening in the valve, Q, the downward stroke of the piston causing the tubular valves in the valve-ports, Q, to be closed, and this will continue so long as the water in the tank is not lower than the bottom of the water cylinders. The water thus raised may be passed off through one or other of the sluice-doors in the box, according as the machinery is required to be used either for draining, irrigating, or raising water. The waste steam from the cylinder passes into the box, Z, and the water from the cold-water pump passes through the pipe, G, into the said box. The cold water, as it passes down the pipes, I I, becomes heated to the boiling point, or nearly so, in which state it is forced into the boiler by the hot-water pump, which receives motion from the crank-shaft. The inventor states, that, in adapting this machine for pneumatic purposes, the cistern and box may be dispensed with; and the position of the piston and valve must be reversed, and the velocity of the crank-shaft should not be less than 120 revolutions per minute.

The second part of this invention consists in the application of vanes, mounted upon a spindle in sets, each set being placed in an opposite direction to the other. The inventor states that, although lie has used flat vanes, he does not confine himself to them, as, in some instances, he prefers using vanes forming the segment of a screw, similar to those used for propelling boats. These vanes are mounted upon each end of a spindle, the periphery of which fits into a short cylinder, and such cylinder is being open; and such cylinder is fixed within a box or cistern, at one side whereof is a suction-pipe; and, at the top of the open cylinder, there is attached a pipe, which is the exit-pipe for the passage of water, or air. The said spindle may receive motion from manual or steam power; and the motion of the vanes in one direction will cause the water to be raised in the pipe, and a reverse movement of the vanes will raise it up the other pipe—the water, in the first instance, passing between the
vanes, through the open ends of the short cylinder, and, in the latter case, passing out at the ends of the cylinder, and down the suction-pipe. The velocity of this machine, when employed for raising water, should not be less than 150 revolutions per minute; and, when employed for pneumatic purposes, about 1400 revolutions per minute.

The inventor claims the combination and arrangement set forth as constituting improvements in certain hydraulic and pneumatic machines; and, secondly, the combinations and arrangement of a high-pressure engine for such purposes.

COPYING PRESSES.

WILLIAM HENRY KEMPION, of South-street, Pentonville, gentleman, for "Improvements in copying presses."—Granted March 23; Enrolled Sept. 28, 1847.

This invention consists of a copying press so arranged that the act of shutting a lid or cover acting on a bed or surface is, by the resistance of a spring or springs, caused to produce the requisite pressure for copying letters or other documents, as shown in the annexed engraving. Fig. 1 is a plan of the copying press open, and fig. 2 a sec-

...tion thereof, the lid or cover being closed. a, the frame; b, the bed, constantly pushed upwards by a spring or springs, c, for giving the requisite elasticity between the bed b and the lid or cover e. f, stops to prevent the bed or surface, b, rising too high. The letter or other document with dampened paper and other materials, as in other flat copying presses, are to be placed on the surface of the bed b, and then the act of closing the lid e will cause the bed b, to be pressed downwards, and the lid is to be retained shut by a bolt g, for a short time, when the desired copyright will be obtained.

OIL CAKE PRESSER.

JAMES ROBSON, of Dover, Kent, engineer, for "A new and improved instrument to be used in expressing oil from vegetable and other substances, and in making oil cake, &c."—Granted April 15; Enrolled Oct. 16, 1847.

When manufacturing oil-cake, it is usual to employ instruments made of horse-hair, called "hairs," for enclosing the flannel bags containing the substance to be pressed; but, in consequence of the horse-hair fabric soon becoming clogged, the patentee substitutes an instrument constructed of metal, as shown in the annexed engravings.

Fig. 1 is the interior view, and fig. 2 the exterior of the instrument, in an open or extended state; fig. 3 a longitudinal section, and fig. 4 a transverse section, of the instrument. a, b, are two metal plates or flaps, corresponding to those hitherto made of horse-hair cloth; but the shape may be varied. c, is a leather hinge, connecting the two plates; and d, a handle. Along the sides of the plates, and at the ends of the plate b a rim is formed, to prevent the material from being pressed beyond the edges of the plates. Across the inner side of each plate, a series of ridges and depressions are made, in such a manner that when the instrument is closed, the ridges on the plate a, will come opposite the depressions in the plate b; and through the sunken portions of each plate a series of holes, a, are formed, opening into grooves 4, across the back of the plates; these holes may be one-sixteenth of an inch in diameter, and half an inch apart; but the patentee does not confine himself to these dimensions. The linen or other matter to be pressed is prepared and placed between the plates, and pressed in the same way as when using a like instrument made of hair.

RAILWAY CHAIRS AND FASTENINGS.

CHARLES MAY, of Ipswich, Suffolk, civil engineer, for "Improvements in railway chairs, the fastenings to be used therewith, and in trelails."—Granted March 27; Enrolled September 27, 1847.

The first part of this invention consists of improvements in manufacturing railway chairs. In performing this part of the invention the mould is formed in a similar manner to that described in Ramsome and May's patent of Feb. 1841, in which side plates of metal are used to form part of the mould and for guiding the core. This part of the invention consists of forming the core for the interior of the jaw of a chair, with sand upon a metal interior, or core-bar, combined with the using of metal side-plates or surfaces as part of a mould, and as supports to the core. This part of the invention also consists of having a cross-bar attached to the flask, into which the tail-end of the core projects. And further, it consists of using metal cores for casting the holes for the trelails or fastenings.

Fig. 1 shows a longitudinal section; fig. 2, a plan of a flask, with a sand-mould representing a chair cast on to a core, the top side of the mould being removed. In the left surface in certain parts of the chair, the iron part of the core is left to come in contact with the melted metal, as is shown at a, fig. 1; the extent and portion of this clean or chill surface may be varied. To produce clean or chill holes for the trelails, the metal cores at b, b, are used; c, is a
The cross-bar fixed across the flask, so as to receive the tail-end of the core, in such a manner as to ensure its correct placing and holding when in the sand-mould, which cross-bar will be found advantageous (when casting railway rails) for holding the core used, whether employed separately or in conjunction with the side-plating shown.

The second part of the invention consists in so arranging apparatus that a rammer, or rammers, worked by mechanical power, may be employed in ramming the sand into a core-box, so as to make suitable cores for casting railway rails.

The third improvement relates to combining a process for preserving the wood used for fastenings of railway rails and treenails with the process of compression, that for preserving the wood being first performed, and then the compression—Take the heavy oil of coal-tar, called creosote, and pass through it, in a close vessel, a stream of steam from a boiler capable of sustaining from 200 to 100 lb. pressure; the pieces of wood prepared for the treenails or wedges are placed in a vessel also of great strength, and the combined vapour of water and creosote allowed to act upon them for some time (half an hour to an hour); this combined vapour penetrates the wood effectually, and when it is desirable to combine more of the creosote with the wood, it is subjected to the vapour of creosote only, without the vapour of water. The patentee states that such modes of impregnating wood with preservative matter is not claimed by him, the same being old and well known. The process of compression is to be performed (when the wood is dry) as described in the said former specification.

The fourth improvement relates to the manufacture of wood fastenings used with railway rails, and of wood treenails. In practice, such fastenings as are described under the said former patent are liable to exposure to moisture before inserting them, or applying them to the purpose for which they are intended, and they thus frequently become swelled. And it has been found desirable to retard this swelling process, which the patentee accomplishes by covering with any repellant of water, as varnish or grease; but it is not intended that this shall permanently repel moisture, as they are required to swell after driving. It has been found that a thin solution of common resin in oil of turpentine answers very well, which is used as a coating to such fastenings as soon as they are made.

**LUBRICATOR FOR MACHINERY.**

JAMES CARTER, of Oldham, Lancashire, painter, for "an Improved Lubricator."—Granted Dec. 14, 1846; Enrolled June 14, 1847. [Reported in *Newton's London Journal*.]

This improved lubricator is for lubricating shafts, bearings, axles, and working surfaces of machinery generally, and is intended to furnish a certain quantity of oil or other lubricating matter to the surfaces at determinate intervals, which may be varied and regulated at pleasure.

The annexed engravings show a lubricator as applied to a bearing, and are calculated to furnish the oil or lubricating matter once in every 5,200 revolutions of the shaft. Fig. 1 is a side elevation of the apparatus; and fig. 2 a transverse section. a, is the shaft to be lubricated; b, the journal carrying the same; and c, the cap or top-plate of the bearing. To the top of the cap e, a box d, is attached; to which is fixed a bracket a, for carrying the shafts f and g. Upon the shaft a, is keyed a worm h, which is cast in two pieces (for the convenience of fixing on the shaft), and fastened together with small screws. This worm actuates a worm-wheel i, of twenty teeth, keyed to one end of the shaft f, which, at its other end, carries a worm j, in gear with the worm-wheel i, which also carries a worm k, for driving a worm-wheel m, having twenty-seven teeth. This wheel m, is fixed at the upper end of a hollow plug n, which is ground true, and revolves in the box d. To

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**REVIEW.**

The present work has much the same merits and defects as its predecessor, it displays, on the one hand, the same diligence and care in collecting important facts and original experimental information; on the other, it displays the same want of care and diligence in arranging these valuable materials. This "catechism" is not, as far as we have been able to discern, arranged on any definite plan, and the order of the various topics has apparently been left to chance. This, however, is not a very great disadvantage in a work dealing principally with facts, and not professing the character of a systematic exposition of the general theory of the steam-engine. The scientific principles are, for the most part, tolerably accurate, but they are scattered up and down the book—not connected by a logical chain of reasoning, of which every single link is necessary for the continuity of the whole. It may even be doubted whether the construction of such a chain be yet possible—whether we yet possess body of facts respecting the operation of the steam-engine sufficiently copious and precise to permit their reduction to one general code of laws. Mr. Bourne has not attempted here this perilous enterprise, but has accomplished a task less ambitious, but far more useful—that of collecting in a compendious form a great number of experimental observations, practical details, and dimensions and minutiae of the construction and management of engines of various kinds. This practical information will render his book one of real and direct utility to a large class of our readers.

Some, however, of the doctrines laid down by our author require elucidation; the following is one of them:

**Q.**—By what considerations is the momentum proper for the fly-wheel of an engine determined?

**A.**—By a reference to the power produced every half stroke of the engine, joined to the consideration of what relation the energy of the fly-wheel rim must have thereto, to keep the irregularities of motion within the limits which are admissible. It is found in practice, that when the power resident in the fly-wheel, such as at its average speed, is from two-and-a-half to four times greater than the power generated by the engine in one half-stroke—the variation depending on the momentum inherent in the machinery the engine has to drive and the equality
of motion required—the engine will work with sufficient regularity for all ordinary purposes.

The last paragraph is rendered ambiguous by the vague use of the word "the" and the incorrect use of "will" instead of "must." It is true that the engine must use a certain amount of force to move a body or bodies subject to pre-judicial resistances, and that the greater the force, the greater the velocity, up to the point where the resisting forces become equal to the driving force.

The "power generated by the engine in one half-stroke," likely signifies "work done," or the pressure on the piston multiplied by the distance through which it acts. This "work done" is always equivalent to a definite amount of force; that is, if it acted on a body or bodies subject to no prejudicial resistances, it would produce a certain velocity, such that the "velocity" would be the same, whether the mass acted on were small or great. Consequently, Mr. Bourne's rule may be stated thus:—when the engine is in its normal state of working, the rating of the fly-wheel would be the square root of one half of the mass in pounds on the fly-wheel multiplied by the square root of the actual velocity in feet per second; and a half to four times greater than the "velocity" which the engine would produce during a half-stroke. For example, if the mass of the fly-wheel (supposed to be collected at its rim) were M and V the linear velocity with which it generally moved, M V^2 would be its actual "velocity." Suppose that if the engine could act on the fly-wheel exclusively for a half-stroke, the velocity generated would be v; the corresponding hypothetical "velocity" would be M v; and adopting the highest of Mr. Bourne's ratios, we should have

4 M V^2 = M v^2, or 2 V = v,

which would reduce the rule to a simpler form, as follows:—the mass of the fly-wheel must be so chosen, that the velocity which the engine would produce in it by setting on it exclusively for half a stroke may be half its actual velocity when the engine is in its ordinary state of working.

We have endeavoured to develop the rule in the above manner, not from its intrinsic value, but merely to illustrate the extreme importance of adhering, in all mechanical disquisitions, to measures of force about which there can be no possible ambiguity. The use of vague terms has sometimes had a prejudicial effect on the difficulty of the subject. If a precise, systematic nomenclature were universally understood and adopted, there would be far fewer of the idle discussions of principles with which we and our contemporaries are bored, and far less money would be spent in securing by patent the exclusive right of effecting impossibilities.

With respect, however, to the intrinsic value of the above rule respecting the fly-wheel, it is to be observed that it can only apply to engines performing a particular class of duties. The duties may task the engine in such an equable and uniform manner, that no fly-wheel need be required. Or, again, the resistances may be capable of such great fluctuations, that a fly-wheel of enormous dimensions may be required. The variation of resistances is not taken into account in Mr. Bourne's rule. A fly-wheel is a kind of bank in which force is treasured up in times of abundance, to be redistributed in times of scarcity. The greater the superabundance at one period, and the deficiency at another, the greater is the demand on the capacity of the bank.

Another doctrine adopted in this treatise, and which seems liable to lead to erroneous conclusions, is the following:—

"Setting aside less from friction, and supposing the vacuum to be a perfect one, there would be no benefit arising from the use of steam of high pressure in condensing engines, for the same weight of steam used without expansion, or with the same measure of expansion, would produce at every pressure the same amount of mechanical power. A piston, with a square foot of area, and a stroke of three feet with a pressure of one atmosphere, would obviously lift the same weight through the same distance, as a cylinder with half a square foot of area, a stroke of three feet, and a pressure of two atmospheres. In the one case, we have three cubic feet of steam of the pressure of one atmosphere, and in the other case I cubic feet of the pressure of two atmospheres. The volume of steam in the second case is exactly the same weight of steam, but the steam in the second case contains a greater quantity of heat and water in its vapour, and it appears a given weight of steam would, under such circumstances, produce a definite amount of power, without reference to the pressure."
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One peculiarity pointed out is that the remaining abutment piers on the exterior of the upper wall of the south aisle take their places beyond the lines laid out below, and are based on the brick vaulting with perfect security. The reason of this is not explained, nor is it obvious. Messrs. Buckler have observed that many of the smaller arches in the building are irregularly curved, and indeed distorted. This is not uncommon in Norman buildings of elaborate design and costly material, and is supposed to arise in some cases from the arches being turned over the openings without the help of wooden ceirings, or with rough frames.

In this church the system is fully seen which was adopted by the Norman architects of building walls across all the openings, so as to tie the whole of the work together for greater security. The extent of this underground work as discovered by Messrs. Buckler within the eastern aisle is said to be truly astonishing. The system was sometimes imitated by the architects who made additions to the building.

The columns of the nave it is remarked that there is far less bulk and appearance of casing than in those of Winchester cathedral, as greater dependence could be placed upon the strength of the brickwork core, than upon that of rubble-work.

The west front was 155 feet in its extreme breadth, being flanked by two lofty towers, measuring 40 feet in the square on the outside, and being constructed of engaged piers.

With an opinion of the authors, in reference to another subject, we cannot but concur. They observe that in Herefordshire, the greater number of church towers are characterised by slender spires, constructed of timber and covered with lead. They regret that these should ever be removed, as they so often are for the value of the lead. Though the spires may be less ancient than the towers, their age is still great, and their destruction cannot but be considered an act of barbarism.

In conclusion, we cordially recommend this work to the libraries of our readers, to whom its moderate size and price offer an additional inducement.


What the object of this pamphlet may be we cannot make out. The author introduces new and complex processes, without any preface; and he gives new definitions, which are no more definite than the old ones, and much less philosophical.

GOELOGICAL LECTURES,

By Professor AMSTER. Delivered at King's College, London—Session, 1847.

Geological Considerations affecting Agriculture.

After some prefatory observations, Professor Amster proceeded to explain the points in which the practice of agriculture was affected by geological considerations and knowledge. They were two in number—first, that the materials, taking in the formation of the earth; and, second, that the materials, forming a part of the preceding lectures: under this head they would have to consider the nature, use, and way of modifying those materials. Secondly, considering the earth as the basis of operations, they would have to observe how agriculture was affected by the formation of the earth. The author concluded by observing that the materials, forming a part of the preceding lectures, under this head they would have to consider the nature, use, and way of modifying those materials.

Among the illustrations are a specification, small barrel culverts, large culverts with wing walls, open culvert, bridges, occupation road, occupation bridge, skew bridge, viaduct, timber viaduct, another with iron tension of, &c. There are likewise plans and sections with curves set out, off-sets for unsloping, outside fencing, and ditches, &c.

Mr. Gardner gives a number of descriptions, 297 lines for the easement of cuttings and embankments.

Mr. Gardner recommends that the number of parts measured should always be placed first, to prevent error of quantity, such as occurred a few years since in the erection of a new church a few miles from London, where the gallery was measured and not twice, thus leaving one gallery wholly out of the quantities, which could hardly have happened had the No. 2 gallery been placed last. In all cases, even in cabins the dimensions given for practice, Mr. Gardner urges that every dimension should be checked, to prevent error; and before beginning to measure, to well study and understand the plan.

We think the work will be found useful by the parties for whom it is designed.


The first of these little volumes contains a collection of rules for applying logarithms to geometry, navigation, &c. The second volume gives separately the demonstrations of the rules. This separation may be useful to those who are required to deal rather with results than principles—whose occupations render it necessary for them to obtain arithmetical results, by processes of which they are unwilling or unable to comprehend the logical accuracy. We do not much admire the learning-made-easy system; it misses all the advantages of mental discipline, and fosters mere superficial attainments. The knowledge-doctors are the professed apologists and coadjutors of shallow-headed students;—their very trade is to coarct ignorance with a varnish. However, there are certain cases in which it is absolutely necessary to set people in the way of working without understanding the principles of them; for instance, how it would appear from the work before us, that this necessity exists at the Royal Naval College.

The rules are concisely and clearly expressed, and are accompanied by numerous examples fully worked out.


The idea of this book is a good one, and, once conceived, it was easy for Mr. Gardner to carry it out; while as a special work, it is likely to pay well. It consists chiefly of working plans and forms from the Brighton Railway, the South Western, the Farnham and Alton, Syston and Peterborough, and Salisbury Branch Extension Railways.

The book is therefore practical enough, and, by having a number of ruled pages, can be studied and worked up at the same time. Among the illustrations are a specification, small barrel culverts, large culverts with wing walls, open culvert, bridges, occupation road, occupation bridge, skew bridge, viaduct, timber viaduct, another with iron tension of, &c. There are likewise plans and sections with curves set out, off-sets for unsloping, outside fencing, and ditches, &c.

Mr. Gardner says enough about tunnelling to enable the student to understand the mode of measurement, and how to set off the ranging line from above to below. Full directions are given as to the measurement of cuttings and embankments.

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also very important minerals, known as loam and sand—they being admissible of clay and sand, and the latter of clay and lime stones. With respect to the nature of detritus, the sands were subrounded, and the gravels were pebbled or sandstone. The pebbles were of different kinds, and were generally of the same kind, and in a decomposed state. These rocks evidently had the greatest importance in the composition of the soils, and were of different kinds, and their different decompositions. The sands were in various states, being often in the state of detritus, and being, in some measure, decomposed by various processes. The gravels were frequently seen, and were often in a decomposed state. The pebbles were, however, obtained directly, as almost all soils in England, except gravel, were obtained directly. The pebbles varied in size, from a few inches to 10 feet or 20 feet; but, exceptionally, were from a few inches to 3, 4, or 5 feet in depth. The loams also varied, a good deal in depth, which depended very much upon local circumstances. The loams then referred to the diagram of a road section near Penryn. The foundation was slate-rock, and over that was a kind of rubble, into which the rock was decomposed. Rubble was a general term used to describe any rough detritus of rock, or broken fragments, with sand; and from the rubble was derived the subsoil, and from that the soil on the surface. In another section, of which a diagram was exhibited, the slate at its usual depth lay in the ordinary position of the slate. In this case, it was remarked, that it was impossible ever to determine the true dip of beds close to the surface, as it was a common thing to find altered at the surface—broken, as it were, by some mechanical forces, and often combined in a considerable angle with the underlying bed. This often helped in the formation of the soil, and the lithological movements were such that the whole would be converted into a rubble, from whence the soil was directly derived. In the diagram alluded to, the next bed to the rubble was a loamy clay, which contained about 50 per cent. of sand. This, however, was not so rich, and it put on the surface with great force, but there was a large amount of sand, and a large amount of clay. Clay generally contained a good quantity of sand, and when mixed with about 50 per cent. of sand, became a loamy clay. In that state it was better fitted for agricultural purposes, perhaps, though it still required a small amount of sand to make it proper for agricultural purposes. In this bed the clay was about 2 feet of this loamy clay, which was called the subsoil, and above that the true soil, which, in this case, was of a loamy nature, and contained a rather large quantity of sand. Here, then, was the soil and subsoil directly derived from the rock. The lecturer also further illustrated this point by other diagrams, in which granite was the base from which the rubble was formed.

Soils varied much in value according to their different depths, and the texture of their materials. The depth at which the clay was, they were liable to be carried away, or to be soon exhausted by the growth of vegetation on it; and then those particular ingredients, on which the vegetables subsisted, were required to be replaced, or a further decomposition of soil, at a more rapid rate than ordinary, became necessary. The application of other substances to a different soil presents many difficulties, as it is of different chemical, as well as geological, knowledge was indispensable, or more harm than good might be done. The texture of soils differed very much. Some were exceedingly dense and heavy, and would not easily wash away, or dissolve, as it would be difficult to make them fit for agricultural purposes. They were managed, particularly when they were so dense as scarcely to allow the roots of plants to penetrate. Others, again, were so imperfectly made up, and were coarse, as to prevent the use of the ordinary instruments of cultivation. Some soils contained a great deal of clay, and were so tenacious, as to scarcely allow the plough, or even the spade, to act upon them. These were exceedingly unmanageable, for though it might be thought that a large admixture of sand would lessen this stickiness, it was generally found that the sand, after it had been washed through several times, and was then ready for use, the clay was formed into lumps, instead of making it more loose. Some soils possessed a large absorbent power; while others would allow water to pass through them very readily. In soils of the latter kind valuable manures were soon washed through, and the dunging almost useless, and a remedy might be found in the practical application of geological knowledge, as, for instance, liming the land, by putting on unburnt limestone in small lumps, instead of slicing lime, and trusting to the slow decomposition of the limestones by exposure to the air. There were many other circumstances of a similar nature, such as the capillary power of the soil, the drainage, the surface of the land, the crack and form great ravelling changes in times of drought; the relations of the soil with regard to heat, as it soon becoming hot sand, or remaining cold, or transmitting heat slowly, like clay. These points depended almost as much on the substance that was below it, as on the texture of the soil itself.

The lecturer then proceeded to describe the soils derived from the various geological formations in different parts of England. The districts, which yield the best and most fertilized soils, were so different in character, that portions of Wales, and the greater part of Scotland, in all of which existed areas of geological conditions, to be considered in reference to agriculture. In composition these rocks were chiefly granite, or, as it was called, porphyry; and they were made up of the crystal included in a kind of granite, generally of crystals of felspar and mica, in a base of quartz. These rocks were generally decomposed by various processes, and the difference in the nature of the different ingredients, and their different decompositions. First, they had the quartz, often in compact masses, and so hard, that it was exceedingly difficult to break. Where this mineral was in large masses, and not much deformed, it was found to be a very good tract for agriculture, and indeed was almost impervious, as it was next to impossible to get it, disintegrated by any natural exposure. When mixed with felspar, however, the case was different, for that mineral contained substances of the greatest importance in the composition of the minerals. When the felspar is in a granite decomposed, no such effect results as that from the decomposed felspar. On the condition of the minerals might depend much of the disintegratability of the granite.

The next rock, he would consider, was gneiss, which contained the materials of granite in a metamorphic condition. These would consist of a felspar soil, but they might safely conclude, if it were hard and compact, that a good soil would not be likely to form. In the Highlands of Scotland there was a vast quantity of gneiss and slate soil, and those counties not much modified, it presented a most uniform and characteristic form, and among the most useful and important ingredients were the rich and fertile soils, as was exemplified by the districts in which Indian-cotton was grown. These rocks, which in England were often called impregnate, and which were probably poured out millions of years ago, were capable of great modification, and the clay- and slate-weathered, and among the materials most required by vegetables. Clay-slate was, however, a little iron, and sometimes a little soda, and other like ingredients, but not in such a state as would readily mix with carbon, and the gases products necessary for plants.

The third were the oldest rocks, or Silurian rocks, which formed in Wales, twisted and contorted in every possible way. The lower portions of these rocks were eminently siliceous, with a very small quantity of alumina, carbon, and limestone, and a little potash and soda. Other parts, not much modified, it presented a most uniform and characteristic form, and among the most useful and important ingredients were the rich and fertile soils, as was exemplified by the districts in which Indian-cotton was grown. These rocks, which in England were often called impregnate, and which were probably poured out millions of years ago, were capable of great modification, and the clay-slate-weathered, and among the materials most required by vegetables. Clay-slate was, however, a little iron, and sometimes a little soda, and other like ingredients, but not in such a state as would readily mix with carbon, and the gases products necessary for plants.

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In the first place, it was important, if the soil at the surface was not good, and it was sought to be improved by a mixture, to consider its geologic origin, and what changes it had undergone which had made it what it was. It is to be noted, in the first instance, by sections and sections. This knowledge was indispensable; for, without it, they would neither know where to find the material required, nor, when found, be able to get it. Then, again, it was very important to know what climate the rocks were under which the soil had been formed, and the kind of soil the climate would produce. There was a large number, supplied in their lower portion a great quantity of building stones, quarried in the neighborhood of Bath, near Oxford, at Keton, in Leicestershire, and elsewhere. These stones were often overlaid by beds of ironstone—plenitude of kind—from which came the ironstone ridge—used in their upper portion the soil again contained a quantity of base and valuable building stones, as in Portland island.

Lastly, there were the cretaceous rocks, which included the dark red sands of the Sherrard, and the broad and extensive downs of Sussex and Wiltshire, and extended through Devon to Yorkshire.

**Geological Science applied to the Mixture of Soils, and to Draining for Agricultural Purposes.**

Professor Ansted referred to his previous lecture, upon the above-mentioned highly interesting topics, by some observations upon the formation of soils from certain rocks, which, in his previous lecture, he had but just glanced at; and, first, as to the cretaceous, or chalk formation, which extended from the White cliffs of Dover, near Ramsgate, to nearly the whole of Dorsetshire, and running in a north-east direction, through Buckinghamshire and Bedfordshire, to the east and south-eastern shores. The chalk formation was divided into two kinds; the most important of which, in some places, was a kind of sand, and in others, a kind of clay. The upper cretaceous consisted of limestone; and in certain parts, formed a stiff clay. In either case, the materials would soon mix with the green sand, and generally produced rich and productive soils—this formation was usually seen in the counties of Bedfordshire and Hertfordshire, and in some other parts. The quantity of water required for the support of a small number of animals diminished its value in this respect very considerably.

Next referred to the tertiary beds, which, in England, embraced only a comparatively small series. The London clay formed the great mass of the tertiary deposits: it was found principally in the neighbourhood of the Thames. The London clay was generally understood by a more plastic clay, and sometimes, a stiff clay. This was particularly the case at Bexley Heath, in a large tract of country near Woking, traversed by the South Eastern railway; and those who had travelled upon that line would find it at its best for the most part through a green and somewhat sterile country; this clay was, in a large extent, a pebbly and sand, it was capable of becoming lees in its texture, and of forming a more available soil, and, indeed, a valuable soil, by means of a great deal of manure. The tertiary beds, however, could not be considered naturally valuable for agriculture, although they were often found under similar circumstances. The tertiary deposits of Suffolk and Essex consisted of argy, and consisted either of a shelly or a sandy sand, but generally the latter. This was generally capable of being made a good soil, sand-dressed with the clay near it.

There were other beds, which, as geologists, they were bound to consider—namely, those which were known by the general name of gravel, which would be found in the country, in the same manner as the London clay, in every favourable locality, was met with everywhere; it was, in fact, the most abundant of the earth's superficial coverings. The circumstances which induced it were exceedingly various, though mostly connected with the changes effected by running waters. Where it had accumulated and deeply, the finest and would be found mixed with the nearest pebbles; in other cases, it might contain a great deal of clay; and in others still, these formed masses, which required always to be considered in regard to their local relations. The gravel, as soil for agriculture, and it was readily drained; but it depended on what was near it, or with it, whether it could be made a good one.

All the circumstances connected with the formation and nature of soils—governed into account when the agriculturist studied that most important subject, the improvement of the soil by admixture of other soils. This was a question which required the most careful handling, for it was one of the most dangerous things to play with, and equally hazardous to make mistakes. The more knowledge one had on this subject, the more advantage it was to have a certain amount of that knowledge, and also an intimate acquaintance with many facts which were purely geological.

Where there was no natural drainage, the artificial operation connected itself inevitably with the circumstances under which the superfluity of water occurred. One of two things ordinarily would have to be done: they would either have to get rid of the superficial water, and that...
which might arise from springs, or they would have to get rid of floods produced by the overflowing of rivers. In either case, the superficiality above that would be a natural water table or an artificial drainage, the treatment of a district, this would be easy or difficult, according to circumstances. But, whatever the nature of the effect to be produced, a knowledge of the peculiar structure of the district would be dispensable; and a practical application of the principles of drainage, by taking advantage of the formation of the earth's crust. Where beds of clay, or other impermeable soils at the surface, rested on beds of sand, the upper beds might be drained by means of percolations, allowing water to enter and drain out the land, and the water in the gravel, in which case the attempted draining would increase, rather than lessen, the water surface. This condition of the lower beds would, however, be detected by the geologist from a reference to the natural course. Another remark worthy of notice is, that, in a stream forming its bed cutting out the water by springs, was that of cutting a trench along the strata from which the springs arose on their natural outcrop, and thus conveying the water away. The drainage of the surface, however, and cutting off springs, were very different things, and belonged to entirely different conditions of structure.

The subject of drainage on a large scale was one of great importance; and though the drainage of the fen lands was a well-advanced science to the geologist, yet a knowledge of the principles of drainage was necessary to the agriculturist, if he wished to take a full advantage of the work of the engineer. The principal works of this kind in Holland and Holland, in Lincolnshire and Cambridge- shire, there was a vast tract of land nearly level, composed of a tough clay, quite impermeable to water. It was partially drained by a number of streams which ran across it; but which also drained the higher lands and which the flat country was hemmed in on the land side. These streams brought down a large body of muddy water, and their tendency was to spread the mud over the low country. When there was a broad expanse of flat land, and a quantity of water thus running over it, the, shall we say, a little thing seems to check the passage of the running streams. In the present instance, the Ouse, the Neve, the Giska, and the Welland, and their tributaries, all ran along the surface of the land; and if any accumulation of silt were allowed to remain at their mouths, and they could not with facility escape into the ocean, the movement of the stream would be checked. If any foreign body should accidentally fall into the stream, a portion of the bank on the other side of the obstacle would be carried away; and, on topography, the water ran in a straight line at first, it would, in a short time, arrive at the height, and those meanderings which were so admired in other rivers, but which were so fatal in these, would be the cause. The more tortuous the course of the stream became, the slower it would be its pace, and the less effectual its power as a draining agent. At the same time, the gradually increasing accumulation of silt at the mouth would stop the ocean out, and the flow of water from the river would be thrown back upon the land, and thus the land would eventually become a swamp. All this, however, might be easily counteracted by keeping clear the streams, and removing the obstructions at their mouths; but, supposing that the natural drains, the rivers, were not sufficient to carry off the whole surplus water, some further provision necessary, such as the results of draining being to make the land lower, embankments to keep out the sea were required, and steam-engines, to pump the water from the drains over the embankments into the ocean. The selection of the line of these engines was, therefore, as interesting as the laying out of the roads and means. The result of the work, in the opinion of the engineers, was operations which had to be performed by the engineers.

Of the fen districts of England, a great deal had already been done towards their drainage—badly at the commencement of the undertaking, but still a great deal also had been well done, and whole districts were now in the course of being drained satisfactorily. The fen district was divided into several sections, known by the names of the streams which intersected them. The principal of these were the Ouse, the Neve, the Giska, and the Welland. These were the Ouse, and in the Ouse, which had been conducted in the most perfect manner, and at a very enormous expense; the drainage was partly effected by two great cuttings, parallel to each other, from St. Ives to Downham, not far from the course of the Ouse. In the Ouse, and in other parts of the Ouse, which comprised 5,000 acres, was used for the purpose of holding the surplus water, and so preventing its running over the drained land. There were another series of cuttings, called the Gretna, which were required to keep out the sea, and embankments to keep off the ordi- nary streams by means of steam power. But the case was different when the sea had a tendency to inundate the drained land. This required to be kept out by embankments along a line of coast. This was the case of Holland, the delta of the Rhine, and of river deltas generally. Debris consisted of the land formed by deposits of mud at the mouths of rivers. This was so considerable, as to be called the Gretna, which were killed by the action of the salt water upon them. The difference between the condition of Holland and the fen lands of England was this—in Holland, the soil was being daily added to by the sea, and just at our Speculations of proportions of beauty, and by admiring one class of production as superior in rank to another, without reference to a comprehensive view of the artist generally, a great injustice has been engraved on our received opinions upon art. Distinctive ranks in the departments of art, Mr. Dwyer confided, were a
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- great evil, and to equalise them would be a great good achieved. Until the difficulties attendant upon the operations of art are understood, and unjust prejudices removed—until painters in oil, water, encaustic, and fresco, cease to consider their work a mere occupation, and artists their art a true vocation, until all artistry in practice of art shall be dissipated, and art, in humble garb of plaster and clay, be looked upon as kindly as if in marble, until some new energy shall have swept away these prejudices, as his vaunted, and for his vaunted, and both are necessary, the same course of comprehensive inquiry and dispassionate reasoning, shall contribute to that one great purpose called art—we must not, it was contended, look for a positive and marked progressive feature to be developed in our time, but we must regard the art of the past as a monuments to the study of the present, that the memory of it may train the mind, before the really beautiful in art can be properly appreciated, or the genius evinced receive a just and fair criticism. Several instances were referred to, showing the power of art in expressing clearly and intelligibly to all whatever sentiment it intended to impress on the "Laughing Faun" and the "Dying Gladiator," in sculpture; and the Creation of Adam," by Michael Angelo; the Transfiguration," by Raphael; and the Last Supper," by Leonardo da Vinci, in pictures. These examples, it was said, testify to a metrical or reasoning ideality, combined with a skill in depicting the essence of things material, and should therefore rank far above imitative skill in the abstract. Idealism is yet more severely tested in connecting the several ideal embodiments into a grand whole, or in the union of the parts into the whole, as in the architecture of N. Cottrell. Art such as this, he said, might be called high art; but the qualification ought not to be attached to the works of an ordinary artist, whose vanity leads him to lay a surreptitious claim to rank under such a banner.

The chance to which the art critic has only been referred from the examples last mentioned, although both have received great and well deserved admiration. The Greeks, however, approached only to a perfect embodiment of the beauties of their art, and introduced, in pictures, the higher powers of mental reasonings: this would arise simply from their progressive refinements being based chiefly on skillful imitation. Art had undoubtedly been extensively encouraged by the Greeks, from the great number of their works; and it is not by the service a mere, but by the service they, that they have sought to impart a moral purpose (expressions as well as bons are to be taken in the broad sense), then, indeed, would their productions have attained to a truly glorious eminence. It was Mr. Dwyer's opinion that their wonderful skill, and the additional reasonings, would have created much nobler works through their embodiment of mental attributes. The frieze of the Parthenon, he contended, while he had the full appreciation of its beauties, ought not to be viewed in any other light than as a production in imitative art. Nature, he said, had been so faithfully studied and delineated, that very few inaccuracies could be discovered; but he deduced from this and the pervading similarity of features and vacant expression, not only that the models must have been of a superior class, but also that the ancients had relied upon their powers of imitating objects as they were seen by them.

The second part of this paper was read by Mr. Dwyer on October 27. His plan of treatment sought rather to embody generally, than to judge of art in its parts. He proceeded to the history of architecture in art; and although these are the most rarely developed, they are more readily recognised by the public. What constitutes historical art? Is it represented by battle scenes, massacres, processions, or reviews? He thought that, as a matter of course, each period in history, and each age, bore traces of the period in which it was remembered, and place, harmonising with the event represented, and with mental attributes commanding reverential attention, and exciting a feeling of emulation in the spectator. In painting, the accredited substitutes are too commonly portraits and gatherings from old prints. The recent exhibition at Westminster Hall, professedly of historical art, was in point. The painting of Alfred the Great inciting the Saxons to prevent the landing of the Danes," displayed a high purpose; an attempt to show in a simple fact what our ancestors had done; and by his genius to improve the bulwarks of our country, and laid the foundation of our present mercantile greatness. On the other hand, "The Battle of Measeney" could not be denominated of horror, and was better fitted for the Horse Guards than for a decorative ornament to St. Martin's Church. A lesson might be discovered in "Richard Coeur de Lion compelling Bertrand de Gourdon,"—an embodiment of a noble principle in Christianity. On the other hand, "Edward the Confessor to the People of Calais during the Siege of 1346," is too problematical. He was led to attend to a single cartouche, by Mr. Riviere, relating to the "Seven Acts of Mercy," in which the conditions of sickness, hunger, and the houseless, were expressed through the laborious and arduous dealing in English garb to English understandings, and thus rendering art more sympathetic.

The decorations for the new palace at Westminster, according to the comprehensive system laid down by the Commissioners of Fine Arts, afford an interesting opportunity to the architects to gratify the desires of all who venerate painting only in its noblest workings. He observed that "decorations" would not continue as hitherto be misunderstood and restricted in its meaning, by artists generally, and that the time had returned when all branches of the arts would be considered honoured in their applications as decorations. What has lately been the general estimation of painting on a wall? why, mere ornamentation, whereas, if removed from such a position and framed as a picture, it is recognised as of fine art, or high art. He further remarked that artistic works in metal, such as jewellery, &c., would, if in marble, take rank as fine art. These false distinctions require an indemnity of a nation must always influence their production. Whatever is truly great or practically useful is always based upon simplicity. The simple outlines of Greek and Etruscan vases, have caused, perhaps, more abstruse geometrical investigations into conic sections than have the planetary systems; yet a thought, geometry had not been brought to assist art in their formation.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Nov. 1.—SAMUEL ANGEL, Esq., V.P., in the Chair.

The Chairman addressed the meeting on the occasion of the opening of the new Session, and alluded to the generally improved character and style of many new buildings in progress, and to the sanitary measures that now so properly engage much of the public attention. He adverted to the loss the Institute had sustained by the death of Mr. George Allen, Fellow, and likened the latter to the "Dying Gladiator," as an architectural talent whose talents had justly brought him into considerable notice.

A paper was read by MATTHEW DICKY WYATT, Esq., on "Mosaics as applied to Architectural Decoration," which he illustrated by a large collection of reproductions, and his remarks were followed in various Italian churches, some rare Roman and Florentine mosaics, and a variety of specimens of those of modern manufacture by Messrs. Minton and Co., Mr. Alfred Singer, and Mr. Jenkes.

Nov. 15.—CHARLES FOWLER, Esq., Vice-President, in the Chair.

Mons. Firmin Epellet, and Major-General Howard Vyse, M.P., were elected as Fellows, if interested, among the candidate members. Epellet is the architect of the department of the Paz de Calais, and he has recently completed the town-hall of St. Omer.

Mr. T. L. DONALDSON remarked on Mr. Knowles's plan of the Parthenon, which was among the drawings exhibited, that it showed a joint in the pavement under the centre of each column of the porch, quite contrary to modern practice. Mr. Donaldson always considered that there must have been some communication between the naos and the opisthodomos, for the latter was used as the treasury, and it was necessary that the priests should have access without having to go round to the outside and other end of the building.

Mr. BENROSE did not think that this hypothesis could be established, for there were no signs of such a doorway in the remains of the Parthenon.

Mr. C. H. SMITH gave an account of a kind of trap or porphyry building at Totnes in Devonshire called a Bride's Chair. He presented specimens to the Institute. It belongs, he said, to the igneous formations, and is formed chiefly of melted felspar, but having many bubbles, afterwards filled up with carbonate of lime. Its colour and durability are excellent.

Mr. OPPENHEIMER described a fine Grecian vase, that of a girl, on which he observed that the line of bed could not, he observed, be detected, so as to afford any inference as to its indicated durability of the stone. He took the opportunity of remarking that with respect to limestone, such as Bath stone, the oilites, Caen stone are the line of their beds made no difference; it was only in the case of sandstones that any benefit was gained. It is quite impossible for any person to say from an inspection of the block of Caen stone, that is the way of its bed. The best locking stone is the least durable, and the darker the most durable; and generally speaking, the finer-grained oilite are the least durable, and the coarser the more durable.

Mr. GEORGE GODWIN called the attention of the meeting to some experiments made in the weather, and observed, that Mr. C. C. With the aid of Mr. Andrus and Mr. B. The weather, a piece of Caen stone of the size of a brick, laid with the bed parallel to the pressing surfaces, required a crushing force of 50 tons; another piece laid with the bed perpendicular to the pressing surfaces was crushed with a force of 20 tons only.

Mr. ABBOTT POYNTON thought it well worthy of notice that the mullions in the windows of Henry the Sevensr Chapel stood, throughout, contrary to the way of the bed, and yet they are in the best state of preservation. The Vice-President thought this statement of Mr. Poynton's might be reconciled with the experiments detailed by Mr. Godwin, for the mullions had little or no weight to carry, and consequently no crushing force, while they were best preserved from absorbing wet, by having the bed-line directly vertical instead of perpendicular.

In the course of the discussion it was remarked that Caen stone was very variable, containing hidden veins and faults, and nodules of clay, which were liable to be affected by frost.

Mr. DONALDSON laid before the Institute an account of the church of Santa Maria del Fiore, at Florence, and of the design for completing the
### ON MODEL EXPERIMENTS.

("Omitted from page 266.")

In the last number of the *Journal* we obtained formulae for the comparison of the weights capable of being sustained by similar girders; we now proceed to apply our formulae to the experiments so ably conducted by Mr. Hodgkinson, with reference to the proposed bridge over the Menai Straits. A report of these experiments will be found in the May number of the *Journal* for 1846, from which we extract the following table and explanation:

To obtain the strength of tubes, precisely similar to others tubes fixed—say—but proportionately less than the former in all their dimensions, as length, breadth, depth, and thickness,—in order to enable us to reason as to strength from one size to another, with more certainty than hitherto, as mentioned before. Another object, not far pursued, was to seek for the proper proportion of metal in the top and bottom of the tube. Almost more is required in this direction.

In the three series of experiments made, the tubes were rectangular, and the dimensions and other values are given below.

<table>
<thead>
<tr>
<th>Length</th>
<th>Distance between supports</th>
<th>Weight</th>
<th>Thinnest Plate</th>
<th>Last observed resistance</th>
<th>Corresponding Weight</th>
<th>Breaking Weight</th>
<th>Values of ( \sqrt{w} ) for breaking strain</th>
</tr>
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<tbody>
<tr>
<td>ft. in.</td>
<td>ft. in.</td>
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<td>lb.</td>
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<td>31</td>
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<td>10</td>
<td>24</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

The tube placed first in each series, is intended to be proportional in every loading dimension, as distance between supports, breadth, depth, and thickness of metal, and any variations, are allowed for in the computation. Thus the three first tubes of each series are intended to be similar; and in the same manner of the other tubes, etc.

There it will be observed that in the first set the dimensions are four times the dimensions in the second set nearly, and the dimensions in the second set are nearly twice those in the first. Comparing the first and third sets, we find in the first of the second set, the weight of the tube 78 lb. 18 oz., and the breaking weight 9,737 lb. ; and in the first of the third set, the weight of the tube 10 lb. 12 oz., and the breaking weight 2,444 lb. Now, by the formula deduced in our last paper, if \( w \) be the imposed breaking weight, \( w' \) the weight of a girder in scale 1, the breaking weight of a similar girder in scale 2 will be

\[
\frac{2w - (u-1)w'}{u'^2} \tag{1}
\]

Here \((u-1)=1\); \(w'=10\) lb. 12 oz. = 2 lb.; \(w = 2,444\) lb.;

\[
2w - (u-1)w' = 4918 \text{ lb. nearly} \quad \frac{2w - (u-1)w'}{u'^2} \times u'^2 = 9336.
\]

This, as will be seen, is only 140 lb. less than the breaking weight as found by experiment. It will be observed, moreover, that the tube in the second set is rather more than twice as thick as that in the first, which sufficiently accounts for the slight discrepancy. Comparing now the first experiment of the first and second sets, we shall find the value of the breaking weight in the first, deduced by the formula from the second—too great:

Putting \(u = 4\) lb., \(w' = 78\) lb. 13 oz., \(w = 9,737\) lb.,

the breaking weight was about 70 tons,—an excess over experiment of nearly 31 tons. The reason of this difference is obvious: our formula supposes that the breaking tension per square inch, is all the metal compared by it, is constant. This, no doubt, would have been the case in the model tubes of Mr. Hodgkinson, had they been constructed of one uniform plate of metal, and not rivetted. The necessity of riveting is one great cause of the disasters which are constantly occurring in iron bridges,—as we assuredly show a few numbers back, in a paper on the design of the Menai Bridge (see Journal, p. 234): the larger the bridge, the wider and more numerous must be the joints, and the greater the chance of irregular stresses. The effect of riveting, we observe, has been to reduce the breaking tensile per square inch one-thirtieth, in the first of the first set of experiments as compared with the first of the last set,—how much that effect would be increased in a tube of 68 feet long, or 30 inches in the dimensions of the largest experimented on by Mr. Hodgkinson—we have no means to judge.

We trust, in the meanwhile, that Mr. Hodgkinson will continue his labours on tubes of still greater length, by which means only can we hope for anything like an approximation to a law for the mean effect of an number of riveted joints. However, as we have often observed, the mischief must to be apprehended is not of a radical but dynamical character,—the constant occurrence of vibrations, leading to looseness of joints, perhaps to spalling of the masonry of the arches, and ultimately to weaken the structure, that a slight jar or strain may be sufficient to produce sudden interruption of the whole.

### CITY OF LONDON UNION WORKHOUSE COMPETITION.

A controversy is going on as to the competition for this building, which is likely to draw the general attention of the profession. The facts are, we are informed, as follows.

The surveyor who measured the ground for the guardians is named as the favoured candidate, and by a majority of two obtains the award of the first premium. He has reported to the extraordinary-measure of sending second grounds to guardians of his own design, and so has himself before the tribunal of the public. On the plan he is charged with having taken 17 feet more ground in width than is allowed to the other competitors, the presence or absence of which would make a great difference in the accommodation, as the space of ground is comparatively narrow.

Had the matter rested merely with the board of guardians, we could not have interfered in a decision had been given; but as the surveyor has pleaded to the jurisdiction of the public, we feel that we have a full right to institute such a comparison between the first and the second plans, as will show that there are no sufficient reasons for the selection; and under the peculiar relations of the surveyor and the board of guardians, we cannot but look with suspicion on the present state of the case.

The comparison, unfortunately, is of the defects of the surveyor's plan, from which the other is free. Only eight day rooms are provided for 1,900 inmates,—but then the surveyor says that two "workrooms" are day rooms, and two "dining rooms" in the basement are day rooms, having, consequently, two sick wards as string yards. No preparation is made of aged women, mothers with children, and prostitutes, who are to be placed in one day room. The rooms for aged couples are made to look out upon a brick wall covered with dead wattle, and surrounded by a rail without privies and urinals beneath. The infirmary does not contain sufficient accommodation. The Poor-Law Commissioners have wisely protested against domiciliary on the ground-board, but the surveyor has provided them. The passages are insupportable, and many of them will require gas in the daytime.

As the strip of ground is long and narrow, the surveyor has made his buildings to stretch across it, so that they can be built against a future time, and light and air excluded.

As to the design of the chapel which he has sent round, we cannot but think it too ornate and pretentious as applied to such a building.

The other plan runs in one compact block along the ground in its greatest length, having wide spaces on each side for courts and yards, which can never be interfered with by any buildings on either side. One corridor is carried through the building from end to end, proper access is provided, fourteen day rooms are laid down, no communication can take place between the sexes, and even the male and female infirmaries are separated.

A body of masters of unions have pronounced in favour of the second plan and against that of the surveyor, and it is certain that the latter will be rejected by the Poor-Law Commissioners. Whether the board of guardians, who are friends to the surveyor, will dare to press his plan after the discussion which has taken place, remains to be seen; but if they do, we shall certainly not fail in our endeavours to do justice to the architectural profession.
SYDNEY SMITH'S PATENT STEAM INDICATOR.

At the third quarterly meeting of the Institution of Mechanical Engineers, held at Birmingham on October 25th, a new steam indicator, patented by Mr. Sydney Smith, was explained to the meetings; it consists of a dial six inches in diameter, and the body four inches deep, and in all, about ten inches high, as shown in the annexed engraving:—

The details of the invention were not given, but from what could be gathered it appears to be a tube of cold water communicating at one end with a steam syphon, attached in the usual manner to the boiler, and the other end of the tube is closed by a flange to the flange a of the indicator: at this point there is an elastic web of india rubber, which cuts off the communication of the cold water in the tube; on the top of this elastic web there is a vertical rod, which, as it rises or falls, acts on a weighted pendulum fastened on to the axis of a pinion, gearing into other wheels that communicate with the hands of the indicator. It will thus be seen that as the steam in the boiler increases in pressure, it presses upon the surface of the cold water in the syphon, and the pressure is transmitted through the tube of water to the elastic web, and raises the vertical rod, which actuates the gearing of the dial. The only use of the cold water is to keep the india rubber web cool. It does not matter what length the tube may be,—if the indicator be attached to one of the legs of the syphon, 15 inches to 2 feet long; it will be sufficient.

The apparatus is out of the reach of the engineer, and the value of the invention is enhanced by the accuracy of the indications not being affected by the distance at which the dial plate may be from the boiler. For example, in marine boilers the indicator may be alongside the compass, and be as faultless a guide of the pressure of the steam, as that instrument is of the course of the vessel.

Mr. George Stephenson considered it a most valuable invention, and stated that he had had one put up at his collieries at Tipton:—"It is placed some distance from the boilers, and in another house, and works most beautifully, showing the rise and fall of the steam in the most delicate manner. The indicator is like the face of a clock, with a pointer, making one revolution in measuring from 1 lb. to 100 lb. upon the square-inch of the pressure of steam; it is quite from under the control of the engineer, or any other person, so that its indications may be relied upon, and the construction is so simple that it is scarcely possible for it to get out of order."

"The Indicator" is adapted alike to high or low-pressure engines.

The high-pressure is figured from 1 lb. to 100 lbs., and the low-pressure from 1 lb. to 50 lbs. upon the square inch.

One of these has been placed on the boiler at Messrs. Miller and Ravenhill's manufactory, Glass-house-fields, Batcliffe, another in the Jinty steamer; and one at the Polytechnic Institution.

to the best advantage under a closed glass, from which supplies of atmospheric air were excluded, it was quite certain that combustion had nothing to do with the matter." Thus the efficiency, which could be produced as readily in water as out of it, he showed its ap- pliancy to coal mining, for it could not explode the finest atmosphere, and then came to the comparative cost of the electric and other lights. With a stationary light consisting of 150 candlepower, he had developed equal to 250 mould candles (sizes), or 300 wax candles, or 64 candles of the best gas, burnt in the standard burner. This was effected by a consumption of nine equal to 0/77, or 17-100ths of a pound, being more than twice as much as the gas at that time was warranted to support, viz., brought to its maximum, by increasing the distance of the electrodes to their limit, the light was increased nearly threefold, whilst the current itself was reduced to about three-fifths in quantity. "This curious fact (continued Mr. Stait), I have frequently observed before. So that the light, when developed under the best circumstances consistent with its permanence, was produced by a consumption of a seventh part only of a pound of nine pce. per hour—and that light equal to 300 tallow candles. Assuming that the nine so consumed was worth one halfpenny, and that the cost of the working labour, deducting the value of the products (sulphate of nine, etc.), was as much more, we have the following comparative result:—Electric light, 1d. per hour; gas, light equal thereto, 6d. to 8d.; tallow candles, 7s. 6d.; wax, 12s. 6d." [But, in addition to the size and solution, an allowance must be made for apparatus, skill, labour, etc., as in the manufacture of other lights—gas, wax, tallow, etc.]. In conclusion, Mr. S. observed, "By a careful examination of all the modes of effective artificial illumination, I think I am justified in saying that there is no other so cheap as the current of electricity; and there is certainly none which exhibits such pure and brilliant results. The absence of all smoke and flames, and obnoxious non-consuming oxygen—the impossibility of its lighting surrounding substances—and the possibility of the apparatus to give perfect recommendations for the adoption of the light in all places where purity, and brilliancy, and safety, and economy, are sought for."

NOTES OF THE MONTH.

The Building Act.—A committee, nominated by Lord Morpeth, consisting of Mr. Monkton, Mr. Payntor, and Mr. Shaw, the official referees; Mr. Powall and Mr. Allan, district surveyors; and Mr. Biers and Mr. Piper, builders, has been appointed, for the purpose of considering the objectionable parts of the present act, with a view for amendment in the present session of Parliament.

Tidal Harbour Board.—Capt. Betham, R.N., Capt. Washington, R.N., and Capt. Vetch, R.N., have been appointed to form a "Tidal Harbour and Conservancy Board," under the jurisdiction of the Admiralty, each to receive £200 per annum. How is it there is not a C.E. in the appointment?

The Nelson Column, Trafalgar Square.—Mr. Carew, the sculptor, has just completed the model of the principal base-relief, for the compartment of the base facing Whitehall. The group is taken from Southey's "History of the Battle of Trafalgar," and the composition of the work is said to be one to be a third professor, but the appointment has not yet been filled up.

Cape Town Car Works.—In consequence of an article which appeared in our Journal some time since, stating that the apparatus for lighting up Cape Town by gas was then being obtained in England, a correspondent writes us word from the Cape that he may be of some service to your readers to know that the works have since been erected and in operation now two months, to the surprise as well as gratification and satisfaction of the inhabitants; the scheme was liberally encouraged by the undertaking, the works having now already 600 lights to supply, with a steady, increasing demand, and which success must be mainly attributed to the mobility and persevering energy of the engineer, Mr. Alexander W. Lachlan, who has already turned out several of the greatest credit is due for the manner in which the works have been carried out and conducted, but it must not be omitted to mention the able managing director it gentleman in the late lamented F. S. Watermeyer, Esq., through whose instrumentalities the company was first formed."
College of Surgeons.—The College have bought Alderman Copeland's house in Lincoln's-inn-fields, for £16,000, so as to enable them to enlarge the library and Hunterian museum. This is likely to make more work for Mr. Macready, for the time being, and to increase the scale of the transactions. 

Royal Academy.—Mr. Sydney Smirke and Mr. F. R. Pickersgill have been elected Associates.

Highton's Electric Telegraph.—The electric telegraph on the Baden Railway, opened on the 15th of October last, is worked by Highton's Patent Telegraph Company, the great merit of which is the high perfection of the apparatus, and the great economy of the charges, which are so much lower than those of any other system. 

China Grass Rope.—A rope has been lately manufactured from a new material, called "China Grass," at Manchester, by Mr. Thomas Briggs, of Salford, expressly for the iron works of the Earl of Fitzwilliam, at Eccles; it is 450 yards long, and weighs 14 cwt. 6 qrs. and 14 lb. Ropes made from China grass are stated to be much stronger and more durable than those composed of hemp, but are more expensive. Before manufacturing ropes of a large size from this material, Mr. Briggs had some small ones made, which he tested by working in blocks on his own concerns; he found them to work well, also to be very strong, and of great durability. In coal-pits and mines, where ropes of great strength are required, those made from China grass are much sought after.

—Traverse to British Science from the Sultan Mahmoud.

—Mr. Fairburn, of Manchester, has been presented with a decoration of one of the Turkish orders, in consideration of the valuable services performed by him in his capacity as engineer to several extensive works, under the orders of the Sultan.

Professor Willis has undertaken the editorship of Mr. Parker's new edition of the "Glossary of Terms in Gothic Architecture." This engagement will ensure the work being brought out with success.

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LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM OCTOBER 22, TO NOVEMBER 25, 1847.

Six Months allowed for Enrolment, unless otherwise agreed.

1. William Kiltie, of Warner-place, Hackney-road, Middlesex, for "an improved combination of material for building purposes, and a new application of certain materials for building purposes."—November 3, 1847.

2. Edward Barker, of Budeleigh Salterton, Devon, gentleman, for "certain improvements in the preparation of marl," from this material, Mr. Briggs had some small ones made, which he tested by working in blocks on his own concerns; he found them to work well, also to be very strong, and of great durability. In coal-pits and mines, where ropes of great strength are required, those made from China grass are much sought after.

3. William Thomas, of Cheshelm, merchant, for "certain improvements in the construction of ships, and in machinery for manufacturing ships; parts of which machinery are applicable to weaving."—October 30.


5. Thomas E. W. Meyer, of Artillery-place, Finsbury, Middlesex, for "certain improvements in the manufacture of umbrellas and parasols."—November 2.

6. James V. Hopkinson, of Manchester, gentleman, for "improvements in weaving."—November 2.

7. Thomas Wilson, of the Wellingborough Iron Works, Manchester, for "improvements in the manufacture of railway-wheels and axles, and in machinery and apparatus for ploughing purposes, and in the working of rails, for removing them from one line of rails to another, and for turning them."—November 2.

8. William McDowell, of Baker-street, Portman-square, Middlesex, gentleman, for "improvements in the construction of bridges, canals, &c."—November 2.


10. Bertrand van Risen, of Putney, Surrey, civil engineer, for "improvements in obtaining and applying motive power."—November 2.

11. William Lang had, of London, gentleman, for "improvements in the manufacture of all kinds of cloth."—November 2.

12. James Medhurst, of Staple Inn, Middlesex, for "an improved capstan or small case for protecting materials enclosed therein from the action of the air, and an improved material to be used in the case of said capstans."—November 2.

13. Thomas Hancox, of Stoke Newton, Middlesex, for "improvements in fabrics, made with the use of silk, jute, or any of the varieties of cinchona plants."—November 2.

14. Richard Lamb, of Slough, Middlesex, for "improvements in manufacturing and purifying coal gas, and in treating a residuum of such manufacture, and in preparing materials to be used in the purification of coal gas."—November 4.

15. Charles Low, of Rosebery-place, Dalston, Middlesex, gentleman, for "improvements in the manufacture of cotton fabrics."—November 4.


17. John North Britton, in machinery for cutting, dressing, and finishing the grain, for "improvements in machinery for cutting, dressing, and finishing the grain, and for preparing metal forays, and for other similar purposes, and which invention is intended to call or attract a valuable commodity to be used in the preparation of the grain."—November 4.

18. George Wells, of 7, Penton-place, Watford, for "a machine for the purpose of canceling communication between the guards and engine-drivers of railway carriages, whilst traveling, and also for conveying communication between vessels at sea and the shore, and for other similar purposes, and which invention is intended to call or attract a valuable commodity to be used in the preparation of the grain."—November 4.