SCIENTIFIC AMERICAN

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AN IMMENSE VACUUM PAN FOR SUGAR MAKING.

The representation herewith shows probably the largest vacuum pan ever built, recently constructed by Robert Deeley & Co., at their works, foot of West 32d St., New York city, for the California Sugar Refinery, San Francisco, Cal., Claus Spreckles, president. The body of the pan is of iron, 1½ inches thick, there being four perpendicular sections, two dome-like sections at the top, and one bottom section, all accurately and carefully fitted and bolted together. The inside diameter is 17 feet, the height being 31 feet 7 inches, and the height to top of overflow 42 feet 6 inches. The capacity of this pan is about 1,000 barrels, or over 100 tons, of sugar at each "strike," the time required to make a "strike," or sufficiently exhaust the water from the juice before treatment by the centrifugal, being under ordinary conditions three hours.

The principle on which a vacuum pan is based is the fact that the boiling point of water, sirup, or any liquid, is in part dependent upon the pressure of the atmosphere, the temperature at which the liquid boils being higher or lower according as the atmospheric pressure is increased or diminished. In practice, with these pans, the liquor is boiled at a temperature of 110° to 120° F., so there is no danger of burning the sugar, the inversion of sugar is reduced to a minimum, and the rapidity of the operation is greatly increased. A pan of this size must necessarily be of great strength, in order to resist the atmospheric pressure, which increases according as the vacuum is more perfect.

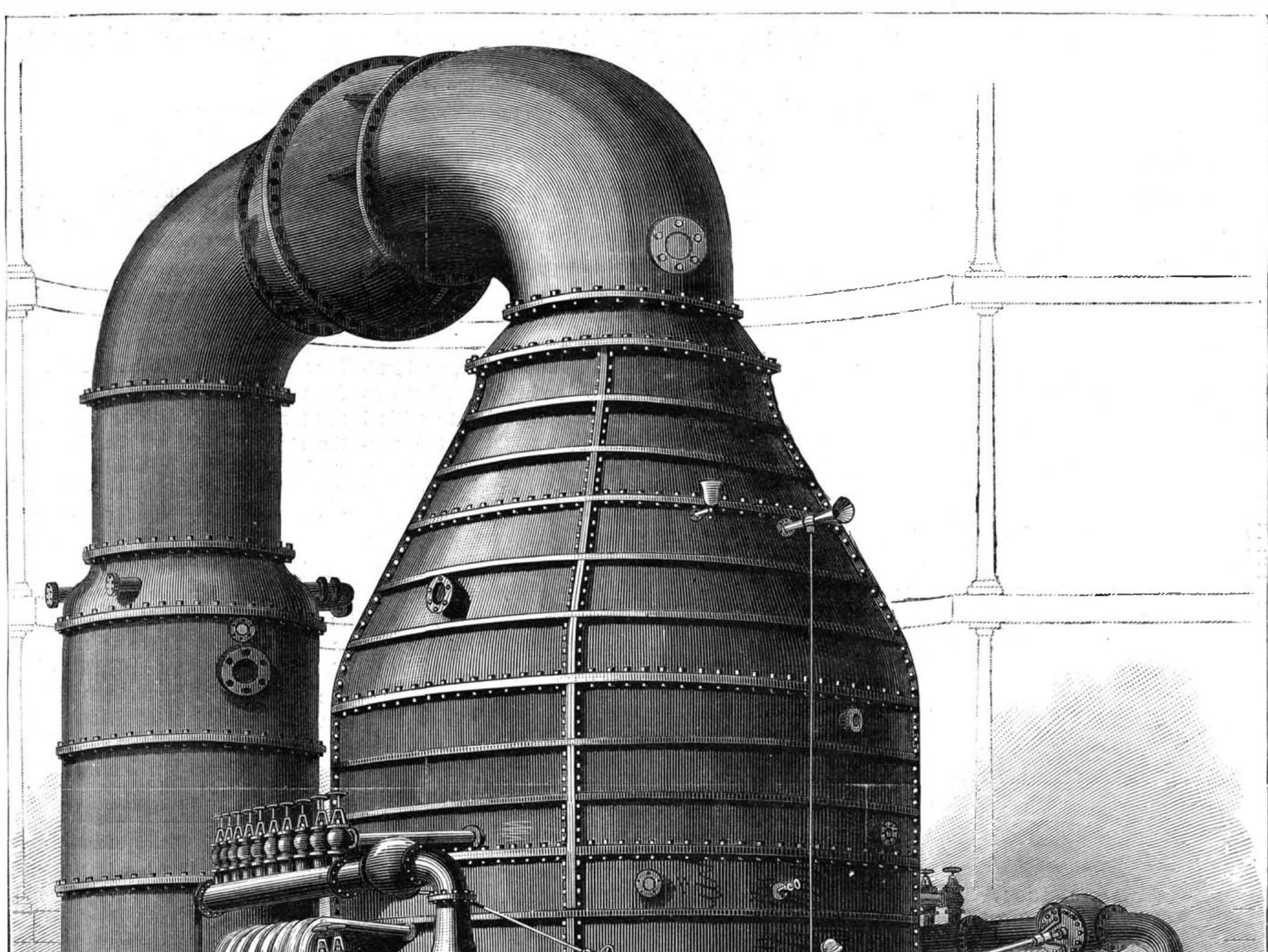
The arrangements for heating will be readily understood by reference to the illustration, the copper coils for this purpose presenting a surface of over 3,000 square feet. There are eight of these separate coils, five being of 4 inch diameter and three of 5 inch diameter, affording 69 inlets and outlets, and connected with eight steam trunks, two of 8 inch and six of 12 inch diameter, the steam being supplied by a 30 inch main. Every facility is given for easy working, all the main valve stems being carried to convenient positions on the working platform, from which also the "strike," or discharge valve at the bottom of the pan, is operated. This valve is 20 inch diameter.

The pan is charged with the liquor through two 6 inch valves, controlled on the working platform, the atmospheric pressure readily forcing the liquor in. The cane juice with which the pan is charged usually gauges 25° to 30° Baume, or about 10 pounds to the gallon, and when discharged it is about the consistency of thick mortar. It is intended, in operation, that this pan will be filled with liquor only to a depth of 18 feet, leaving 8 feet vapor space above within the pan itself, besides the room allowed in the great pipe leading from the top. There is a spray catcher or intercepter in the dome of the pan, and the vapor pipe leading up from its top is 6 feet in diameter. Situated in this vapor pipe, between pan and condenser, as shown on illustration, is a portion enlarged to 10 feet diameter forming a trap to catch any overflow, which can be returned to pan or tanks, as desired, and thence the 6 foot vapor pipes continue to condenser, which is 8 feet diameter and 28 feet high. The condenser has two 8 inch perforated injection pipes and four scattering plates. The pumps which make and maintain the vacuum are connected with the condenser, forming what is termed a "dry" vacuum.

The pan has two of what are styled lock proof-sticks, for removing and testing from time to time a small quantity of the sirup, but these proof-sticks are in reality tubes with nicely fitted valves and a piston for removing the sirup without destroying the vacuum. There are also eight eye-glasses arranged in different positions to enable the operator to keep a constant watch on the work going on inside the pan. A barometer and thermometer are also connected with the interior of the pan, by which the extent of the vacuum and the temperature of the contents are indicated at a glance. Formerly vacuum pans were built almost exclusively of copper, but of late years cast iron has been the choice, only the heating coils being of copper, the coils being so fixed as to prevent their vibrating during the boiling, and allowing for expansion and contraction without strain.

Besides the amount of fuel saved and the economy of conducting the sugar manufacture with a pan of such device as this, where the work can all be so easily overlooked and the process minutely regulated, probably the greatest advantage of all lies in the largely increased proportion of sugar thus gained, and the comparatively small quantity of molasses which each "strike" affords. By such improved pans the yield of sugar amounts to six or eight hogsheads to one of molasses, while by less improved means only two or three hogsheads of sugar are obtained to one of molasses.

The whole work was completed in four months at the Deeley Iron Works, the order having been received July 10, while the pan was being taken down for shipment the second week in November.



AN IMMENSE VACUUM PAN FOR SUGAR MAKING.

The Journey of a Million.

Statistics as carefully studied by Dr. Farr tell us that of a million children ushered into life nearly a hundred and fifty thousand pass away by the end of the first year. Twelve months later fifty-three thousand more will have followed. At the end of the third year the number living will be diminished by twenty-eight thousand more. Each year of the decade following will make its inroads upon the ranks, but less serious in amount, till the thirteenth year will call for less than four thousand. Those remaining will fall out by twos and threes till the end of the forty-fifth year, when it will be found that in the intervening period about five hundred thousand have succumbed to the hardships of the way. At the end of sixty years three hundred and seventy thousand gray haired veterans would still be keeping step with the duties of the passing days. Eighty years would see thirty-seven thousand remaining, with strength impaired and steps growing feeble. At the end of ninety-five years but two hundred and twenty-three would linger in the darkening path, and these would be rapidly thinned till in the one hundred and eighth year the last survivor of the million would disappear, and join the ranks of his predecessors in the great host of the majority.

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SPECIALLY FOR OUR READERS.

The annual election of periodicals may be said to be going on now. This is the time when people make choice of the papers and magazines they are to enjoy during the next twelve months. New volumes begin with the coming year, and subscriptions are soon to be entered up. All readers of the SCIENTIFIC AMERICAN will, as a matter of course, renew. The cost—$3.20 a year—is less than a penny a day. We should be glad if each of our friends would send in one additional penny per diem, and thus add the SUPPLEMENT to their regular subscriptions. For $7 a year—less than two cents a day—both papers are supplied. These are the cheapest as well as the best scientific publications in the world. We issue a double number this week to present the catalogue of valuable papers published in the SUPPLEMENT. The reader will therein find the key to vast wealth of information, and will conclude, we trust, that duty to himself, to the needs of his calling, to the wants of his mind, requires him to give the additional penny and enroll his name as a subscriber.

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We have one additional request to ask of our friends, namely, that they will inquire if the SCIENTIFIC AMERICAN and SUPPLEMENT are regularly taken and filed in the town libraries and reading rooms. If not, the attention of the managers should be at once directed to the matter, for there are no publications so valuable and necessary as these for reading room purposes; and in respect to scientific subjects none are so cheap. The yearly numbers of the SUPPLEMENT alone furnish a mass of reading matter equal in extent to ten large volumes of 350 pages each.

We shall esteem it a special favor if our readers will send us postal cards giving the addresses of the libraries or reading rooms in the towns where they reside; we shall then take pleasure in forwarding specimens of our papers, from which librarians may determine their usefulness.

THE EFFICIENCY OF FLUID IN VAPOR ENGINES.

Last year, when the so-called thermic motor, or bisulphide carbon engine, was on exhibition here, an effort was made by several engineers to subject the motor to critical tests, to determine how nearly correct were the pretended claims of great economy set up by the motor people. But no disinterested tests were allowed, and purchasers of stock are said to have been badly stuck. Among those who desired to test the "thermic" were the mechanical engineers, Messrs. H. L. Gantt and D. H. Maury. Failing to obtain permission to test the engine in question, they were compelled to confine themselves to a purely theoretical discussion of the subject, and the results they have now given in a very able paper, under the above title, published in *Van Nostrand's Magazine.*

The authors say: "Rankine, Clausius, and others have proved that the amount of heat transformed into work does not depend upon the fluid which is the conveyer of that heat, but simply upon the limits of temperature between which the fluid is worked. It follows that, theoretically, all fluids are equally efficient in transforming heat into work; it does not follow, however, that all fluids are equally valuable as the working fluid of an engine, for there are other considerations besides efficiency to be taken into account in making choice of a working fluid. We have set ourselves the task of choosing the best working fluid from the following liquids: water, alcohol, ether, bisulphide of carbon, and chloroform."

The final conclusions reached are substantially as follows: "*If we limit maximum pressure to that employed in the steam engine, steam is the most efficient fluid we can use.* The relative size of cylinder necessary to produce the same power is smaller for steam than it is for the non-aqueous vapors when all have the same initial pressures.

The higher initial pressure, involving higher initial temperature, and consequently greater range of temperature, causes such an increase of efficiency of the non-aqueous vapors as to put them all above that of water, and to cause some doubt as to which would be the best working fluid, judged thermodynamically only.

As the most convenient method of deciding the question just raised, we may compare each of the vapors with that of water, showing their advantages and disadvantages.

The vapor of alcohol gives us 1·4 per cent more efficiency than steam, and requires a cylinder whose volume is only 0·853 of that of the steam cylinder to produce the same power. The disadvantages of alcohol are the high tension of the vapor, the great danger which arises from the ready inflammability of the hot liquid, and its cost.

The use of ether would give us a greater gain in efficiency (2·11 per cent), and would require a still smaller cylinder (0·535 of that of steam), but it is open to the same objections as alcohol, and in a more marked degree.

The vapor of bisulphide of carbon gives a gain in efficiency of 3·71 per cent, and demands a cylinder 0·550 of that of steam. It, however, is not only open to all the objections that have been stated against alcohol and ether, but it has two which are peculiar to itself, viz., its intensely disagreeable odor and its power of rapidly corroding iron which comes alternately into contact with it and with the air.

The vapor of chloroform, which gives a gain of 3 per cent efficiency, and requires a cylinder 0·761, the volume of that of steam, is not open to the objection of inflammability, but it has so high a cost that it is probably impossible that it can ever be used economically in competition with steam.

All the apparent advantages of the non-aqueous vapors may be gained in the steam engine by an increase of initial pressure; and, as the tendency of modern practice is in that direction, it seems certain that *none of the non-aqueous vapors will ever successfully compete with steam.*"

STEEL UNIFORMITY.

The users of steel for manufacturing purposes, and probably the producers of steel, would welcome any information that would insure uniformity in the product. It appears to be almost a waste of investigating endeavor to argue on the relative merits of steel produced from the iron and that cemented from the bar. The true test of their relative merits is that of use in practice. Yet there seems to be an almost insane desire to turn all our iron into steel, and to produce steel as directly from the ore as pig iron is produced. An enthusiast recently called attention to some lathe and planing tools, cast from iron melted in the cupola in the regular way, and then submitted to a cementing process of brief duration, claiming them to be true cast steel, or its equivalent. And there are others who assume that all the work of cementation and the after processes may be dispensed with, and good tool steel result.

This nonsense will be taken up and repeated by mechanics who may be like the Athenians described in Acts xvii., 21; but there are workers who know steel from carbonized cast iron, and who require for their work all the proper qualities of cast steel.

What is needed in regard to steel information is how to make cast steel to-day, to-morrow, and so on indefinitely, the same. We know that iron can be refined, and that its components can be changed, so as to improve its quality, and so that it can assume some of the qualities of cast steel, and be called steel commercially. But what is required is an equable quality of the steel used for tools.

This equable quality does not exist among the steels made by the best known manufacturers; they may claim it, but the facts of practice do not sustain the claim. All the differences in working different lots from the same makers, in working different bars from the same lot, in working from the same bar, do not come from the difference in treatment and manipulation. A chart of tests comprehending the steels of five of the best known manufacturers of steels show not only a difference between the products of the different establishments, but a great lack of uniformity in the specimens tested from the same maker. An establishment that makes the production of small steel tools a specialty, and is probably as successful as any other in this country, or other countries, has its tools returned for failure in exactly opposite directions—too soft, too brittle. What is to be done? There is the same treatment of, commercially, the same material. The fact is that uniformity in the character of crucible steel is an attainment yet to be reached and it is time that scientific and practical men devoted their attention to this attainment, instead of arguing on the identity of purified iron, called "Bessemer steel," and cast steel *per se.*

St. Petersburg Canal.

This canal, which has just been completed, is intended to enable ships of large tonnage coming from abroad to reach the port of St. Petersburg direct, and to take in cargoes there, without having recourse to the hitherto inevitable transshipment at Cronstadt. The canal extends from Goutouiew on the Neva as far as the small roadstead of Cronstadt. A branch has been excavated along the Pontilow Railway in the direction of the Catherinhof, an arm of the Neva. The Neva has also been dredged to meet the requirements of the Russian navy, between the canal and the source of the Catherinhof. The length of the canal is 17¾ miles, and the length of its branches is 2½ miles.

The bed of the Neva has been dredged for a distance of 5,333⅓ feet. The canal and the dredged portion of the Neva have a depth of 24¼ feet. The depth of the branch varies between 17½ feet and 23½ feet. On the portion of the canal which is protected by embankments, the width of the base is 213 feet for the first four versts from the Neva. This width is carried to 275½ feet for the next 3¼ miles, and to 355½ feet for the remainder of the canal, which is the portion of it which is not protected by embankments. The work of excavating the canal was almost entirely carried on by means of nine dredgers. The imperial order prescribing the construction of the canal was signed June 1, 1874, but the works were not actually commenced until September, 1878. Water was admitted into the canal in the presence of the Emperor Alexander III., November 12, 1883; but it is only recently that the canal has been finally made available for the passage of vessels. The works of the canal cost altogether 1,642,464*l.*

METHODS OF ESTIMATING DISTANCES.

There appeared recently, in *La Nature*, a simple method of estimating distances, with illustrations and formulæ, for use of the military in the field. The method was as follows: Small silhouettes of standing and kneeling soldiers are cut out from stiff card-board, and painted black, or the actual uniforms may be shown in color; the standing soldiers to be about one inch in height, and the kneeling ones two-thirds of an inch. These figures and the average height of of soldiers (say 65 inches) have a constant value, and in the formula given stand h and H respectively. A distance, for illustration, is now paced off, by the person holding the silhouettes, of say 3 meters, or about 10 feet, from the person who is to make the observation, and the silhouettes are adjusted to just cover the soldiers seen in the distance. This base line, l, of ten feet, being given, the ratio will stand: $x = l\frac{H}{h}$, or required distance, and for this value of l should be 650 feet. By proportion it is shown thus:

$$\begin{matrix} h & & l & & H \\ 1 \text{ inch} & : & 10 \text{ feet} & :: & 65 \text{ inch} : x = 650 \text{ feet.}\end{matrix}$$

It will be seen by this operation that l must vary with x.

There is another method of estimating distances which the writer of this adopted several years ago merely for pastime. As some surprisingly accurate measurements have been made by this method, and as some of the ideas appear to have a bearing on the question of a possible absolute ratio of measurement, pertaining to, and variable with, each individual, it is given herewith, for the purpose of inquiry and thought. The experiments at the time were based upon this idea, that the true focal distance of every eye will furnish a true working ratio for all distances, provided practical application of the same can be realized. In this method, H, the diameter or height of a distant object, and l, the focal distance of 10 inches, will each be constant; but h will have to vary with x, or, $x = H\frac{h}{l}$, provided the normal focal distance l of the observer is 10 inches. To make the matter still clearer to the mind, let us consider that for every unit of distance an object decreases in width $\frac{1}{10}$, or for 10 units a decrease of 1 is found. By this, it can be readily seen that a focal ratio is obtained for a measurement in units; whether in inches, feet, or miles; as the diameter of the distant object shall determine.

In this simple way an approximate distance of the moon or sun, as well as terrestrial objects, may be worked out in a few minutes.

My method of operation was as follows: Having, after repeated trials, fixed upon 10 inches as the true focal distance in my case, a simple sight piece and measuring apparatus was constructed, consisting of a ten inch wooden rod or eye rest, to the end of which was attached a movable slide or gauge, exposing an opening in an upright metal diaphragm, which was firmly attached to the end of the rod; by moving the gauge in and out, the diameter of a distant object could be easily sighted, and the open space could be then measured by a micrometer. Several measurements having been obtained, the mean is taken to be the true one.

Further, to illustrate: Suppose the same distance is taken as in the measurement given with the silhouettes, taking the formula $x = H\frac{h}{l}$, and substituting the figures, we have $x = 5{\cdot}5 \text{ feet } \frac{0846}{10} = 650$ feet. That is, the focal measurement of a soldier 5·5 feet in height is found to be 0·0846 of an inch, and one-tenth of this gives the ratio for every foot of distance.

A good way in estimating short distances is to select a window of a dwelling. The average width of windows is about 3 feet; at the distance of half a mile one should just cover 0 011 of an inch in the micrometer.

Any object may be selected, the average width or length of which is known, such as barns, houses, haystacks, stone walls, sections in rail fences, or a common barway, telegraph poles, etc.

If a focal distance of less or more than 10 inches is used in sighting and measuring an object, it should take the place of 10 in the formula given above; the approximate distance obtained in either case should be the same. Suppose some pleasant night we wish to find the distance of the moon from the earth. For this purpose a glass micrometer ruled with dark lines should be used, ruled either to the $\frac{1}{64}$ or the $\frac{1}{100}$ of an inch; after several trials, an average diameter should be obtained of about 0·09 of an inch; this of course will vary somewhat with the moon's distance. Now the approximate distance will be:

$$x = 2{,}162 \text{ (moon's diam.)} \div 0{\cdot}09 = 240{,}000 \text{ miles.}$$

Let us next smoke our micometer, and during the day time take a look at the sun.

Suppose our measurement stands 0·093 of an inch, the distance obtained in the same way as above would be:

$$x = 850.000 \text{ (sun's diam.)} \div 0{\cdot}093 = 92{,}391{,}000 \text{ miles.}$$

There is considerable misapprehension on the part of most people concerning the great difference between the apparent visual diameter of the moon and the sun and that to be obtained by micrometric measurement. But few people will believe that the actual measurement of either is less than the tenth of an inch, until a fair trial has been made. In a similar way, with the aid of a telescope, and the diameters as given by the astronomers, we may partially verify the approximate distances of the planets. There are many ways in which this little formula will amuse as well as instruct.

G. R. C.

Our Trade with Japan.

Middle aged readers can readily recall the time when the empire of Japan and the heart of Africa were equally unknown to the world, and the memory of Perry's notable unsealing of the ports and commerce of Japan must be fresh in their minds. It was a triumph of American diplomacy, and to-day there comes to these shores $14,000,000 worth of goods annually, while the amount and value of these imports augment rapidly. A feature of the Japanese trade seems to be that those engaged therein almost invariably make money. It is a trade which calls for special fitness, and once established seems better than the average silver mine.

Of Japanese imports, during the season ending December 31, 1883, New York took nearly $6.000,000 in value; Chicago, $2,500,000; San Francisco, a half million; and Canada say three and a half millions. Their value goes to show that in exchange for the half million dollars' worth of refined petroleum sent to Japan last season, Uncle Sam gets an assortment of invaluable articles. First in value and importance is crude camphor, a substance that more closely resembles a cheap grade of white sugar than anything else. It was imported to the value of half a million dollars last season—33 241 piculs.

Japanese vegetable wax is another important product of the awakened island. It is a rival of paraffine wax in many ways, and is consumed in great quantities by New England cartridge makers, and by manufacturers of celluloid. Of this substance, over 2,600 piculs were imported last season, worth nearly $300,000. The cuttlefish bone, without which the life of the imprisoned canary would be stale, flat, and unprofitable, is still another product of Japanese origin. Over 1,600 piculs were imported last season, worth $246,000. This article showed an increase in the amount imported of 100 per cent over the previous year's trade. Then comes Japanese fish oil, a competitor of our menhaden oil. The wonderful abundance of fish in Japanese waters, and the fact that labor can be procured for a few cents daily, enable exporters to send this oil 10,000 miles, and still compete with that expressed from fish that swarm along the Atlantic coast. Of this article, over 100,000 piculs were imported, worth $246,000. Isinglass, due to the abundance of fish already referred to, was imported from Japan last season to the extent of nearly 9,000 piculs, worth $264,500.

The metal antimony, of prime necessity in medicine, is yet another valuable product of Japan, and the last season brought out nearly 30,000 piculs, worth $138,000. The type founder is a large consumer of this peculiar metal also, for it possesses the singular property of retaining its volume when cooling after melting, while other metals shrink. This endows metal alloyed with antimony with the attribute of retaining a clear cut impression of the mould, so requisite in type making. Among the articles which are found among the Japanese merchants' samples is a silvery powder. This powder glistens from the surface of modern wall paper, imparting a beautiful appearance, and it serves to enhance the charming snow scenes depicted on Prang's Christmas cards. This substance is Japanese mica, ground to powder, and when used as described gives the article it is spread upon all the sparkling beauty worn by the surface of snow under the moon's rays.

The list of Japanese goods includes a long array of articles, some of them as unique as the country from whence they come and the people who make them, but the *Independent Record* asserts that above are the leading articles of interest to our trades.

Working to Advantage.

It is amusing to notice how easily a workman who understands some of the mechanical principles that govern the behavior of matter, will handle a difficult undertaking with no other strength than his own, assisted with a little forethought and head work. A large water wheel shaft lying in a wheel pit, and loaded down with pulleys and a large gear wheel, was brought out by a single workman and placed across the beams of iron, while the rest of the machinery was in motion, and sent off to the shop without any one ever noticing the difficult undertaking. When this same piece of machinery was first set in place, a dozen hands took part in the undertaking and stirred up the whole concern for material to work with, and arranged a slide with pulley blocks strong enough to launch a vessel on dry land, pulled and hauled everything to pieces, cut and injured everything that came within their reach, to say nothing about the other little incidents that would last a village gossip for a week, such as a few broken bones, a lame foot, wtth the doctor's bill thrown in.

But the shaft found its place, however; and when the time arrived for a change in its position, as well as additional fits to be made, a chain made fast to the beam overhead and fast beneath the shaft through the open spaces in the pulleys to another at the other end, enabled the workman to roll the shaft up out of the pit by turning the gear wheel, while he himself backed up the ladder till the load was placed carefully on the planks that had been left, with a little forethought, where he could slip them in place with his feet. Such an undertaking is certainly a risky one, and we would not advise such a proceeding, especially when the machinery on all sides was in motion. Instances of this kind have been noticed where it was almost impossible to understand how such difficult undertakings could have been accomplished with the material they had to work with, while others, of a very simple nature, have brought mishaps and failures, with nearly everything any one could ask for to work with.

A large gear wheel, several feet across, was to be placed over the end of an upright shaft, and nearly a whole day had been expended in making the preparations for moving the wheel on rollers and elevating with jack screws, when two strong hands took hold of the wheel and placed it in its position on the shaft while the others were taking their noon hour, by first balancing the wheel on one edge of the hub and rolling it on this portion of the wheel up the incline of a stout beam, without meddling with the blocks and roller ways that had been all the forenoon in preparation.

A heavy column was once elevated into its upright position by a small lad, with no other help than his own strength and a little calculation, after those who had been employed to raise the structure had given it up in despair, by taking advantage of the rocking motion allowed in the position the column was to occupy, which allowed this youthful specimen of grit to set up each shore, on either side, by moving one at a time as the column was crowded on to the other, till at last it stood upright upon its base.

Hundreds of instances of this kind can be related where the success was owing to the careful manner in which the whole performance had been laid out at the commencement, and followed with care and forethought that protected the whole proceeding from accidents and mishaps, while others have come to an untimely end in their endeavors, through negligence and carelessness on the part of the work hands, who had no definite idea as to what they were driving at.—*Boston Journal of Commerce.*

The Utilization of Natural Forces in Electric Lighting.

In the discussion of the paper on "Domestic Electric Lighting," read by Mr. W. H. Preece at the recent meeting of the British Association in Montreal, Sir W. Thomson referred to the facilities afforded by the proximity of the Lachine Rapids, situated five miles distant, for lighting the city by electricity generated by the aid of natural forces. An experiment in this direction is now being made at Bellegarde, in the department of the Saone-et-Loire. Some two and a half years ago M. Dumont, a manufacturer of the town, was granted permission to utilize the waters of the Valserine (a stream in the vicinity), with the view of obtaining a supply of motive power; and the necessary works were commenced. They were finished last year, and are described in *La Nature.*

The course of the stream lies between high rocks, and the water is dammed up by means of a wall about 40 feet wide at its base, and having three sluices for regulating the direction and volume of the current. The water has a fall of 165 feet, and flows out at the rate of 1,100 gallons per second; being equivalent to a hydraulic power of 2,000 horses. This force it is intended eventually to divide between three turbines, one of which (of 600 horse power) has already been fitted up, and is employed in driving the machinery used in the lighting of the town by electricity. The current is generated by two small Gramme machines; and the lighting is done by Edison incandescent lamps placed in the ordinary street lanterns. No accumulators are employed, so that the current passes to the main conductor (which is carried round the town on poles) directly from the generators; its strength being regulated, not by them, but by the turbine which drives them. The lighting is said to be brilliant; but there are several inconveniences attending it. In the first place, the lamps (even those of the private consumers) are either all alight or all out at the same time. Then there have been some rather untimely extinctions; while occasional variations in the luminous intensity of the lamps have testified to certain irregularities in connection with the machinery. Leaving these out of consideration, M. Dumont may be said to have succeeded fairly well in lighting a town by electricity generated by the aid of natural forces. He hopes, however, to go beyond this, and afford, by means of electric cables, a supply of power to those works whose proprietors may be willing to take it of him.

Idunium.

"Idunium" is the name proposed by Professor Websky for the metal just discovered by him as one of the components of native vanadate of lead. The mineral is rather a scarce one of a yellow color, and contains several other metals, of which zinc, iron, and arsenic are among the most prominent. Idunium resembles vanadine in several respects, both physically and chemically, while the only oxide hitherto examined forms stable salts with alkaline bases, and thus would appear to possess distinctly acid properties. It will probably be known by and by as "idunic acid," and as its general characteristics and reactions correspond to those of vanadic acid, its formula will probably be Id_2O_5.

To News Agents.

If for any reason your news company fails or declines to supply back numbers of the SUPPLEMENT, send the order direct to this office, and we will have it promptly filled. The SUPPLEMENT is never "out of print." We supply all the back numbers. The news companies have no valid excuse for not furnishing any copy of the SCIENTIFIC AMERICAN SUPPLEMENT that may be called for.

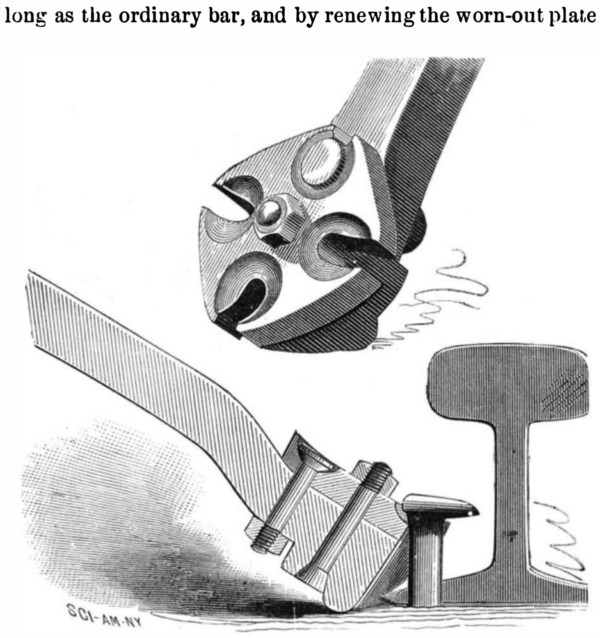
The Value of the Coefficient of Expansion.

An illustration of the way in which a coefficient like 0·000006, that of the expansion of steel, may become a big thing with a few degrees of rise of temperature and long lengths has been seen, says the *Engineer*, on the new Midland line between Irchester and Sharnbrook, recently opened for goods traffic. The rails were laid during winter time, and insufficient room was left for expansion, consequently the summer heat expanded the rails to such an extent that the road burst out of line. Traffic had to be at once stopped and the permanent way altered and properly spaced. Accidents from the "spreading" of rails are far more frequent that is supposed on roads in this country. Your compiler long ago showed the vital necessity of regulating the space allowed for expansion at the ends of rails by constant reference to the height of the thermometer on the spot and during the whole process of laying the rails.

CLAW BAR.

The square face-plate of hardened steel has its corners bent upward, rounded, and recessed to form claws for receiving the body and head of a spike; the under side is slightly convexed to fit snugly upon the curved upper side of the bar, to which it is united by means of a pivot bolt and nut. The bar is formed substantially the same as an ordinary claw bar for drawing railroad spikes, with a recess in the end for the body of the spike. Through the bar, directly in the rear of the pivot bolt, is a hole, through which is passed a bolt whose head rests in one of the claw recesses of the face-plate; the under side of the bar is rabbeted to form a bearing for the nut. If the claws which are in use should break, by removing the rear bolt another pair of jaws may be brought over the recess in the bar. The recesses in the face plate may be of different widths to adapt the bar to spikes of different sizes.

It is evident that this claw bar will wear four times as long as the ordinary bar, and by renewing the worn-out plate



HARDWICK'S CLAW BAR.

can be quickly refitted for use; and as the plate can be more nicely finished and better tempered than the end of the common bar, still greater durability is insured.

This invention has been patented by Mr. James L. Hardwick, lock box 569, Cedar Rapids, Iowa.

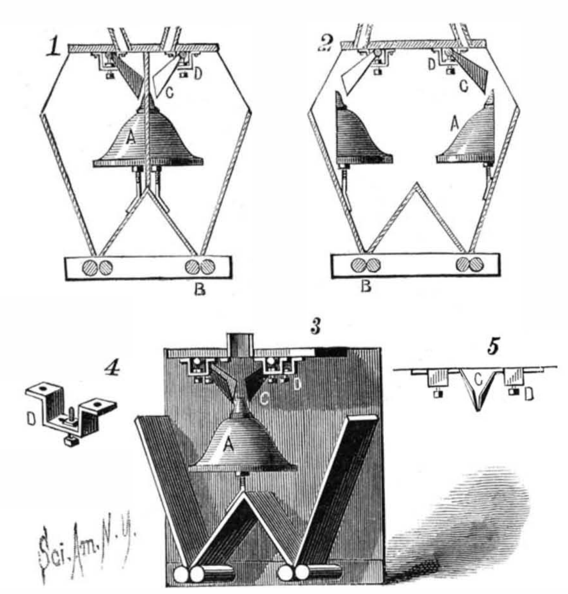
Bessemer Steel Works in the United States.

There are 21 Bessemer steel works in the United States and 1 in process of building. These 21 works contain 46 converters, and 3 converters are building. The total annual capacity of the works completed is 2,490,000 net tons of ingots. The plant building is that of the Benwood Iron Works, at Benwood, W. Va. The States that have Bessemer works are: Massachusetts, one, with two 4 ton converters; New York, one, with two 7 ton converters; Pennsylvania, nine, with twenty-two converters, and one building, ranging in size from 2 ton to 10 ton; West Virginia, one, with two 5 ton converters, and one building, which will have two 4 ton converters; Ohio, three, with five converters, ranging in size from 4 ton to 10 ton; Illinois, four, with nine converters, ranging from 6 ton to 10 ton; Missouri, one, with two 7 ton converters; Colorado, one, with two 5 ton converters.

The first Bessemer plant in the United States was erected in Troy, N. Y., and made its first blow February 15 1865; the second was erected at Steelton, Pa., and made its first blow June, 1867; the third was erected in Cleveland, Ohio, which made its first blow October 15, 1868. The largest Bessemer plant in the United States is that at Steelton, Pa., which contains two 7 ton and three 8 ton converters. The next largest are the Edgar Thomson, at Pittsburg, and the North Chicago, at Chicago, which have three 10 ton converters. The domestic works are now more than able to supply all domestic demands for Bessemer steel, and one of them recently received a 10,000 ton order from Canada for rails.

FEED MECHANISM FOR ROLLER MILLS.

The engravings illustrate a feeding device for roller mills, patented by Mr. Julius Busch, of Marine, Ill., which will deliver the material evenly to the rolls. The material is directed to the grinding rolls, B, by cant boards. Adjustably supported from the cant boards or the sides of the hopper by a threaded rod having an adjusting nut is a half-bell shaped



BUSCH'S FEED MECHANISM FOR ROLLER MILLS.

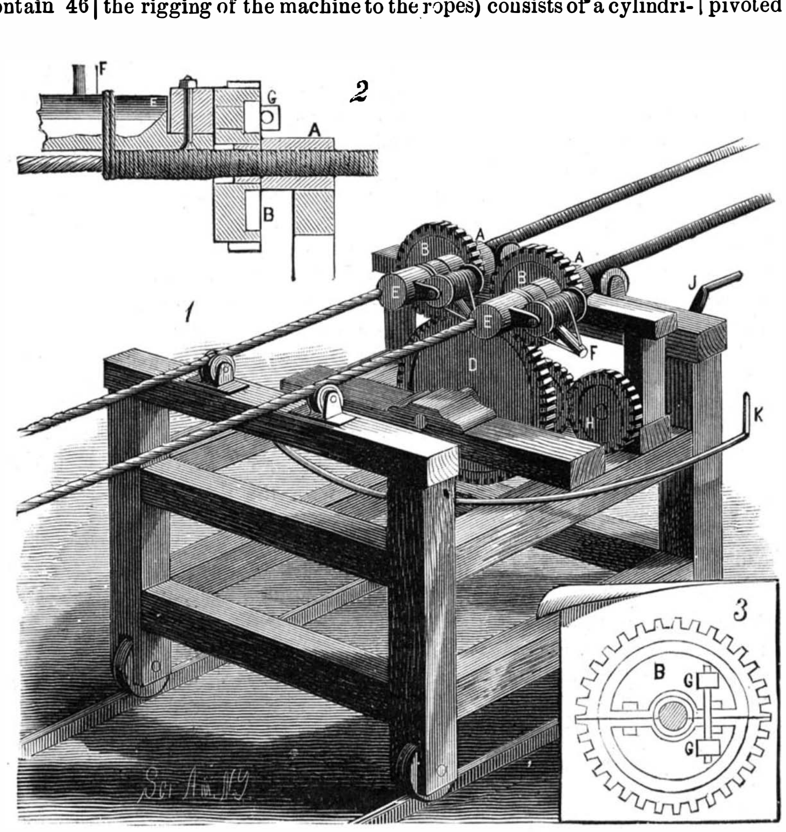
distributer, A, as shown in Figs. 1 and 2; or as shown in Fig. 3, two of these distributers may be combined. Fixed to a rod supported within slotted brackets, D, is an inclined spout, C, the lower end of which is directly over, or nearly over, the apex of the distributer upon which the material is delivered. The rod is prevented from turning by the action of screws and nuts resting upon the bottom of the brackets, the inclination of the spout, to deliver the material higher or lower, having been previously affected. The slots in the brackets permit of the lateral adjustment of the rod to admit of the lower end of the spout being located farther from or nearer to the distributer, according as the end of the spout is raised or lowered. A smaller distributer may be placed upon the apex of the large one when fine, soft material is being fed to the rolls; two of these may be united for use with the distributer, A, Fig. 3. Material is fed to the hopper through delivery spouts. For coarse, sharp middlings the distributer, A, only will be needed. The middlings from the spout, C, striking upon the curved face of the distributer, will be spread in a thin, even stream, which, falling upon the side of the hopper or the cant board, will be delivered in an even stream to the rolls. For fine, soft middlings the smaller distributer may be placed upon the apex of the other, and the spout so adjusted as to deliver near the upper apex.

ROPE SERVING MACHINE.

The frames are supported upon wheels adapted to run on suitable rails for moving the machine along the ropes that are arranged in guides, A, on the top beam. Mounted on each guide is a toothed wheel, B, which is geared with a master wheel, D, operated from a crank, J. Each of the wheels, B, carries a boss extending a short distance from the side parallel with the rope to which the tension device, E—called by the inventor a "mallet"—is pivoted to bear on the rope. This device (Fig. 2 is a section of one of the guides and tension devices, and Fig. 3 shows a tension device and reel carrier divided in two parts and bolted together to facilitate the rigging of the machine to the ropes) consists of a cylindrical block of wood of considerably larger diameter than the rope, and having a groove along the side next to the rope, in which the rope is made to bear by the yarn which, in passing from the spools, F, is carried around the mallet and the rope a couple of turns, first passing through an eye in an arm projecting from the mallet. The spools are pivoted in arms projecting from the mallet and from the boss, so that the spools and mallets are carried around the ropes.

The guides are made in two parts, the upper of which may be taken off to facilitate the adjusting of the ropes, and the wheels, B, are also divided for the same purpose. To enable the attendant to turn the winding wheels while walking by the side of the machine, and also to enable the crank to be applied so as not to be interfered with by the ropes, the train of wheels, H, is geared with a wheel on the shaft of the master wheel, D, the crank being applied to the shaft, H. The machine will naturally feed along by the pressure of the coils laid on the ropes against the yarn being laid on; but it will need to be pushed to some extent by the attendant, and the push rod, K, is so arranged that the force is applied at the middle of the front end; the rod extends back, so that the operator can push the machine with the left hand while turning the crank with the right.

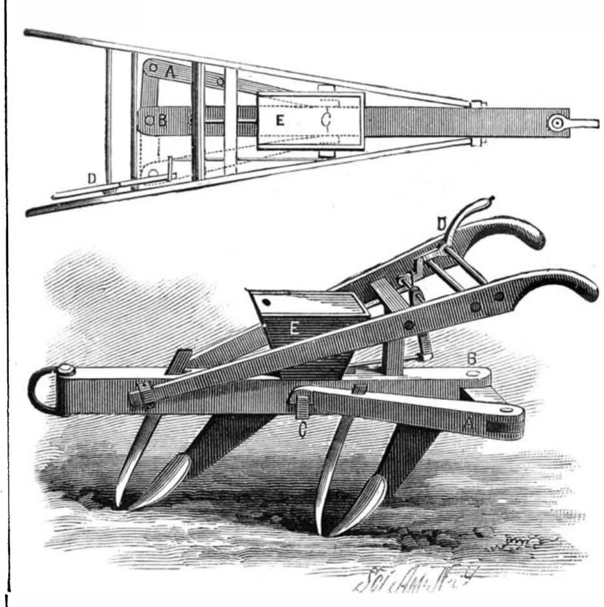
Further particulars regarding this machine may be obtained by addressing the inventor, Mr. Archibald McQuarrie, Post Office, Buffalo, N. Y.



McQUARRIE'S ROPE SERVING MACHINE.

AN IMPROVED PLOW.

The accompanying engraving shows a plow which, although suitable for use on level ground and as a cultivator after planting, is more particularly intended to be used as a sidehill corn planter. The inner plow beam carries, near its forward end, a share secured to a standard, and a colter. The corn hopper, E, is provided with a slide operated from the handle, D, by means of intermediate connecting rods and levers. A supplementary plow beam, A, carries a share, standard, and colter similar to those on the main beam.



STEVENSON'S IMPROVED PLOW.

This plow beam is arranged to lie to one side of the rear portion of the main beam, as shown by the full lines in both cuts, or to either side of the main beam, as shown by the full and dotted lines in the plan view, to do the hill-side or special work required of the plow and planter. To accomplish this purpose the beam is fitted to turn horizontally from the rear end of the main beam to opposite sides of the latter. The ends of both beams are slotted and connected by a link pivoted at each end. When the beam, A, is swung to a position in line with the main beam, its share and colter face in a reverse direction to the forward share and colter; but when it is swung to either side, the shares and colters face in the same direction with the rear ones to one side of those forward. The movable beam is held in place by a tooth on its free end, engaging with a latch, C, on either side of the main beam. A very important advantage of this combined plow and planter is that the share on the beam, A, may always be located on the upper side of the hill when at work, to operate as a covering shovel.

This invention has been patented by Mr. James N. Stevenson, of Salvisa, Ky.

Petrified Wood.

The petrified wood which is so abundant in Arizona, Wyoming, and Rocky Mountain regions, is utilized in San Francisco, where there is now a factory for cutting and polishing these petrifactions into mantelpieces, tiles, tablets, and other architectural parts for which marble or slate is commonly used. Petrified wood is said to be susceptible of a finer polish than marble or even onyx, the latter of which it is driving from the market. The raw material employed comes mostly from the forests of petrified wood along the line of the Atlantic and Pacific Railway. Geologists will regret the destruction of such interesting primeval remains, and some steps ought to be taken to preserve certain tracts in their original state.

IMPROVEMENTS IN UPRIGHT PIANOS.

Improvements in the construction of upright pianos have been invented and introduced by the Mason & Hamlin Co., of Boston, New York, and Chicago, which add materially to the value of these instruments, rendering them capable of tones of extraordinary purity and beauty, and much increasing their durability; overcoming in large degree the tendency to fall from the pitch and get out of tune, which has been the most serious practical difficulty in the pianoforte.

The principal of these improvements, which we shall illustrate and describe, consists in a different mode of fastening the strings. Instead of holding them by iron pins driven into wood, as has heretofore been done, the Mason & Hamlin Co., by an ingenious invention, fasten each string directly to the iron plate itself, so holding it exactly, securely, and permanently. From the instability and changeable character of wood it has been impossible to do this when the latter material was employed. Yet upon such exact holding evidently depends very largely the quality of tone of the piano, and in still greater degree its capacity to stand at correct pitch.

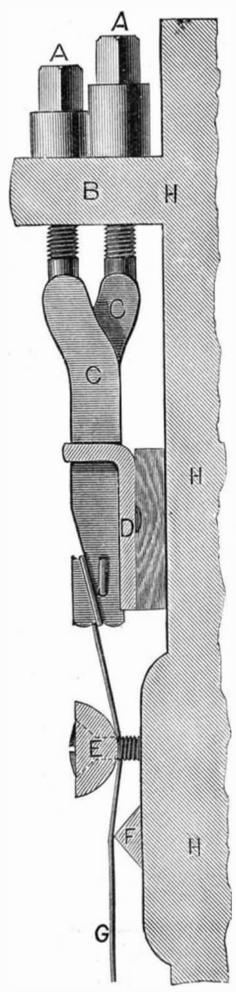


Fig. 2.

THE OLD METHOD OF STRINGING PIANOS

is shown in Fig. 4. X is a part of the iron plate, which, when securely bolted to the heavy wood support at its back, *y*, forms the frame on which the strings are stretched. These strings are held by the iron wrest pins, Z Z Z, which are simply driven into holes prepared for them in the wood. Sometimes the iron plate is extended to cover the whole of the wooden frame, and in that case has holes through which the wrest pins are driven into the wood. In tuning the instruments the iron pins are turned back or forward, winding or unwinding, and so tightening or loosening the strings. Disadvantages of this old method evidently are:

1. It is difficult to tune the instrument exactly. A very slight turning of the pin back or forward changes the tension of the string sufficiently to alter the pitch materially. The tuner has, therefore, to turn the pin back and forward repeatedly until he hits, partly by chance, the exact tension required. Sometimes he is compelled to effect the slight difference needed by bending the pin, or forcing it toward or away from the string, so as to tighten or loosen it very slightly. Now, the hold of the pin upon the wood, by which the string is held, is mainly through friction, and by the process of tuning this friction is lessened, just as the hold of a round nail in wood is diminished by turning it round and bending to and fro. Thus every time a piano constructed on this old system is tuned, it is more or less injured. It is not a rare case that the injury is so great as to render the piano practically useless in a few years, because it becomes practically impossible to tune it with any reasonable approach to accuracy.

2. A yet more important disadvantage of this old method of holding the strings arises from the changeable nature of the wood, which swells and shrinks with atmospheric changes. It must be remembered that a very slight change in the tension of the string will affect the pitch of its tone. Hence least changes in the wood, which would ordinarily be immaterial, are of consequence here. The great liability of pianos, as they have been made, to get out of tune, arises mainly from this cause, and every player knows that its constant getting out of tune is the great difficulty in the use of the piano. The fact that the whole iron plate of the instrument has been securely bolted to a heavy wooden frame increases this difficulty, because in swelling and shrinking the wood springs the plate more or less.

3. The heavy wood support of unvibrating wood at the back of the iron plate is a detriment to the instrument, preventing the freest, fullest vibration of its strings, and tending to make its tones dull and mixed with mere noise.

THE IMPROVED METHOD OF STRINGING

invented by the Mason & Hamlin Co., and introduced in their pianos, is shown in accompanying cuts. Fig. 1 shows a piano with the front of the case removed. H is the iron plate or frame, made strong enough to bear the full strain of

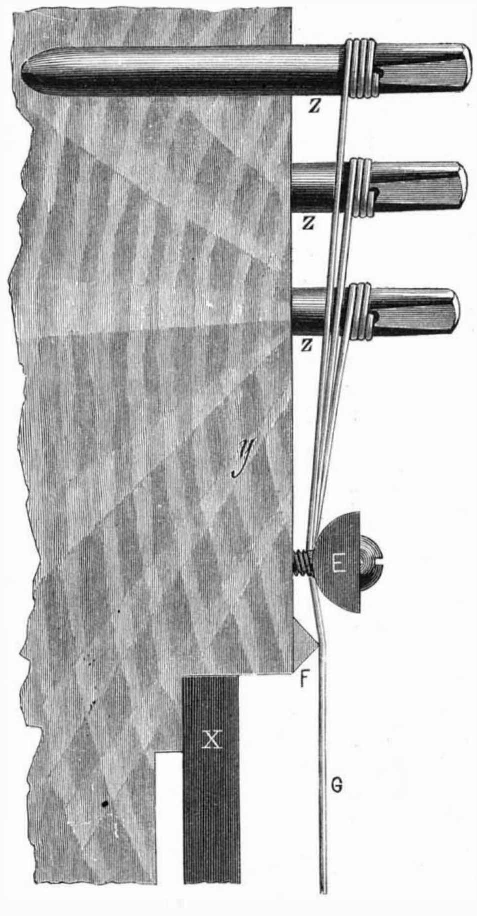


Fig. 4.

the strings without any wood support at its back, which is so left open for more perfect and free vibration of strings and resonance of tones as reflected from the sound board, which extends behind the strings to the top of the frame. B B is a metal flange cast in and forming a part of the iron plate or frame itself. Through this flange pass the screws, A, to the lower ends of which the strings are attached.

Fig. 2 shows on a larger scale a side view of the stringing device, by which the string is fastened to the iron frame and its tension is regulated.

Fig. 3 gives a front view of the same, showing the upper parts of six strings (producing two tones).

A is the screw threaded nut, by the turning of which the strings are drawn up or let down. B is a flange, cast in and a part of the iron plate itself. C is the screw headed blade to which the strings are attached. D is the guide which holds the screw headed blade in position during the process of tuning. E is the usual pressure bar which holds the string firmly to the upper bridge. F is the upper bridge, a triangular piece of metal, on which the strings rest, and are properly spaced. G is the string itself. H H is a part of the iron plate or frame on which the strings are stretched.

It will be seen that by this method of stringing, the employment of wood, either for the fastening of the strings or the support of the iron frame at its back, is entirely dispensed with, and so the disadvantages of its use are avoided; metal with its greater strength and comparatively changeless character being substituted. Principal advantages claimed for this method of stringing are:

1. Peculiarly bright and pure musical tones are produced. The strings, being exactly and permanently held at each end, are not liable to the imperfect or false vibrations which are inevitable in the old way of stringing. Then the absence of the wood at the back of the metal frame is a material advantage, giving great freedom to the tones produced by the vibration of strings as perfectly reflected from the sounding board.

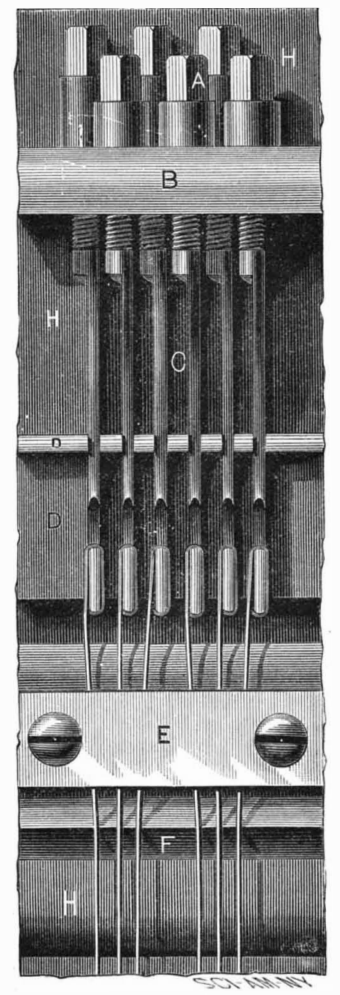


Fig. 3.

2. Permanence in good qualities of tone is secured. The strings remain as properly stretched on the iron frame, and are not subject to the unfavorable changes coming from fastenings in changeable wood.

3. The piano is easily and exactly tuned, and has extraordinary capacity to remain in tune. Under the old system considerable force was required to turn the wrest pin, and one revolution of it tightened or loosened the string as much as the whole circumference of the pin. By the new system a complete revolution of the tuning screw tightens or loosens the string only the width of one thread of the screw, requiring proportionately less force to operate it. Exact work is thus rendered easy.

The metal frame and fastenings are not liable to change. After a few tunings, sufficient to take out the mere stretch of the strings, they remain as set, and the piano hardly requires tuning at all. Moreover, it is not injured by tuning, as must be the case with wrest pins set in wood, as has been shown. These pianos are, evidently, peculiarly adapted to positions where tuners are not readily available, as well as to climates which involve trying conditions, not only as to temperature, humidity, etc., but also from ravages of insects, which in some countries so destroy the fiber of the wood that in a short time wrest pins lose their hold upon it, and the instrument becomes useless.

Other improvements of minor importance are included in these pianos. One is an improvement upon the French upright action, now very generally used, by which its capacity for rapid repetition of tones is much increased.

The cost of these pianos will be somewhat more than that of instruments constructed on the old system; but advantages obtained evidently warrant this.

The Mason & Hamlin Co. are well known as having been the first to introduce and manufacture the American organ, which has now become the most popular and largely used of large musical instruments. Their very successful experience in the manufacture of 150,000 organs has amply fitted them for the improvement of musical instruments, and given them a worldwide reputation which they would be very unwilling to jeopardize. They have, therefore, been experimenting with pianos several years, and testing their improvements in every way before being willing to give them to the public. They have now obtained and thoroughly tested results which warrant them in the extensive manufacture of their new upright pianos.

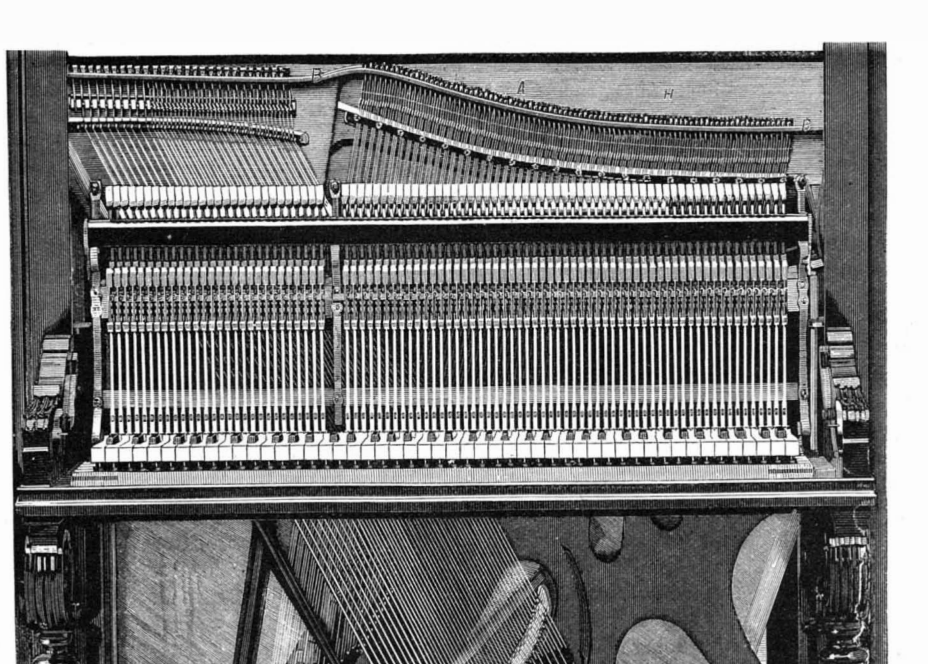


Fig. 1.—MASON & HAMLIN'S IMPROVED UPRIGHT PIANO.

The Burning of Iron and Steel.

Iron that has been raised to near its temperature of fusion and slowly cooled is designated as "burned" or overheated metal. It is both red short and cold short, and exhibits a coarse, crystalline structure and a bright glistening fracture. Such iron contains oxygen. But this oxygen is not, as is commonly believed, derived from without during the heating; but it was previously contained in the iron itself through the medium of the scoria or slag impurities mixed with it. When the iron is raised to the fusing heat, or near it, a chemical reaction takes place; the metallic iron reduces the sesquioxide to protoxide, which, by being dissolved in the iron, alters the properties of the latter. The coarsely crystalline quality of iron so treated is not due to the presence of the oxygen. The metal usually contains a notable quantity of phosphorus, which is well known to give a coarse grain accompanied by the quality described as cold short. The crystallization takes place during the slow cooling while at rest. The greater the proportion of phosphorus present, the lower is the temperature to which the iron may be raised without being burned. Pure iron should not take up more than 0·25 per cent of oxygen in solution. Though this substance does not greatly affect the ductility of the metal when cold, it acts like sulphur on its malleability.

The qualities of steel also undergo change when heated to a high temperature, or when subjected to a lower temperature for too long a time. The richer the steel is in carbon, the lower is the temperature at which the change takes place. Therefore, the harder the steel, the more carefully is it to be dealt with in the fire. Such overheated steel becomes coarse grained and brittle; that is, cold short. If the temperature be increased, showers of sparks are thrown off, and the steel is said to be "burned." The alteration brought about in this way has generally been attributed to a diminution in the proportion of the carbon constituent, though this assumption is not warranted by the results of analysis. The presence of manganese and silicon is of more weighty consequence. When steel containing these is heated it is not the carbon, but the manganese and silicon, that first becomes oxidized, and there results an important change in the properties of the steel. Later the carbon is oxidized; and while the oxide of carbon escapes, those of the manganese and silicon remain behind, and the whole molecular structure of the metal is altered. If the heating be carried still further, the iron will next be oxidized. A cast iron furnace door, exposed for several years to the flame of a coal fire, was found to contain 27·8 per cent of oxygen, in combination with iron, sulphur, nickel, copper, phosphorus, and arsenic. The cause of the sparks is not the combustion of the carbon, and the consequent generation of carbonic oxide gas, but the escape of gases imprisoned in the steel. Similar results may be brought about by exposing the steel to a lower temperature for a longer time; the oxidation of the constituents will, in this case, be effected in the order mentioned above, the only difference being in the slower action. Steel altered in this way is well described as "dead." A regeneration of the metal by mechanical treatment is hardly possible, since the original chemical composition cannot be restored by such means.—*Jahrbuch fur den Berg- und Huttenmann.*

An Interesting Relic.

A writer in the Panama *Star-Herald* says: Recently I had the pleasure of examining an old piece of Spanish ordnance. It is a brass breech-loading cannon, the property of our esteemed friend, the Bishop of Panama. The exact measurements of this shapely piece of artillery are as follows:

The diameter of the bore at the muzzle is three inches. Back of the muzzle band, on a raised square measuring two inches by two, is the letter R, for Rey. The circumference of the muzzle band is eighteen and a half inches. The circumference of the second band is thirteen inches. The extreme length of the piece is forty-four inches. The distance between the edges of the trunnions is nine and a half inches, their circumference is seven and a half inches, and their diameter two and one-eighth inches. The first part or swell of the breech, just back of the trunnions, measures twenty-one and a half inches. Circumference of the breech at its thickest part, twenty-one and a half inches. Thickness of its sides, one and a half inches. Internal diameter of the bore where breech block closed the gun, three inches and an eighth. In the upper posterior third of the breech, on both sides, are two slots, measuring two inches and a half horizontally by three-quarters of an inch wide. These undoubtedly were used for passing a transverse bar, that held the block in position during traveling and firing. In the under surface of the breech chamber there is an opening, square externally, measuring half an inch; it tapers off to a small round hole that enters the chamber about its center. One can hardly fancy that it was the firing hole. A careful examination leads one to suppose that as the block fitted with almost mathematical accuracy, this opening was probably left to allow air to escape in closing the breech, and permit rapid firing, etc. The measurements of the breech chambers are five and a half inches longitudinally by four and a half inches transversely.

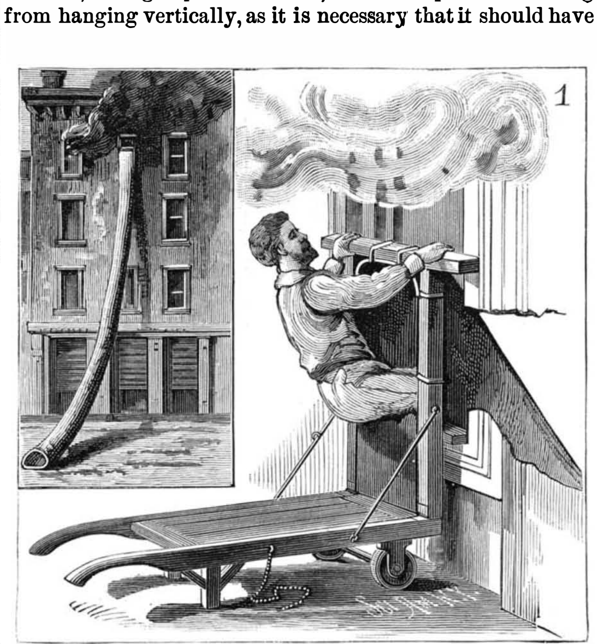
The gun evidently was designed and cast upon well known scientific principles, such as are recognized to this day. The upper part of the breech lock, fitted under a strongly cast shoulder of brass, in the thickest part of the side of the bore, just inside the trunnions. As stated, the diameter of the bore anteriorly is three inches; posteriorly, three inches and an eighth. Did the early Spanish artillerists cover their shot with lead to secure accuracy of aim, and prevent the loss of the gases generated by the explosion of the powder?

The weight of this very interesting relic of the Spanish Main of "ye olden days" is probably 125 pounds. In view of its antiquity, the symmetrical proportions are excellent. While Lieut. Napoleon Bonaparte Wyse's expedition was in the Darien, three guns of this type were discovered and brought to Panama. The gun under consideration was presented to Bishop Paul, and the others are in the Paris Museum.

A NOVEL FIRE ESCAPE.

A bag or chute made of canvas or other suitable material, and open at both ends, is folded regularly and placed upon a truck provided with wheels and handles. One end of the bag is secured firmly to a frame hinged to the truck in such a way that when raised to a vertical position its lower ends will rest on the ends of the side bars of the truck frame. At the hinged end of the frame is arranged a cushion that can be placed over the window sill. The end of the bag is secured to the frame in such a manner that it can be entered through the frame. The frame is held in a vertical position by hinged side braces, and the top cross bar is of such length as to extend beyond the side bars of the window frame. The lower end of the bag is provided with handles.

To use the fire escape the truck is rolled to a window, the frame is swung to a vertical position, and the bag is dropped out of the window. The weight of the chute presses the top cross piece of the frame against the uprights of the window frame. The cushion is placed over the sill, and the lower end of the bag is held by a few powerful men, who grasp the handles, and thus prevent the bag from hanging vertically, as it is necessary that it should have



WINDMAYER'S NOVEL FIRE ESCAPE.

a certain inclination to prevent the persons from sliding down too rapidly. The people to be rescued step through the frame into the chute and slide down, the speed of the descent being checked by pressing the knees and elbows against the bag.

Further particulars regarding this fire escape can be obtained by addressing the inventor, Mr. A. J. Windmayer, of Fort Madison, Iowa.

Dispatch in the Machine Shop.

The importance of a reputation for promptness in the fulfillment of engagements, and the execution of orders on the very day they are promised, is well illustrated by an incident related in a contemporary, *The Industrial World.*

A short time since a party who contemplated having some expensive machinery made was inquiring where he had best send his order. A friend suggested the name of a well known machinist near at hand. The reply to this suggestion was: "While I know A to be one of the best machinists in the town, yet he is so proverbially slow that there is no telling when he would complete the work. I cannot afford to take the chances of his delays." A did not get the job; it was given to a firm who had a superior reputation for getting out work in a satisfactory manner with great dispatch.

This order was the beginning of a very large business, and it is safe to say that A's reputation for negligence lost him business the profits on which would, in a short time, have amounted to no less than ten thousand dollars. How many similar customers A has lost on account of his lax methods, no one knows. It is probable that his losses in this respect amount to many thousands of dollars, for he is only doing a limited business, notwithstanding his reputation for good workmanship is second to none, he being capable of successfully completing all sorts of the finer and more intricate mechanical work.

There is nothing that can be seemingly more vexatious than the customary delays in perfecting machine work. While it may be true that in this kind of employment there are numerous unexpected occurrences tending constantly to defeat the prompt dispatch of work, yet these difficulties are such as can be overcome by the display of extraordinary exertion and by paying a due regard to the minute details of the business. Machinists have frequently a fault of accepting orders for more business than they can do within the time stipulated. In their endeavors to fill their shops with work, they book more orders than they can take care of, and hence let their engagements get ahead of them, resulting too often in delaying important jobs, and in keeping everybody connected with the business in a bad temper.

It can readily be conceived that when a man orders a machine completed on a particular day, and has made his arrangements in accordance with a belief that the machinist will live up to his engagement, the disappointment in the event of a non-fulfillment must be very great, as in not a few cases is also the loss.

All that some people care for is to get the orders on their books, and little regard is paid to the time when they are filled. This is a wrong which will operate seriously to the discredit of the offending machinist.

If there were no loss of trade, no decline of reputation, or other ill-effects of the inexcusable course, a due regard for doing what is just and right should inspire the machinist to do his work promptly and in the best manner.

When a man leaves an order and agrees to pay a price for work done for him, there is an obligation on the workman's part to perform it in manner and form as agreed. Nothing avoidable should be allowed to prevent the honest consummation of this agreement.

There are occasionally valid excuses for the non-fulfillment of an agreement to get out machinery at a specified time. In such instances no blame can attach to the machinist, but it is safe to say that ninety per cent of the customary delays in machine shop practice might be prevented by intelligent forethought or by extra exertion.

Gumbo.

On the Canadian Pacific Railway, west of Winnipeg, it is noticeable that all the prairie land is free from stones. For great distances along the line, one bushel of stones could not be gathered in fifty miles. In the neighborhood of Brandon the soil is gravelly, and there are some large bowlders, which are striated in the east and west direction; these are the only bowlders to be met with for 400 miles from Winnipeg.

The absence of earth-worms and slugs is a marked feature of this soil. When dry, it is hard to work; during the summer it can scarcely be plowed; when wet, it adheres so hard to carriage wheels and boots, that it can only be removed by being scraped off. A very little moisture produces this state. It is very difficult to work in this condition, as it can scarcely be cast off the shovel or the scraper; with 20 per cent. moisture it somewhat resembles half-set mastic or glue. The most adhesive qualities of this soil are termed "gumbo." When "gumbo" dries, it bakes too hard to be plowed; on several occasions it was taken out with picks, in large blocks, and laid by hand in the dump. In its worst condition of moisture it will hold the hoofs of horses working in it and pull their shoes off; this has occurred repeatedly, and within one hour of their having been set. The authors kiln-dried and soaked some of it, and found it would absorb 72 per cent. of moisture before becoming "slurry."

The frost penetrates the ground to a considerable depth. In the excavations for the main sewer in Winnipeg some years ago, a layer of frozen clay, 12 inches thick, was found 8 feet below the surface in the month of August. The presence of frost in the lower layers of the subsoil is not prejudicial to the growth of the crop. The soil does not heave when the frost leaves it in spring, which is a marked difference to the clay subsoils of the eastern provinces. Houses can be built on sills laid on the surface of the ground; foundation walls or piles have to be carried down 8 feet. Frost has a beneficial effect on the earthworks, crumbling down the "gumbo" and causing it to fall like fine garden soil. It also consolidates the embankments.

Robert Henry Sabine.

This eminent electrician, who is well known for a variety of useful works, died in London on the 24th of October. Sabine was born at Dorchester on November 6, 1837, but subsequently lived at Bristol with his father, Mr. H. S. Sabine, a solicitor. Educated at Bristol, he entered his father's office at the age of seventeen; but manifesting a preference for engineering studies, he was sent to Manchester to enter an engineering firm, and there met the late Sir William Siemens, who engaged him as an assistant. In 1859 he went to the Mediterranean on H.M.S. Firebrand to test the Siemens deep sea thermometer, and afterward was transferred to the Berlin works of Siemens & Halske. He subsequently engaged in cable work abroad, and finally left Siemens, Halske & Co. to become a consulting engineer in 1867. In 1871 he became associated with Sir Charles Wheatstone in a private factory, which afterward developed into the British Telegraph Manufactory. Here the first Gramme machines were made, and many interesting experiments in electric lighting carried on. Sabine was married to Sir Charles Wheatstone's second daughter. For some years he was in partnership with Sir Samuel Canning. His best known works are the "Electrical Tables and Formulæ," which he prepared with Mr. Latimer Clark, and his "History and Progress of the Electric Telegraph," which, although overweighted with the productions of Messrs. Siemens Brothers to the exclusion of other inventors, is nevertheless a clear and correct work. His best known research is on a "Method of Measuring the Contour of Electric Waves passing through Telegraph Lines," and his most original invention is perhaps the "wedge and diaphragm photometer."

Correspondence.

Electricity from Machine Belts.

To the Editor of the Scientific American:

Seeing in this week's (Nov. 15) Scientific American and Supplement notes about electricity on machine belting, in which I was very much interested, I concluded to send you a word of my experience, hoping some others may do the same, who may have it.

We have at present a very marked production of electricity on a pair of elevator engines in a very unfavorable place, it being in a basement of a large warehouse for stoves. This basement is very moist at all times, and the engines are well connected electrically through the steam pipe to boiler and feed pump, and to the ground by water main, also steam traps in the ground; the engines being set on large stone slabs. In spite of this, they at all times produce enough electricity to be seen. I have seen sparks 2¼ inches long, this being from the belt to nearest point on the frame of the engine. Another effect is that both kinds of electricity are produced, the electricity being reversed when the engines are reversed. When the belt is running from the lower side of drum pulley to engine pulley, positive electricity escapes from edge of belt to brake rod. When the belt runs in opposite direction, negative electricity escapes from the frame of engine to face of belt. To judge from the experiment I made, as below mentioned, a moist temperature does not seem to totally prevent the production of electricity. I have brushed the edges and face of belt with a handful of moist waste, after which the sparks were as usual. Even on rainy days I have noticed the sparks to pass the same, when I was not able to produce any with the plate machine.

I have no doubt about the sparks setting fire to combustible dust. I have burnt holes through papers of several thicknesses. The sparks are of a very bluish to a yellowish color, with a loud crack, the passage of negative being most bluish. I notice by running a wire across the face of belt, it reduces the size of the sparks, but it did not prevent the production of same. Have oiled the belts with castor oil without producing any change.

The elevator engines are made by Crane Brothers, of this city. They are a pair of 4,000 pounds capacity, double vertical engines, in the basement of the new stove warehouse of Rathbone Sard Co., running for two hours every working day.

I have no doubt there are engines in more favorable places than these which do not produce electricity. G. A. H.

Chicago, Ill., Nov. 17, 1884.

First Principles for Young Mechanics.

A well grounded knowledge of the great law or principle of conservation of energy should be taught with the multiplication table. It can be so taught if the teachers themselves are certain that there is in the universe only so much energy, and that we cannot make one particle more than already existed. With a clear understanding of this principle, no time will be wasted in search after perpetual motion machines, and fewer mistakes will be made by really earnest seekers after improved machines for use or improved methods. When a young man brings to me some wonderful improvement over the ordinary crank motion, some device that is to supersede the crank of the steam engine, a feeling of utter helplessness comes over me; I know not where or how to begin; he has had no opportunity to learn the simple laws of mechanics, and to point out the fallacy of his argument means to teach him the laws of mechanics, so I can only say to him, "Don't," and may advise him what books to read.

We hear or read almost daily of the wonders of science, and what is to be accomplished by electricity. "It is to be the great power of the future." Is it a power now? We may use it indirectly to drive machinery, we may make use of it to propel the cars on our street roads, but is it a power in the sense that steam is a power? Let us think of this a few moments. We call steam a power, and our factories are driven by steam power; or we call water when falling a power, and we drive the machinery in other factories by water wheels; or we pump water into the reservoirs at Fairmount by water power. Where we have no fall of water, and where fuel is scarce but wind plenty, we grind corn in a mill driven by wind, and the wind is our power; these and other sources of power may be called primary powers.

Secondary power is that which is transmitted from the prime motor to a machine. One machine may be driven by belt power, and another may be driven by gearing, etc. Electricity, as we now use it, as a power must be classed in its greatest economy with the secondary powers, with the belt or the gearing, not with the steam engine and the water wheel. We dig from the earth coal that contains the stored up energy of the sun's heat expended on forests that existed long before man came to live on this planet. We burn that coal under our boilers, and the steam generated by this application of heat to water is used to drive the piston of the steam engine, and from thence is the power conveyed by belt or gearing by shafts, or even by electricity, to the machines to be operated. We can burn up zinc in costly acids, and generate electricity that can be used to drive an electric engine, and so in turn operate machines exactly as in the case of the steam engine. In this case electricity is a power exactly as steam is to be considered as a power; and what is more, the electric battery will give us more nearly the whole of the stored up energy of the metal eaten up in the battery than the most improved steam engine can give us of the stored up energy of the coal that is devoured in the furnaces under the boilers. With all this advantage, electric batteries are not used to drive machines with any hope of economical results.

Zinc has been gathered from the earth as an ore, it has been converted into a metal, or the metal has been gathered from the ore by means of coal and much labor; its market price is measured by the cost of its production. To burn up zinc at five cents a pound in acids costing but few cents per pound, with a certainty of getting from the metal 70 or 80 per cent of its theoretical energy in motive force, yet makes the venture a more costly one than the burning of coal under a boiler with the knowledge that we are at the best getting but little more than ten per cent of the theoretical power that lies hidden in that coal. The electricity that is now lighting our streets, the electricity that is utilized in places to drive the street cars, has behind it the steam engine or the waterfall, the windmill, or some other motor.

By means of a steam engine we drive a dynamo electric machine, and the electricity thence proceeding lights our streets or may be reconverted, with some loss, back into the power that created it; for one dynamo machine can be made thus to drive another, the electricity being carried from one to the other by proper conductors. What, then, is electricity as we now use it in the way of power, but as the belts and the gearing that carries our steam power to the machines? It is a belt with more or less slip. But this is not to remain so forever. The future of electricity as a power is full of promise. The coal we now squander, using but a small percentage of its theoretical dynamic force, is capable of yielding its energy either as heat or as electricity; and the time will come when we will not burn this coal to boil water, and in that boiling lose say 1,000 units of its heat at the moment of the conversion of water into steam, lose all this, never to be getting it back, but we will take from the coal its energy in the form of electricity, we hope in more near ratio to its true value, and then we can convert that energy into whatsoever other form of energy we may require. The best that science can do is to point out just what energy there is in this or that source of power. The most we can hope to utilize of this energy as power will never amount to 100 per cent. Nature gives us nothing without exacting something in payment.

A pound of water is the same as a pound of metal so far as its power from gravity is concerned. In falling through space it will exert just as much force as any other pound weight is capable of doing, and no more; it will do the work due to one pound falling at any given velocity less the friction of the machine or of the moving parts. We turn water into steam with a certain knowledge of the power that can be gained by using the elastic vapor as a spring, or we may tear the gases, which combined form water, apart, and use these gases in recombination to produce power, but less power than was taken to tear them apart, never more.

Science has made us so sure of these facts that we can base our faith on them, and with this knowledge we are willing that others than ourselves shall invest their money in machines which are claimed to be able to develop from five drops of pure water inclosed in a ball, power enough to propel the largest steamship across the ocean. It is ignorance of the unalterable laws of physics that leads ignorant people into squandering money on so-called wonderful inventions that, out of nothing, are to give us great results. An ignorant man will spend his time pondering over perpetual motion machines, so will a man with brain gone wrong; the first will quit his folly with more learning, the second finds his home in the madhouse. A third and worse class aim to deceive, and, for a time, many a one has done so. When shrewd ignorance resorts to dishonest methods, the confiding public is apt to suffer in pocket.—*Coleman Sellers.*

A Smoke Burning Locomotive.

A new locomotive, invented by Mr. Charles B. Coventry, tried on the Chicago and Northwestern Railway, has given great satisfaction. During two succeeding weeks it has been on trial on the suburban trains on the Chicago, Rock Island, and Pacific. The poorest quality of bituminous coal was used, and yet at no time, although at one point it ran 50 miles an hour, did any black smoke come out of the stack. Not a particle of cinders and dust was thrown out. The smoke that was emitted was thin and white looking—much like escaping steam. There was no bad odor from escaping gas, as is the case in ordinary engines. Mr. Coventry explained that the gases on ordinary engines are usually thrown out of the stack, which is the cause of the density of smoke. On his engine the gases are all burned, and that is what causes the absence of smoke, which results, of course, in a saving in fuel. The new locomotive presents an entirely different appearance from those now in use. Instead of having a large, conical-shaped smoke stack in front, it has a straight smoke stack, similar to those in use on locomotives in England and Europe, in the rear just in front of the cab. The boiler has two sets of flues, small ones in the lower part and larger ones in the upper part. The smoke runs twelve feet through the lower flues, and then returns by the larger flues to the rear, where the smoke stack is placed. Thus the smoke traverses twenty-four feet before reaching the smoke stack, instead of twelve feet, as is the case in ordinary boilers. The heavy cinders and dust, not being able to rise from the lower small flues into the upper large ones, fall into a smoke arch in front and can be emptied on the ground at any time. There is another smoke arch to catch the lighter particles of dust and ashes at the end of the larger flues in the rear of the boiler. Thus nothing but a light white smoke passes through the smoke stack in the rear, and no cinders, sparks, or fire is thrown out.

Oysters.

The oyster industry is rapidly passing from the hands of the fishermen into those of oyster culturists. The oyster, being sedentary, except for a few days in the earliest stages of its existence, is easily exterminated in any given locality, since, although it may not be possible for the fishermen to rake up from the bottom every individual, wholesale methods of capture soon result in covering up or otherwise destroying the oyster banks or reefs, as the communities of oysters are technically termed. The main difference between the oyster industry of America and that of Europe lies in the fact that in Europe the native beds have long since been practically destroyed, perhaps not more than 6 or 7 per cent of the oysters of Europe passing from the native beds directly into the hands of the consumer. It is probable that from 60 to 75 per cent are reared from the seed in artificial parks, the remainder having been laid down for a time to increase in size and flavor in the shoal waters along the coasts.

In the United States, on the other hand, from 30 to 40 per cent of all the oysters consumed are carried from the native beds directly to market. The oyster fishery is everywhere carried on in the most reckless manner, and in all directions oyster grounds are becoming deteriorated, and in some cases have been entirely destroyed. It remains to be seen whether the governments of the States will regulate the oyster fisheries before it is too late, or will permit the destruction of these vast reservoirs of food. At present the oyster is one of the cheapest articles of diet in the United States, while in England, as has been well said, an oyster is usually worth as much as, or more, than a new laid egg. It can hardly be expected that the price of American oysters will always remain so low as at present: but, taking into consideration the great wealth of the natural beds along the entire Atlantic coast, it seems probable that a moderate amount of protection will keep the price of seed oysters far below the present European rates, and that the immense stretches of submerged land along our coasts especially suited for oyster planting may be utilized and may be made to produce an abundant harvest at a much less cost than that which accompanies the complicated system of culture in France and Holland. *G. Brown Goode.*

Animals as Barometers.

Says a writer in the *Cincinnati Enquirer:* I do not know of any surer way of predicting the changes in the weather than by observing the habits of the snail. They do not drink, but imbibe moisture during a rain and exude it afterward. This animal is never seen abroad except before rain, when you will see it climbing the bark of trees and getting on the leaves. The tree snail, as it is called, two days before a rain will climb up the stems of plants, and if the rain is going to be a hard and long one, then they get on the sheltered side of a leaf, but if a short rain on the outside.

Then there are other species that before a rain are yellow; after it, blue. Others indicate rain by holes and protuberances, which before a rain rise as large tubercles. These will begin to show themselves ten days before a rain. At the end of each tubercle is a pore, which opens when the rain comes, to absorb and draw in the moisture. In other snails deep indentations, beginning at the head between the horns, and ending with the jointure of the tail, appear a few days before a storm.

Every farmer knows when swallows fly low that rain is coming; sailors, when the sea gulls fly toward the land—when the stormy petrel appears, or Mother Carey's chickens, as they are called, predict foul weather.

Take the ants: have you never noticed the activity they display before a storm—hurry, scurry, rushing hither and yon, as if they were letter carriers making six trips a day, or expressmen behind time? Dogs grow sleepy and dull, and like to lie before a fire as rain approaches; chickens pick up pebbles, fowls roll in the dust, flies sting and bite more viciously, frogs croak more clamorously, gnats assemble under trees, and horses display restlessness.

When you see a swan flying against the wind, spiders crowding on a wall, toads coming out of their holes in unusual numbers of an evening, worms, slugs, and snails appearing, robin redbreasts pecking at our windows, pigeons coming to the dovecote earlier than usual, peacocks squalling at night, mice squeaking, or geese washing, you can put them down as rain signs. Nearly all the animals have some way of telling the weather in advance. It may be that the altered condition of the atmosphere with regard to electricity, which generally accompanies changes of weather, makes them feel disagreeable or pleasant. The fact that the cat licks herself before a storm is urged by some naturalists as proof of the special influence of electricity. Man is not so sensitive. Yet many people feel listless before a storm, to say nothing of aggravated headaches, toothaches, rheumatic pains, and last, but not least, corns.

A NEW ELEVATED TRAMWAY WITHOUT RAILS.

The question of the Paris Metropolitan Railway is the order of the day, and not a week passes without the presentation of some new project, which is very naturally superior to all others—at least in the mind of its promoter.

Whatever be the future in store for the one that we desire to lay before our readers on the present occasion, it would be difficult to deny it its dominant character—originality. The following is a resume of the considerations through which Captain Edward Mazet was led to invent his "New Metropolitan Railway without Rails, Cars, Bridges, or Tunnels." The sequel will show in what measure the system justifies its appellation. Two systems of metropolitan railways are in presence, viz., the underground and the elevated. Captain Mazet makes short work of the former of these: "What prevents and always will prevent the establishment of the first of these systems in such a city as Paris, is that it would have been necessary at the original formation of the city, in view of its present and future extension, to combine in advance the different routes that would have to be taken later on, without any possible entanglements, by the sewers, the water and gas mains, and the telegraph and telephone tubes, etc., and finally to make provision for a free and sufficient space in which a double-track railway could run without the necessity of changing any of the sewers, mains, etc., now existing.

"But, as one could not foresee what Paris would become, any more than we can divine what it will be in future time, and as we are, moreover, convinced that this impossibility of divining will be perpetuated to future ages, we believe that we can put forth the opinion that the material and financial difficulties that have accumulated since the first tribe settled upon the banks of the Seine, up to our own day, will now and forever prevent the establishment of an underground line at Paris.

"In sum, the creation of such a line *should precede* the creation of the city in which it is to be established, since, when a city is in existence with all the arteries indispensable to its life, the material and financial difficulties that present themselves may be considered as insurmountable. In the second place, the creation of an underground railway *cannot precede* the creation of a city where it is to be established, since the necessity of such a line only makes itself felt when there is an agglomeration of inhabitants, that is to say, a city.

"We see that, on the one hand, they *ought to precede*, and that, on the other, they *cannot*, and so we conclude that city underground railways must be rejected."

Captain Mazet allows ten years for the construction of an underground, and passes in review the present means of locomotion, that have become entirely insufficient, in order to demonstrate that an immediate solution of the problem is necessary.

"It is necessary that we shall in six months be able to travel in Paris with a speed of 24 miles per hour, and that trains shall pass in all the principal streets every two minutes."

The following is the judgment that he pronounces upon elevated roads:

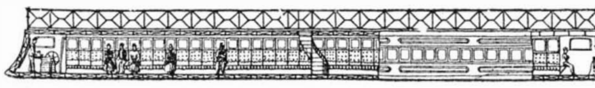
"Foreseeing the antipathy of the Parisian to an underground road, an endeavor had to be made to seek another mode of carriage, and, for a certain length of time, a project for a railway running over bridges has been under study.

"This would have required the erecting of bridges upon pillars in all the principal streets and boulevards, and it is upon these that the trains would have run on a level with the first stories of the houses, which then would have passed to the state of ground floors, while the shops, the ornaments of Paris, would have descended into the cellars. It would have been senseless—still more so than the underground. Paris, that coquette who passes all her time and spends all her money in embellishing herself, would have been forever disfigured.

"Hideous bridges of cold-gray cast iron, hiding the houses, the hotels, the *Opera*, would have proved a mortal blow to Paris, which would have soon passed to the state of a borough.

"Fortunately, the Opera was there, well seated upon its base; and strong in its majesty and popularity, it was able to say, 'You cannot pass!' This was the obstacle, the fortunate obstacle if there ever was one, that prevented the commission of a piece of foolishness without appeal.

"But, leaving the Opera out of view, would it have been possible to allow two elevated railways to pass in such streets as Montmartre, for example? These roads would have touched each other, and would have grazed the houses and completely closed the street. A new causeway would have been created on a level with the first stories, while horses and carriages would have moved about in a forest of cast iron pillars.



Coupe extérieure.

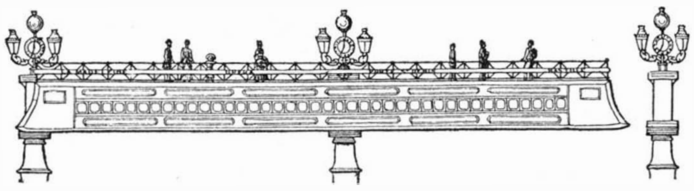


Fig. 1.

"Financially speaking, the affair was a colossal one. Mr. Songean, the president of the Municipal Committee, spoke of nothing less than a billion and a half. In face of these figures, which carry alarm with them, I shall go no further."

In the system proposed by Capt. Mazet there is no change made in the configuration of the city. In principle, it consists of a series of cast iron columns, 30 or 45 feet apart, upon which slides a boat or aerial car which is long enough to always rest upon *two* columns at once. This car is formed of double T irons connected by cross bars and diagonal stays made of light iron. The bottom slides, through the intermedium of rollers, in grooves in the columns serving as track (Fig. 1). The engine room is in front, and the brake is at the rear. The rest is reserved for passengers. Fig. 2 gives a transverse section of the car, and shows how it is suspended, and also the form of the columns.

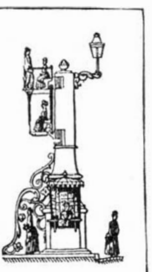


Fig. 2.

Fig. 3 is a perspective view showing the boat-cars running in the boulevards.

The lower part of the boat-car projects only about 3½ feet. Upon placing the columns in the line occupied by the trees, the external side of the car would be perpendicular to the edge of the sidewalk. The posts or columns replace the present lamp posts. They are about 15 feet in height, 4 feet in diameter at the base, and 20 inches at the top. The grooves are slightly fan-shaped on each side, to serve as a guide to prevent the car from missing a support, should the wind or vibrations give it an oblique direction.

"The motor may be either an electric one, supplied by Faure-Sellon-Volckmar, or Reynier, or Ayrton & Perry accumulators, or a steam one, without smoke, or a compressed air or carbonic acid one.

"If, in order to render the car lighter, or in order to obtain a greater seating capacity, the engine were done away with, the motive power would be furnished by a central station, which would set a roller or a wheel in motion.

"The lower part of the car, which passed over this roller or wheel, would be threaded so as to prevent sliding, and the car would follow its route by being carried along by the revolving rollers at each post.

"The power might be transmitted from the central station by means of an endless cable passing through underground tubes at the base of the columns, and actuating the rollers through intermediate gearing, or by means of compressed air, steam, electric conduits, etc."

We think it would be simpler and more practical to imitate what has been done in telpherage by Mr. Fleming Jenkins, to leave the motor on the car and lead the current from a central station by underground conductors, with contacts on each column. The endless cable arrangement appears to us impracticable. The same is the case with the system of propulsion consisting of a complication of racks and clicks, which would necessarily furnish abrupt and jerking movements.

We have no intention, however, of making a complete technical criticism of Capt. Mazet's project; it has sufficed to indicate the prominent lines of his very original idea. Carried out upon a small scale, it will obtain a certain success at fairs, and somewhat rejuvenate those wooden horses whose antique form is beginning to tire amateurs. Alongside of this recreative application there is another and more important one proposed by Capt. Mazet, and that is the use of the system for crossing rivers, marshes, plains, and precipices. This is shown in Fig. 4. Aside from the economic question resulting from the suppression of arches, and the facility of construction, a still more important advantage would be gained, and that is the facilitating of navigation through the rivers being no longer closed by those barriers which at present fix a limit to it. A glance at Fig. 4 will give a better idea of the matter than a long explanation.—*La Nature.*

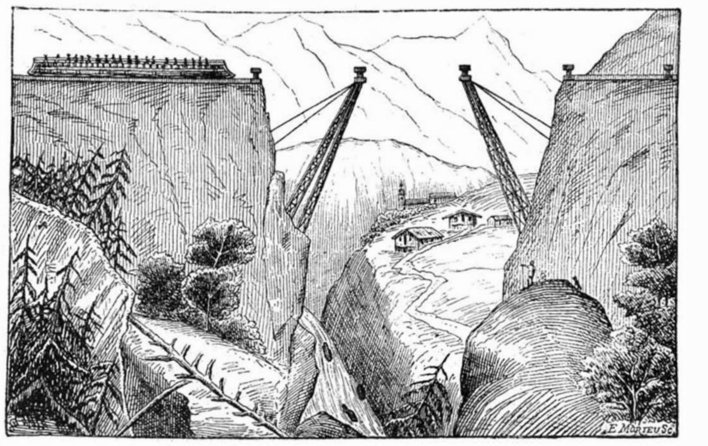


Fig. 3. A NEW ELEVATED TRAMWAY WITHOUT RAILS. Fig. 4.

Liquefaction and Color of Ozone.

The most important discoveries during the past three years concerning the properties of ozone are those made by Hautefeuille and Chappuis. They found that ozone is a blue gas, the color appearing sky blue even when only so much ozone is present as is obtained in the ozonation of the oxygen contained in a tube a meter in length by the silent discharge. Furthermore, they found that under very great pressures the condensed gas becomes indigo blue. If the pressure is increased to 75 atmospheres and then suddenly relieved, a dense white cloud is formed, showing the beginning of liquefaction, while the same phenomenon does not take place with pure oxygen until a pressure of 300 atmospheres is attained. The ozone must be compressed slowly and with constant cooling, otherwise it will explode with evolution of heat and light. By mixing the ozone with carbon dioxide, and then submitting the mixture to great cold and pressure, Hautefeuille and Chappuis succeeded in obtaining a deep blue liquid, the blue color being due to the liquefied ozone.

The same observers have studied the absorption spectrum of ozone, and accurate measurements of the same have been made by W. N. Hartley. The latter has extended the research to the absorption of certain parts of the sun's rays by atmospheric ozone. By this new optical method he has arrived at the conclusions: 1st. That ozone is a constant constituent of the upper atmosphere. 2d. That it is present in larger amounts in the upper than in the lower part of the earth's atmosphere. 3d. That it is the cause of the blue color of the sky.—*Prof. A. R. Leeds.*

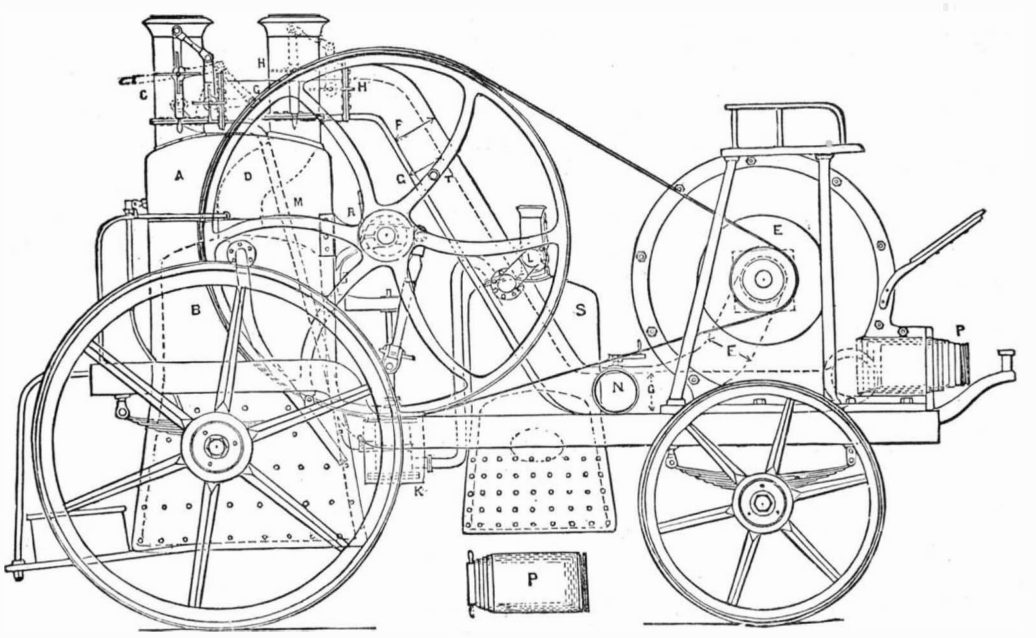
Scientific Ballast.

Some years ago a most interesting find of fossils was made at the Portland stone quarries. They were of high scientific value, and it was decided to send them to Yale College for preservation and study. They were accordingly loaded upon a flat car at Middletown and sent on their way, a car load of them. It was at that time that the fine stone bridge of the Consolidated road was being built across the Farmington River, at Windsor. After the arch of the bridge was set, the space was filled in on top with quantities of broken trap rock from the companies' quarries at Meriden. This broken stone at just this time was being drawn to Windsor by the cars for this purpose. The conductor of one train discovered the car load of fossils side-tracked at Berlin, and felt sure that it was a lot of ballast for the Windsor bridge which had been accidentally left behind. With commendable zeal he fastened to it at once, and drew it on to the bridge. There the rare fossils were dumped with the other stones, and there to-day they lie in the solid flooring of the massive bridge.—*Hartford (Conn.) Courant.*

THE CARBON BLAST.

We have recently had brought under our notice a new principle of extinguishing fires. It is the invention of Mr. John K. J. Foster, and is being introduced in London.

In our engraving, A is a boiler or the jacket of a firebox, B, in which a fire is burnt for the purpose of vitiating air. It has an uptake, C, for steam from the boiler or jacket, and another, D, for the products of combustion from the fire box, B. E is a fan drawing the products of combustion from the firebox, B, through a pipe, F, connecting the uptake, D, with the fan casing. G is a similar pipe connecting the steam uptake, C, with the discharge outlet of the fan. H H¹ are throttle valves coupled so that when H closes the outlet through the chimney, H¹ opens a passage through F to the fan, and *vice versa*. A similar pair of coupled valves, I I¹, control C and G. S is a small high pressure boiler supplying steam to an engine, K, which drives the fan. Its chimney is connected with pipe, F, by a pipe, L, and a similar pair of coupled valves is provided to control the communication. M is the exhaust pipe of the engine leading to the uptake, C, below the valve, I. N is an opening in the suction pipe, F, of the fan closed by a throttle valve, which is only opened when ordinary pure air is to be admitted to the fan to clear a room of the vitiated air after a fire. P is the delivery pipe of the fan, made of metal in short lengths, fitted together telescopically. Other similar telescopic pipes, P¹, may be added on by screw couplings, or the delivery pipe may be otherwise constructed. The fly wheel of the engine is connected to the crank shaft by a clutch, so that it may be thrown in and out of gear by a handle, *r*, to enable the fan to be driven by hand at first by a handle, T, on the fly wheel, for the purpose of creating a draught in the furnace of boiler, S, the valve, I¹, then being shut, and the fan drawing air through the pipe, L.



THE CARBON BLAST FOR EXTINGUISHING FIRES.

We thus have what theoretically appears to be a very perfect means of extinguishing fires, and which we hope soon to see tried in practice. Our engraving shows an engine adapted for fire brigades, but for mills and factories generally the fan may be so adjusted to the furnace of the ordinary boiler as to be ready at any moment. Steam may be allowed to mix with the vitiated ai if advisable.

The fan would draw the atmosphere through the fire box, the oxygen would be destroyed, and could be conveyed into any room in the factory at will by a fixed sheet iron conductor of sufficient dimensions, having branches with valves to communicate with every room. In case of fire the fan could be turned by manual labor, when, on the valve leading from main flue into the room that is on fire being opened, in two minutes the room would be filled with vitiated air and the fire extinguished.

This same appliance, by simply opening one valve and shutting another (automatically), could be used to exhaust the warm, fœtid air out of any or all the rooms in the factory, or to force fresh air into the rooms at will. The whole of this apparatus would be of little cost, and when applied in the case of small fires, could not do harm as in the case of extinction by water; 20,000 feet of cubic air per minute can be put into circulation by hand power alone. The apparatus in this connection would be stationary, and independent of any other appliance.

For use by railroad companies the hose could be attached to the funnel of an ordinary locomotive engine. In case of fire at a station or goods department, all that would be required would be to run the engine near the fire, attach the tail pipe of the fan to the funnel of the engine; the air drawn through the fire would be vitiated or deprived of oxygen, and conducted by the blast conducting pipe into the burning building, and the fire would be got under at once. Another important application is that of ships. For steamships the fan could in case of fire be attached to the funnel exactly as for locomotives. With Foster's carbon blast the vitiated air could easily be conveyed into any part of a ship's hold. If the hold, or any room in a vessel, was filled with vitiated air and steam, no fire could live many minutes. For ventilation purposes the apparatus would also prove very useful. In short, there appears to be a wide field of usefulness for this invention, and we look forward with interest to its practical introduction.—*Iron.*

THE making of large lenses is a matter of many difficulties, as may be inferred from the fact that there have been nineteen failures to cast the thirty-six inch glass for the great Lick telescope to be mounted in California.

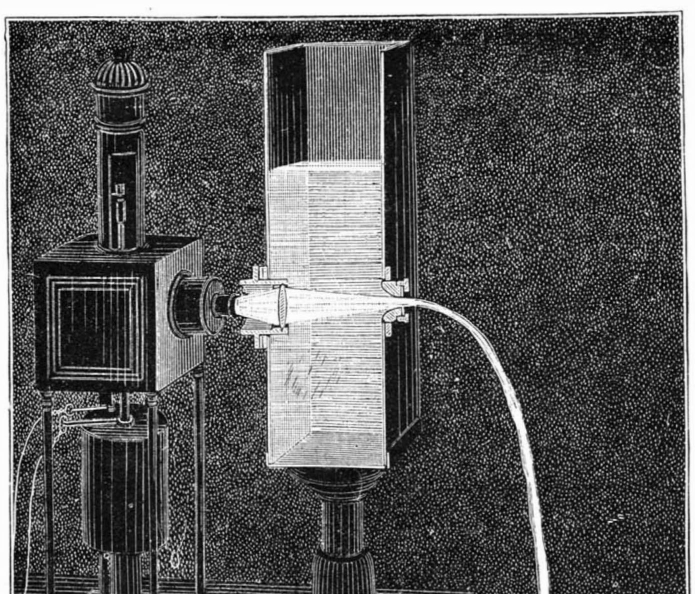
Centenarian Women.

Mrs. Phœbe Brockway died at Union Springs, N. Y., on the 14th of November, 1884, at the remarkable age of 112 years. She had four children, of whom three are still living, Mrs. Marshall Whipple, aged 80, Mrs. Menzie, and William Brockway. Mrs. Brockway was well known as a strong and active woman, who enjoyed excellent health until within a short period of her decease.

At Beaver Brook, Mass., on November 14, 1884, the 100th year of the life of Mrs. Elizabeth Putnam was celebrated by her children. The aged lady is still very vigorous, memory and all faculties in good condition. She has had twelve children, six sons and six daughters, all of whom grew up and were married. Two sons and three daughters still live. All the children lived to be over 66 years of age except two, one of whom died at 30 and the other 34. There have been 42 grandchildren and 24 great-grandchildren, many of whom are living.

Yellow Dye.

A. Poirrier, of Paris, has taken the first step in the direction of producing a yellow dye, to compete with Persian berries; this is the *Jaune solide*, an azo color fixed with acetate of chromium. Poirrier has shown that it can be used like the Persian berry yellow, and that it can be sold cheaper. If fixed alone, the *Jaune solide* gives fine orange-yellow tints of much solidity, and resisting soap and light. —*Manchester Textile Recorder.*



COLLADON'S FOUNTAIN.

THE COLLADON FOUNTAIN.

In my lecture courses I have often endeavored to render visible to all the pupils assembled in the amphitheater the different forms that are assumed by a stream of water issuing from various orifices, and it was for this purpose that I was led to illuminate internally a stream placed in a dark space. I have found that such an arrangement is well adapted to meet the object I had in view, and that, moreover, it offers in its results one of the most beautiful and curious experiments that can be performed during a course of lectures on optics.

The apparatus that I use for these experiments consists of an oblong vessel, about three feet in height, in one of whose sides, a little above the base, there is an aperture into which are screwed different diaphragms in order to vary the size and form of the jet. This latter escapes from the vessel in a horizontal direction. In order to illuminate it internally, an aperture is formed in the back of the vessel, and to this there is fitted a convex lens, while outside of the vessel there is added a short, horizontal, internally blackened tube designed to prevent the rays that are oblique with respect to the axis from entering the vessel.

The apparatus is placed in a dark room, one of the window shutters of the latter may be provided with an aperture for adapting the blackened tube to, and a fascicle of solar light may, by means of a mirror, be thrown parallel with the tube's axis. One may also employ with advantage an oxyhydrogen or electric lamp which throws a fascicle of horizontal light, as shown in the engraving. The luminous rays traverse the lens and the liquid, and converge in the aperture through which the stream is escaping; and when once they have entered the latter, they meet its surface at a sufficiently small angle to cause them to undergo a total internal reflection. The same effect is produced at every new point of incidence, so that the light circulates in the transparent jet as in a pipe, and follows all its inflections.

If the water be perfectly limpid, and the aperture of the diaphragm very sharp, the jet will be scarcely visible, although a very intense light is circulating within it. But at every point where the jet meets a solid body that interrupts it, the light which it contains escapes, and the points of contact become luminous. So, upon the jet being received in a vessel that stands horizontally, the bottom of such vessel will be illuminated by the light that issues from the apparatus through the jet. If the stream is falling from a great height, or if its diameter is but a few millimeters, it will be reduced to drops at its lower part, and it will be there only that the liquid will be illuminated, and every point of rupture of the jet will throw out a bright light. If a continuous jet is falling upon a surface capable of a certain number of vibrations, the vibratory motion will be communicated to the liquid, and the latter will then be broken to some height above the vibrating plate. This experiment of Savart, as well as several others that he has studied, and described in the *Annales de Chimie*, may be repeated and rendered visible by this new process. It will be understood, moreover, that it would be just as easy, by means of reflectors, to illuminate a jet that had any other direction, or to illuminate the interior of the jet with all the colors of the prism by interposing colored glasses between the lamp and blackened tube exterior to the apparatus. The only essential precaution to take is to use water at the temperature of the room in which one is operating, in order that no moisture may be deposited upon the lens. In experiments designed to render the jet visible near the orifice, in order to study the contractions of the stream, it is indispensable to render the liquid turbid by means of some solution or other or by dust. The light will thus be dispersed at the jet's exit from the orifice, and the liquid will become luminous at the upper part.

A fact that may be always observed with this apparatus is that slight blows against the vessel, near the orifice, made with a hard body, break the jet in the very plane of the orifice and produce therein true fissures, which are easily seen and which are very brilliant. Sometimes these fissures do not close immediately, but continue in the stream for some instants.—*D. Colladon, in La Nature.*

CANVAS bags, it is said, can be made as impervious to moisture as leather by steeping it in a decoction of one pound of oak bark with fourteen pounds of boiling water, this quantity being sufficient for eight yards of stuff. The cloth from which the bags are made has to soak twenty-four hours, when it is taken out, passed through running water, and hung up to dry.

Old Furniture and New.

The present rage for old articles of household use, table decoration, and personal adornment is a whim of fashion, in many instances the coveted articles having no element of propriety in our modern life. Very few of them are valuable in the light of sentiment, having no association with beloved friends or with historical events.

But apart from these considerations the love for genuine old relics of furniture, especially, has an excellent reason for its being. There are really valuable and useful articles of household economy which unreasoning style has relegated to the second-hand furniture store, to the attic, or to the barn, or perhaps ruthlessly destroyed, and which have been replaced by modern articles far inferior. The present spring seat sofa with its tufted cushions and tortoise back seat is not half so inviting and restful as the old-fashioned, flat seated, broad sofa, long enough to receive the outstretched form of a six-footer, and broad enough to hold him safely if sleep overtook him. Many of these articles are of solid wood with no suspicion of veneering, and their forms are really more elegant than those of to-day. Modern veneered and upholstered furniture requires repairing every few years, or is worn beyond revamping within the recollection of a ten year old child. It is a source of regret that with the rage for antique furniture there is not also a demand for old time honesty in workmanship.

In spite of the sneer against the old style straight backed chairs, most of the old style furniture was made for convenience. There never was a more convenient article of furniture than the old desk and drawers combined—drawers below a folded-back desk, the back being pigeon holed, and the desk on hinges to be let down to form a writing shelf, and projecting far enough forward to give room for the writer's knees. The cupboard was another useful article for the kitchen or the dining room. It contained two or more wide drawers, with doors above them opening on shelves and racks, the whole standing on legs high enough to admit of sweeping under the cupboard. Memory recalls one, the framing and ends being of white walnut or hickory and the door panels and drawer fronts of cherry, both native woods, the creamy white of the hickory contrasting finely with the warm wine red of the cherry. These colors were set off by pendent pulls and door key escutcheon of polished ungilded brass that could be repolished and kept from the dilapidated appearance of the worn gilded brass of the present. Such an article of furniture would give an air of substantial comfort to any modern home.

The inferiority of modern made furniture cannot properly be attributed to machine duplicated work; it is as possible to make first class work by duplicating by machinery as by hand; else our hand tools and machine tools would be much more costly than they are. But it is undeniable that most of the furniture made within the memory of the elderly portion of the present generation compares favorably with that now made, in durability and integrity of workmanship. In these qualities it would be well if our manufacturers shared in the rage for the antique.

A Sheet of Letter Paper May Move a Ton One Mile.

The modern cargo steamer has now become a wonderfully economical freight carrier, especially as regards consumption of fuel. A freight train run under the most favorable conditions seems wasteful in comparison. The Burgos, a modern steamer especially built to carry cargo cheaply at a slow speed, lately left England for China with a cargo weighing 5,600,000 pounds. During the first part of the voyage, from Plymouth to Alexandria, the consumption of coal was 282,240 pounds, the distance being 3,380 miles. The consumption per mile was therefore only 83·5 pounds, and the consumption per ton of cargo per mile 0·028 pound. In other words, half an ounce of coal propelled one ton of cargo one mile. Assuming that paper is as efficient a fuel as coal, we have, says the *Railroad Gazette*, only to burn a letter on board this steamer to generate and utilize enough energy to transport one ton of freight one mile. It is difficult to realize that such a trifling act as burning a letter involves such a waste of useful energy, or can have any reference to the energy sufficient to perform a feat which, under less favorable circumstances, requires a couple of horses and a teamster for about half an hour.

The best locomotive performance in this country of which we can find any authentic record gives a consumption of about two ounces of coal per ton of freight hauled one mile at the rate of 13 miles an hour including stoppages. On lines having grades of from 53 to 70 feet per mile, the consumption often rises to 5 or more ounces of coal per ton of freight hauled one mile.

The engines of the Burgos are on what is termed the triple compound system, the steam being expanded in three cylinders in succession. The boiler pressure is 160 pounds per square inch. The average speed at sea in all weather is very nearly ten miles an hour.

A Beautiful Slide.

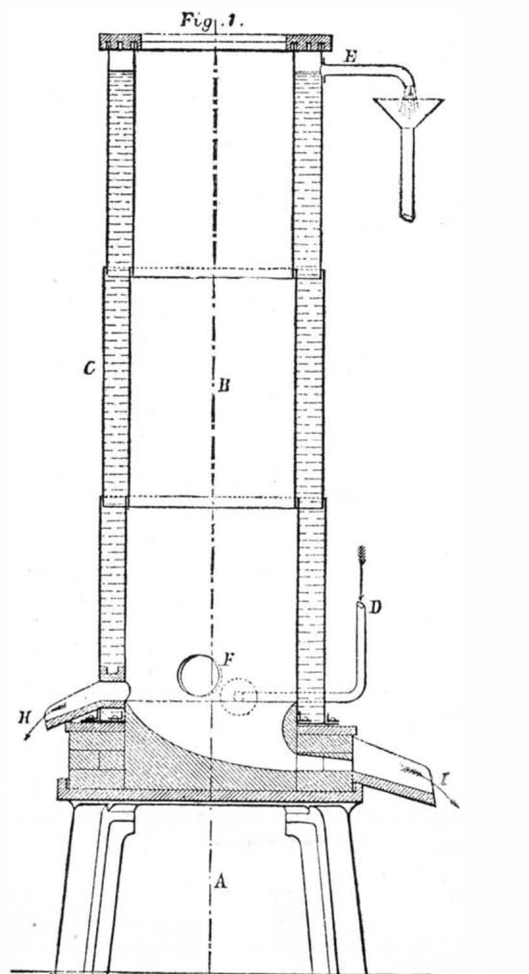
A very beautiful polariscope slide may be made, says the *Microscope*, as follows: Heat a slide until it will melt a small portion of a menthol pencil as it is drawn evenly back and forth over a perfectly clean surface. Do not use more heat than necessary to melt the material evenly. Then, as it commences to crystallize, arrest its progress frequently by passing the slide quickly over the flame of your spirit lamp; soon the crystallization will be completed, a little at a time, and a very desirable slide will be the result.

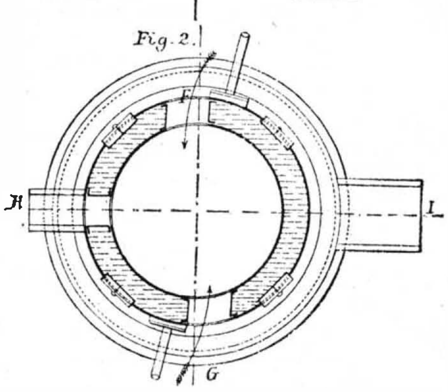
DR. OTTO GMELIN'S CUPOLA.

The cupola shown in the annexed engraving was invented by Dr. Otto Gmelin, of Buda-Pesth, for smelting iron, copper, or other metals, and has during the last few years won ground in Austro-Hungary, and is now also being introduced in Germany.

The illustration hardly requires any further explanation, considering the simplicity of the principle on which the furnace is constructed. Two concentric cylinders of boiler plates with two annular spaces between them, closed at the bottom, and open at the top, are placed on a foundation ring of brickwork. Cold water enters the annual space at the bottom, and the warmed water flows off below the upper edge of the cylinders.

The interior of the inner boiler-plate cylinder is, says *Engineering*, made rough, and is covered with fire-clay. The circular space between the two cylinders is covered over by





DR. OTTO GMELIN'S CUPOLA.

a cast-iron plate which lies loosely on the top of the two cylinders. Two circular grooves in the cast-iron top plate maintain the two cylinders at the correct distance from each other.

The outlet of the metal and of the slag takes place through tubular boiler-plate connections passing through the water space and attached to the inner and outer cylinders. The construction has lately been considerably simplified and strengthened by making the inner furnace cylinder of a welded tube, with tubes for air inlets welded on all in one piece.

The novelty of the above construction consists chiefly in the cooling of the smelting furnace by water without using an air-tight water space. The inner cylinder can expand and contract without any resistance as the temperature in the furnace changes, and the consequence is that repairs are hardly ever required. The first furnace built upon this principle has now been at work daily for the last 2½ years without ever having required any repairs to the boiler plates of the cylinders. The smelting operations can therefore also be kept up for any length of time without interruption. The energetic cooling of the inner smelting cylinder, which takes place with this system of furnace, is also stated to afford advantages as regards the saving of fuel (equal to 6 to 8 per cent) and the decrease of burnt metal as well as the good and equal quality of the castings. The upper part of the furnace never gets hot, and the coke does not begin to burn until it arrives at the lower part of the furnace, where the smelting process takes place. The carbonic acid formed here escapes unchanged without being reduced to carbonic oxide as it passes through the upper charge of the furnace. The metal thrown in at the top of the furnace arrives completely unchanged into the smelting zone, where it is brought to the smelting point at once by a very strong blast.

The furnace remains always round and smooth, which is also a very important feature with regard to economy of coke and good quality of the castings. It is likewise unaffected by chemical action, and the quality of the castings will therefore be considerably improved by the fact that this furnace admits of an addition of any quantity of basic substances without any risk of damage.

This furnace offers special advantages in cases where scrap iron can be had cheaply, as on account of the small consumption of coal and silicium much more scrap iron than usual can be used along with the pig iron, without any fear of obtaining hard castings. The arrangement also offers advantages in cases where it is necessary to produce special qualities of castings—for example, hard castings—as the foreman can with much greater accuracy calculate the proportions of the materials to be put into the furnace to procure an even quality throughout, than he can with ordinary cupolas.

The firm of Ganz & Co., of Ofen, who have a very high reputation for their chilled rolls, is now altering all its furnaces to Dr. Gmelin's principle, and a number of other firms of high standing have also adopted Dr. Gmelin's furnace; namely, the machine factory of the Hungarian Government Railway, Buda-Pesth; the Ozterr Alpine Montangesellschaft, Vienna; the Austro-Hungarian Government Railway, Vienna; the Eisenhutte, Undine; Count Waldstein's Iron Works, Sedlec, Bohemia; and Howaldt Brothers, Kiel, Germany.

A Mexican Iron Mine.

A correspondent of the *Alta California*, describing the wonders of the Cerro del Mercado in Durango, owned by the Durango Iron Mountain Co., of Chicago, says that the vast deposit comprising it is not a mine, but a yard for storing iron ore, the floor of which is iron. Its dimensions are grander than all the combined iron ore yards of Europe, added to all that there are in the United States. It is nearly a mile in length, nearly a fourth of a mile in width, and towers 650 feet above its ponderous base. This is, I have reason to think, not one-hundredth of the ore in the property—40,000 acres—which comprises the area covered by the company's purchase, for the mountain above ground, which measures fully one billion tons of ore, is but the peak of an immeasurable mountain, which nature has, in no exceedingly remote period, formed by eruptively metamorphosing other forms of iron ores than the prevailing ones, which at present comprise the mountain. At one-fourth and one-half mile points from the base of the iron mountain, on the company's grounds, are other lesser peaks of iron. The low intervening lands are but coverings over iron ore.

The iron ore of the deposit has no intermingling rock, no debris like clinkers out of or from a huge smelting hearth. The ore is magnetic oxide, producing a forged iron equal to the best in the world and far superior to the English, because made with charcoal and because there is abundant reddish oxide of iron present, which affords a liquid very necessary for the elaboration of steel. The whole mountain undoubtedly will yield an average of 62½ per cent, or five-eighths iron of the weight of the ore. Charcoal, for the making of which there are worlds of forests, is cheap, and so is labor. The ore is in bowlders. It is already mined. This is ore that is unusually magnetized. A piece of it attracts the needle at one end and repels it at the other. There is limitless coal on the Pacific slope should any but charcoal be needed. All needed accessories for mills for working iron ore after being smelted, and for manufacturing purposes, are near at hand. There is a great abundance of both heavy and light building timber, water for power, moulding and building sand, fire-brick clay, stone, lime, and the Murga River on the grounds. Mexico, by her heavy duties on iron, shields the owners of Iron Mountain. Nails, spikes, horse-nails, wagon and other springs, are charged 5½ cents per pound. Plate iron for tin (and ores of the latter are abundant) is 6 cents per pound; steel is 3 cents; iron chain, 4½ cents; iron columns, much needed in the styles of architecture used generally, are 13 cents duty per pound; screws of all kinds and iron bedsteads, 8½ cents per pound. This grandest of all iron deposits known to man is so conveniently located, so cheaply worked, and its product so pressingly demanded by the wants of its 12,000,000 people, that in the mining and metallurgical world it is peerless as an industrial enterprise.

A Chance for American Inventors.

Senor Don Matias Romero, the Mexican Minister, has transmitted to the Secretary of State, at Washington, a decree issued by the State of Yucatan, Mexico, offering a prize of $20,000 to the inventor of a machine which shall successfully extract the fiber from henequin, under the following conditions: It must be automatic and not require skilled and experienced workmen to manage it; it must be entirely free from danger to the operators; it must require less motive force than the machines now in use with relation to its producing power; it must increase the production or extraction of the fiber within a given time, diminishing its loss, compared with the various machines in use. The reward is to remain open for three years, and is without prejudice to the right of proprietorship and of patent.—*The Iron Age.*

Wood Preservation.

One of the greediest mouths which the forests of the United States are required to fill is that of the railway demand for ties, bridge timber, etc. According to Poor's Railway Manual, there were in the United States at the close of 1883, 121,592 miles of railways. The average number of ties needed per mile of track is 2,820, and the duration of a tie averages about six years; hence the annual consumption of ties by all the railways of the country amounts to the stupendous total of 57,148,240. This number of ties represents, at the lowest estimate, 144,203,933 cubic feet of timber, enough to make 1,714,447,700 feet of lumber. At 20 cents a tie, the value of the ties laid yearly foots up $11,429,648. The amount of white pine cut in the Northwest in 1883 was not four and a half times larger than the above figures, a comparison that readily shows how much timber this one branch of the railway industry demands.

It must be borne in mind that we have only given statistics here of the number of ties required for the existing railways, but this large total is being continually increased by the construction of new lines of road, and we have omitted any estimate of the quantity of timber in other forms required for railroads, wharves, bridge timbers, etc., etc.

In view of this enormous draught on the forests of the country, it is evident that the time is approaching when scarcity will cause an advance in price. The not remote prospect of such an advance, as well as the present economy of a proper preservative treatment, has induced several railroads in the United States to conduct experiments looking toward some feasible means of timber preservation; and the American Institute of Civil Engineers has been for some time past collecting information regarding the various processes for this purpose, with the object of embodying such information in a report to be shortly given to the public. The question of timber preservation is one of national importance, and as it is the aim of this journal to keep its readers informed in regard to everything connected with the lumber interest, we do not think we need to apologize for devoting considerable space to an account of the causes of the short life of timber used by railways, together with a description of some of the methods for its preservation.

There are two principal causes of the destruction of timber in use by railways, namely, decay and mechanical wear. When wood is exposed to the atmosphere, its decay may be considered a species of fermentation set up by the combined action of heat and moisture in the watery and albuminous constituents of the wood, which gradually convert it into *humus*, or rotten wood, this process being at the same time expedited by the presence of numerous boring insects, which take up their abode in the cells of the decaying wood and feeed upon its juices.

The object of any rational treatment for preserving wood is the coagulation of the albumen by substances capable of effecting this; of these the most effectual, as well as the most practical on account of its low cost, is creosote, which exercises a powerful action in the coagulation of the albumen, and is also so destructive to all kinds of insect life as to completely exclude them from any wood which has been treated with it; the presence of a sufficient quantity of creosote in any liquid at once and completely arresting fermentation for an unlimited time, and destroying all germs of animal and vegetable life.

Of the substances containing creosote, the two most important, and in fact the only ones available for this purpose, are coal tar and wood tar. When coal tar is distilled in iron vessels there is produced, in addition to other substances, as naphtha, etc., about 30 per cent of the so-called creosote, or dead oil, which has since 1850 been used in continually increasing quantities for this purpose. The quantity of coal used for gas making in Europe is about 10,000,000 tons annually, producing about 5 per cent of tar, yielding about 150,000 tons of dead oil, the whole of which is available for treating timber. There is also a very large quantity of coal tar produced as a by-product of the gas manufacture in the United States, but excepting in a few cases nothing has been done toward utilizing the dead oil contained in it.

The second substance, wood tar, referred to above is the tar produced by the destructive distillation of wood for the manufacture of charcoal. Considerable quantities of this substance are produced, but as yet it has been only considered as a waste substance or available for fuel.

As wood tar contains a large percentage of true creosote, which is entirely absent in the case of coal tar, it is a better preservative of timber than any of the constituents of coal tar, and recent experiments have demonstrated that it may be used by itself for this purpose if forced into the cells of the timber while heated and in a fluid state. Many other substances have been proposed for treating timber, but on account of their cost and the comparatively small quantities produced are not available to any important extent for this purpose.

The method of treatment which is generally considered to be the most thorough, practical, and rational is that which involves first the subjection of the timber in close vessels to the action of high pressure steam for a sufficient length of time to enable the steam to penetrate all the cells of the wood and to vaporize the liquids contained therein, these being afterward removed by a vacuum pump. After this preparatory treatment the preserving substance is forced into the cells of the wood under powerful pressure, the quantity of this substance being regulated according to the use for which the timber is destined. If simply to be used for bridges or elevated structures, the quantity of the preserving substance required is less than for ties, and if for use under water or exposed to the attacks of the teredo the largest amount which can be forced into the wood becomes necessary.

The apparatus needed for treating timber by this method is simple and comparatively inexpensive. It consists of a cylinder of boiler plate, the size of which depends upon the dimensions of the timber to be treated. This cylinder is made strong enough to resist a pressure of 300 pounds per square inch, and has a track extending for its whole length along the bottom, the ends of the cylinder being closed by strong iron doors, provided with suitable means of rendering them air and water tight. Iron cars, having wheels of small diameter fitting the track on the bottom of the cylinder, are provided to carry the timber or ties while under treatment. A steam boiler with vacuum and force pumps, and also reservoirs fitted with steam coils for containing and heating the preservative substance, are also provided. The operation may be briefly described as follows:

After the cars loaded with the timber for treatment are run into the cylinder and the doors closed, steam at about 100 pounds pressure is injected into the cylinder, and the supply continued for a length of time depending upon the nature of the wood and its dryness. The steam is then shut off, and the vacuum pumps started and kept at work as long as any liquids or vapors are obtained. The vacuum pumps are then stopped, and the hot preserving liquid allowed to flow from the reservoir into the cylinder until it is filled. After this the force pumps are started, and their action maintained until the pressure in the interior of the cylinder rises to about 100 pounds per square inch, the pressure being maintained at this point until a sufficient quantity of creosote oil or other preservative liquid is forced into the cells of the wood. The force pumps are then shut off, and the creosote oil or other liquid contained in the cylinder discharged into a suitable cistern, after which the doors at the ends of the cylinder are opened and the car carrying the timber or ties run out.

When wood has been creosoted in the manner described, paying proper attention to the complete removal of water and juices previous to the injection of the creosote, the density of the wood will be found to have considerably increased, and that its tenacity for holding spikes, etc., as well as its ability to resist mechanical wear, has also increased to a very notable extent. One of the Southern railroad constructors stated some time since in a report on this subject that in his opinion (we quote from memory) a soft wood tie properly creosoted is much more valuable, both as regards resistance to decay and to mechanical wear, than the best white oak tie; in fact, he considered creosoted soft wood ties worth $1 each for railroad use.

One of the principal causes of the rapid destruction of ties from mechanical wear is imperfect road beds, but we think that as ties become less abundant and more valuable, more attention will be paid to devices for protecting them from the direct action of the rails; and, as the life of a creosoted tie when exposed to decay alone, is practically unlimited, the advantages of creosoting will under those circumstances become still more apparent.

The principal item in the cost of preserving is the quantity and cost of the preserving substance. In the case of ties, three gallons of dead oil or of wood tar will be required, while for bridge timbers a smaller quantity will suffice.

The cost of treatment, aside from the cost of the preserving agent, will not in the case of ties vary much from 5 cents per tie. The cost of dead oil ranges from 7 to ten cents per gallon.

Ties for creosoting should be carefully selected, as it is manifestly poor economy to creosote a tie in which decay has already commenced.

The necessity of a most thorough preliminary treatment of the ties for the removal of fermentable substances cannot be too strongly insisted upon, as the value of the subsequent preserving process depends almost wholly upon its proper performance, and its neglect has been the cause of frequent failures in wood preserving operations. It is not long ago that complaints were made in some European journal that creosoted beech wood ties became rotten in the middle of the tie, while the outside for an inch or two in depth remained perfectly sound. The reason for this condition of the tie seems clearly traceable to neglect of a proper preliminary treatment of the tie; the water and juices had been removed from the surface of the tie, but not from the interior. Consequently, the creosote oil was unable to penetrate that portion of the tie on account of the cells being already filled with water.

We do not wish to be understood in this article as advocating the immediate adoption in all cases of wood preserving processes, for this will depend largely upon the cost of the ties. In many localities their cost is still so low as to preclude any treatment of this kind, but there are many others in which their cost has already increased beyond the point where creosoting may be profitably employed; the area of such localities is continually increasing, and it needs no prophetic vision to foresee that in the near future the adoption of some preservative process for wood will become universal.—*N. W. Lumberman.*

THE *Quarterly Therapeutical Review* says methyl salicylate (oil of wintergreen), mixed with an equal quantity of olive oil or linimentum saponis, applied externally to inflamed joints affected by acute rheumatism, affords instant relief, and, having a pleasant odor, its use is very agreeable.

Patent Office Business, Fiscal Year 1883-84.

Hon. Benjamin Butterworth, the Commissioner of Patents, has made a report to the Secretary of the Interior of the business of the Patent Office for the fiscal year ended June 30, 1884. For purposes of comparison we add to the figures thus presented those for the preceding fiscal year, as follows:

Applications.	Fiscal year to June 30, '84.	Fiscal year to June 30, '83.
For patents	35,204	32,845
For design patents	1,322	1,039
For reissue patents	244	247
For registration of trade marks	1,077	854
For registration of labels	975	749
Total	38,822	35,734
Caveats filed	2,672	2,688
Patents and Trade Marks Issued.		
Patents granted, including reissues and designs	22,822	21.185
Trade marks registered	903	883
Labels registered	833	618
	24,558	22,686
Expired and Withheld for Non-payment.		
Patents withheld for non-payment of final fees	2,461	2,056
Patents expired	10,230	7,471
Receipts and Expenses.		
Receipts from all sources	$1,145,433	$1,095,884
Expenditures (not including printing)	901,413	677,628
Surplus	244,020	518,255

The number of applications awaiting action by the office June 30, 1884, was 9,186, an increase of 5,087 over the accumulated applications at the end of the preceding year.

Firefly Light.

MM. Aubert and R. Dubois have recently made a number of interesting observations on the light emitted by "pyrophores," or fire-bearing insects of the family Elateres, genus Pyrophorus. These pyrophores have three luminous organs, one situated at the ventral part, and two at the superior part of the prothorax. The last are always visible, and were submitted to the tests. The light was produced by rubbing the insect with a light brush, and was examined by means of an ordinary spectroscope with a prism of very refrangible glass and a micrometer. The spectrum was very fine, continuous, and showing neither brilliant nor dark rays. This peculiarity has already been pointed out by Pasteur and Gernez, who studied the light from a pyrophore belonging to the late Abbé Moigno, editor of *Les Mondes*. The spectrum occupied about seventy-five divisions of the micrometer, and extended on the red side to the middle of the interval which separates the rays A and B of the solar spectrum, and on the blue side a little beyond the ray E. When the intensity of the light varied, its composition changed in a remarkable manner. When the brightness diminished the red and orange disappeared entirely, and the spectrum consisted of green, and a little blue and yellow. The green rays lasted longest. The contrary took place when the light grew in brightness, the green appearing first and the spectrum extending a little on the blue and a great deal on the red side. The least refrangible rays are therefore emitted last. No other luminous source known appears to behave in like manner. The only case which bears a resemblance is that of sulphate of strontium becoming phosphorescent under the action of light at a growing temperature. As the temperature rises, rays less and less refrangible appear in the spectrum, but at the same time, as Edmond Becquerel has shown, the less refrangible rays disappear. When the light of the organ begins to appear, the central and forward part only of the organ is luminous. It is only when the light is very bright that the periphery of the organ is luminous, and then the red rays are visible. The light was found to give photographic images on a gelatino-bromide plate; the insect being two centimeters from the plate, and the time of exposure reduced from an hour to five minutes. The photographs show that the light of the pyrophore is capable of producing intense chemical effects, if the smallness of the quantity emitted be taken into account. The light also determines the phosphorescence of sulphate of calcium, after an exposure of five minutes; and eosine and azotate of uranium are rendered fluorescent by it.

Natural Gas vs. Coal.

The steadily increasing use of natural gas in Western Pennsylvania, West Virginia, and Ohio, for manufacturing purposes as well as for lighting, suggests the possibility that its employment may soon have a depressing effect on the anthracite and bituminous coal business over a considerable section of country. A Pittsburg paper, referring to this matter, says: "In so far as natural gas has been applied to the manufacture of iron, steel, and glass, the quality of the products is rather in its favor. For steam raising it is very superior to solid fuel, not merely in the lessening of labor and freedom from ashes, but in that the heat can be more equally distributed lengthwise and around the boilers, to the benefit of the latter in the matter of safety and durability. It is safe to say that the use of gas fuel in this locality now supplants the use of several thousand tons of coal each week, and there is no doubt that the use of gas fuel will largely increase in the near future. Coal proprietors who have depended upon manufactories for their business already feel the local rivalry of this wonderful and valuable agent for the industries, and this competition between coal and natural gas can only be measured by the gas developments of the future."

ENGINEERING INVENTIONS.

A car starter has been patented by Mr. Jacob J. Anthony, of Sharon Springs, N. Y. The invention consists of a compound lever and ratchet mechanism, that can be operated by hand or foot for the development of power, by which street cars may be started or stopped, or the device may be used with steam cars for making up trains, thereby dispensing with locomotives for this purpose.

AGRICULTURAL INVENTIONS.

A check row corn planter has been patented by Mr. Jo l Kirkwood, of Mauzy, Ind. This invention covers a special construction and arrangement of parts to make a simple, efficient, and durable machine for planting corn or other seeds in accurate check rows.

A hand cultivator has been patented by Mr. Judson B. Hurd, of Hardin, Texas. It is made with a plow plate having wings bent to destroy the grass and weeds and leave the soil level, while with the plow beam and winged plow are connected two or more rotary cutters, whereby the soil, roots, grass, and weeds will be cut in parallel lines in front of the plow plate.

A plow standard has been patented by Mr. John R. Sampson, of Bennettsville, S. C. It is made with a ground bar and a beam plate arranged with the forward parts at a greater distance apart than their rear parts, and connected at their forward ends by a front bar, so the plow plate can be moved up and down to vary the angle at which its cutting edge enters the ground, as the work and the character of the soil may require.

MISCELLANEOUS INVENTIONS.

A churn has been patented by Mr. James H. Taylor, of Westfield, Mass. This invention covers a special arrangement and construction of parts for making churn barrels or cylinders whereby the parts thereof may be conveniently set up and tightened or loosened as desired.

A chimney cowl has been patented by Messrs. Martin Ludwig, James S. Barber, and John S. Barber, of Beloit, Kansas. This invention covers a novel construction whereby a stationary cowl is adapted to prevent downward currents of air in the chimney when the wind is blowing from any direction.

A pegging machine has been patented by Mr. Hans Schurhuber, of Vienna, Austria. This invention covers a new and improved pegging machine for fastening the soles to shoes of all kinds, being especially designed to do the work thoroughly, rapidly, and with a superior finish.

A peg wood sharpener has been patented by Mr. William G. Scott, of Batesville, Miss. This invention provides a simple and convenient implement for the use of jewelers and others for sharpening rods of peg wood employed in cleaning the pivot holes of watches, clocks, and other small machines.

A coal cleaner has been patented by Mr. William H. Shepherd, of Pittston, Pa. This invention provides a new and improved machine for separating slate and rocks from coal by means of screens and a current of air, and is an improvement on a former patented invention of the same inventor.

A vessel for dispensing fluids has been patented by Mr. Peter Hartmann, of Brooklyn, N. Y. This invention provides a vessel in which volatile liquids may be kept from air, and yet sufficient may be supplied for use as desired, the main body of the liquid, by this novel construction, being protected from exposure.

A pyrethrum soap has been patented by Mr. Johann Zacherl, Jr., of Unter Dobling, near Vienna, Austria-Hungary. It contains an addition of the soft resin which forms an ingredient of pyrethra plants and contains the insect killing stuff, the soap being especially designed for destroying insects and other parasites.

A casing for pipes has been patented by Messrs. James F. Wood and John F. Wood, of Wilmington, Del. In combination with disks adapted to surround a pipe are open tubular casing sections surrounding the disks, each having at one longitudinal edge and at one end a pocket, the free edges of the sections being held together by nails, pins, etc.

A mail bag fastener has been patented by Mr. Charles W. Jefferson, of Rugby, Tenn. Steel strips are fastened on the sides of the mouth of the bag, one side being adapted to overlap the other, and the overlapping part being provided with a staple projecting from its inner surface and adapted to be passed through the strips and the closed top of the bag.

A whip has been patented by Mr. Ephraim M. Turner, of Fort Worth, Texas. In combination with a spring wire core and rubber compound covering of the body of the whip is a metallic coupling and a detachable screw whip handle, made to form a clasp knife, such whip being more especially designed for stock farmers or those of like calling.

A safety attachment for elevators has been patented by Messrs. John D. Phyfe, of Demarest, and James J. Harold, of Tenafly, N. J. It consists in the application of revolving wheels or cylinders, with studs arranged to come in contact with suitable fixed detents, in case the elevator rope should break, furnishing a positive lock to the falling of the elevator cage.

A lock faucet has been patented by Messrs. Richard W. Howard and Charles B. Locke, of Apponang, R. I. Its construction is such that a barrel may be connected by pipe with a room above, and liquid may also be drawn from the barrel through the lower end of the cock without disconnecting said pipe, while by suitably turning the cock egress either way may be shut off.

A fruit jar has been patented by Mr. Nathaniel W. Krouse, of Haysville, Pa. The construction is such that, when both cover and jar are of glass, the contents can only be exposed to contact with glass, and the jar, besides complete locking arrangement, has a bail of peculiar construction, which helps press down the seal and also forms a convenient means for carrying or handling the jar.

A crucible or casting ladle has been patented by Messrs. Jacob F. and Ernest G. Zimmerman, of Hanau, Germany. It has an inner and an outer triangular vessel, the inner one with its angles crossing those of the outer vessel, and with downward sloping sides and apertured bottom, so constructed as to retain the slag and prevent its being poured out with the molten metal.

A stop watch has been patented by Mr. Eugene J. A. Dupuis, of New York city. This invention covers a modification of the levers for operating the fly backs, and the pawls for operating the ratchet wheels that start and stop the chronograph mechanism are made of a single piece of spring metal, thereby being simpler and occupying less space, with other novel features of construction and arrangement of parts.

A hot air furnace has been patented by Mr. Nathaniel A. Boynton, of New York city. It affords a novel construction of the dome and radiator and their flues or passages, and arrangement of the dome within the radiator, insuring compactness and a more effective circulation of the products of combustion, with enlarged heating and radiating surface, the flues being caused to clear themselves of soot.

A watch case has been patented by Mr. Jacob Macher, of New York city. By this improvement the key, or combined key and push pin, can be withdrawn sufficiently from the pendant to clear the inner edge of the center, thus permitting the works to be passed into the case, but the push pin or push pin and key cannot be withdrawn entirely from the pendant.

A can holder has been patented by Mr. John W. Edwards, of Seattle, Washington Territory. A basket, or cage, adapted to hold a can or carboy, is made to swing easily between two specially devised brackets, so it can be tilted very easily to draw off the contents of the can or carboy, the device being also especially designed to facilitate drawing off the contents of heavy vessels.

A machine for making and inserting umbrella frame rivets has been patented by Mr. Daniel M. Redmond, of Philadelphia, Pa. The wire is forced through tubes and clamped, and, the rib and brace being brought into po ition, the wire is cut off and headed therein, the operation being performed with great rapid ty and ease, and the machine being adapted to different sizes of wires.

A printing press has been patented by Mr. Peleg S. Dodge, of Stanton, Mich. This press has a reciprocating flat form bed, over which is mounted the impression cylinder, and in the frame underneath, or otherwise equivalently arranged, is the steam cylinder of a direct acting horizontal steam engine, whose piston has a stroke equal to one half the circumference of the impression cylinder, and power is thus directly applied to run the press.

A knock down barrel has been patented by Mr. James H. Miller, of Hearne, Texas. This invention affords a cheap and easily constructed barrel for shipping fruits, etc., affording a free circulation of air; wooden slats or staves of proper lengths are secured to two or more hoops, which may be readily bent around a hinged head, and fastened by loops in the hoops, but the barrel can be knocked down and packed in crates or boxes to occupy very little space.

NEW BOOKS AND PUBLICATIONS.

THE GUNSMITH'S MANUAL. Messrs. Haney & Co., 10 Spruce Street, New York.

This is an illustrated volume of 375 pages, edited by Messrs. J. P. Stelle and W. B. Harrison. It is a volume of practical information for gunsmiths, and is calculated to be of interest and value also for sportsmen. It explains how their weapons are made, how they should be used, and how cared for when not in use. The manual is replete in useful information for gunsmiths and sportsmen.

INDUSTRIAL CYCLOPEDIA OF SIMPLE MECHANICS. By George E. Blakelee. Fords, Howard & Hulbert, New York.

The 700 pages of this book give plain, detailed directions for doing 2,000 common things. Its author is a practical mechanic, and was long an editor of a leading agricultural paper, so that he knows how to give his information in language devoid of abstruse terms, and so the "common people" will readily comprehend what is meant. It is not intended as a guide for professional workers in any special department, but to give valuable hints on "how to make and how to mend" to men, women, and children, indoors and out, as a daily aid in industrial affairs.

STATIONARY STEAM ENGINES FOR ELECTRIC LIGHTING PURPOSES. By Robert H. Thurston. John Wiley & Sons, New York.

Some such book as this has been an evident want for quite a little time back, and Professor Thurston has kept sufficiently abreast with the progress of modern engineering to be eminently well qualified to do justice to his subject. The modifications in engine building which have taken place since electricity has been largely introduced are here concisely stated, and particular mention is made of the most conspicuous claimants for public favor in this field, showing what changes in construction and operation have been made, with the causes therefor.

Received.

THE CHILDREN OF THE BIBLE. By Fanny L. Armstrong, with introduction by Frances E. Willard. Fowler & Wells Co., New York.

THE PHYSICIAN'S VISITING LIST. A pocket memorandum book with blanks for each day of the year, with numerous handy references. P. Blakiston, Son & Co., Philadelphia.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Name and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter**, should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Minerals sent for examination should be distinctly marked or labeled.

(1) H. W. G. writes: 1. I have a so-called lightning saw, attached to a small machine. The saw works well in logs not larger than 1 foot 6 inches in diameter; by cutting larger logs, the saw will grind the dust into flour, and do no cutting at all. How would it do to file every third tooth down to a scraper, thus making two double teeth for loosening the dust and one double tooth to scrape it out? A. Probably your saw is too small for logs larger than 18 inches diameter. Every tooth should be capable of taking out its own cut. Sharp, well set teeth, proper feed and power will make the saw cut. 2. Will there be any success in taking letters patent for a corn planter which will plant corn in square hills without squaring off or using the rope or wire so-called check rower? A. The success of your corn planter depends upon its utility and originality and your business application. 3. What is the correct name for the gases known in the German language as sauerstoff, wasserstoff, stickstoff, and kohlenstoff? A. Sauerstoff, oxygen; wasserstoff, hydrogen; stickstoff, nitrogen; kohlenstoff, carbonic acid gas. 4. Do you know of any publication, Treatise on Perpetual Motion, in the German language? A. No, and consider any attempt to attain perpetual motion as effort wasted.

(2) M. S. asks (1) a receipt for making soap that will take grease spots out of cloth. A. Powdered fuller's earth 1 ounce; just moisten with spirits of turpentine, add salt of tartar 1 ounce, best potash 1 ounce, work the whole into a paste with a little soap. 2. A receipt for a paste or composition that will polish gold or silver, something to be put up in tin boxes? A. Equal parts of precipitated subcarbonate of iron and prepared chalk. An impalpable rouge may be prepared by calcinating the oxalate of iron. Take quicksilver with chalk half an ounce, and prepared chalk 2 ounces; mix them. When used, add a small quantity of alcohol and rub with chamois leather.

(3) J. A. G. writes: In using borax with salicylic acid to increase its solubility (equal weights of each), are the antiseptic or disinfecting qualities of the acid changed or diminished? Can you name a better plan? Dissolving in water alone is troublesome, and in alcohol is expensive. A. Borax is of itself an antiseptic, and therefore aids in its degree; alkalies and alkaline salts are said to increase the solubility of salicylic acid. Another method consists in dissolving 10 parts salicylic acid in 24 parts ammonia, and then adding 16 parts dilute acetic acid, or just enough to produce a slightly acid reaction. For bee culture a solution is made by dissolving one ounce of the crystallized salicylic acid in half a pint of French spirits; of this solution add one ounce to pint of soft water at 60° Fah. In cold weather perform this operation in a warm room. This is said to be the method used by all German masters.

(4) N. B. P.—In casting steel and other metals, does it form any longitudinal grain the way it runs, so that it becomes tougher one way than the other? A. No. 2. If combed and pressed in one direction while wholly in a liquid state, will that make it tougher one way than the other? A. No. Cast steel and cast iron are granular, not fibrous.

(5) E. B. asks: 1. What is the difference between a dynamo-electric machine and a magneto machine? A. A dynamo-electric machine furnishes a current which excites its own field magnet. A magneto-electric machine is provided with field magnets formed of permanent magnets, or with magnets excited by a current from another machine. 2. What would be the temperature of a vacuum if no heat was supplied from the outside? A. We do not know by what means the temperature of an absolute vacuum could be determined. The term itself precludes the idea; for to suppose a state of heat or cold implies that something is hot or cold. 3. Would a helix, if formed of steel wire and magnetized, attract soft iron the same as copper wire with electricity flowing through it; and would the attraction be permanent in the steel helix without the use of electricity, that is, if the helix was first magnetized? A. A helix formed of steel wire would act like a copper helix, but not to the same degree. If the steel is hardened, the helix may retain some magnetism, but a spiral form would not give the steel any advantage over magnets of other forms.

(6) W. F. H. writes: Ashes of forest trees here are chiefly carbonate lime. Is this common? Can you supply a few approximate analyses of common forest tree ashes, such as oak, fir, beech, or other? If our ashes are chiefly lime, and no potash to speak of, can we draw any conclusion as to best crop after burning the bush, while land is still too full of stumps to plow? A. The following analyses are taken from Professor Johnson's How Crops Grow, a standard authority on such subjects:

	Oak.	Fir.	Beech.
Potash	10·0	11·8	16·1
Soda	3·6	4·6	3·4
Magnesia	4·8	9·1	10·8
Lime	73·5	50·1	56·4
Phosphoric acid	5·5	5·8	5·3
Sulphuric acid	1·4	2·3	1·0
Silica	1·1	15·0	4·7
Chlorine	0·2	0·4	0·1

In each case you will notice that the lime exceeds in amount the other ingredients. We should therefore infer that your finding so much carbonate of lime perfectly normal. It would hardly be safe to calculate in regard to the crops, unless upon exact information.

(7) M. R. W. asks whether there is such a thing possible as keeping in solution the pulp from which fine paper is made, so that it might at any time be spread with a brush in the manner of paint, and then quickly harden and become paper, and adhesive? Or any chemical that will dissolve paper, and hold it in a liquid form? A. As the mixture of paper fiber and water which forms a paper pulp is entirely mechanical, we know of no way of sustaining the paper fiber in the water, except by means of size, water glass, or some similar substance. Collodion is the nearest approach to a solution of paper that we know of.

(8) W. H. K. asks if a battery can be made powerful enough to feed an incandescent lamp. If so, please tell me which kind of battery would do for that purpose, and how many cells of such a battery it would require. A. A battery may be used for supplying an incandescent light, but it is not an economical way of producing a light. 10 or 12 cells of plunging bichromate battery will operate a medium sized incandescent lamp; it will require 15 to 20 cells of Bunsen or Grove battery to do the same thing.

(9) N. W. writes: I claim that at the same number of revolutions per minute a 5 ton fly wheel of 30 feet diameter would be as effectual as a 20 ton fly wheel 15 feet diameter, because the rim of the 30 foot wheel has twice the leverage and twice the velocity of the rim of the 15 feet diameter, and what is true of rim is true of the weight in the arms. Other engineers say I am wrong. What do you say? A. You are about right as far as the momentum is concerned, but there are mechanical reasons inimical to the construction of large light fly wheels for the quick running modern engines, such as deep wheel pit, difficulty of truing, as well as height and floor space. The friction in air would also be greater than the additional friction of the smaller and heavier wheel upon its journals.

(10) P. S. M. asks: What are proper speeds for turning soft wood, hard wood, brass, cast iron, and wrought iron, and what are proper speeds for circular and band saws for ordinary wood sawing? A. The cutting quality of woods and metals is so variable that no empirical rule adapted to forms and qualities can be given. A good rule is to give the work all the speed it will bear without injury to tools. These speeds may be from 500 to 1,000 feet per minute for soft woods, about the same for hard woods, 30 to 60 feet per minute for brass, 10 to 30 feet per minute for cast and wrought iron. Much depends upon the size of the cut. Large cut should be slow, while a small water cut may be run at a high speed.

Speed of saws, 8 inches, 4,000 to 4,500 rev. per minute.
" 10 " 3,600 " "
" 18 " 2,000 " "
" 24 " 1,500 " "
" 36 " 1,000 " "

Intermediate sizes in proportion. Speed for band saws, 2,000 to 3,000 feet per minute.

(11) J. R. S. writes: We have a Worthington pump 10x10x7, double action suction pipe 4 inches diameter, distance from pump to river 2,900 feet, elevation 16 feet. We cannot find out why it does not work well. I think the distance is too far to fetch the water. My friend thinks not. Please give the cause of failure. A. You do not state enough particulars as to the lay of the pipe, or whether you have a foot valve. The pipe should be laid so that the air will naturally rise toward the pump, with a foot valve at the end of supply—an opening or stand pipe near the pump through which the whole pipe may be filled before starting. If there are siphons in the line that will retain air, they should have openings at their apices, with plugs that can be made air tight. The plugs to be used for filling the suction with water; also have a large air chamber near the pump. With these precautions we think you will have no difficulty. Air in a long suction is very elastic, and cushions in the clearance of the pump.

(12) R. D. G. writes: 1. What is the standard taper for steam and gas pipe thread, taps and dies, and number of threads of different sized pipes? A. Taper of pipe threads, ¾ inch in 1 foot in diameter; ⅛ inch pipe 27 threads; ¼ inch and ⅜ inch pipe 18 threads; ½ inch and ¾ inch pipe 14 threads; 1 inch, 1¼, 1½, 2 inch pipe 11½ threads; 2½ inch and upward 8 threads. 2. What is the best way to braze small articles ⅛ inch to ¼ inch diameter, outside open forge fire? Can I get heat enough any way from an alcohol lamp? I cannot get gas. A. You may braze small articles with a blow pipe and alcohol lamp, using a large wick, say ½ inch diameter, in a side nozzle like a tea kettle spout. This gives you facility for casting a downward flame upon the work. 3. Can you give me dimensions to go by to make a camera box for making 5 inch by 8 inch pictures, such as the amateur outfits sold by dealers? I can buy a lens, and make my own box if I could get measurements. How can I tell the focal distance by a lens, to place the ground glass screen? A. You require a good achromatic lens or a pair to make an acceptable picture. Get the focal distance by casting an image of the window upon the wall or a card, and measure the focal length. Better get the lens before you make the box.

(13) R. A. R. asks: 1. Does water running through piping produce friction? If so, at what rate? A. It does; the amount of friction is governed by the size of the pipe and rapidity of flow, or height of head. 2. Can water be brought a great distance on the siphon system, say 1¼ miles, with a fall of 30 feet, the water lower where it starts from than some of the intermediate points? Will a 1 inch stream run through an inch and a half piping one mile with a fall of 20 feet, and no intermediate points higher than where it starts from? Suppose, then, water can be conveyed 1¼ miles through piping on the siphon plan, when the fall is 30 feet with intermediate elevated points, about how many gallons of water would run through per day, when the piping at starting point is 2 inches for a quarter of a mile and 1½ inches for a mile? If larger piping is used at either starting point or stopping point, which point is it best to use it at to get the largest flow of water? Or is it as profitable to use 1½ inch altogether, instead of 2 inch a part of the distance? A. If the apex of a local arched siphon is lower than the source of supply, the flow will be forced over it naturally. Or, in other words, if the source of supply is higher than any intermediate ground between it and the delivery, the undulation of the pipe laid over the ground will not materially affect the flow, although the air may have to be discharged at the apices where the undulation is excessive. With 1½ inch pipe the whole distance you will obtain a flow of 8,000 gallons in twenty-four hours. By putting down 2 inch pipe for a quarter of a mile, you will increase the flow about 1,000 gallons per day. We do not recommend two sizes of pipe in the line, but if two sizes are required for special reasons, put the largest at the supply end. In constructing a line over undulating ground that is higher than the supply source, arrangements must be made for starting the siphonage by putting openings with short standpipes at the high points for filling. After filling, the openings must be capped air tight. Cocks or plugs must be used at both ends while filling. Fill at the highest point, or, if you have a force pump, you may fill by pumping in the water at the source of supply, keeping the vents open until they overflow, then cap them.

(14) T. D. writes: A large amount of money is wasted by manufacturers in using a blast for gas. We heat our soldering irons in this way, and have often thought it a wasteful method. Would a row of small holes for small gas jets be cheaper? A. Mixed gas and air, either by concentric nozzles or the Bunsen principle, are now preferred for heating purposes.

(15) A. M. F. asks: What horse power is necessary to get best results to run the screw of a 300 ton boat of 125 feet length? A. The best result does not come especially from the power applied, but depends upon the lines of the boat and the form of the screw. A 75 horse power engine and boiler would probably give you a good working speed of say 7 to 10 miles an hour, according to lines and load. We do not know of the engine you mention, and if we understand your other question, would suggest pure rubber.

(16) T. D. G. asks (1) for the process of tin smelting. A. The metallurgy of tin is given quite fully in the English edition by Crookes and Rohrig of Bruno Kerl's well known "Practical Treatise on Metallurgy." Both the English and Continental processes of smelting are described, and illustrations of the furnaces used are given. 2. Will putting limestone in water used for drinking and cooking extract any of the lime, and make limestone water? A. The limestone if added to water will dissolve to a certain extent, and any free carbonic acid forming in the water will combine with the limestone, forming the bicarbonate.

(17) G. H. J. asks (1) the difference between benzine, naphtha, and gasoline. A. The names mentioned are given to products of the distillation of crude petroleum coming over at different degrees of temperature, and consequently they vary in their specific gravity thus: Gasoline is the lightest mentioned, and has a density of 95° to 80° Baume, naphtha 80° to 65° Baume, and benzine 65° to 60° Baume. 2. Where can I find the process of boring artesian wells described, and the tools used? A. The subject of artesian wells has been very elaborately treated in a series of articles contained in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 156, 157, 158, 159, and 160.

(18) M. C. writes: Please give me a receipt for sticking cork to metal, as cork to the keys of musical instruments. Do you know if a palissandre (rosewood) is liable to crack in our climate? If so, what is good to fill surface cracks, besides shellac? I can use the wax that is in use for express packages for cork to metal, but that will require heat, which I wish to avoid. A. For cement use shellac dissolved in alcohol. The condition of the rosewood must be considered before a definite answer can be given. Well seasoned wood should not crack. Filling composition or fillers can readily be purchased from painters or dealers in their supplies. These consist of whiting, plaster of Paris, pumice stone, and litharge with suitable coloring matter selected to match the wood. French yellow, asphaltum, Vandyke brown, and terra di sienna are the principal substances used for the coloring. After the proper shade has been determined, the selected ingredients are mixed with 1 part japan, 2 of boiled oil, and 3 of turpentine, and ground fine in a mill.

(19) N. Y. K. asks: Will you please tell me of some article that will effectually remove the color from hair? I tried peroxide of hydrogen, but it did not have the desired effect. A. Peroxide of hydrogen is undoubtedly the best bleaching agent that can be used to remove the coloring matter from hair. Gaseous chlorine has been used, but not with such great success as the hydrogen peroxide. In fact, the oxygen is the bleaching agent, and whether it be obtained from the various chlorine compounds or from other substances, its effect must be the same. 2. The best article you know of that will remove hair. A. Electricity is used to remove superfluous hair from the face. Various pastes made from the sulphide of the alkalies and alkaline earths are likewise used. The following is a well known depilatory: Mix 3 parts sodium sulphide crystallized, 10 parts finely powdered quick lime, and 11 parts starch. It should not be applied longer than 2 to 4 minutes.

(20) J. A. writes: Is there any particular rule for the manufacture of triangles? In a portion of this town the ringing of bells on locomotives is so frequent that the ordinary bell alarm on a fire station does not attract the attention of the people, and a triangle is suggested. We want a triangle containing about seven feet long of steel. What width and thickness is best, and is there any particular rule for the make of it? A. For a triangle, take a bar of good tool steel 1 inch square about 7 or 8 feet long. Suspend it by a cord at two points, or lay it upon two pieces of rope upon a bench about one-third of the length from each end. Strike the bar with a mallet and ascertain the axis of vibration by moving the bearings in or out until a full tone is obtained, then mark the bearings and bend the triangle.

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