Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- [ ] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [x] Bound with other material/ Relié avec d'autres documents
- [x] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

- [ ] Coloured pages/ Pages de couleur
- [ ] Pages damaged/ Pages endommagées
- [ ] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] Showthrough/ Transparence
- [x] Quality of print varies/ Qualité inégale de l'impression
- [x] Continuous pagination/ Pagination continue
- [ ] Includes index(es)/ Comprend un (des) index

Title on header taken from:/ Le titre de l'en-tête provient:

- [ ] Title page of issue/ Page de titre de la livraison
- [ ] Caption of issue/ Titre de départ de la livraison
- [ ] Masthead/ Générique (périodiques) de la livraison

- [ ] Additional comments:/ Commentaires supplémentaires:

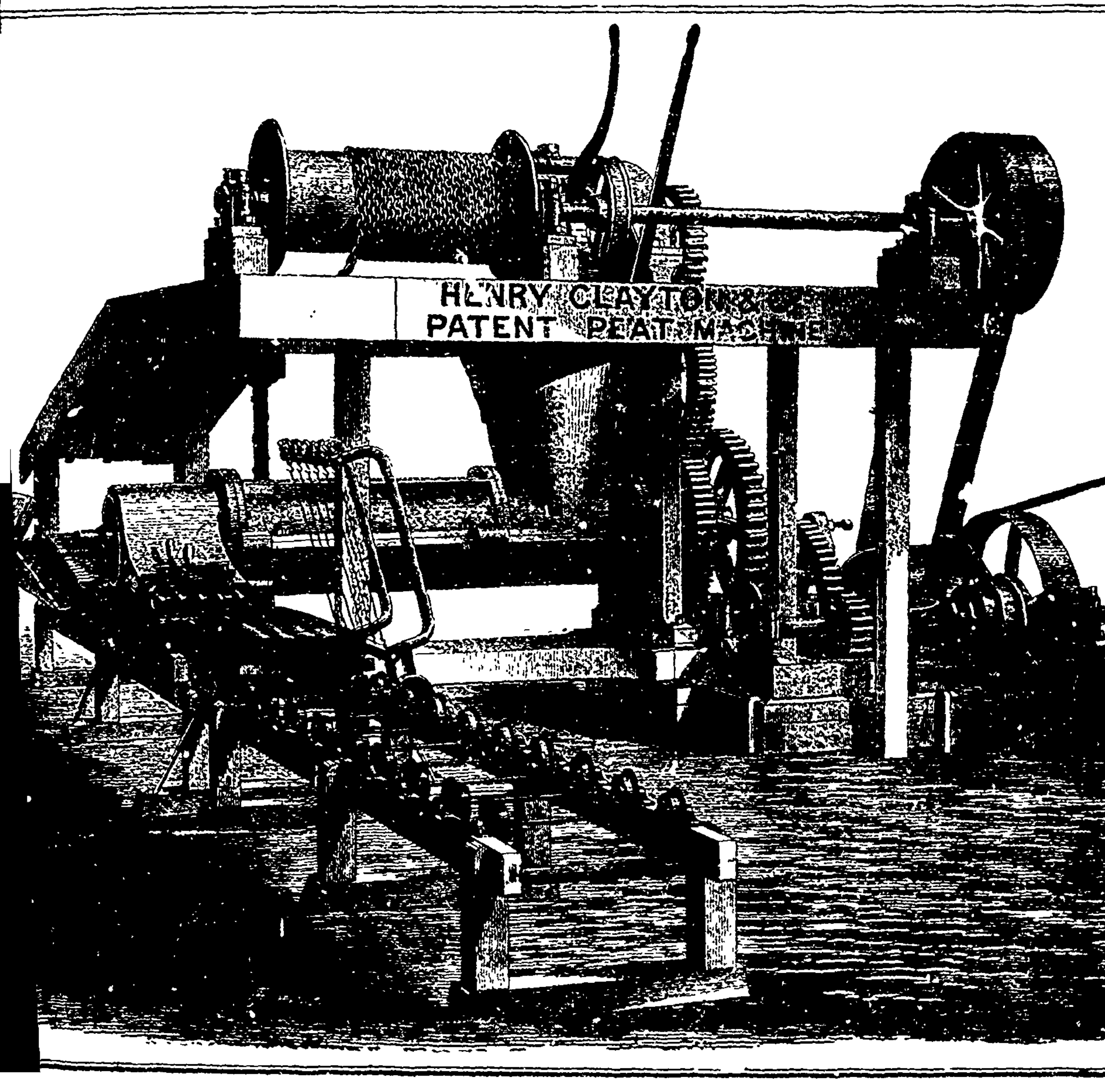
This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X				14X				18X				22X				26X				30X			
																	✓						
		12X				16X				20X				24X				28X				32X	

The Canadian Patent Office Record and Mechanics' Magazine

Vol. I.—No. 4. JULY, 1873.

Price in Canada $1.50 per An.
United States - $2.00 "



PEAT FUEL.

There is little doubt but that the manufacture of peat fuel in the Province of Quebec is destined, at no distant time to assume proportions far exceeding the present scale of operations. The deposits are immense and in view of the probably continuous increase in the cost of coal, a home fuel will certainly attract greater attention every year. About the middle of last month a number of gentlemen were invited by the President and Directors of the Canada Peat Fuel Company to inspect the works of the Company at St. Hubert, about six miles from Longueuil. On the arrival of the party at the bog they were conveyed over a portion of the ground and embarked on board a large scow which had been covered in and decorated with evergreens It was slowly towed through a cut made by the previous excavation of peat, which is about 6 miles in length and about 5 to 6 feet in depth. The barge traversed the extent of the cut to the point where new excavations had been made. The works have now been in operation for about five years, during which time 25 miles of peat have been taken out. There are 250 men at present employed on the works at St. Hubert, with three excavators driven by powerful steam engines each cutting about 250 feet per day about 6 feet deep. A new and important feature in the drying process has been introduced which cannot fail to be of immense importance to the interests of the Company. Rows of racks have been erected along the canal in which the peat is placed, and it is thus dried in one quarter the time employed by the old process.

We hope, before long, to be able to give our readers an illustration of the machinery employed at St. Hubert. In our last number we refer to the peat machinery designed and manufactured by Messrs. Clayton, Son, and Howlett, and to its working at their establishment in the Woodfield-road, Harrow-road. Since the machinery was described in our columns several alterations have been made in its details, improvements having suggested themselves to Messrs. Clayton in the course of its working. We now, therefore, illustrate on page 97, from *Engineering*, the latest arrangement, the engraving having been prepared from a photograph of the apparatus taken as it stands in Messrs. Claytons' yard. To follow the course of manufacture with this apparatus we must begin with the squeezing trucks, which we have not thought it necessary to illustrate. These are simply closed wagons running upon a light railway, and fitted with covers which are secured when the wagons are filled. The sides and bottom of each wagon are perforated with small holes, and one end of the body of the wagon is movable and is actuated by a screw. As soon as the wagon is loaded this movable end is forced inwards by means of the screw, and thus the peat is put under pressure so as to rid it of some of its surplus water on its way to the machine. These wagons are used when the peat contains much surplus water, but in cases were the peat is not very wet, the ordinary tipping trucks only are required. The wagons are hauled from the bog to the works by a barrel hoisting gear which is erected over the machine and from which it is driven.

From the trucks the peat is tipped into the vertical hopper of the machine, in which are inclined blades fixed upon the vertical shaft. The blades break up the lumps of peat and press the mass downwards into the horizontal cylinder into which it is fed by a worm placed on the central shaft. The peat is thus brought within reach of the propelling arms which are fixed spirally around the central shaft in the horizontal cylinder, and which pass between sharp steel knives. The knives are made with dove-tailed feet and are received into corresponding grooves in a removable bar-plate, which is secured in the side of the horizontal cylinder by bolts. By means of the scissor-like action of this internal machinery the peat is cut up into small pieces and squeezed or kneaded together. The fibres of peat are, by this treatment, so divided that facility is given for setting free all moisture and fixed air that may be retained in the cells of the stalks, and the peat is deprived of elasticity, or resiliency, so that it is reduced to a suitable condition for moulding. The spaces between the cutting knives are gradually reduced from the feeding to the delivery end of cylinder, the propelling arms being correspondingly placed. The moulding orifices are adjusted at the nose of the machine, and may be of any desired form. Five of these orifices have hitherto been used and have been found convenient in working.

Beneath the chamber upon which the moulding orifice is fixed, and which is seen to the left of the machine, is a roller table on which the trays for receiving the moulded peat are placed in succession by a boy, so that they run in a continuous series underneath the moulding orifices and receive the peat issuing from them. As the front end of each tray comes up, the workman severs the streams of moulded peat by means of a sliding cutter, and pushes the loaded tray forward until it is opposite the cutting frame, in which several wires are stretched. These wires being brought down on the peat severs each bar into pieces 5 in. long, which is a convenient size for use. The loaded trays are sent along the roller table until they are opposite the tray racks. The trays are then lifted off on to the racks, where they remain for about three days, until the peat will bear handling, when they are placed upon the open shelving for final drying. The tray racks consist of uprights with arms fixed upon them, between which iron rods are strained. The contingency of accident to the machinery from stones or hard foreign substances passing in with the peat, is provided against by means of a friction clutch seen to the right of the machine in front of the driving gear. This clutch can be screwed up to give any desired pressure, or resistance, and when any substance having an objectional degree of solidity passes into the machine, the clutch slips, its resistance being overcome, and breakage is thus avoided. The cylinder has a movable cover so that the interior may be readily examined, foreign substances removed, knives replaced, or anything else necessary done.

Various kinds of peat have been tried by this machine, and it is interesting to notice the difference between the peat dried without having been previously treated, by the machine, and that which has been operated upon. Peat of very fibrous nature when dry has an open spongy appearance, suggestive of cocoa-nut fibre. The same peat treated by this machinery becomes compact and hard and assumes a specific gravity of from 1.05 to 1.10, whilst black decomposed bog condenses to about 1.20. A set of machinery to work 100 tons of crude peat employs in all ten men and five boys including diggers, engine drivers, men in drying sheds, &c, so that the cost, allowing a fair amount for wear and tear, is placed by Messrs. Clayton at 3s. 6d. to 7s. per ton.

The calorific value of peat, which has been much questioned, varies considerably, some kinds of peat being very rich in heat-producing power, whilst others are very poor. In Canada prepared peat is said to do 5.06 the work of coal. With regard to the intensity of peat, it appears from the practical use of this fuel in Canada and in Europe, that a large grate surface and slow draught are necessary for its most advantageous combustion, and under such conditions its full intensity is realised. The form in which it is used is another consideration, that is whether applied in the form of condensed peat or merely dried turf. In the latter case the fuel is too light to withstand any considerable draught, whilst that in the concentrated form has been successfully used under strong blasts. Experiments now being carried out by burning in a locomotive the peat recently made by Messrs. Claytons' machine, give promise of its successful application in this direction The value of peat charcoal too, has long been recognised, and as the peat produced by this apparatus appears to be in good form and condition for charcoal making there are grounds for anticipating its use in this respect. This point is also being practically tested, and there is no apparent reason why this, as well as the other applications, should not succeed, in which case this condensed peat, being economically produced, will become a general manufacture.

ATMOSPHERIC TELEGRAPH AT PARIS.

We illustrate on page 101 the despatching room of what is somewhat erroneously called the Parisian Atmospheric Telegraph Company. By telegraphing we understand the transmission over wires of messages by means of electrical signals. The system we are about to describe briefly is exactly similar to that which has been in successful operation for some time in London for the distribution of mails to and from the different post offices. It consists in the propulsion through tubes of small carriages containing within them messages, etc These tubes are of small dimensions as may be seen by the illustration and are laid down beside the gas and water pipes. The system is composed of sixteen tubes each of which is about 1300 yards in length. These sixteen tubes placed end to end, are separated by sixteen telegraph offices, the distance between each of which is traversed in rather less than a minute. The carriages might be sent more rapidly but the speed mentioned is found quite sufficient The oldest part of the work was constructed during the time of the Empire and consists of six tubes forming an almost regular hexagon. These tubes are traversed every fifteen minutes by *trains* of small carriages or boxes which move with the sun.

On this central system are grafted two branch systems and three single lines. Counting stoppages the trains travel at the rate of more than a mile in five minutes It is said that, when properly delivered, a message should not take longer than when sent in a cab by a special messenger. The trains are propelled by atmospheric pressure which is obtained by means of an ordinary air-pump piston. The manner in which the carriages are placed in the tubes is shown clearly in the engraving. The despatch and reception of trains is communicated from station to station by electric telegraph signals. The simplicity of the operations is manifested by the fact that three men suffice for the work of the central station, one of whom is also employed occasionally as messenger. The principal work of the system, as may be gathered from its name is the distribution through Paris of telegrams from the provinces.

GOODS LOCOMOTIVE AT THE VIENNA EXHIBITION.

We illustrate on page 112 one of the numerous locomotives exhibited at Vienna. This is an eight-coupled engine constructed for mountain service on the Royal Hungarian State Railways. The cylinders of this engine are outside, and are 20½ in. in diameter, with 2 ft. stroke, the piston rods being carried through the front covers. The wheels are coupled by outside cranks, and are 3 ft. 6¼ in. in diameter, while the wheel base is 11 ft. 9¾ in., the trailing axle having lateral play to give increased flexibility to the engine. The diameter is 4 ft. 9½ in. It contains a large number of tubes, namely, 223, these being $2\frac{3}{16}$ in. in diameter by 15 ft. 3¼ in. in length between tube plates. These tubes give an external heating surface of 1823 9 square feet. The fire-grate area is 21 52 square feet, and the steam pressure 8½ atmospheres effective, or 125 lbs. per square inch. The weight of the engine of which we are now speaking is 41 tons empty, and 46 tons in working order, 10¾ tons of this latter weight resting on the leading wheels, and 11¾ tons on each of the other pairs. The axle boxes of the second and third pairs of wheels are, we should state, connected by compensating beams, a single spring on each side, arranged between the plates of these beams serving for both axles.

Bronzing and Varnishing Plaster Figures.—These should be sized first, and painted with color according to the colored bronze required, as red, white, green, yellow, black, &c. Before the colors are thoroughly dry, that is, when they feel "tacky," the prominent parts should be bronzed with bronze powder, applied by a piece of chamois leather. Varnish afterwards with some quick drying varnish.

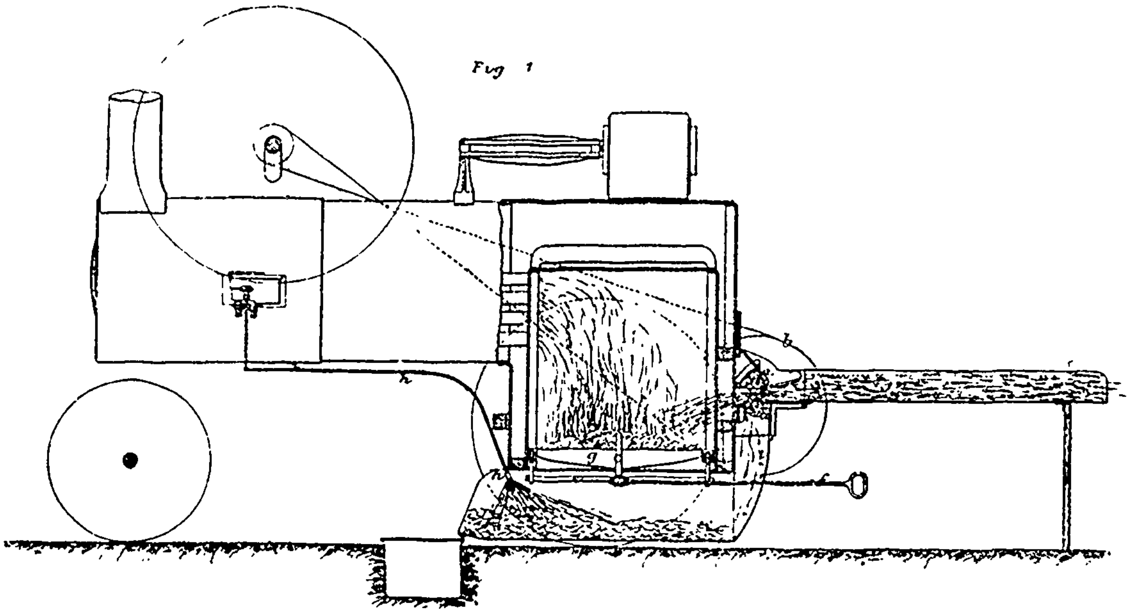
STRAW-BURNING PORTABLE ENGINE AT THE VIENNA EXHIBITION.

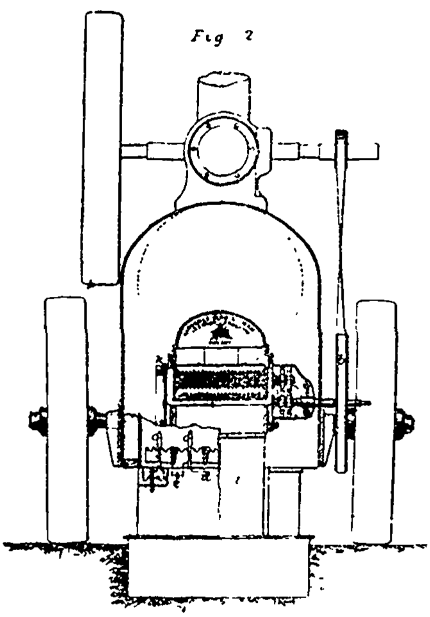
We illustrate, from *Engineering* on page 100 the portable straw-burning engine of Messrs. Ransomes, Lun- and Head of Ipswich, England. This engine has been an object of special attention to the great grain growers of Western Europe. An engine of this kind would be of small service in the densely peopled parts of this continent and of Europe, but there are vast grain producing areas in America where such a machine would be invaluable. They are regions where straw is so abundant, and where the surrounding circumstances are such that it is rendered valueless. In such regions steam has hitherto been little employed for agricultural operations—not because its advantage over animal power was disputed, but on account of the impossibility of obtaining coal or wood as fuel for the engines, except at a cost which would render their use almost prohibitive.

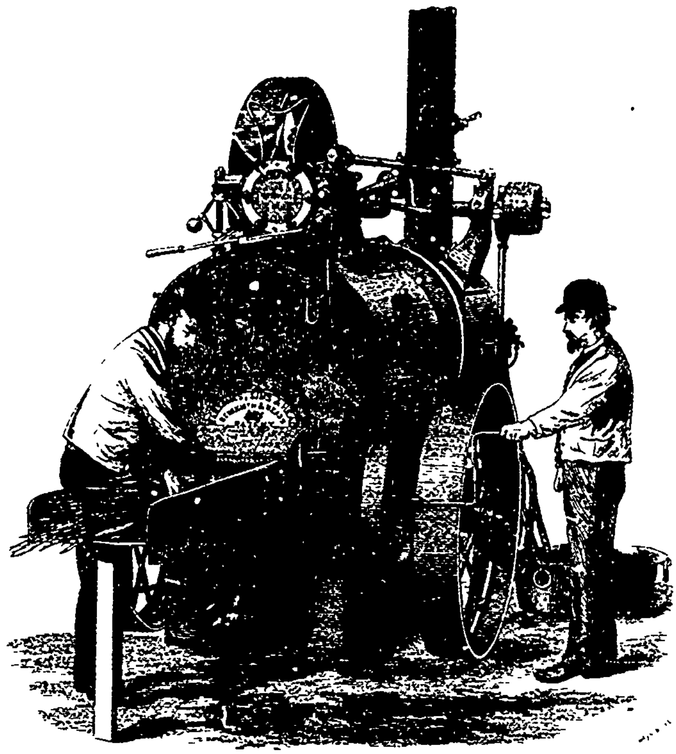
The idea of burning the straw as fuel to raise steam is not quite new. Some years have elapsed since it was tried, and not wholly unsuccessfully, in Russia, and after a very primitive fashion. The wheels next to the fire-box of the locomotive engine were taken off · the ash-pan and fire bars removed; a huge pit was sunk in the ground lined roughly with brule or stone, if procurable; a sort of flue funnel at one side, just the area of the interior of the fire-box of the engine, which was then placed right over this. The pit was filled with straw that was set on fire, and continually fresh straw was thrown in. The fire-box and tubes—in fact, the whole boiler and engine—became thus only a flue prolonged from over this straw furnace. Steam was gently kept up, but the waste of heat was great, the supply of straw immense, as was the labour of bringing that to the immovable point where the pit was once for all formed: and the exterior of the fire-box, indeed the whole engine, became so heated as often to be destroyed, and always rapidly injured.

So matters stood until Messrs Ransomes and Co. turned their attention to the problem which they have now so completely solved, namely, to adapt to the ordinary locomotive engine such arrangements as should enable it to be worked steadily and to its full power with straw fuel, these arrangements being as simple as possible, as alone suited to the rude people who are to manage them, involving the least possible amount of change or addition to the ordinary engine—of such a character that the engine can be, with very insignificant amount of charge, restore to its condition for burning coal, timber, or any other fuel. These conditions fulfilled, it is obvious that besides the abolition of the waste and technical difficulties of the pit-burning method, the great advantage would be secure that the locomotive now could follow its fuel in place of the fuel having to be brought from a distance to supply it. This problem, in all its conditions, has been most perfectly solved by Messrs. Ransomes and Co ,and by means which are strikingly simple. We have examined an eight-horse (nominal) locomotive fitted for straw burning, and seen the engine for some time at work, applied to a dynamometer brake, which gave a resistance requiring the steady application of twenty-horse actual power to overcome it.

The following constitutes the arrangements to adapt an ordinary engine of this class to work with straw fuel. The engine is constructed with a fire-box larger than that needed for coal fuel—in this case it is one simply 1ft. *longer* than that for coal The fire-bars are taken out, and three or four light wrought iron cross bars about 4 in. apart supply their place. To the fire-door opening of the fire-box a cast iron mouthpiece is attached, carrying two or three small doors for inspection of the fire, and in and close to and beneath these, a pair of gathering, or "finger rollers," placed with their axes parallel, horizontal, and transversal, are arranged. These are geared together, and can be worked at the slow speed needed either by hand, by a winch handle, or by a strap and pulley, by the engine itself. A flat shoot, or tray, much like that of a common chaff-cutting machine, extends for 4 ft. or 5 ft. outwards from the rollers, in width equal nearly to their length, and open on top. Beneath the wide grille of bars described as taking the place of the fire-bars, is an ash-pan, open to the front end of the engine; across the open mouth of this, and above the level of the grille, is a small tube perforated with minute holes, which discharge in little vertical threads, a small amount of water supplied from a pipe led from the ordinary feed pump of the engine. This is the entire apparatus. To start to work the fire-box is moderately filled with straw, led into it from between the finger rollers. This is ignited, and the supply of straw is kept up by continuing to turn these rollers by hand, drawing in straw, fed into the shoot by the stoker, until steam is got up. As soon as this occurs the strap pulley keeps the finger rollers going, and all that is needed is to keep up the supply of straw by the shoot. Such is the entire apparatus. The blast pipe in the funnel supplies the draught in the usual way. Nothing appears to escape from the funnel but a white cloud, chiefly of watery vapour. The consumed straw does not, as might be expected, form a dense glassy slag of the silica and potass or soda contained in it naturally, but falls to the bottom of the ash-pan as a dusky flock or wig—the *pseudomorphs*, so to say, of the straws. This is little coherent, and when it accumulates the *grille* or ash-box is cleared of it by a rake or slice provided to be worked from the feeding end of the fire-box. On the occasion of our inspection, the boiler being full, the water at the temperature





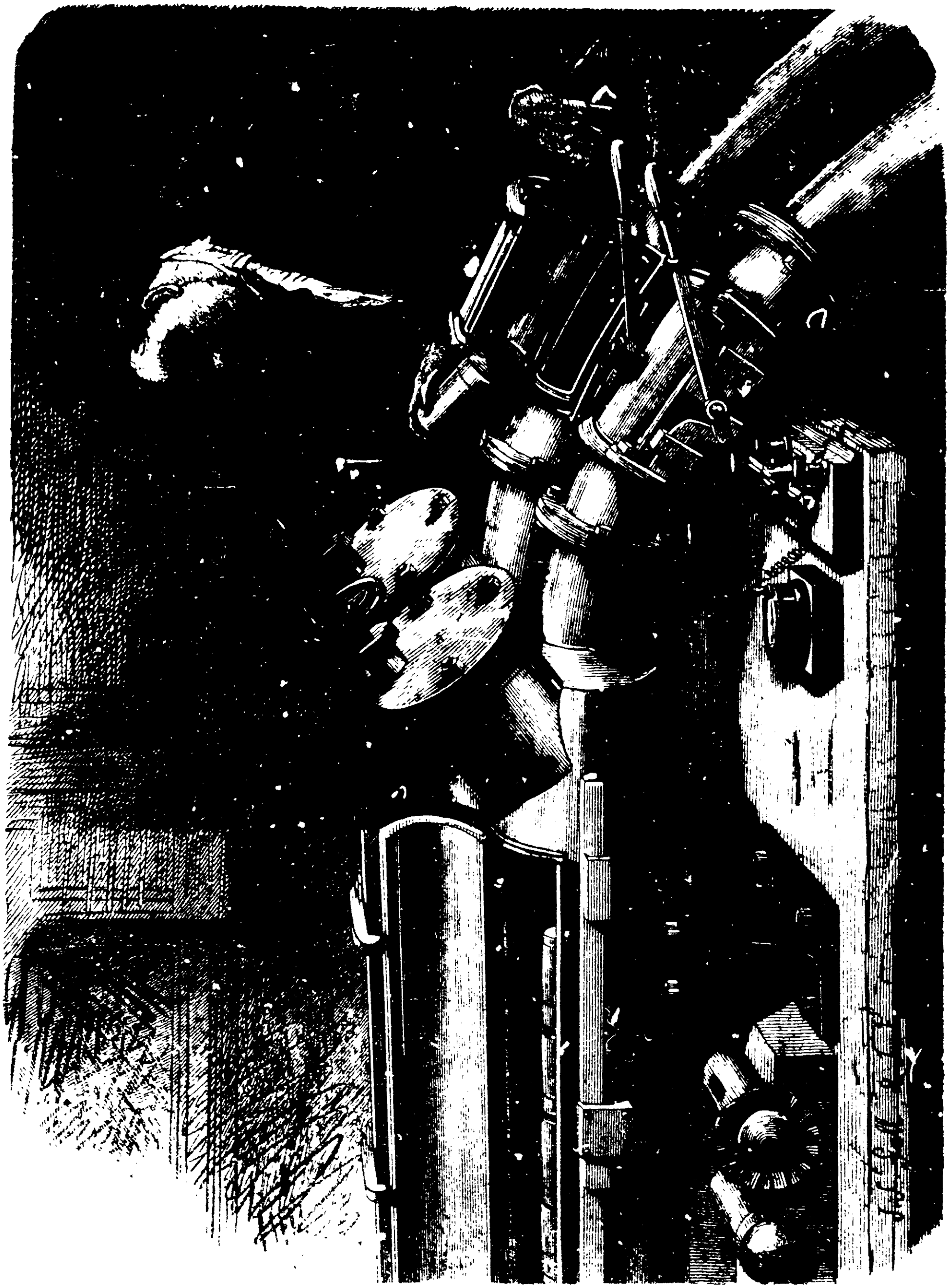


STRAW-BURNING PORTABLE ENGINE AT THE VIENNA EXHIBITION (See page 99.)

of the day—probably, rather under 50 deg Fah.—the fire was kindled as described. In less than fifteen minutes steam began to be formed, and in about forty minutes was at 40 lbs. to 45 lbs pressure. The time of getting up steam is, in this case, comparatively unimportant, but this rapidity is sufficient to prove that straw is a more effective fuel than commonly is supposed.

The dynamometer brake having been adjusted to the resistance due to 20-horse power, and the engine being provided with a counter, was kept at work for some time, and the general phenomena presented noticed. One man was readily able to feed in the supply of straw fuel. There was but little skill required in this operation, and a sufficient uniformity of supply was easily maintained. The entire fire-box was kept full of a ruddy glowing blaze, and the mass of flame was observed completely to fill the tubes and to reach the smoke-box.

One hundred weight (112 lbs.) of straw was then weighed out, and, from the commencement of its being fed in, was consumed in about fourteen minutes. This may be considered as about 460 lbs. per hour, or $\frac{460}{20} = 23$ lbs. per hour per horse-



ATMOSPHERIC TELEGRAPH (See page 98.)

power Locomotive engines of this size and make, not being provided with an expansive gear, consume of coal probably from 5 lbs. to 5½ lbs. per hour per horse-power. It would follow, therefore, that straw fuel burnt in this way is equal to from one-fifth to one-fourth its weight of coal This is not a large result, but it is one that proves straw to be a far less despicable fuel than it has been reported or imagined. It is one, too, the use of which we think will be improved upon yet. The engine as fitted for straw burning can be worked with brushwood, furze, dry leaves, heather, bulrushes, reeds, etc; and so may find its use in other regions devoid of good fuel besides the grain plains of Europe or of America, and in the latter country may yet be destined to enable culture to be introduced into the treeless prairies of the North-West United States or of British America.

BRADLEY'S NEW APPARATUS FOR ELECTRIC MEASUREMENT.

The engraving on page 105, for which we are indebted to the *American Artisan* represents an apparatus, the most recently and thoroughly improved of any known to science, for the absolute and direct measurement of electricity in its several departments.

The measurement of electricity, by positive and well defined units, is a modern discovery. Within a few years past several inventors have constructed instruments for the purpose, and each for himself have adopted certain quantities as units. Those employed in the use of this apparatus are

FIRST, THE OHM,

which is the unit of the resistance which a conductor offers or opposes to the free passage of a current of electricity through it, and is equal to the resistance which a prism of pure mercury, one square millimeter section, and 1.0486 meters long, opposes at 0°C.

SECOND, THE VOLT,

which is the unit of electro-motive force, resulting from the chemical affinities of the elements of a galvanic battery, and is about that of a cell of zinc and sulphate of copper battery.

THIRD, THE VEBER,

which is the unit of strength or quantity, or electro-chemical equivalence of a current, as it is variously called, and represents that quantity of electricity which flows through a circuit having an electro-motive force of one volt and a resistance of one ohm in one second.

One Veber of electricity decomposes:

.00142 grains of water, or develops
.000158 grains hydrogen, or
.1721 cubic centimeters mixed gas,

at a temperature of 0°C, and barometric pressure of 760 millimeters.

The apparatus is employed with great facility in accurately determining the electro-motive force, the resistance and the strength of batteries, indirectly measuring the resistance of all conductors of electricity, telegraph wires, etc, from the hundredth of an ohm to 10,000 ohms, in determining the insulation resistance of telegraph lines up to millions of ohms, in locating breaks, faults, crosses on telegraph lines, cables, etc., in determining the quantity of metal of any kind, deposited in a given time in the process of electro-plating, gilding, etc., in determining the specific conductivity of metals, especially of copper, a matter of importance to those manufacturing or using wire for telegraphic or other electrical purposes.

The capacities of all other instruments for similar purposes combined, are embraced in this one in a substantial and compact form, convenient for transportation and comparatively safe from injury.

It consists of a tangent galvanometer and a rheostat.

The galvanometer is entirely new, and is constructed with a circular needle, in the form of a thin dish of steel, balanced upon a fine pivot, and having light aluminum pointers traversing a graduated circle five inches in diameter (more or less). Underneath the needle are four (or less) distinct coils so placed that the current flows parallel with the meridian of the needle. They are somewhat wider than the diameter of the disk. By this means all parts of the steel composing the needle are subjected to the same inductive influence in all its deflections.

It is a condition indispensable in the construction of a true tangent galvanometer, that the current through the coil should act as uniformly upon the needle in all its deflections as the earth's magnetism does A narrow coil under a long needle does not fulfil this condition; for, as the extremities of the needle in its deflections pass more and more away from the coil, the inductive is less and less, as compared with the earth's influence.

On the contrary, if we place a very broad coil under a long needle, the same difficulty occurs, but in the opposite direction. While the needle is on the meridian it is under the influence of but few convolutions in the middle of the coil, but as it deflects it comes under the influence of an increasing number of convolutions, and, therefore, the influence is more and more increased.

It being evident that the truth lay between these extremes, the expedient of a needle, in the forms above described, was resorted to, and with entire success, for in this the condition sought is accurately fulfilled.

Coil No. 1 is composed of very fine copper wire, wound evenly back and forth over the whole width of the coil, and of a sufficient number of layers to give a resistance of 150 or more ohms.

No. 2 is of No. 30 wire wound in the same manner, and to twenty-five or thirty ohms resistance. No. 3 is of two layers of No. 23 wire, giving one or two ohms resistance. And No. 4 is a strip of sheet copper of the width of the coils, and wound three and a half times around, so that the current passes four times under the needle; the resistance of this may be considered as null, or not sufficient to be noticed or taken into account.

The outer ends of all the coils are connected with a common screw-cup B, while the inner ones are connected each with the cup bearing its proper number.

One, two, or even three of the coils may be dispensed with in galvanometers for special purposes, according to the function to be performed.

Coil No. 1 is for currents of high intensity, No. 4, for those of great quantity, and Nos. 2 and 3 for mixed or intermediate currents.

The true tangential proportionality of these galvanometers has been amply tested, and fully proven.

The close proximity of the coils to the needle, the wide range of their capacities, and the facility with which all resistances, from the highest to the lowest, may be correctly measured, give them decided advantage over all others hitherto in use.

The rheostat is constructed in the usual manner, having coils of German silver wire accurately adjusted and so arranged that any required resistance from $\frac{1}{100}$ of an ohm to 10,000 ohms can be obtained by withdrawing the proper plug or plugs. There is switch A, and four screw-cups respectively marked I, II, III, IV, an arrangement which constitutes an important novelty of the invention.

The process of measurement is that known among electricians as the method of substitution. It consists in connecting one electrode of a suitable battery with the galvanometer screw cup B, and the other to the rheostat cup I. A wire connects cup II, with that coil of the galvanometer (1, 2, 3 or 4) which is found to give the most convenient degree of deflection. The unknown resistance intended to be measured (as, for instance, the coil C), is connected between III and IV. The switch and connections are now so arranged, that when the switch is turned to the left, the current goes through the rheostat, and when to the right, it goes through the conductor to be measured.

The switch being to the right, the degree of deflection is noted; then, on turning the switch to the left, plugs are withdrawn so as to bring the needle to the same degree of deflection. The sum of the resistance of the several coils thus substituted is the true resistance of the conductor measured. Nothing can be more simple; the principle is as obvious as that of several pairs of scales, one for weighing grains, another for pounds, and a third for weighing tons, and the results are equally reliable.

ROCK DRILL AT VIENNA EXHIBITION.

Mr. Herman Osterkamp, of Aix-la-Chapelle, exhibits at Vienna the rock drilling machine which we illustrate on pages 104 and 105. This rocky drilling machine consists essentially of a cylinder and piston, the piston filling the cylinder partially and being rendered air-tight by a packing made of five or more rings or recesses turned out on the surface of the piston. In the same manner the piston rod is kept air-tight in the cover of stuffing box through which it works. The drill is fixed to the outer end of the piston by a wedge. The other end of the piston rod is formed square, and embraces a rod which passes through the cover of the cylinder, and has a bevel wheel fixed thereon for imparting rotary motion to piston. The piston at the same time works up and down the cylinder with the piston rod. The rotary motion of the aforesaid bevel wheel and piston and drill is effected by a second bevel wheel fastened on an axis which has a toothed wheel. The reciprocating movement of the piston is effected by the distribution of the parts and their construction which essentially differs from drilling machines or engines as heretofore constructed. At the side of the aforesaid cylinder and in connection with it, is attached a smaller cylinder fitted with a piston the rod of which has two ports or passages formed therein, forming a slide valve for admitting and cutting off the compressed air as desired.

In our engravings Fig. 1 shews a section of the cylinder and piston, *a*; and Figs. 2 and 3 shew the outside of the cylinder X. The piston *a* fills the cylinder partly and works tight therein by an air-tight packing produced by five rings, B, turned out on the surface of the piston. In the same manner the part C, of the piston is tightened in the cover, *c*, as in a stuffing box, and the drill is fixed at the end of the piston by a wedge at 1, the other end of the piston rod being formed with a square aperture to receive and embrace a rod *d*, of the same shape. This rod passes through the cover of the cylinder and terminates in a bevel wheel, *e*, by which it can be turned round in the cover of the cylinder, turning at the same time the piston which also moves up and down with the piston rod.

The rotary motion of the bevel wheel and piston, and the drill 2 fixed thereto, is effected by a second bevel wheel, *g*, fastened on the axis, *f*, which has a ratchet wheel, *t*, fixed on it. At the side of the cylinder X, and in connexion with it, is attached a smaller cylinder, *h*, fitted also with a piston, the rod, *i*, of which has at the back end two different apertures, *k* and *l*. When the pistons of the cylinders are in the positions shown at Fig. 1, the compressed air, which is the motive power to be employed, streams out of the tube through the aperture, *k*. of the small piston into the working cylinder, X, pressing the piston and with it the drill forwards until the upper end reaches the aperture, *n*, then the air enters into the distributing cylinder, *h*, pressing likewise the piston *o*, forwards. The aperture, *k*, in the distributing rod then goes beneath the entrance A, of the cylinder, and when the working piston continues its course to the fore end of the cylinder, the opening *l*, of the distributing rod comes against the entrance A, thus effecting the communication of the compressed air in the cylinder with the atmosphere.

At this moment the working piston goes backwards, driven by the compressed air of the common reservoir, which communicates without interruption with the lower part of the piston by the channel *r*. Immediately after the fore part of the piston has reached the lateral opening *p*, the air goes also into the distributing cylinder, driving its piston backwards into the piston shown at Fig. 1, and also the piston in the cylinder X. This movement then begins again when the working piston goes forward, the compressed air which was before it returns to the reservoir, whilst the small volume of air which was working in the smaller cylinder passes through the small opening *g*, into the open air.

On the back end of the distributing rod is fastened a pawl, 3, for moving the toothed wheel, *t*, forwards at each stroke of the piston, and with it the axis, *f*, and the working piston, *a*; a catch, *u*, prevents the wheel going backwards. The drilling machine is fastened to a support *b*, by a wedge, and this support can be moved to and fro on a frame, *e*, by the screw, *d*, and the crank, *c*. Two rods, *f*, fastened to the frame in combination with a third rod *g*, which can be shortened and lengthened form a stand, which in most cases is sufficient for the use of the machine without any need of fixing it otherwise. The moving forward of the drill is by the workman by means of the crank, *c*, on the screw, *d*. The man who works the machine is always able without any difficulty and without the least loss of time to effect the moving forwards of the drill and to accommodate this precisely to the degree of hardness of the rock. Figs. 4 and 5 give two views of one of these machines mounted on its support.—*Engineering.*

ON MORTAR AND CONCRETE.

Read before the Edinburgh and Leith Engineers' Society, by Mr. R. C. Reed, C.E, March 5th, 1873.

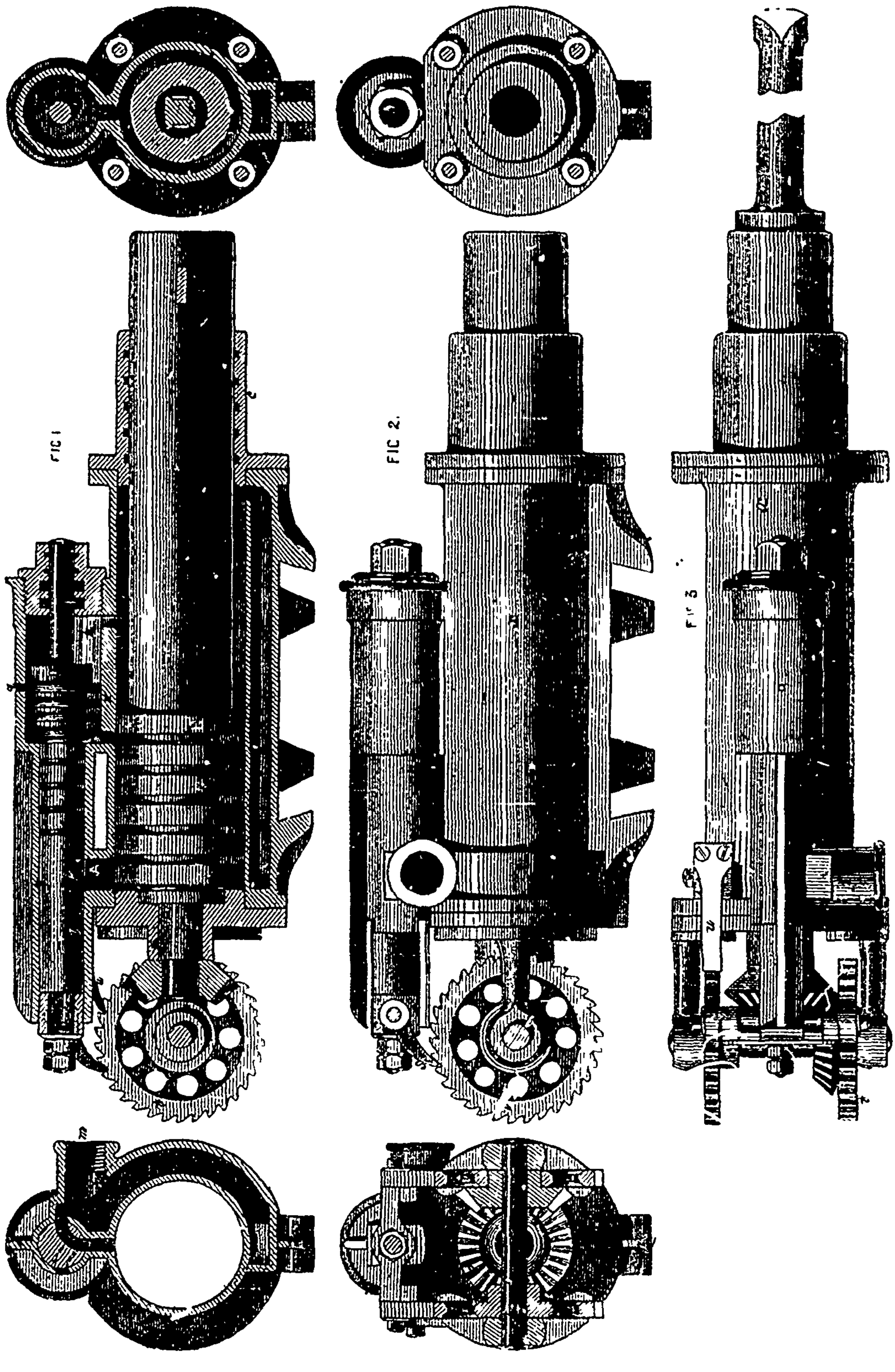
The importance of mortar and concrete as building materials is so great, that a few notes on the subject may not be uninteresting to members of this Society, and ought to be the means of raising a discussion by which some valuable practical information may be elicited. I do not intend to go into the chemistry of limes and cements, because my knowledge of chemistry is not sufficient to throw any additional light upon them than what has already been written. It will be sufficient for my purpose to classify the cementing materials as follows: 1st, rich limes; 2nd, hydraulic limes; 3rd, cements.

Rich limes consist of almost pure lime, such as may be obtained by calcining marble, which is nearly a pure carbonate of lime; the heat having the effect of purging the limestone of all water and carbonic acid, and of producing the material called quick lime. When rich quick lime has had water applied, a rapid disruption of the particles and effervescence takes place, and the solid shell falls into powder. This is called the slaking process, during which time a great amount of heat is given out. The mortar made from rich lime mixed with sand will never set in water, and even in the air it only hardens by absorption of carbonic acid from the atmosphere, thereby bringing it back to its original condition of carbonate of lime, with the addition of sand. This, however, is a slow process, and where the mortar is in thick masonry it will take centuries before carbonate of lime is formed all through, and by that time, if the masonry has stood, the hardening will not do it much more good.

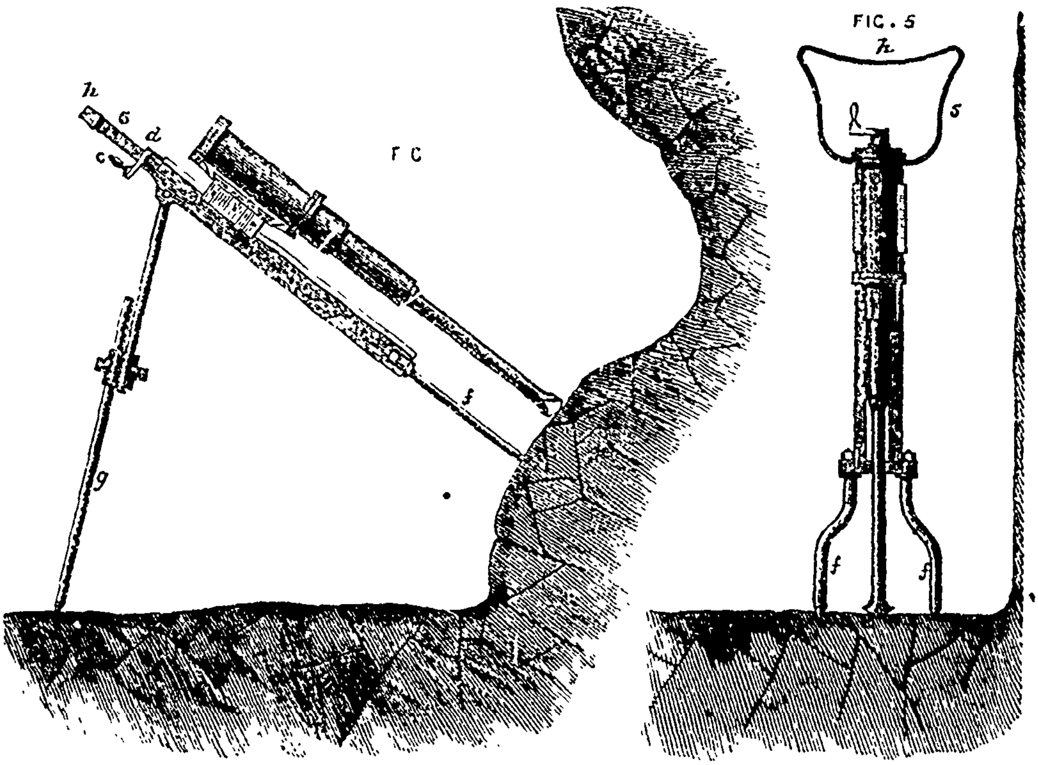
The second class, viz., hydraulic limes, are so called owing to their property of setting in water. They consist chiefly of a mixture of lime, silica, and alumina—that is, lime and clay. There are sometimes other foreign matters, such as iron, magnesia, &c.; but they form a small portion of the whole. When burnt into quick lime, it may be slacked with water like the rich lime; but the disruption of the particles and the heat given off is not nearly so violent as in the case of rich lime slaking, and, indeed, some limes will hardly slake at all without being previously ground into fine powder; the Elgin or Charleston lime and the Arden lime are instances of this, and they are the best hydraulic lime in Scotland.

The third class, viz., cements, may be called "very eminently hydraulic limes"—that is, with a great proportion of silica and alumina. They set rapidly either under water or in the air, and have to be ground and finely sifted before being used, as they would not otherwise slake. Rich limes may be made to set under water—that is, made artificially into hydraulic limes by the addition of calcined clay; and, indeed, Portland cement is nothing more than the chalk and plastic clays found in the London basin, mixed up together, burned, and ground to a fine powder.

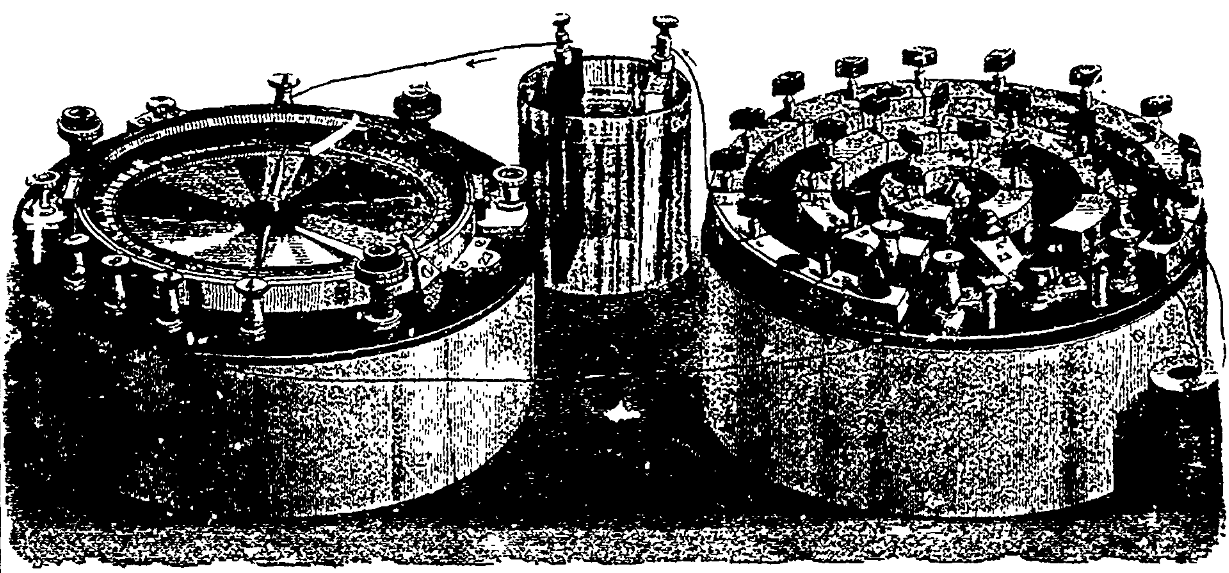
The ingredients chiefly used for making mortar in this country are, of course, lime, sand, and ground smithy ashes, mine dust, burnt bricks, and tiles. In foreign volcanic countries, such as Italy, they use what is called puzzuolana, which is a kind of clay that has been subjected to great subterranean heat. The quality of sand used is of great importance. It ought to be clean and sharp, or angular, so that the lime or cementing material may get thoroughly into every pore. If it be a loamy sand, for instance, the particles will be often sticking together in clods, and are thereby kept from being cemented together. The sand, then, ought to be perfectly clean, so that each grain may get completely surrounded with the matrix of lime or cement. Yet how often do we see builders in this city deliberately making their



ROCK DRILL AT VIENNA EXHIBITION (See page 103.)



ROCK DRILL AT VIENNA EXHIBITION (See page 103.)



BRADLEY'S APPARATUS FOR ELECTRICAL MEASUREMENT (See page 102.)

mortar with the alluvial soil they had dug out of the foundations, just because it was ready to hand. Ground bricks and ashes have a tendency to make lime more hydraulic in its properties, and mine dust, which is the refuse from iron ore at the calcining ovens, has a most excellent effect, provided that it be thoroughly ground and mixed with the lime in the grinding pans, so that the particles may be small enough to effect the desired chemical union. It may be here remarked that all those materials which, when mixed with lime, render it hydraulic, must have been subjected either to subterranean or artificial heat previous to slaking.

There are many ways of slaking mortar. The common plan is to throw water on the heap of shells; another is by immersion, that is, dropping the shells in a basket amongst water, and quickly drawing it out again; another is to allow it to slake spontaneously by exposure to the air, as is often done by farmers when used for the land. In slaking mortar care must be taken that no more water is used than what will cause the lime to fall to a dry powder, that is, not more than the lime will absorb, but still sufficient to cause sufficient disintegration. If more water be added, then setting immediately commences, which is more or less rapid according as the lime is more or less hydraulic. After slaking the shells the resultant powder ought to be kept for some time under cover, in order that the particles may have time to get completely disintegrated. A week is probably sufficient for this purpose. When the slaking process is accomplished, the resultant powder may be mixed with the sand and other ingredients, with sufficient water to render the mass plastic.

Another plan is to grind the lime before slaking along with the mine dust or puzzuolana, and in that case the mortar may be used immediately after slaking, indeed the slaking and mortar making form one operation The grinding dry is a more expensive, but perhaps it is the best plan, as I believe a good deal more benefit will be got out of the puzzuolana if mixed with the lime before it is slaked. Then in the method of slaking, first, it is necessary to grind the mortar after water is applied, in order that the mine dust may be reduced, and the grinding action has the effect of destroying the angularity or sharpness of the sand, thereby reducing the tensile strength of the mortar by depriving the sand of the dovetailing effect which is due to its angularity. Again, a great amount of heat is caused by the motion of the heavy grinding wheels moving at a considerable velocity, and that heat may have some deteriorating effect upon the setting properties of the mortar. In the case of a quick-setting cement grinding is positively the worst thing possible, for it disturbs the setting when it is actually going on; and if a cement be continually mixed up for as long time as it would take to set, and get hard if left alone, it would be found that it would be completely destroyed. A case in point occurred last year on a new graving dock work, where the cill had to be taken out because it was leaking and therefore likely to give way when the pressure of the water was brought to bear upon it. The contractor pleaded that the fault in the work was in the cement, which had been specified to be ground for fifteen minutes after water was applied, thereby destroying the setting properties of the cement, which would have set within the stated time of fifteen minutes had it been let alone. The case came to arbitration, and the arbiter decided that the specification of the cement mortar was impracticable, and relieved the contractor of all responsibility. This shows how careful engineers require to be in drawing out their specifications, and that a complete knowledge of the materials to be used is indispensable.

The safest plan is to grind the cementing materials dry, and then slake and mix up the mortar by one operation in a pug mill. By this means we have the lime and puzzuolana or mine dust thoroughly mixed and reduced to powder, which admits of the water getting at every particle whenever applied and then the sand, which is added with the water when in the pug mill, is preserved in all its angularity and sharpness. If, however, this latter plan be adopted, the mortar must be used soon after being mixed up, not longer than twenty-four hours for lime or half an hour for cement; but then, again, there is a risk in using it too soon, because, if the particles of lime are not properly slaked before being placed in the masonry, "blowing" may occur, that is, those unslaked particles will draw in water, and swell up, causing the stones to be shifted out of their positions.

It is also interesting and useful to know what quantity of mortar or concrete is to be expected from a given quantity of materials measured separately—in other words, the contraction in mortar making—since it is only by information on this contraction that we can deduce a theory by which the quantity and cost of mortar can be calculated.

The cost of mortar plays a very considerable part in the expense of masonry, and if engineers or architects do not define the proportions in their specifications, I do not think it can be expected that builders can make reliable estimates; and it is impossible to expect first-class mortar when the offerer is not told it is required to be so, for in a competing estimate he will make it up as if a cheap mortar were to be used. The perfection of mortar must be when every particle of sand is imbedded in a matrix of cementing material and no more, in the same way as obtains in a piece of sandstone. If, therefore, we can get at the amount of voids that exist in a given quantity of sand, that ought to be the quantity of lime required to thoroughly incorporate the given quantity of sand A cubic foot of sandstone weighs from 130 lb. to 170 lb., and as much of dry loose sand weighs 88 lb.; so that assuming the cementing material of the sandstone to be of the same specific gravity as the particles of sand in it, the amount of space in loose sand ought to be from 40 to 50 per cent. of the whole bulk. In corroboration of this I may give a note of some experiments taken out of Vicat's work on cements which were carried out by ascertaining the amount of space by measuring the quantity of water the sand licked up, without increasing the bulk, the results were that gravel of ¾in. diameter (beans) had 50 per cent. of void, gravel or coarse and, $\frac{1}{10}$ in. to $\frac{2}{10}$ in., had 42 per cent. of void, sand of $\frac{1}{20}$ in. diameter had 40 per cent. of void, sand of $\frac{1}{100}$ in had 33 per cent. of void, powder or very fine sand 30 per cent. of void.

Thus it will be seen that the spaces vary from 30 per cent. to 50 per cent. of the bulk of the sand. To be safe, therefore, no mortar ought to have less lime in it than 50 per cent. of the bulk of sand, that is two of sand to one of lime. Now if a mixture of two of sand to one of lime be tried the resultant mortar is nearly equal to the sand, just what we ought to expect from the theory already stated. The water seems all to be absorbed by the lime, and does not bulk provided there is not an overdose of it.

THE SAINT GOTHARD TUNNEL.

The accounts of the progress of this great work to the end of March are satisfactory. According to the accounts of the Swiss Federal Council the driftway had been driven on March 31 to the extent of 252 metres, enlarged to its full size along 210 metres, and the masonry finished over a distance of 103 metres. The average number of men engaged in the work during the month was 617, and the maximum number 813. On the Gœschenen side the tunnelling is through granite, or a hard gneiss, more or less faulty, and full of fissures. On the last day of March the first experiment in mechanical perforation was made with the machines of MM. Dubois et François. The operation took place on the Airolo side, through a schist in beds of unequal thickness. At the distance of 148 metres from the mouth the temperature of the air was 13° c. and of the water 70° c., the air outside the mouth of the tunnel showing a temperature of 7°; at 162 metres the air rose to 17° c., when the outer air showed 9°.

The infiltration, which was trifling at first, grew in proportion as the increase of the mica and the diminution of quartz, and the frequency of argillaceous beds between the mica schist, all of which circumstances, of course, diminish the consistency of the soil excavated. The quantity of water augmented considerably at the point of 164 metres; a stream broke in at the rate of more than sixteen gallons per second, and disintegrated the rock to such an extent that several slips occurred, and the work was suspended in consequence for some days. At the end of March the out-fall of water at the mouth of the tunnel was found to be equal to about nine gallons per second.

RAILWAY MATTERS.

The rails are being rapidly laid on the Galt & Doon Railway.

The permanent way of the Toronto, Grey and Bruce Railway will be completed between Wroxeter and Teeswater in about a month, between Harriston and Wroxeter the work is not progressing so rapidly.

The St Gothard Railway.—According to the latest official returns it appears that the progress made, up to the 30th of April, at the St Gothard tunnel, was as follows:—At north end, Goschemau, 117 metres; south, Aisolo, 177 meters. Total length of gallery driven up to the 30th of April, 294 metres; to the 31st of March, 252 metres. Length driven during the month of April, 42 metres.

Progress of the Hoosac Tunnel during the Month of June, 1873.—Headings advanced westward, 131 feet; eastward, 126 feet. Total advance during month, 257 feet. Length opened from east end, westward, 14,084 feet. Length opened from west end, eastward, 9,540 feet. Aggregate of lengths opened to July 1st, 23,624 feet. Length remaining to be opened July 1st, 1,407 feet, being 87 feet more than one quarter of a mile.

A new car, intended for railway construction and ballasting purposes, has been introduced into the United States. The floor is composed of a series of trap doors, which, when open, make a kind of grating, and when closed form a level surface. Being loaded with ballast, and removed to any required spot, the contents, by simply loosing a bolt, drop through upon the track, and an arrangement beneath secures their distribution between and outside the rails, which are kept clear. The invention is claimed to cost but little above an ordinary platform car, and it evidently saves much time in shovelling.

In every car on the Connecticut River Railroad there is a box overhead, at one end in which is contained the name of the next station, which it is the duty of the brakesman to change as they leave the stations. And it goes further; it states where they connect with other roads. As the change is made, a bell strikes twice, which attracts the attention of the passengers, so that the box always exhibits the name of the next station, and so on. Thus passengers always know the name of the stopping place, and also if it connects with any other railroad.

Machine for Testing the Condition of Rails.—A Russian engineer named Sakhovsky, has invented an apparatus, a kind of differential gauge, of very simple construction, which is said to have been found to work admirably at the Moscow Terminus of the Nijni Railway, and on several other lines. The apparatus consists of a wooden beam, about five feet long, provided at one end with an articulated lever, on the shorter arm of which is a stud that presses, by means of a spring, against the inner face of one of the rails, and at the other with a fixed stud, the beam is drawn along the rails by a man by means of shafts, or it may be attached to a truck. As the gauge proceeds along the line, the deviations from the normal width between the rails is shown by the longer arm of the lever, which moves against a dial-plate. The apparatus costs only eight roubles, and its superiority over the common gauge is striking, especially as regards the rapidity and continuity of its action. The directors of the Nijni and other lines have adopted the invention, which we believe is patented. Such a gauge run along a line every morning might save many an accident.

Singularly enough, the *Iron Age* argues that paper is to become the general, if not the universal substitute for wood, leather, and indian rubber, as also, to some extent, for copper, tin, and zinc, and that even iron is not adapted to uses so widely various—it being practicable, indeed, to bring paper pulp to such a state of toughness and solidity, by pressure as to be almost as fire proof and indestructible as iron, and thus our railroad cars may be made of paper, instead of iron, thereby preventing the dangers now incurred in case of accidents It is claimed that, in proportion to its weight, paper is, probably, the strongest material of construction known, combining more perfectly than any other substance the qualities of strength, lightness, flexibility, durability, and cheapness. So many and various, too, are the articles which can be made, that it can be manufactured in quantities practically unlimited in every civilized country, and, so long as plants continue to grow, paper manufacture can be sustained. It is, also, under all circumstances, an easy material to work and handle. The fact is probably well known that the paper wheels which have been used with success on some of the palace-cars are formed of compressed paper fitted into a steel tire; iron plates are then adapted to each side of the paper, and bolted together to prevent any displacement of the filling.

DOMINION.

A joint stock company has been formed at Teeswater for the purpose of sinking a well to ascertain if salt can be found in that locality.

The Hamilton city bell tower is now 55 feet high, and 26 feet more are to be added. Its appearance is at once substantial and ornamental.

The shipments of oil from the Petrolia station for the week ending July 10th, were 5,060 brls. crude, 6 refined, and 2,940 distilled.

The Kegashka Magnetic Iron Ore Company, with a capital of $84,000 in $50 shares, intends applying for incorporation to carry on operations in the county of Saguenay with the head office in the city of Quebec.

The total shipments of oil from Petrolia station from the 1st of July, 1872, to the 1st of July, 1873, were 495,423 barrels. The totals for the three kinds shipped:—crude, 386,286 bbls.; refined, 13,195 bbls.; distillate, 95,942 bbls.

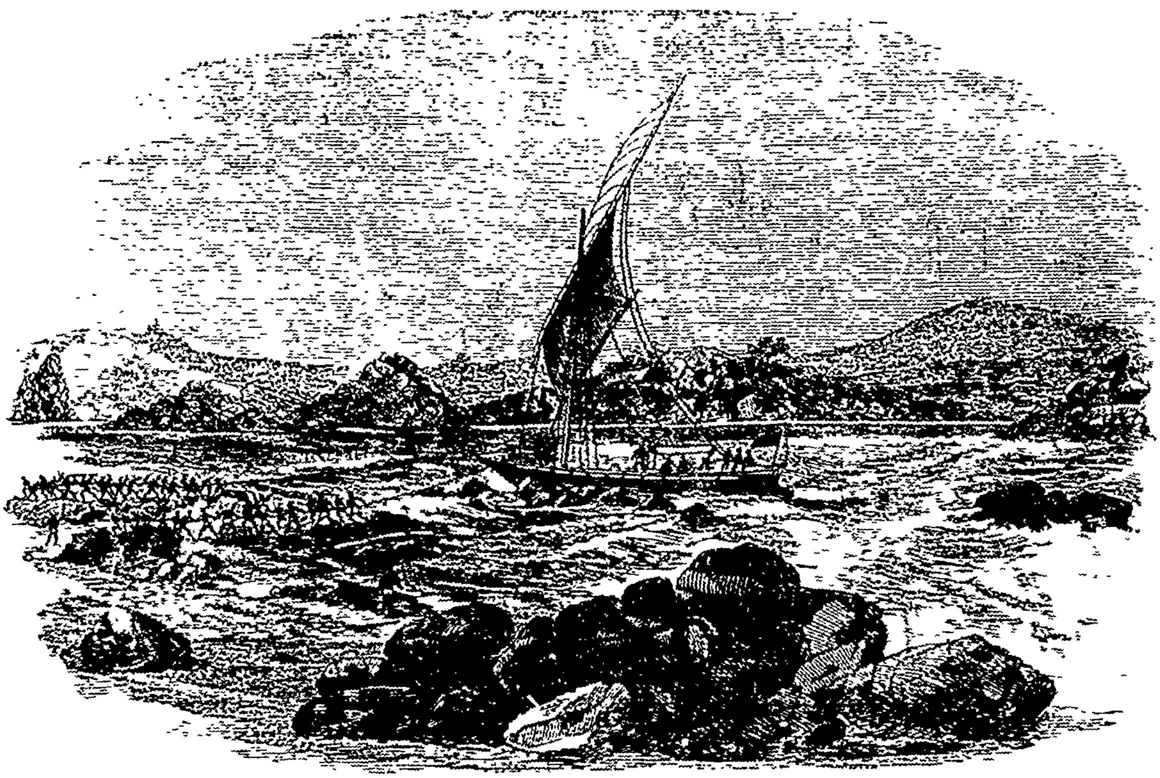
The Belleville *Ontario* says:—Mr. Vennor, of the Geological Survey, is at present making some explorations in Hull and Templeton. He reports favorably on one or two deposits of Baryta. The iron will require some further investigation; as will also the Apatite or Phosphate of Lime. Dr. Harrington will visit both the Hull and Haycock Mines during the coming week.

Very favourable accounts are given at San Francisco of the Douglass coal sent from Newcastle Island by the Vancouver Coal Co. It is reported that the Pacific Mail Steamship Company will become customers for a large quantity of Nanaimo's Black Diamonds, which are the best produced on this coast.

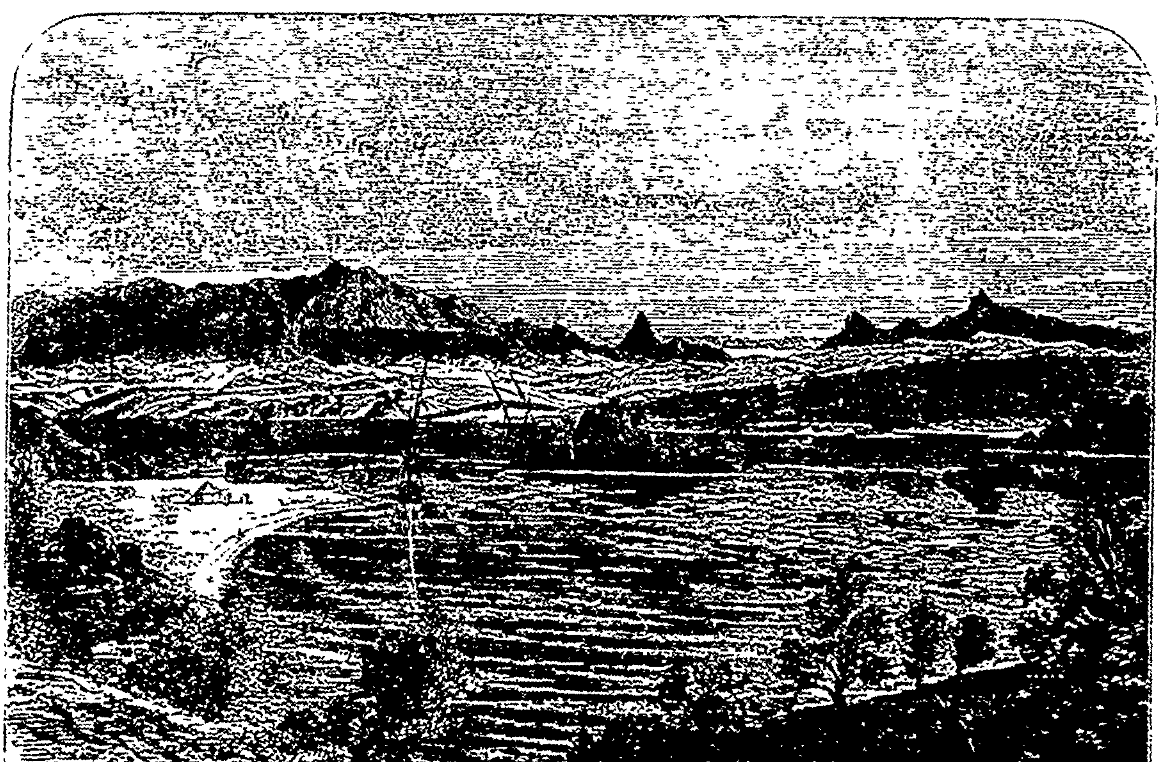
The Lower Fraser *Guardian* says coal of superior quality has been discovered at Chiliwhack by an Indian, who has made known its locality, and a company has been formed to work it. The seam is half a mile from Chiliwhack River, and eight miles from the Frazer. Caverns—in one of which Mr. Shannon, one of the prospecting party, walked 300 feet, are seen there.

Goderich.—An English and Canadian Salt Company, with a capital of $130,000, have purchased, to-day, the large farm to the south of the town known as the Wilson farm, for the sum of $9,000, where they intend to commence at once the manufacture of salt on a large scale. The demand for Goderich salt has now become very great in the Western States, and the wells at present in operation, to the number of thirteen, cannot half satisfy it. There are half a dozen buyers in town now from Chicago, Milwaukee and other places in the West, and we may expect to see any number of wells put down during the season. Property has increased in value fifty per cent., and buildings are going up in every direction and Goderich promises to become a very important place.—*Globe* of the 8th July.

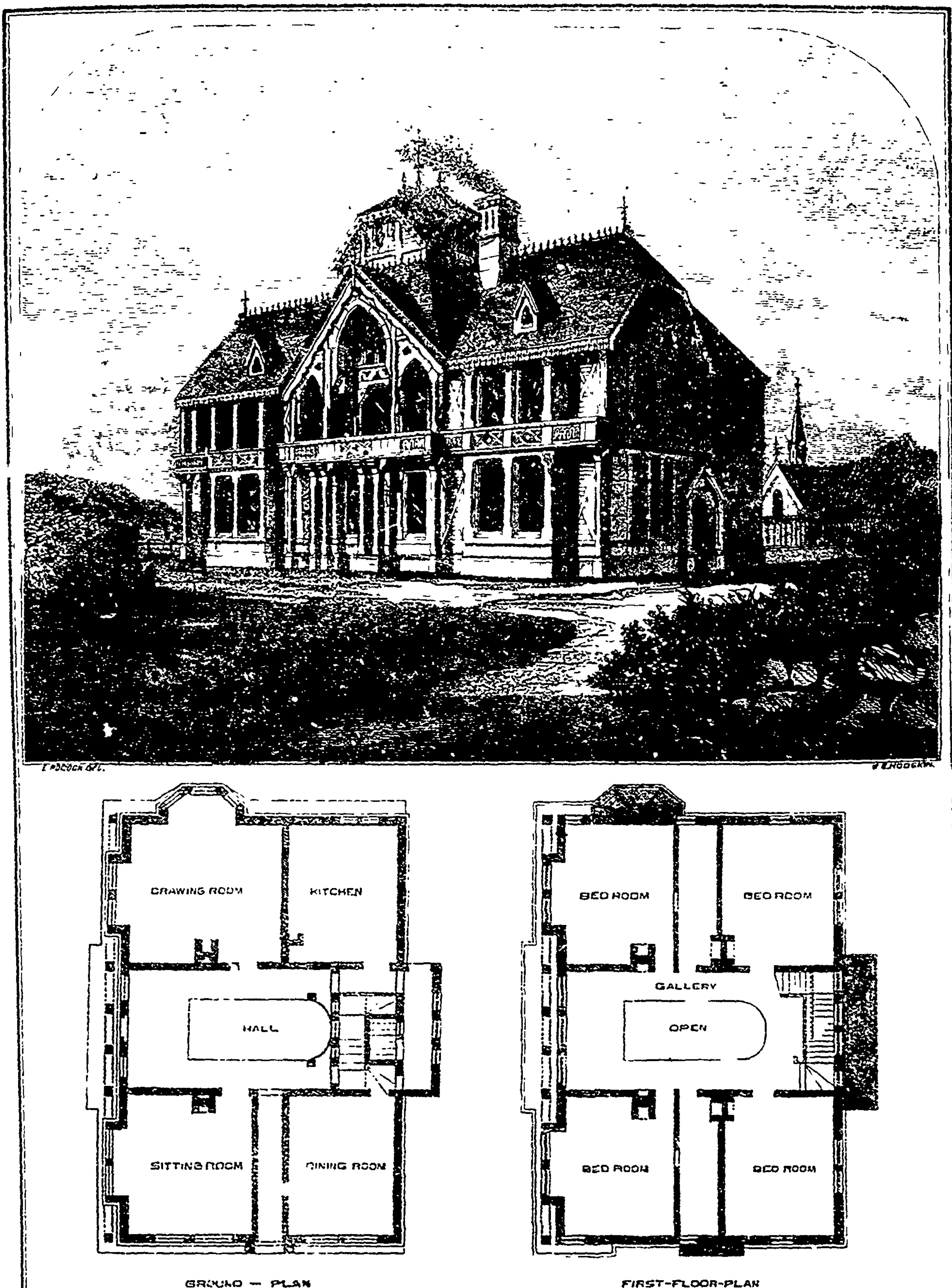
Artificial Indian Ink.—C. Kochlin, of Mulhausen, finds that by mixing lampblack with ten times it weight of sulphuric acid (sp. gr 66° Beaumé), allowing the same to stand for some hours, and then washing out all the acid, the material has acquired the power of mixing readily with water, and possesses all the properties of genuine Indian ink.



HIGHER CATARACT OF AMBIGOLE.



SOUDAN RAILWAY EXPEDITION (See page 111.)



DESIGN OF WOODEN HOUSE (See page 118.)

MECHANICS' MAGAZINE.

MONTREAL, JULY, 1873.

Quebec does not at present seem inclined to remain far behind Ontario in the matter of roads. We have just witnessed the completion of a new short line to Boston viâ the Passumpsic R. R. The North Shore Road now seems to be an assured fact. A surveying party under charge of General Seymour left Quebec on the 14th inst. for Three Rivers in order to re-examine the North Shore between that place and Montreal, and at a recent meeting of the Board of Directors the President stated he had received information of the determination of the contractors to carry out the contract. The amount of local traffic along the North Shore is increasing very fast. We were very glad to see on passing Lanoraie recently a pile of new T rails and judge from this that it is the intention of the proprietors of the line between the St. Lawrence and Industry to replace immediately the old strap at present in use there by good rails. The shareholders of the Missisquoi and Black River Valley Railway have also recently met and negociations have been entered into for the early construction and equipment of this important road, should the municipalities, companies and others directly and indirectly interested, promptly extend the aid fairly expected of them.

The influence of the newspaper press seems to be extending itself in directions where such enterprise would hardly have been looked for. The N. Y. *Herald* sends a man to find out Livingstone in the centre of Africa. The task seemed hopeless but the result shewed how little we know what can be done in this age. The *Daily Graphic* of the same city now comes forward as the chief supporter of an attempt to cross the Atlantic Ocean in a ballon. The subject has frequently been talked of before, but now it has assumed definite proportions. There is no doubt but that the attempt will be made. As to the probabilities of success they are of such a nature as few if any men can talk about with any authority. There may very probably be an upper current of air constantly setting towards the old continent at a rate of from forty to one hundred and fifty miles an hour. It is stated that proofs of the existence of such a current have been established. If this current really exist the passage would certainly be deprived of most of its terrors. The most powerful auguries of success, however, are that the equipment will be of the most perfect and thorough character and that the enterprise is entered upon in no spirit of bravado but of quiet determination. As the *Graphic* says, "The balloon will not be exhibited to make a sensation, but as soon as it is finished will take its flight." As we said before, it is hard to say now a days what it is possible and what is not. It only remains to hope that the success which has so steadily borne the *Graphic* along hitherto may also be attendant upon this new enterprise.

According to latest accounts the interior of the Exhibition building at Vienna was at length in a completely finished state but some few arrangements remained to be made outside. The amount of work to be done there may be estimated from the fact that some people in Vienna said that the Exhibition would never be quite finished. We shall illustrate and describe as far as possible such exhibits as may be of interest to our readers. The Machinery Hall, one of the most interesting features to mechanics is probably the largest building of the kind in the world, being 2615 feet long by 164 feet wide. It consists of a central nave flanked by an aisle on either side. According to *Engineering* the shafting is arranged otherwise than is usually the case. There are two lines of main shafting carried by as many rows of cast-iron columns erected parallel to the axis of the building, each row being 3 metres distant from that axis, the columns are consequently 6 metres apart transversely, while longitudinally they are set at distances of 3.57 metres. Their heads in each row are connected together by massive plate girders, while transversely also every column is connected to the corresponding one of the opposite row. As a rule each column is a cast-iron tube 0.24 metre in diameter in the shaft, and swelling out at the base; but wherever a stationary engine is situated the arrangement is slightly different, for here, for the sake of greater security, four ordinary columns are grouped together and bolted into one. The shafting is 0.09 metre (3.6 in.) in diameter, and is carried on American adjustable bearings which can be raised or lowered vertically through a considerable distance by means of screws working in lugs which are cast on to the tubular columns. The boilers are all located outside the main building in separate sheds, each country exhibiting machinery in motion having its own boiler house. These consist merely of rectangular pits sunk in the earth to such a depth, that the tops of the boilers come up to about the level of the ground; the pits are of course bricked in, and access is gained to them by a flight of steps on either side, so that the public can view their contents as objects of exhibition; they are, moreover, each surrounded by brick parapets, and are covered over by plain shed roofs supported on open timber framing. Each house has its own chimney, consisting of a long tube of wrought-iron plate, standing on a brick pedestal and stayed with chains after the manner of the funnel of a steamer.

These tubes are much admired by some English engineers from an economical point of view, the price of a large brick stack being far greater than that of a plain wrought-iron tube lined for a short distance up with fire-bricks. They say that if such stacks are good enough for use at the Vienna Exhibition they ought to be good enough for almost universal use. The show of boilers is not very good except in the locomotive department and none of the makers shew anything in regard to the making, staying and putting up of boilers, which is regarded as a serious omission. The shew of locomotives by Continental makers is very good, but there are but few exhibitors in this department from England and none from America, in spite of the fact that American wood-burning locomotives are being extensively imported for use in Russia. Those exhibited are of all classes from the finely finished express engine built at Antwerp with four coupled drivers 7 ft. 4 in. in diameter and the numerous heavy locomotives for very heavy traffic, to the little narrow gauge engines with drivers from 2½ to 3½ ft. in diameter. Taken altogether the locomotives exhibited constitute the largest and finest collection of the kind ever exhibited.

The workmanship and finish in this class as in others is said to be of very high merit.

REVIEWS.

Analytical Report on the Water Supply. By Dr. Baker Edwards, Bishop's College, Montreal.

The Montreal water supply has been a subject of discussion for some time past in this city, and the question as to the best means of obtaining a sufficient quantity of pure potable water is still an open one. The part of the question taken up by Dr. Edwards has reference chiefly, if not entirely, to the qualities of the different waters accessible. Twenty-two samples of water from different localities were examined. These waters are grouped as follows:

Group A.—Waters from the North divided into two classes: 1st. Lake waters, pure and free from alkali; 2nd. River waters characterized by organic carbon and alkaline silicates.

Group B.—Mingled waters of Group A. and Group C., taken at different seasons of the year.

Group C.—River waters of the great chain of lakes westward to Niagara River.

Group A.—These waters are very pure, but are objectionable from three causes.

1st. Alkaline silicates cause diarrhœa.

2nd. Shallow and sluggish streams collect during the summer season an enormous volume of organic germs and spores, both animal and vegetable, which are unwholesome and should therefore be removed by filtration.

3rd. All these waters act as solvents on lead, and where the supply is intermittent, the contamination of lead is injurious to all consumers and poisonous to certain individual constitutions.

Group B., is the present town supply which varies greatly at different seasons of the year, the solid contents ranging from 7 or 8 to 14·1 grains per gallon.

Group C., seems to be by far the best if a constant supply of it could be obtained. The city does sometimes, from causes connected with the formation of ice in the river bed, obtain this water, but the general supply is represented by Group B. The waters of Group C. are represented as remarkable for their purity, brilliancy and excellent keeping properties. They contain but little organic matter, are free from alkalies, and do not dissolve lead. The mineral ingredients also are of the most wholesome character.

This excellent report concludes with a full table of analysis setting forth the locality, date of collection, mineral contents, hardness, appearance, &c., of all the different samples collected.

Wood's Household Magazine for July is a very excellent number. It is household, not only in name but in character, and its table of contents shows a wonderful adaptation of articles to the individual members of the family circle. "Sim's Little Girl," a temperance story by Mary Hartwell, "Weathertough Block," by Karl Kase, "How The Vow was Kept," by H. V. Osborne, "Lunatics at Large," by Rev. F. W. Holland, and "The Declaration of Independence," by J. B. Wakeley, D.D., are among the more noticeable articles. The Children's Department is extremely full, and contains a poem, in baby-talk, which without doubt, will be very acceptable to the little ones. The price of the magazine is one dollar a year.

THE SOUDAN RAILWAY EXPEDITION.

(Continued from page 77.)

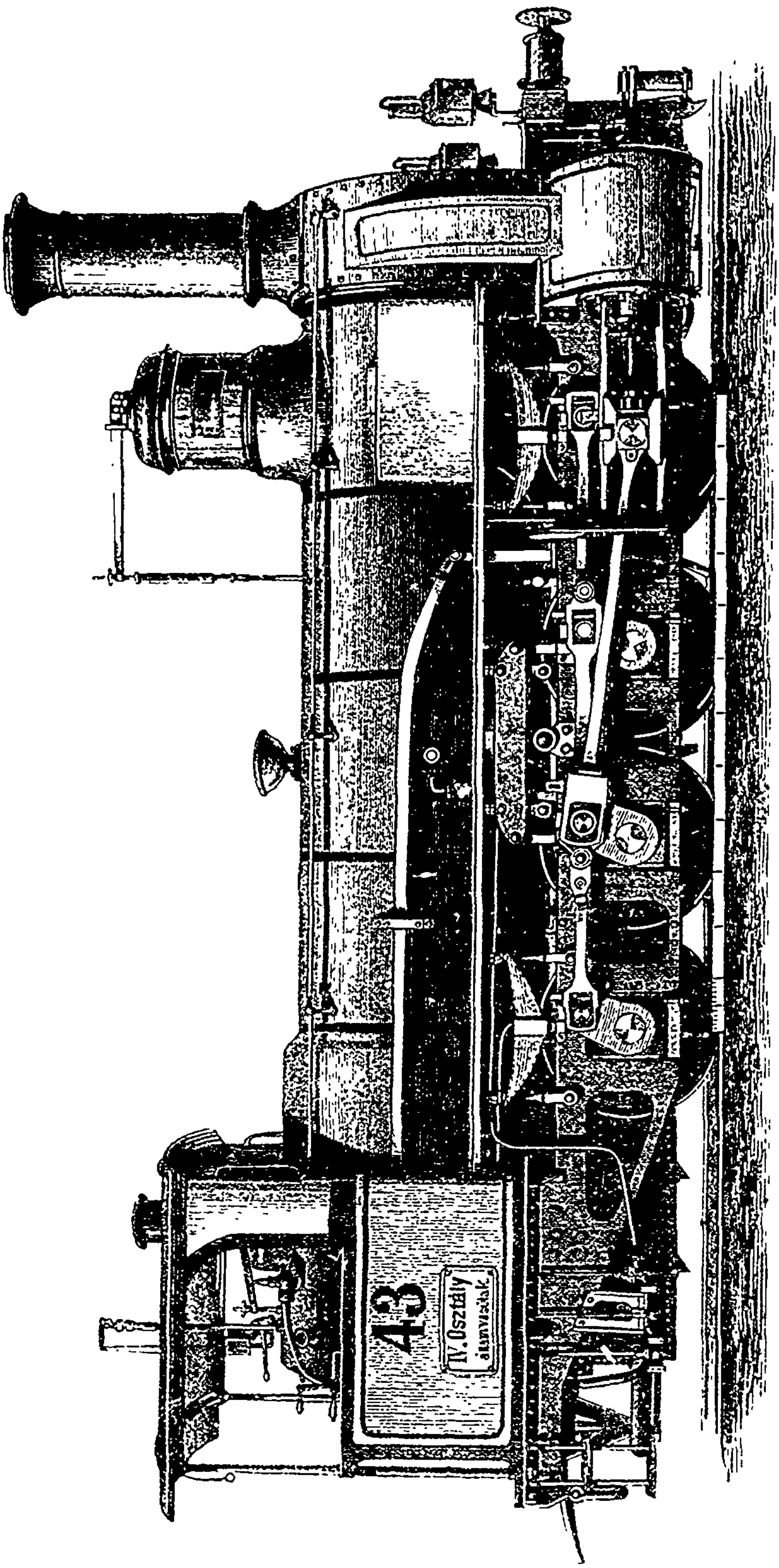
After these few observations upon Egyptian native irrigation, we may return to the surveying party, which we left at the head of the First Cataract making the necessary preliminary studies for the ship incline, that forms the first part of Mr. John Fowler's project. These studies having been completed, and the stores reshipped on board the Dahabeahs, the journey southward was resumed under sail. As many of the sailors belonged to the region of the First Cataract, and as their voyages seldom extend beyond the trip between Cairo and Assouan, a large party of friends and relatives assembled on the western bank to witness their departure to the—to them—unknown regions of the Fifth Cataract, and to testify their sympathy by howling in many keys. The Nile, between the first and second cataracts, presents but slight difficulties to navigation, but as the north wind had not set in, the progress of the boats was slow and tedious, because it was necessary to resort to towing, fifteen to twenty miles a day being the maximum result produced by the Arab sailors, and the populations of the various villages on the route, who were called in to assist in the operation.

The progress was rendered more difficult by the fact that where the banks were rocky the foothold for the men towing was very bad, whilst, on the other hand, in traversing irrigated and cultivated districts the tow-ropes had to be passed over the Zakiehs, which were numerous on the river-banks, and great care had to be exercised to preserve the standing crops from damage.

After proceeding about 80 miles from Assouan, the course being a little west of south, Korosko, or rather Jebel Korosko, a mountain near that place, rises in view on the western bank of the river. The town of Korosko is one of the most important stations on the Egyptian camel routes, being upon the direct caravan course to Khartoum. The houses in the town are flat-roofed, and are built of mud and sun-dried bricks. It contains a bazaar, and holds a market twice a week, at which sandals, made by the Bishareen Arabs, form one of the great staples of commerce.

The traffic coming up the Nile to Korosko leaves the river at this place, and, striking across the Bishareen Desert, a distance of 200 miles, with but one well midway, meets the Nile again at Abou Hammed, after a journey of eight days. By river the distance between the same points is 500 miles. A large amount of gum, ivory, &c., is brought from the interior across the desert to Korosko, where it is shipped to Cairo.

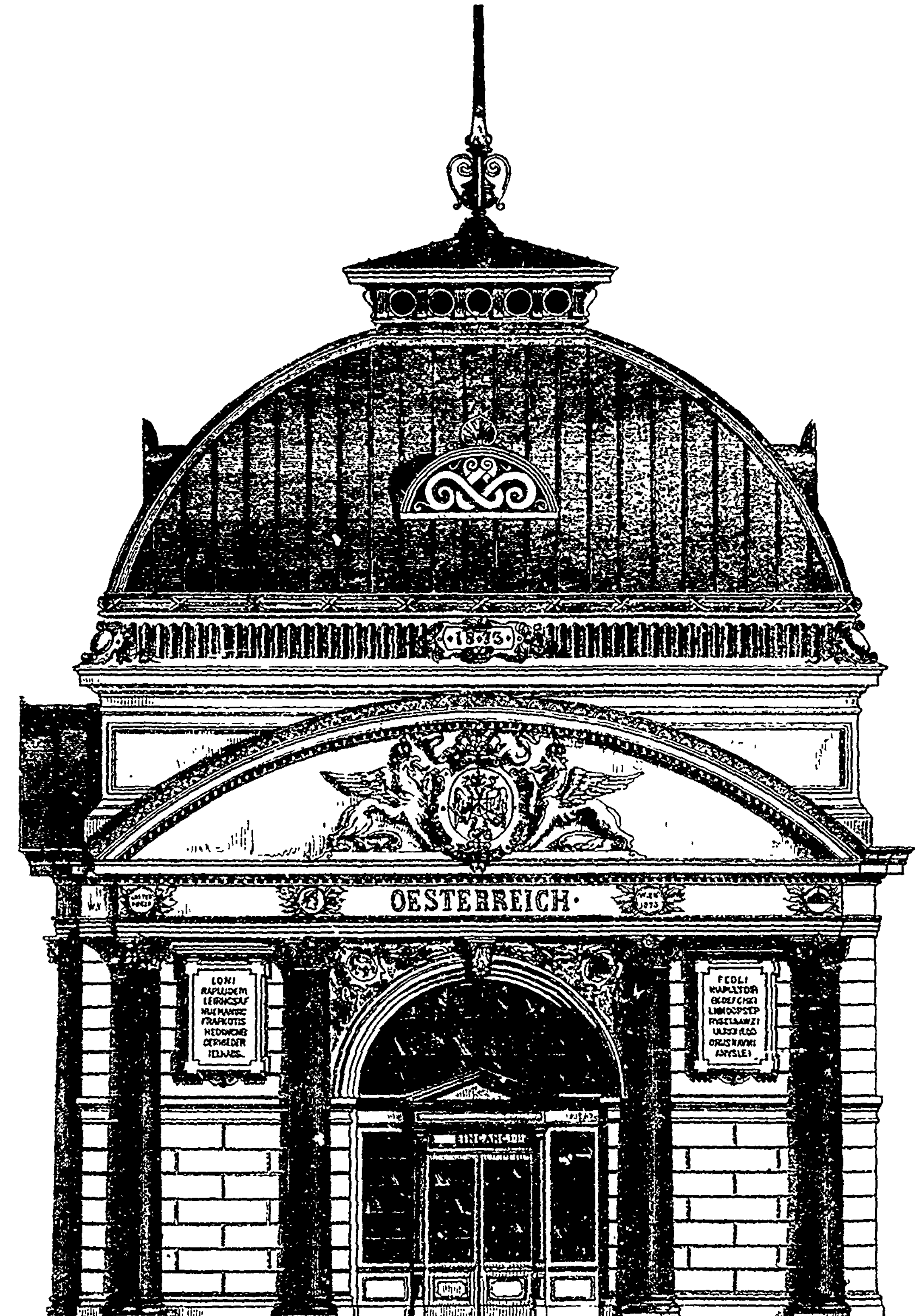
At Korosko, the Nile makes a bend to the north-west for a distance of about 12 miles, then, passing the rock temples of Abou Simbel, it returns to its former direction, which it follows until Wady Halfa, the northern terminus of the Soudan



GOODS LOCOMOTIVE FOR THE ROYAL HUNGARIAN STATE RAILWAYS, AT THE VIENNA EXHIBITION.

CONSTRUCTED BY HERR G. SIGL, ENGINEER, WIENER-NEUSTADT.

(See page 99.)



VIENNA EXHIBITION, FRONT END OF TRANSEPT.

Railway, is reached. When the Dahabeahs arrived at the Second Cataract, a short distance above Wady Halfa, it was necessary to take careful soundings through the navigable channels, in order to ascertain if there was sufficient depth of water for the Dahabeahs to proceed. Investigation proved that such a course would be unsafe, and even if it could be done, the Reis of the Cataract estimated that two weeks would be occupied in the operation, if the whole available force of the Arabs were employed in the work. The difficulty of the operation may be estimated when it is considered that the length of the cataract is about 14 miles, while, in the state in which the Nile was at this time, the water rushed through the navigable channels with fearful violence. It having then been determined to abandon the Dahabeahs, and to take in their place the Noggurs, or cargo boots peculiar to the Nile above the Second Cataract, the whole of the stores and effects were transferred to camels, and taken by them over the 14 miles which separate the foot from the head of the cataract, to be reshipped into the smaller vessels, twelve Noggurs being required to carry the whole staff, servants, boatmen, and stores. For some distance south of the Second Cataract the river runs through sterile and uninviting country; the east side is covered with masses of black rock, the west with mountains of yellow drift sand, which has doubtless travelled from the Great Sahara Desert. The navigation for a long distance is difficult and dangerous, constant eddies and bubbles marking the presence of scarcely-hidden rocks, until after 30 miles of tedious sailing, the fall of Sumeh is reached. The channel usually taken by the Noggurs is almost in the centre of the river, any is not more than 200 yards wide. This channel is closed in on either side by precipitous granite rocks; rising to a height of 50 feet or 60 ft. above high Nile, while on the east and west banks of the river the cliffs rise to a height of 400 feet or 500 ft. On the highest rock upon the eastern bank stand the ruins of a temple, of which, however, little but the bases of the columns remain in position On the western side is a small temple, of which the doorway and a chamber still exist In this barren tract the mimosa occasionally relieves the aspect of the sterile rock, and now and then the presence of a small patch of alluvial deposit is indicated by a cluster of date and dome palms, which have escaped the heavy storms and sand-drifts of the desert.

Twelve miles south of Sumeh are the falls of Tangour, in one part of which occurs a fall of 3 feet. As a favorable wind was blowing hard at the time that the Noggurs arrived at these falls, they were enabled, after several ineffectual attempts, to get through the greater part of the fall under canvas alone, but it was found prudent that each boat should pass through separately. At a short distance above Tangour is the Cataract of Ambigole, the navigation between the two falls being of a very difficult character. The Cataract of Ambigole, a sketch of which is given on page 108, is divided into two principal falls or passes, one on the east, known as the Virgin's Pass, and the other on the west side called the Father's Pass. The formation here is also granitic, and the river has cut its broken way through the hard rocks with singularly wild effect. At the foot of the Virgin's Pass the river is divided by an island into two channels, and this barrier, combined with the abrupt ending of the island on the northward, creates a very powerful cross current, which takes a direction almost at right angles to the current on the east.

In navigating this part of the river under canvas, the Arab and Nubian sailors showed wonderful skill in handling the Noggurs, which under their management developed unlooked-for sailing qualities. Lying under shelter of a rock until the wind freshens sufficiently, the Reis awaits his opportunity, and when it arrives he makes a dash, keeping the head of his boat across the stream, the course on the port side being studded with rocks that would be fatal to the vessel in case of failure, then sailing her about a quarter of a mile to westward he clears the cross current of 9 miles an hour. About a mile further, but on the west side of the river is the second or higher fall of the Cataract of Ambigole. This rapid, which has a fall of 4 ft., requires the aid both of canvas and towage to surmount it, as shown in the sketch. The channel in its narrowest part is about 200 yards wide, and has cuts through the granite rocks some 200 ft. in height. Here, again, as at Sumeh, are scattered mimosas, which have rooted themselves in some of the narrow crevices of the rock, and live upon the scanty amount of Nile deposit accumulated therein. At the head of the Cataract of Ambigole, are seen broken conical mountains, the hollows in which are filled with yellow drift sand, varied with occasional tufts of coarse desert grass. On the eastern side of the river at this place occurs an island of granite boulders grotesquely grouped, and relieved with trees, which grow freely in the alluvial soil deposited upon the island by the Nile. Such islands are, indeed, about this district, by no means uncommon, and combine to make the scenery in this portion of the river, and of which the above sketch conveys a good idea, almost beautiful. Four or five miles higher up the picture again changes, the granite rocks becoming bolder and more rugged, and rising perpendicularly for some hundreds of feet. The river here takes a sudden turn to the east, and for several miles the scenery is remarkably picturesque, the rocks now rising vertically, and now sloping gently upwards from the river, slight signs of vegetation occasionally appearing, until almost suddenly this is exchanged for a broad expanse of water, and the Cataract of Dal. Detached blocks of granite of enormous size here lie singly or piled together in the stream, which rushing through narrow water-worn channels, or boiling over hidden rocks, rush to the calmer water at the foot of the falls.

In passing through this cataract, the wind lulled, and left several of the Noggurs, which had before been well able to hold their own against the rapids, fast upon the rocks, and it was found necessary to relieve some of them of part of their cargo before they could be floated again.

Ever since passing the Second Cataract a strong north wind had favoured the party, but at Dal the boats lay becalmed for three days, and subsequently two days more were lost from the same cause, whilst towing, at this part of the river, was quite impossible.

After a total delay of six days a strong north wind set in, and the remainder of the cataract was traversed under sail. The river here is broken with islands, some a mile in length, with cliffs 200 or 300 ft. in height; in many cases crowned with rude fortifications of a very ancient date; on one bank of the river, too, the granite hills rise abruptly, and the date and dome palms grow freely. Camels had awaited the party at the Cataract of Dal, but they were of course useless while the boats were lying becalmed in the middle of the river, and as, after a fresh start was made, the wind continued steady, it was decided not to employ the camels, as the transit overland would have been slower. At the village of Zergamatto, an infantry sergeant of the Khedive's army was placed on each boat; these officers being intended to overcome any transient hesitation on the part of the local residents to assist in towing. The wind continuing fair, the distance between Zergamatto and Kohé (about 60 miles) was easily traversed, 50 miles having been made under sail, and against a strong current. one day.

We may now briefly indicate the direction proposed for the railway from Wady Halfa as far as Kohé, where the bridge crossing the Nile is to be erected. A level alluvial plain on the eastern bank, which forms a good landing-place from boats at all stages of the Nile, and is in all respects thoroughly adapted for a terminal station has been chosen, the town of Wady Halfa being the point of commencement, whence the line runs by easy gradients on earthworks to the foot of the Second Cataract, 6 miles above Wady Halfa, and thence, for a distance of 12 miles, it follows close to the bank of the river, avoiding as far as possible the rocks which break up the surface. In this first length occur the maximum gradients and ruling curves adopted on the line; for although the works are not very heavy, the highest bank being less than 17 feet, the irregular nature of the ground rendered the levels adopted, necessary. Near the twelfth mile, the line leaves the river to cut across a small bend, but touches it again at the fifteenth mile, from which point, for 8 miles further, a course is selected among the granitic rocks, which are here in some places covered with sand and alluvial deposits. At the twenty-fifth mile the line again leaves the Nile, passing behind some hills, but soon returns to the river, which it follows, with but few exceptions, to the village of Sarrus, near which a water station would be erected. It was intended to continue the river side route as far as the cataract of Ambigole, and a detailed survey was made with this object, as it would have involved the formation of at least six tunnels through the granite, besides other very heavy and costly works. It was, therefore, necessary to make a detour and carry the railway behind the hills on the side of the river, through the Mohrat desert, the Nile being again reached at a distance of about 70 miles from the commencement at Wady Halfa. Again the line leaves the river for a few miles, owing to the natural obstacles of the ground, but touches it again at Songle, near the foot of a lofty mountain, which forms a conspicuous feature in the landscape. The 4 or 5 miles south of Songle constitute probably the most difficult section of the whole line. Along the river huge irregular masses of granite and porphyry oppose almost insurmountable obstacles, whilst the ground about a mile and a half to the east is broken up by deep ravines and the winding channels of the numerous Wadys cut out by the waters in finding an entrance to the river from the desert plateau. To follow the river bank would involve considerable tunnelling through the rocky spurs, so that the irregular ground between the river and the mountain ranges beyond was selected. In this length there will be about half a mile of cutting, not exceeding 17 feet deep as a maximum, and most of it through a hard rock. This is probably the heaviest cutting on the whole line. After this section of 5 miles the line again reaches the river, and runs for 17 or 18 miles over good ground with easy gradients and good curves. At the end of this distance, however, the ground beside the river is again too difficult to follow, and the line, therefore, turns inland for 25 miles, returning to the Nile at the village of Ferket. This last 25 miles passes through the Akasha desert, covered with granitic and white quartz rocks. At Ferket, however, the formation changes, trap and metamorphic rocks taking the place of the granite which is rarely met with unless covered with gneiss or schist.

Regaining the river at a point about 115 miles from the commencement of the line, easy ground along the bank is found for 10 to 11 miles, then a bend in the river is avoided and the village of Amara is reached. A station to accommodate this district, which is extensively cultivated, will be provided; and beyond the line winds in and out between volcanic rocks and irregular cliffs, containing traces of sandstone in many places, for about 20 miles. Beyond here to Kohe a low stretch of land, varying in width from $1\frac{1}{4}$ to 6 miles, lies between the river and the hills, and across this the line will be taken in a straight line, and with works of the lightest description.

The nature of the ground between Wady Halfa and Kohé being as we have described it, the direction of the line is necessarily irregular and involves the adoption of steep gradients, combined with sharp curves. Consequently the works upon the line will be comparatively heavy. The embankment contains altogether some 2,300,000 cubic yards, and the cuttings, which have been avoided as far as possible, about one-thirtieth of this quantity; the material to be dealt with being hard, soft, and medium quartz rock, and light material, in about equal proportion. The culverts are numerous but not large; the total quantity of masonry being about 30,000 cubic yards, the largest work consisting of thirteen openings of 22 feet each in an embankment about 35 feet high.

Quicksilver at the Vienna Exhibition.—In the pavilion of the Ministry of Agriculture, erected on the Exhibition Place, which contains highly interesting collections, a floating cannon ball may be seen. Although weighing 50 lbs. it lies like a down feather on a splendid silvery mass, consisting of pure quicksilver from the celebrated mines of Idria. 150 cwt. of this metal is exhibited in a large iron caldron, offering a sight seldom to be met with, and on it rests the solid iron ball. It was interesting to observe the emptying of the quicksilver into its receptacle. The metal is very cleverly stowed away in bags of white sheep leather, specially prepared for the purpose, each containing 50 lbs. of the mass, the bags being tightly bound round the top, and then put into small wooden barrels, carefully bunged up. Formerly, this liquid metal, which penetrates easily all porous substances, was transmitted in wrought-iron bottles of very expensive make. A gentleman, in testing the resistance of the metal, had to use some force in inserting the hand into the mass: but how great was his surprise when, withdrawing his hand, he found that two gold rings he wore had been changed to silver.

According to T. Griessmayer one part of a solution of bisulphite of lime, sp. gr. 1.06, to 1000 parts of beer prevents the beer from turning sour.

PERFUMES.

From the Middle Ages up to the last century, musk, civit, ambergris, and lavender sum up the best known and most popular perfumes. It is only of comparatively quite late years that the art has made so much progress, and been enriched by so many new ingredients as we find at present. Nevertheless, and in spite of all additions, the base of European flower scents is contained in six flowers only, namely, orange flowers, roses, jasmines, violets, acacia, and tuberoses. Others that have been tried are found of small use, and their special odour is best given by imitative compounds: as heliotrope is imitated by vanilla dashed with almonds, and so on. And to these six bases add geranium, lavender, rosemary, thyme, and some other aromatic herbs—the last three growing chiefly on the mountains round Grasse, Nice, and Cannes, which are the principal European centers for the manufacture of perfumes—add also the peel of bitter oranges, of which the fruit goes to make curacoa; the peel of citrons and bergamots, of which the fruit goes to feed the cows of the district, and is good for the milk; add musk, sandal-wood, ambergris, and gum benjamin; of later days add the leaves of the patchouli (pogostemon patchouli, one of the labiatæ) from India; winter-green (gualtheria procumbens) from the United States; various of the andropagons, which we call goat's-beard in our own wild flowers, from Ceylon; ihlang-ihlang (unona odoratissima), one of the anonaceæ from the Philippine Islands; vanda (aerides suaveo-lens, an orchid) chiefly from Java, but from other places too in the Indian Archipelago; frangipanni (plumeria alba, one of the apocyanaceæ) from both the East and West Indies—and we have some of the principal sources whence our scent bottles are filled, and the delicate soaps and pomades perfumed. But still, wheresoever the material is to be found, the French always remain the greatest producers; and, save as regards a few exceptional perfumes—as attar-gul for one, and eau-de-cologne for another—are the best manufacturers of the sweet scents which pervade the world.

They do an immense trade in perfumery, and England is their best customer, as Russia is their worst. England took, in 1867, when this table was drawn up, 424,500 kilogrammes of perfumery, valued at 2,546,000 francs; Russia only 13,300 kilogrammes, at the value of 79,800 francs. After England comes Brazil, then Belgium, and then Spanish America; but even Brazil does very little more than half the English trade, and Spanish America less than half. The United States took 57,400 kilogrammes, valued at 344,400 francs; and Austria only 14,000 kilogrammes, paying for them 87,600 francs. Germany, in spite of her own especial industry at Cologne, took 107,800 kilogrammes, spending 646,800 francs on her purchase; but it would be interesting to know what amount of her own perfume she exports, and which of her numberless Jean Marie Farinas has the largest clientele. England does a good trade in her own indigenous lavender water; but by far the greatest proportion is exported; perfumes, like prophets, not having much honour in their own country—all that is foreign being instinctively preferred to what is home-bred, and the question of comparative excellence counting for nothing in the choice.—*All the Year Round.*

Fruit in Tin Cans.—The Boston *Journal of Chemistry* says: The impression prevails among those who use freely fruits which are put up in tin cans, that they are injured thereby, and this impression is, in many cases, correct. We have long contended that all preserved fruits and vegetables should be stored in glass, and that no metal of any kind should be brought in contact with them. All fruits contain more or less of vegetable acids, and others that are highly corrosive, are often formed by fermentation, and the metallic vessels are considerably acted upon. Tin cans are held together by solder, an alloy into which lead enters largely. This metal is easily corroded by vegetable acids, and poisonous salts are formed. Undoubtedly, many persons are greatly injured by eating tomatoes, peaches, etc., which have been placed in tin cans, and we advise all our friends who contemplate putting up fruits the coming summer, to use only glass jars for the purpose.

Fig 1

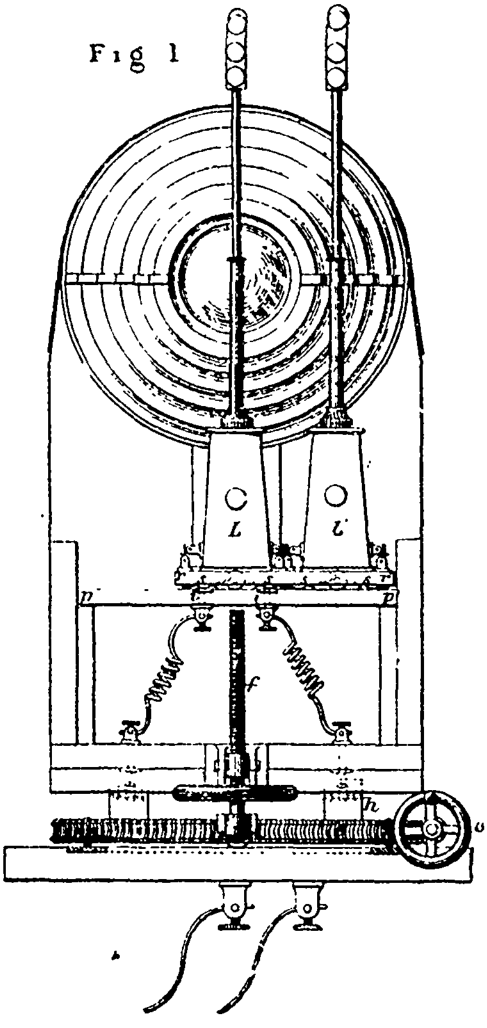
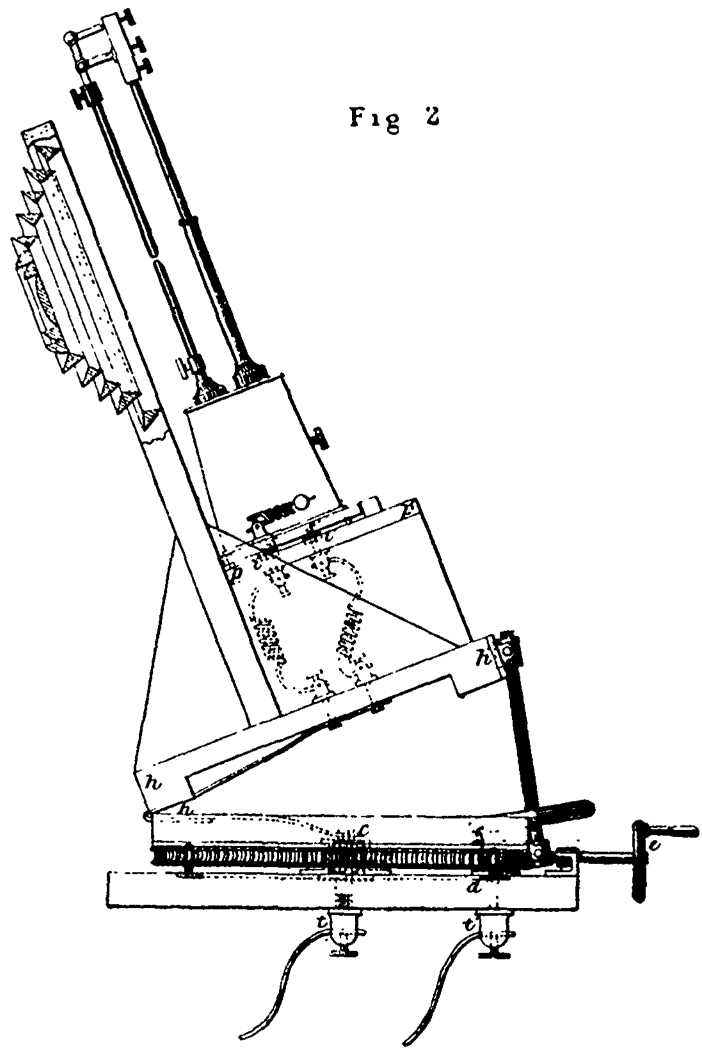


Fig 2



THE WESTMINSTER SIGNAL LIGHT.

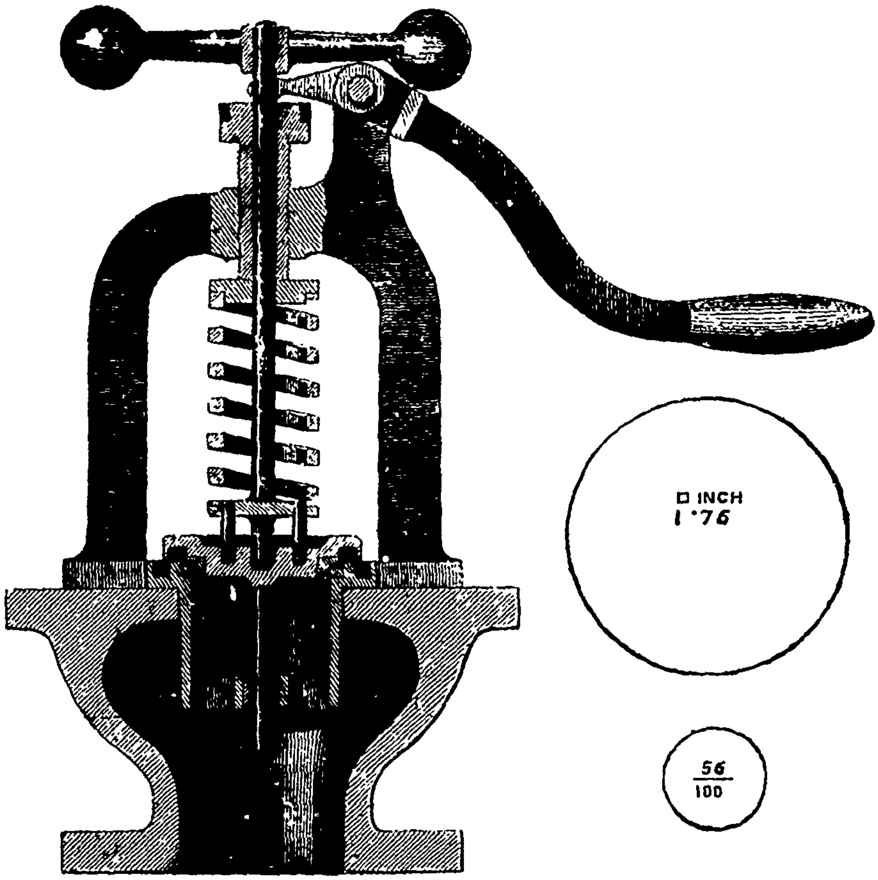
In our last issue we gave a description of the Gramme Magneto-Electric Machine which is being manufactured in England by Messrs. Wheldon and Cooke. Mr. Cooke has now devised a contrivance which we illustrate above for the exhibition of the electric light from the clock tower of the House of Commons in London. In our illustration, for which we are indebted to *Engineering*, *t* and *t'* (Fig. 2) are two large binding screws, which receive the terminals. Two metallic strips conduct the positive and the negative current respectively to *d* and *c*. From *c* the negative is led through the pivot of the revolving table to the right-hand hinge, *h*; the positive at *d* is in connexion with a circular strip of copper, which leads it to the left-hand hinge. Finally the hinges communicate with two studs, *i*, *i*, sunk into the upper surface of *p*, *p'*. Two regulators, *l* and *l'* (Fig. 1) are fixed to a rectangular mahogany board, *r*, *r*, free to slide on rollers from *p'* to *p*. Each lamp carries two copper strips, so bent that the portion to the right rubs against the studs, and thus insures good contact when the flat part reaches them. Fig. 2 shows the metallic pieces of lamp *l*, pressing upon these discs, and thus admitting the current. When it becomes necessary to change the carbons, the table, *r*, *r*, is pushed from *p'* to *p*. The second lamp, *l'*, comes into position; its copper strips are in contact with the underlying studs, and the current passes through its carbons. The time required to effect this change is scarcely appreciable. The light can be directed to any object by means of the screw, *f*, and the worm and worm-wheel *e*. The former, *f*, enables to the operator to project the beam at any angle of depression lying between convenient limits; the latter, *e*, gives him an azimuthal motion of any amplitude required.

One might think the use of two regulators altogether a superfluity, inasmuch as the carbon points may be lengthened to burn for any desired number of hours. But it must be remembered that carbon is an imperfect conductor, and, therefore, to increase its length is equivalent to an increase of resistance. To obtain a continuous light for eight hours, would, at the present rate of consumption, require carbons about 16 in. long. Now it is difficult and expensive to get carbons of that dimension, and even if such pieces could be easily procured their brittleness and want of homogeneousness would constitute very serious inconveniences. If long carbons were really useful, we cannot doubt but they would have been introduced before this into our lighthouses.

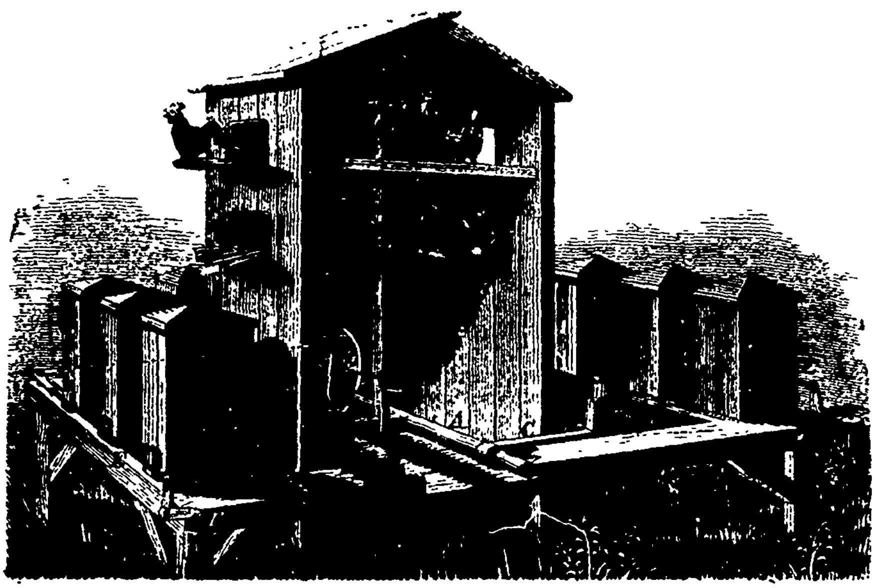
Fig. 2 also shows a vertical section of the holophotal apparatus used. The central piece is a polyzonal lens which refracts into parallelism the rays that impinge upon it at different degrees of obliquity. The upper and lower prismatic portions perform a very important economic office in intercepting and totally reflecting the rays which make large acute angles with the principal axis. The other rays are lost, as it has not been deemed necessary, for the present, to adopt the ingenious prismatic mirror system of Mr. Stevenson, by which those rays, after undergoing two reflections, are concentrated in the radiant point, again to be transmitted. The non-adoption of this appliance is owing, no doubt, to the temporary character of the arrangement on the clock tower, as such an optical aid must considerably increase the effect of the electric light.

ASHCROFT'S "POP" SAFETY VALVE.

This valve was designed by Mr. Ashcroft with the view of equalising the pressure on the valve to that of the boiler, so that the exact degree of pressure on the interior surface of the boiler is really indicated. In ordinary valves the pressure decreases as soon as the valve begins to open, the escaping steam rendering the pressure on the valve surface less than that exerted at the same moment on the plates of the boiler. In the "pop" valve this is not the case, the pressures being equalised. The above engraving is a section of the valve, in which it will be seen that the pressure is regulated by a spring, the valve spindle working in a bush screwed into the framing above. The valve seat and that part of the valve bearing upon it are of nickel bronze, which combines the hardness of steel with the freedom from oxidation which distinguishes gold, so that durability is insured and corrosion prevented. The valve seat is so formed as that when the steam has left the ground joint it enters the annular recess in the valve and is deflected into another annular recess



ASHCROFT'S "POP" SAFETY VALVE.



BEE PROTECTOR (See page 118.)

which surrounds the valve seat. The result of this action is that the steam obtains a leverage, and the valve acts with thorough efficiency. The valve may be moved while under pressure to test its condition, the handle shown being used for testing its blowing off power and for ascertaining that it does not stick. The "pop" valve lifts higher from its seat than any other valve, and its discharge is stated to be equal to that of five valves of the ordinary construction; the 7-in. valve lifting ⅜ in. from its seat. The two circles in the engraving form a comparative diagram, showing the area of the common valve when open and of the "pop" valve; the size of the valve being 3 in. The valve is shown without a dome and it can be locked up without or with that addition, so that it cannot be tampered with. The apparatus is very simple in construction, and its efficiency is proved by the fact that it is in use on more than 4000 locomotives in America, and that the Government of that country have recently adopted it. It is equally applicable to locomotive, marine, and land boilers, and gives promise of very general adoption.

BEE PROTECTOR.

The ingenious inventor of this device, before putting his ideas into practical shape, doubtless became convinced of the immutable truth of these facts: First, the busy bee improves only "shining hours," and gathers honey from opening flowers only by day; Second, the bee moth has a predilection for stealing honey under cover of the night; and third, chickens retire to their roosts at twilight, and are aroused by the "shrill clarions" of the masculine portion of their population at an excessively early matutinal hour. To utilize these propositions to compass the desired end, was the problem: how it has been solved, we proceed to show. The bees are expected to enter their domiciles a little before dark. After they are all in, the period for the roosting of the chickens arrives. The latter, alighting on their perches, operate machinery which closes the hive gates and shuts the bees in. The bee moth, on attempting his burglarious operation, finds himself barred out, and as the mechanism of the device is beyond his comprehension, it is to be inferred that he retires in disgust Meanwhile the chickens repose until the early village cock proclaims the morn, when they abandon their perches to resume their geological investigations into the surface of the adjacent soil, and thus return the bees, their honey all safe, to the airs of heaven and flowers of earth. For the benefit of all who may be interested in this strikingly novel application of the force of gravity through the medium of chickens, we append the following detailed description of the mechanism.

A is a horizontal rock shaft, secured in suitable bearings and provided with three arms, B, C, and D. The arm, B, within the house supports a vertical sliding post which is held in guides, and bears the perches. The arm, C, carries an adjustable weight, sufficiently heavy to overbalance the post and keep it elevated when the roosts are unoccupied. The upright arm, D, is connected as shown by the dotted line with the rods, E E, attached to the gates of the hives. Suitable weights, F, are arranged in connection with the rods, E, so as to hold the gates open.

As the fowls mount upon the roost their weight depresses the post, and it, in turn, presses down the arm, B, and thereby rocks shaft. B, and its arm, D. The latter, operating the rods, E, closes all the hives. As soon as the roost is vacated, the weights bring the parts to the original positions. The advantages claimed are the regularity and certainty with which the hives will be closed and opened, and the fact that any number of hives may be connected with the device and simultaneously operated.—*Scientific American.*

Preserving Grindstones.—A grindstone should not be exposed to the weather, as it not only injures the wood work, but the sun's rays harden the stone so much as, in time, to render it useless. Neither should it stand in the water in which it runs, as the part remaining in water softens so much that it wears unequally, and this is a common cause of grindstones becoming "out of true."

We give on page 109 illustrations from the *Builder* of a house designed by an English architect for a Norwegian gentleman, the owner of several timber farms. The house was to be erected on one of these farms for his own use. The drawings were made under his personal superintendence as to details; and the arrangements of plan are therefore similar to what would be necessary ordinarily in a similar situation. But the architect is chiefly responsible for the double height of verandah and the top room, or belvedere, and other architectural features. The construction was to be of local materials,—that is, the timber of the estate and the chimneys of brick; but as it was to be carried out by local workmen entirely, the cost is not known.

The conditions of climate and of timber supply being somewhat similar, the plan may supply a useful hint or two to prosperous Canadian farmers and others.

As our illustrations do not include a scale, we add the dimensions of some of the rooms:—Drawing-room (*Dagligstue*), about 18 ft. 6 in. by 16 ft. in clear; sitting-room (*Daglickamer*), about 16 ft. by 14 ft.; dining-room (*Spisekamer*) about 16 ft. by 14 ft.; kitchen (*Kiokken*), about 16 ft. by 14 ft.; hall (gallery over), about 25 ft. by 20 ft.

QUALITATIVE ANALYSIS FOR AMATEURS.—II.

By E. J. Hallock, A. M., in the *Boston Journal of Chemistry*.

SECOND GROUP.

This includes those metals which are precipitated by hydrosulphuric acid from acid solutions; namely, mercury, lead, bismuth, copper, cadmium, gold, platinum, tin, arsenic, and antimony. Hydrosulphuric acid (hydric, sulphide, or sulphuretted hydrogen, H S) is a poisonous gas with a very disagreeable odour which resembles rotten eggs; breathed in small quantities it produces headache; is very soluble in water, so that its solution is often employed instead of the gas itself; is combustible, and, when mixed with air explosive. The usual method of preparing it is from sulphide of iron and sulphuric acid. The sulphide of iron for this purpose can be purchased of the dealers in chemicals in large cities, or prepared by carefully fusing together iron-filings and sulphur. The sulphide of iron is broken up in small pieces and put in a bottle fitted with a good cork (soaked in paraffine) through which passes a tube twice the length of the bottle, the lower end reaching almost to the bottom of the bottle, a funnel being attached by a rubber tube to the upper end. Another tube 4in. long, bent at right angles, also passes through the cork. To the end of this is attached a glass tube long enough to reach to the bottom of the test-tube or other vessel in which the precipitation is to take place. The bottle being tightly corked, dilute acid is poured into the longer tube, when gas at once begins to issue from the shorter tube. No heat is required. Another method that I have often found more convenient on a small scale, is by melting together paraffine and sulphur. Some sulphur is first placed in a test-tube, then several pieces of paraffine thrown in, and the test-tube closed with a cork through which passes a single tube bent twice at right angles. After applying heat for some time, hydrosulphuric acid gas is given off; as soon as the heat is removed the gas ceases to be generated, but begins again whenever heat is applied. The gas should always be generated under a flue or in the open air. If prepared in or near a building painted with white lead, it blackens the paint, from the formation of sulphide of lead.

Group second is divided into two divisions: the first including mercury, lead, bismuth, copper, and cadmium, whose sulphides are insoluble in ammonic sulphide; the second including arsenic, antimony, tin, gold, and platinum, whose sulphides are soluble in ammonic sulphide.

REACTION OF METALS OF GROUP SECOND, FIRST DIVISION.

Dissolve a little corrosive sublimate, called by modern chemists mercuric chloride ($HgCl_2$) in a little water in a test-tube. Pour a few drops of this into a second test-tube and dilute, then pass hydrosulphuric acid gas (H_2S) into it; a white precipitate forms, which immediately passes through yellow and red to black. Filter and try to dissolve the precipitate in ammonic sulphide, also in nitric acid; it will be found insoluble in both. Dissolve it in aqua regia, a mixture of 4 parts hydrochloric acid and 1 part nitric acid; this solution is precipitated by chloride of tin, but this confirmatory test is not always necessary. To another portion of the aqueous solution of corrosive sublimate add a drop of potassic iodide (KI); a beautiful red precipitate of iodide of mercury is formed. This reaction is very characteristic of mercury.

A solution of plumbic nitrate (nitrate of lead) also gives a black precipitate with hydrosulphuric acid, but unlike the mercuric sulphide, it dissolves in boiling nitric acid, and from this solution is again thrown down by sulphuric acid as a white precipitate of plumbic sulphate. With potassic iodide it gives a beautiful yellow precipitate, thus distinguishing it from mercury. Very small quantities of lead in drinking water are detected by hydrosulphuric acid.

The subnitrate of bismuth, being sometimes used in medicine, and also in cosmetics, can be procured from any druggist. It is insoluble in water, but dissolves readily in hydrochloric acid. Pour a few drops of the concentrated acid solution into a test-tube half full of water; a white precipitate is formed. This is quite characteristic of bismuth, as very few other salts are precipitated by water. For this reason, avoid diluting the acid solution when about to make a test. Into the acid solution, pass a current of hydrosulphuric acid gas; a black precipitate is formed, which, like the lead sulphide, is soluble in nitric acid, but unlike lead, the nitric acid solution is not precipitated by sulphuric acid, but by ammonia. These reactions suffice to distinguish it from the other metals of the group.

Sulphate of copper can be prepared by dissolving an old coin in sulphuric acid with the application of heat. A great deal of sulphurous acid is set free. The blue-colored filtrate remaining after the silver chloride is precipitated from the coin solution, mentioned in p 82, is principally nitrate of copper. Either this or the sulphate can be used in studying the reactions of copper. With hydrosulphuric acid, copper solutions give a brownish black precipitate, soluble in nitric acid and in potassic cyanide, a substance much used in photography, and very poisonous. In very dilute copper solutions ammonia produces a dark blue colour, but no precipitate is formed. Potassic ferrocyanide gives a reddish brown precipitate insoluble in hydrochloride acid, and this distinguishes it from other metals of this group.

Cadmium is one of the rarer metals, and is used principally in photography. In the analysis of common alloys and minerals it is seldom necessary to test for cadmium. The precipitate with hydrosulphuric acid is a beautiful canary yellow, soluble in nitric acid, but insoluble in potassic cyanide. This enables us to distinguish it from copper, which it closely resembles in some of its reactions.

As the student progresses he should tabulate the results of each series of reactions for convenient reference in future. Sometimes an impurity in his chemicals prevents the reaction from taking the precise form here given. When hydrosulphuric acid is passed into very acid solutions, more or less of it is decomposed, and a white precipitate of sulphur insoluble in nitric acid is formed. This is easily distinguished from a metallic sulphide by its specific gravity and combustibility.

SEPARATING METALS OF GROUP SECOND, FIRST DIVISION.

Supposing you have in solution the five metals of this division of group second, the solution is to be acidified with hydrochloric acid, when most of the lead will be precipitated as a chloride and filtered out, but traces of lead may still remain and must be sought for in this place. The hydrosulphuric acid gas, or a strong solution of it precipitates all these metals. The black precipitate is filtered out, then boiled in nitric acid, and the residue shown to be mercury by dissolving it in aqua regia and adding stannous chloride, or protochloride of tin ($SnCl_2$); a grey precipitate is formed. From the filtrate, the lead, if any is present, is thrown down by a drop of sulphuric acid as a white plumbic sulphate. Ammonia is next added cautiously to the last filtrate, when bismuth will be precipitated. This is recognised, after dissolving in aqua regia, by giving a white precipitate with water, if the solution is strong enough. The filtrate from the bismuth precipitate will be blue, if copper is present. A solution of potassic cyanide (KCy) is added, care being taken to avoid breathing the poisonous fumes given off, next pass more hydrosulphuric acid into it, when a bright yellow precipitate detects the cadmium. To confirm the presence of copper in this last filtrate, a little nitric acid and potassic ferrocyanide are added; the red precipitate is cupric ferrocyanide, or ferrocyanide of copper.

The separation of those metals precipitated by hydrosulphuric acid, and insoluble in ammonic sulphide, may be tabulated as follows:

Precipitated by H_2S

Mercury, black.	Lead, black.	Bismuth, black.	Cadmium, yellow.	Copper, brown.
		Boil with Nitric Acid.		
Residue: Mercury, black.	Lead	Bismuth	Cadmium.	Copper.
		Add Sulphiric Acid		
	Precipitate: Lead, white.	Bismuth	Solution: Cadmium.	Copper.
			Add Ammonia.	
		Precipitate: Bismuth, white.	Solution: Cadmium.	Copper.
			With KCy and H_2S.	
			Precipitate: Cadmium, yellow.	Solution: Copper. Add nitric acid and ferrocyanide of potassium. Reddish brown precipitate.

The principal difficulties to be encountered here are the separation of lead from bismuth, if both are present, and of copper from cadmium. The student of analysis must repeat the reactions of these metals until he is able to separate them with certainty. Mercury, it must be remembered, forms two series of salts, only one of which is precipitated by hydrochloric acid, hence we see why mercury occurs both in the first and in the second group.

HENRY'S IMPROVED SPINDLE STEP.

The object of this invention is an improved construction of the steps of mill spindles or other vertical shafts, whereby they are made adjustable to compensate for the wear of the bearing surfaces.

The illustrations show, Fig. 1, a perspective view with a portion broken away, and Fig. 2, a vertical cross section. In the base, A, of iron, is formed a recess, the walls of which are screw-threaded to receive a correspondingly formed guide or bearing B. The latter is constructed with an inverted conical opening to inclose the toe of the spindle C, the end of which extends through and rests upon the upper of two or more hardened steel discs D, placed in a suitable cavity at the bottom of the recess. The top of the guide forms a collar E, which is bevelled off around the interior to receive oil for lubricating the spindle. The passages ', in the base also serve to conduct lubricating material to the spindle toe. G, is a lock nut screwed upon the guide between the collar and the base. In the engravings, Fig. 1 shows the guide let into the base to the full extent and locked in position by the nut G, screwed down to bear upon the upper surface of the latter. As the guide becomes worn by the rotation of the spindle, it is unscrewed and moved up, Fig. 2, to the requisite height to fit the toe snugly and prevent the spindle from vibrating or running out of true, thus, in short, compensating for the wear. The nut G, is then again screwed down to lock the parts in place.

By using a number of discs, D, one, two, or more can be removed as the spindle drops down, thus adjusting the step regularly to supply the deficiency caused by wear. The invention appears durable and simple.

Fig. 1.

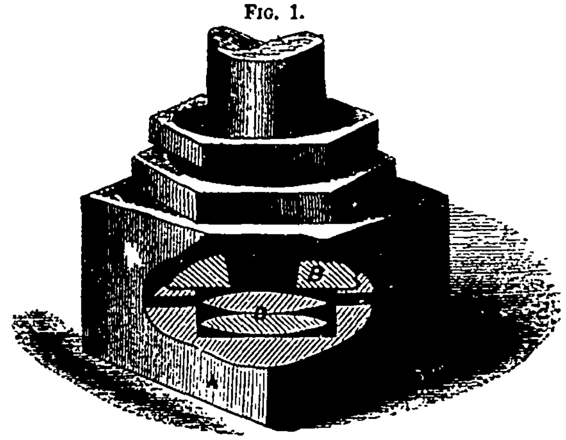
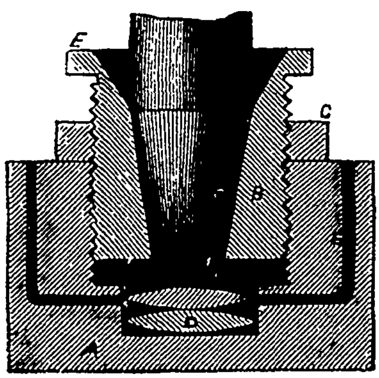


Fig. 2.



HENRY'S SPINDLE STEP (See page 119.)

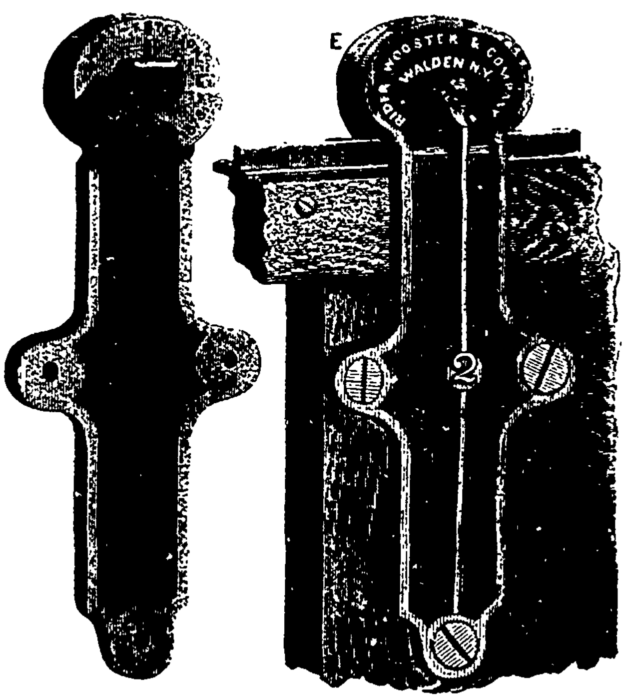
RIDER'S ANTI-FRICTION BARN-DOOR HANGER.

We give on this page, an illustration of a new barn-door hanger which is claimed to surpass anything of the kind heretofore known to the public. It is described as follows by the *American Artisan*:

The distinguishing peculiarity of the hanger is as follows: The weight of the door is supported by an elliptic stud, A, between which and the rail B, is a series of chilled-iron rollers C, completely incased, and which, passing the stud, roll round and return over it in succession. This stud being thick and strong, it is impossible to conceive under what circumstances any breakage could take place. It is remarkable how easily the hanger moves along the rails. It is certain that this principle secures a remarkable decrease in friction. The manufacturers inform us that direct experiment has proved that a weight suspended by these hangers will be moved by one-fourth of the power required by any other hanger they have been able to obtain and experiment with. Nearly all the friction in the working of this hanger is rolling friction, there being no axle to turn in a socket and wear away; no sheave to bear against the side of the hanger; no grooves to grind and break; and, as the rollers are made of chilled-iron, and are harder than steel, it is evident that a remarkable degree of durability is secured for the device.

The rolls are, as shown, completely enclosed by the plate D and cap E, which is held to its place by a pin inserted on the outside, through the end of the stud A. In this way all the bearing surfaces are completely incased and protected from the action of storms. There is, therefore, no necessity of a housing over the hanger, and this effects considerable saving in the expense of hanging doors. The cap E descends somewhat lower than the upper edge of the rail along which the rollers run, and as the rollers will not mount the track like wheels, there is no danger of the hanger running off the track. The case, in its advance, pushes away any obstructions that may arise from ice or snow, so that the hanger is not liable to become clogged. As water will not penetrate the interior, the surface will not be injured by rust, and no lubrication is needed.

Besides these practical advantages, the hanger is very tasteful and neat in appearance and will fit any rail.



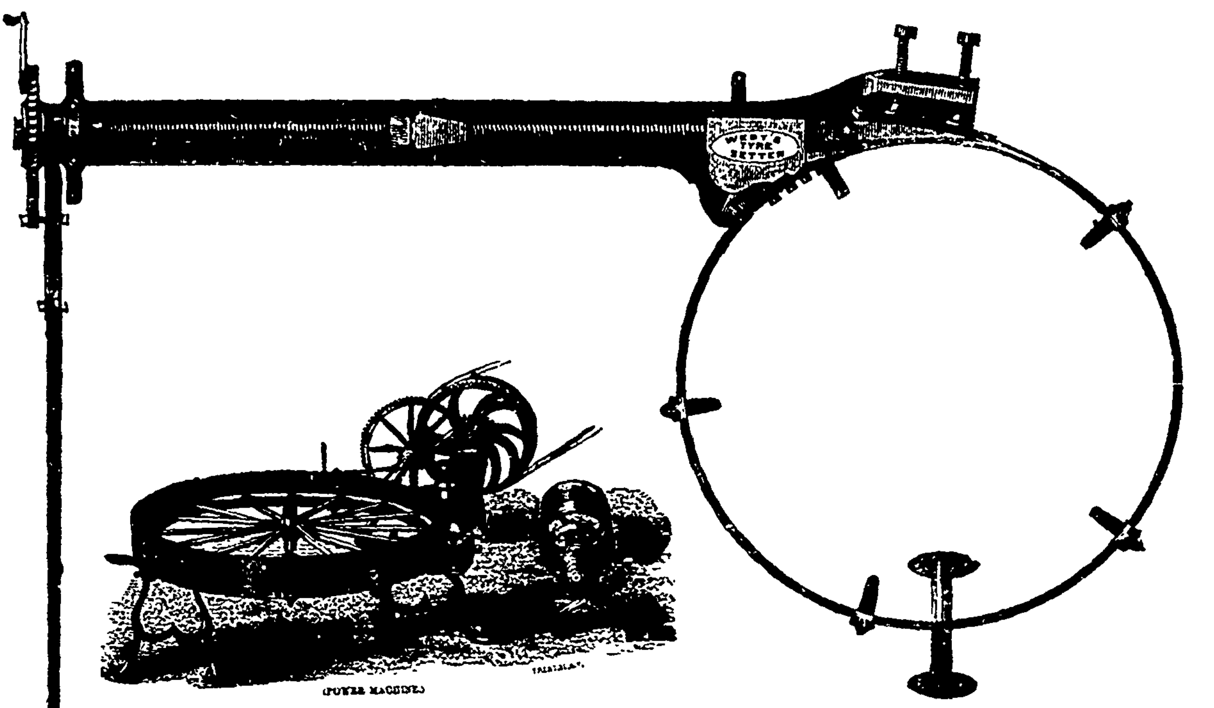
RIDER'S ANTI-FRICTION BARN-DOOR HANGER.

WEST'S TYRE-SETTING MACHINE.

Among the exhibits at Vienna is the annexed American invention which is just now coming into extensive use not only in America but also in England. The machine is simple in its construction and operation and is very expeditious and effective. It consists, as will be seen on reference to the engravings, mainly of a laminated wrought iron hoop, formed of four bands of wrought iron, about 6 inches in depth, and which is expansible and contractile, being associated with a stout frame, carrying a long and powerful screw, which works in a fixed collar at one end, and also through a head-stock to which the hoops are firmly attached. Thereby, when the screw is tightened up (which is effected by hand-wheel, long lever handle, or the larger sizes are fitted with duplicate, fast-and-loose pullies for power) the hoops are drawn up so as to contract the diameter of the circle formed by the fixed end; similarly by the reverse operation the diameter of the circle may be enlarged.

The whole apparatus is carried on suitable stands, and attached to the circle of the hoop are supports which carry the wheel to be tyred. The tyring is effected cold, the tyre itself being made of such a size as to fit loosely on the rim of the wheel. Being thus laid on the bearers within the hoop, the screw is operated, evenly and uniformly contracting the diameter of the hoop, and exerting a regular and uniform compression upon the tyre, gradually increasing in power until the tyre is thereby upset and fixed firmly and solidly upon the wheel.

It is obvious that by the employment of this machine the cost and delay of having to heat the tyre, so as to make it fit on by expansion in the ordinary way, is entirely avoided; and, especially in the case of repairs,



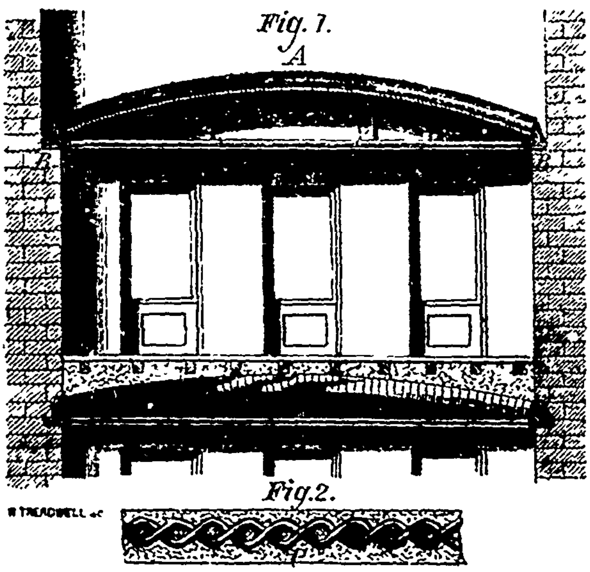
WEST'S TYRE-SETTING MACHINE.

for the re-setting of a loose tyre, it is very advantageous, as the wheel can be removed from the vehicle, set by the compression of the machine, and again fixed on its axle, within a very brief period. As regards the quality of the work, it is clear that the increased density and toughness of tyres so set by powerful compression constitutes an important advantage in point of wear and durability.

This tyre-setting machine is, therefore, one of those simple effective, and economical appliances that no carriage builder's or wheelwright's shop should be without. It is made in various suitable sizes, for wheels of different dimensions, and adapted for operation by hand or power, as shown. The smallest size (No. 1) is fitted for wheels varying from 3 feet to 4 feet 2 inches in diameter, with iron tyres $\frac{3}{8}$ of an inch thick by $1\frac{1}{2}$ inch wide, steel tyres 1 inch by $\frac{1}{4}$ inch. The larger sizes are adapted for diameters of wheels from 3 feet 5 inches to 4 feet 7 inches, iron tyres up to $2\frac{1}{2}$ by $3\frac{1}{4}$ inches, and steel tyres up to $2\frac{1}{2}$ by 1 inch. Each machine is capable of operating on wheels that do not vary more than 14 inches in diameter, and they may be constructed and adapted for wheels of any dimensions

In addition to a saving of over one-third on setting new, and considerably more on old, tyres the following advantages are obtained for the work effected by this machine: durability and diminished wear and tear, because the evils of the old method are avoided, namely, the blackening and staining of the felloe; the steaming, swelling, and subsequent shrinking of the wood; and the early loosening of the tyre, consequent thereon, aided by the wearing away, under concussion, of the particles of wood which have lost their nature and coherence by charring; also the weakness resulting from taking out old bolts and making new holes is avoided, because, in upsetting an old tyre thereby, the bolts are not taken out nor the tyre removed from the wheel.

Temper of Tools.—A correspondent of the Detroit *Tribune* says:—If an edge tool is so hard as to crumble, grind it on a dry stone until the edge turns blue; it will then cease to break, and the temper will generally prove to be about right. Scythes and axes are sometimes too hard at the edge, but if treated in this way will give no further trouble



FIREPROOF FLOOR.

In this invention, Mr. Nathaniel Cheney, of the Architectural Iron Works, New York city, the inventor, proposes to do away with lath and other combustible building material, and apply the plaster, for ceiling rooms, directly to iron wire, which is interwoven with the tie rods of floor or roof arches.

In our engraving the arch A, is formed of metal plates bolted together at the edges by angle bars, and resting at the ends on metal skew back beams B, which are tied together by wire rods C, to prevent end pressure or strain on the walls, and hold the arch up stiff and firm. On the lower floor the arch is made of brick, and is similarly secured, supporting a layer of concrete above.

The connecting or tie wires C, are arranged close together, as shown in the section, Fig. 2, and small wire is woven in at suitable distances. The fabric is suspended by the short rods D, from above, and upon it the plaster is applied in the ordinary manner The device is necessarily fireproof, and is said to form firm floors, incapable of transmitting sound to any considerable extent.

A GUNPOWDER PILE-DRIVER.

At a meeting of the American Society of Civil Engineers, in New York, on March 5th, a paper "On Shaw's Gunpowder Pile-driver," by Samuel R. Probasco, C.E., of Brooklyn, N.Y., was read.

This pile-driver was set at work in October, 1872, on a line of sheet piles for a reservoir-dam in the valley of Parsonage Creek, Long Island. The material to be penetrated was sand and fine gravel, cemented together in places, so as to be hard and difficult to move with a pick, and like "hard pan." Clay was found below the water-level of the basin,—some borings showing it at 15 ft below the surface The lower stratum was tough and tenacious, and the whole material was under water. The machine in form resembles an ordinary pile-driver: a cast iron block, called a "gun," resting on the head of the pile, is bored out, and receives, without windage, a wrought-iron piston attached to another cast-iron block, called the "ram," which is lifted by explosion of powder in the bore. When the piston leaves the gun, a cartridge is thrown in, which, exploded by the heat made by the piston in its descent, throws the ram upward again, and forces the pile downward. The area of the piston is adjusted to the weight of the ram, which also is adjusted to the work to be done. Soda powder cartridges, in cylinders of 1¼ oz. to 1½ oz, coated with black lead and paraffine, are used The coating is expected to keep the powder dry, lubricate the gun, preserve the requisite tightness, prevent escape of gas, and cause the entire force to be exerted on the base of the piston. The piston is made a little smaller than the bore of the gun, and has on its lower end a steel ring which fits the bore closely. The performance was as follows :—At first several explosions were necessary to lubricate the gun, which leaked gas so that the ram would not go to the requisite height to move the pile. After a few shots the piston moved up regularly, and in its descent, fired the charge forcing the pile down and itself upward.

When the resistance is slight, this machine may be economical, but when, as in this case, it required 300 blows from cartridges, costing 2½ cents each, to force a pile down 15 ft. or 16 ft., it cannot be called so The gas from the explosions cut passages in the ring at the end of the piston, and thereby much lessened the power of the machine The gun became hot from the rapid discharges, and the bore enlarged, whereby more gas escaped.

Seven piles were driven with it,—each costing more for powder than the contractor got for piles in place,—when the machine refused to work. On examination, the steel ring was found furrowed by the powder, and the piston (diameter 5 in.) so bent by striking the bottom of the gun as to be useless The air-cushion relied upon to prevent this was lost by the furrowing of the ring.

The inventor, on being consulted, decided that the excessive consumption of powder was due to the piston being too small for the ram, weighing over 1,700 lb.

The bore of the gun was then enlarged to receive a piston of 7 in. in diameter, and ten piles more were driven, when the machine was again laid aside

The result of this trial was similar to the first, except that the piston was not bent The gun got so hot as to fire the powder before the ram reached its place. Altogether, seventeen piles were driven to a depth of from 14 ft. to 19 ft., requiring from 200 to 300 blows of 1½ oz. cartridges. An ordinary pile-driver was then employed, with a hammer weighing 1,800 lb., and falling 8 ft to 10 ft In this way eleven piles were put down, 15½ ft. in ten hours, costing per pile no more than 100 blows from the powder-machine These 100 blows at best would put the pile down but 10 ft.

The piling was spruce, from 10 in. by 10 in. to 10 in. by 14 in , 20 ft. long, with 2 in. square tongue and groove.

The piles were bevelled at the point on three sides, leaving the grooved side untouched The groove was driven on the the tongue of the preceding pile The heads were protected with a light band. Seven piles were driven without shoeing, the eighth split, and showed the necessity of protection at the point A cast-iron cup-shoe, weighing about 40 lb , with a groove in it, and made with three bevels and one plain side, was found to stand the work.

The tendency of the tongue of the pile to work up was obviated by twisting a chain tightly about the pile and tongue, a lever, with rope attached, was used for this purpose, the force being applied as the blow was delivered. Seventy-five piles were driven in this way to a mean depth of 15½ ft By experience, 6 in more depth has been attained, which is about the maximum penetration in this kind of material, and this can only be done with the best of sound, dry spruce.

RESISTANCE OF WOODS TO STRAIN.

Professor R. H. Thurston, of the Stevens Institute of Technology (U. S.), communicates to the *Journal of the Franklin Institute* a description of an apparatus devised by him for determining the torsional resistance of materials, and also the result obtained by submitting specimens of different woods to experiment. By mechanism the force producing torsion is transmitted through the test-piece, and moves a pencil which traces upon paper a curve the ordinates of which are proportional to the torsional moment, while its abscissas represents the amount of torsion to which the specimen has been subjected, thus indicating the relative stiffness, strength, and resilience of the material experimented upon very perfectly. The test-pieces were seven-eighths of an inch in thickness at the middle or smallest part. Some of the conclusions drawn from the results are as follows :—White pine yields quite rapidly as the torsional moment increases The maximum strength of the test-piece was 15½ foot-pounds, and it was twisted completely off at a total angle of torsion of 130°. The substance is thus shown to have little resilience. Yellow pine has much greater strength, stiffness, and resilience. The sap-wood is equally stiff with the heart-wood, but sooner passes its limit of elasticity. Spruce is less stiff than white pine even, but possesses greater strength and resilience, its moment of resistance reaching 18 foot-pounds and twisting through a total angle of torsion of 200°. Ash seems to be weaker and less tough than is generally supposed Its most striking peculiarity is its very rapid loss of strength after passing its limit of elasticity Spanish mahogany is very stiff and strong. It is deficient in toughness and resilience, losing its power of resistance very rapidly after passing the limit of elasticity White oak has less torsional strength than either good mahogany, locust, or hickory, but is remarkable for its wonderful toughness. It passes its limit of elasticity at 15°, but loses its resisting power very slowly. The latter remains unimpaired to a torsion of 70°, and yields completely at 253°. Millwrights are evidently correct in holding this wood in high esteem for strength, toughness, and power of resisting heavy shocks and strains.

The following details of the process followed by the Oxy-hydrogen Gas Company, of Buffalo, N.Y., in the production of oxygen on a commercial scale, may be of interest, though it is in general the same as the process of M. Tessie du Mothay. The *Journal of the Franklin Institute* says, the material employed is called manganate of soda. Whether this definition of its constitution is accurate, from a chemical point of view, we are unable to assert The treatment of the material is thus described by the *American Artisan* : — "The pulverised manganate of soda is introduced into iron retorts 7 ft long, 1 ft. wide and 2 ft deep (a cross section being an ellipse). It is here heated in a current of superheated steam The steam passes through the mass and carries with it part of the oxygen. In ten minutes the current of steam is shut off and atmospheric air is blown in, the soda salt now re-absorbs or re-unites with the oxygen, and the nitrogen escapes. Air is passed in for ten minutes, and then steam as before. From the retorts the gas passes to the condensers, which are like the usual upright cast iron pipes used in all gasworks. Here the steam is condensed, and it washes the gas; from these the gas passes to the scrubber, where all further impurities are washed out; it then passes to the holder." It seems that the process followed is not identical with the published description of the patent. Several modifications in details have been found necessary in practice The manganate also appears not to work to perfection, since it has been found to lose its porosity and agglomerate after being for some time in use. It is found necessary, therefore, to re-charge the retorts after a time with fresh material. Experience indicates that, could the steam be supplied perfectly dry, this difficulty might be obviated. What may be the ultimate success of the company must be left for time to decide. It is at present supplying consumers with hydrogen gas at the rate of 2 50 dols. per M., and oxygen gas at the rate of 5 00 dols. per M.

THE "GRAPHIC" BALLOON.

In answer to numerous enquiries on the subject we give the following details as to the dimensions, material, outfit, etc, of the balloon to be used in the great transatlantic voyage They are from specifications made by Mr. Donaldson.

There will be two balloons, the largest of which will be 318 feet in circumference, 100 feet in diameter, and 110 feet in height. When inflated and ready to start, the extreme height of the balloon, from the crown of the balloon to the keel of the life-boat, will be 160 feet.

The great balloon will require 4,316 yards of cloth. The materials is unbleached sheeting, of a thick, close quality of the brand known as "Indian Orchard." The crown of the balloon will be doubled for a distance of fifty feet from the top, with 150 yards of the same material and a third thickness will be added of "Manchester Mills" bleached, of which 250 yards are required.

There will be 14,080 yards, or eight miles of sewing, in which 10,137,600 stitches will be made. The stitching is now being performed at the show-rooms of the Domestic Sewing Machine Company, by a force of twelve seamstresses. The thread used is silk and cotton, the top spool being silk.

The valve of the balloon will be three feet in diameter, and made of Spanish cedar, with a rubber-coated clapper closing on a brass plate. The valve fixtures and top of the balloon are the essential parts of the apparatus, and are being constructed with special care to guard against accident or derangement.

The net-work will be composed of three-strand tarred rope, known as "marlin." The width of the net will be 212 meshes, and its breaking strength will be 58,300 pounds. Five hundred pounds of "marlin" will be used. From the netting 53 ropes ⅝ inch in diameter, of Manilla, will connect with the concentrating rings. These ropes will each be 90 feet in length, or 4,470 feet in the aggregate. The concentrating rings will be three in number, to guard against breakage, and be each fourteen inches in diameter, each ring being of wood, iron bound. These rings will sustain the car, life boat, and trailing rope, and will bear the strain when the anchor is thrown out in landing. From the concentrating rings twenty-four Manilla one inch ropes each 22 feet long, or requiring 528 feet in all, will depend and form the frames for an octagonal-shaped car They will be kept in place by light hoops, made of ash. The lower ropes will be connected with network, and over the network at the bottom of the car, a light pine floor will be laid loosely, so that it can be thrown out if required. The car will be covered with duck, of which fifty yards will be needed Attached to the side of the car will be a light iron windlass, from which the boat and trail rope can be raised and lowered as may be desired. From a pulley attached to the concentrating rings a heavy Manilla rope will fall down through the car, and thence to a sling, attached to which will be the life-boat. This boat will be of the most approved and careful construction.

It will have water-tight compartments, sliding keel, and will be so made that it will be self-righting. The boat will be provided with a complete outfit of oars and sails, and to it will be lashed instruments, guns, lines, etc., and provisions for thirty days, all in water-tight cases.

The trail rope, by which the aeronaut can maintain any desired altitude without resorting to ballast, will be of Manilla rope, 1¼ inch thick, and 1,000 feet long.

The car will be provided with instruments, provisions, &c., independently of the boat. It will be so constructed that it can be taken apart piecemeal and disposed of as ballast. It will carry about 5,000 pounds of ballast, which will consist of bags of sand, each carefully weighed and marked Among the instruments to be carried in the car there will be a galvanic battery with an alarm, two barometers, two chronometer watches, a compound thermometer, a wet and dry bulb thermometer, a hygrometer, componer, quadrant, chart, parachutes with fire balls attached, and so arranged as to explode when striking the water, so as to indicate the direction traversed; marine glasses, two vacuum tubes, a lime stove, etc. A number of carrier pigeons will be taken along, and despatched at intervals on the route, with intelligence of the progress of the expedition.

The smaller balloon will be 40 feet in height and 34 feet in diameter, and will be made from 408 yards of "Manchester Mills." Its network will consume 20 pounds of 45 thread cotton cord, and 6 pounds of Italian hemp. It will be attached to the concentrating rings of the large balloon, and will be used as may be required to test the upper currents or assist in feeding the large balloon.

The balloons will be coated with a varnish made of boiled linseed oil, beeswax, and benzine, and of these ingredients 1,000 gallons will be used.

The capacity of the great balloon will be 600,000 cubic feet of gas, but it will be inflated with but 400,000 cubic feet, which, at the height of one mile and three-quarters, will expand sufficient to feel the balloon. The lifting power of illuminating gas is about 35 lbs to the 1,000 feet, so that the balloon will have a lifting capacity of 11,600 lbs. The pressure will be one and a half lbs. to the square inch.

The weight may be summed up as follows ·

	Lbs.
Balloon,	4,000
Net and ropes,	800
Car,	100
Boat,	1,100
Drag rope,	600
Anchor and grapples,	300
Sundries,	300
	7,100

Then 4,000 lbs will be allowed for passengers and ballast.

THE NEW CABLE.

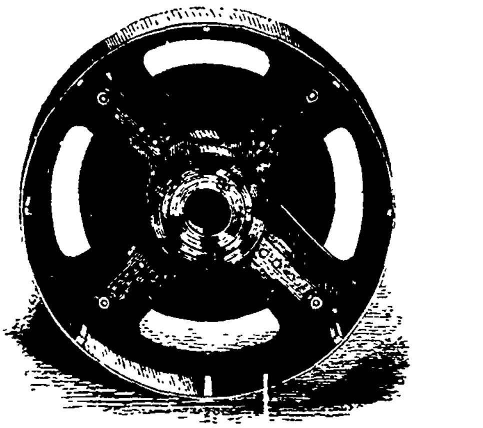
The Newfoundland correspondent of the Montreal *Gazette* writing about the laying of the last cable by the *Great Eastern*, thus describes what he calls "the Atlantic Cable talking."

Mr. Weedon, the able superintendent of the Anglo-American Department, was kind enough to explain to me the mode of telegraphing through the cable, and to permit me to witness its working. I found an operator seated at a table in a room slightly darkened by heavy curtains. On his left hand stood a little instrument named the "Reflecting Galvanometer"—the invention of Sir William Thomson—wanting which Atlantic telegraphy would be a slow process, not exactly two or three words per minute by the ordinary method, instead of eighteen or twenty as at present. This delicate instrument consists of a tiny magnet and a small mirror swinging on a silk thread—the two together weighing but a few grains The electric current, passing along the cable from Valentia, deflects the magnet to and fro. The little mirror reflects a spot of light on to a scale, in a box placed on the operator's right hand, where, by its oscillations, the spot of light indicates the slight movements of the magnet which are too small to be directly seen. The little swinging magnet follows every change, great or small, in the received current; and every change produces a corresponding oscillation of the spot of light on a scale. A code of signals is arranged by which the movements of the spot of light are made to indicate the letters of the alphabet. When receiving a message from Valentia, the operator watches the movements of the little bright speck which keeps dancing about over the scale on his right. To his practised eye each movement of the spot of light represents a letter of the alphabet; and its seemingly fantastic motions are spelling out the intelligence which the pulsings of the electric current are transmitting between the two hemispheres. It is truly marvellous to note how rapidly the experienced operator disentangles these irregular oscillations of the litte speck of light into the letters and words which they represent.

The laying of this last cable has been a complete success, without a single accident, or even a stoppage. The *Hibernia*, with the shore end on board, arrived a few hours after the *Great Eastern*. Three days after, the weather being favorable, she laid the shore end from Heart's Content to the buoy and effected a splice. The cable works most satisfactorily; and having a larger conductor than the old cables, is expected to have a greater transmitting capacity. The next operations of the cable fleet will be to lay a double cable from Placentia to Sydney, in Cape Breton; then to repair the cable of 1865, which has been injured 650 miles from Valentia.

TICE'S DYNAMOMETER PULLEY.

In large cities the letting of rooms with power is a very common practice. Considerable difficulty, however, has been experienced by proprietors in exactly apportioning the amount of power to tenants which their contracts call for. Much disagreement and considerable litigation grows out of this difficulty. It is very desirable, therefore, that some cheap,

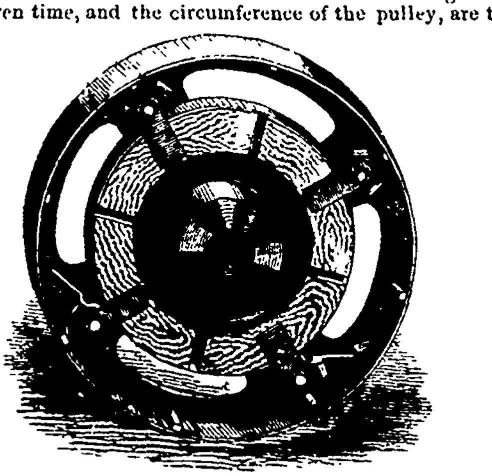


TICE'S DYNAMOMETER PULLEY.—Fig. 1

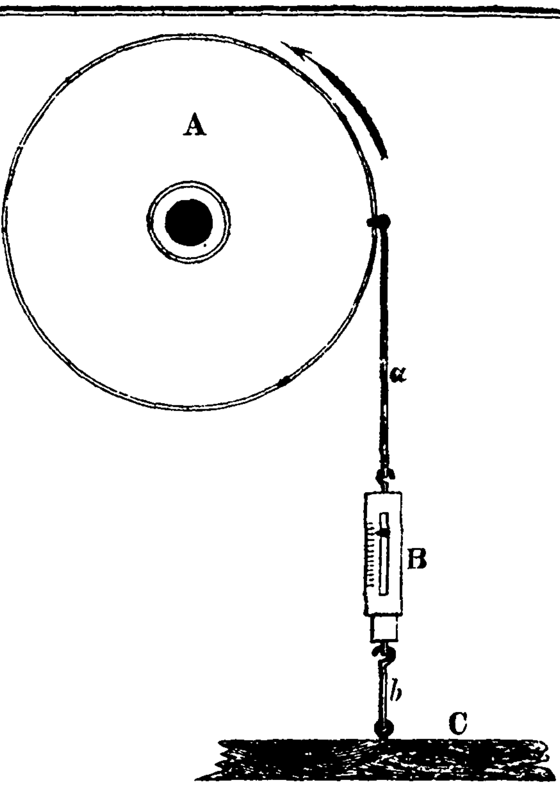
reliable indicator of the amount of power used by tenants, under such circumstances, should be provided.

Our illustrations from the *American Artisan* shew such a device. It is the invention of J. P. Tice, Esq., of New York.

Dynamometer pulleys, heretofore used, have registered the total effect of power developed or transmitted, and although they may be sometimes applied to determine the amount of power distributed from some central motor, they are, for the most part, if not altogether, too expensive, cumbersome, and inconvenient in their application to render their use general. In this device the number of revolutions of the driving shaft, in a given time, and the circumference of the pulley, are the



TICE'S DYNAMOMETER PULLEY.—Fig 2



TICE'S DYNAMOMETER PULLEY.—Fig. 3.

elements from which the power transmitted, reduced to work in foot pounds, is determined.

Fig. 1 is a side elevation of the pulley.

Fig. 2 is an elevation of the opposite side of the pulley.

Fig 3 is a section through the centre of the pulley and shaft, and

Fig. 4 is a diagram showing a convenient mode for determining the amount of friction necessary to produce a given resistance of the pulley.

The general purpose subserved by the pulley, is to not only accurately gauge the amount of power which a tenant may obtain from a line of shafting, but also to prevent his obtaining any more than this maximum, the pulley being set to deliver the exact amount of power called for by the contract, and no more. The means by which this end is accomplished will be seen upon reference to the engravings and the accompanying description.

The parts of the device are as follows: A, is the belt pulley, C, the friction disk, B, the shaft, *b*, springs, and *a*, friction-blocks. Bolts *c*, pass through the springs *b*, and through the spider, D, as shown in Fig. 3. A hub, H, is firmly attached to the belt pulley, A, upon which is screwed a flanged nut, *f*. When this pulley is to be adjusted the main driving shaft B, is revolved at its regular speed. The belt pulley is then adjusted to the predetermined resistance by turning the flanged screw nut *f*, the resistance being measured by a spring balance attached to a floor timber, as shown in Fig. 4, and connected by a link with the periphery of the pulley A. The nut *f*, bears against the inner side of the spider D, Fig. 3, through which the bolts *c*, pass, being also fastened to the springs *b*. It will be seen that it is possible to adjust the pulley without stopping the main shaft—a very desirable provision. The pulley being adjusted as described, will, of course, only impart the amount of power indicated by its adjustment. If an attempt be made to secure more than this by overloading the tenant's pulley, the friction disk, instead of imparting its motion to the belt pulley, slips. In other words, the rim and arms of the pulley proper are loose upon an extended hub, or sleeve, of the disk; the friction surface and blocks of wood being arranged between the two, the blocks being carried by the disk in such a manner as to impart motion to that part of the pulley around which the belt passes. The nut *f*, and spider are so arranged that the friction surfaces may be brought together with a greater or less degree of force. This determines the amount of power which may be transmitted without causing the pulley to slip. A reference to tables furnished for the purpose, will show when the proper adjustment is obtained. We append such a table, prepared for a pulley of twenty-four inches diameter.

As a check, one pulley may be adjusted and used by the landlord, and one by the tenant. Thus, a cheap, reliable, and effective instrument for gauging and regulating the maximum amount of power which should be consumed, is substituted for dynamometers that measure and record the total foot pounds transmitted, and which are too expensive for general use.

It is not necessary to record the total pounds transmitted, when it is agreed between landlord and tenant that a certain

TJOE'S DYNAMOMETER PULLEY. Fig. 4.

amount, say five horse-power, shall be furnished and paid for. It is only necessary to ascertain when that limit is exceeded. The pulley here shown determines whenever an attempt is made to exceed this limit.

It is quite impossible to prove how much power is now consumed in any given case. The thickness of a belt of a given width, the condition of its surface, its tension, the sizes of the pulleys around which it passes, and the speed at which it runs, are elements subject to such wide variations, that even a fair approximation to the power transmitted by them cannot be determined. If, with this pulley, the attempt be made to surreptitiously use more than is agreed upon, it will fail, while the maximum amount of power contracted for will be furnished, but consumed by the friction of the surfaces.

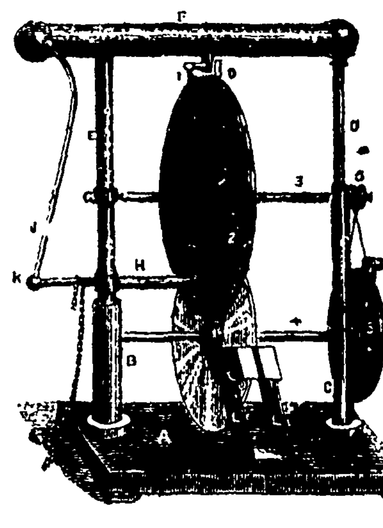
When the pulleys are adjusted for use, they are enclosed by heads fastened by seals that cannot be changed without detection.

CARRE'S ELECTRICAL MACHINE.

For the benefit of such of our readers as may wish to construct for themselves a simple but powerful electrical machine we give an illustration and description of Carre's electrical machine as constructed by a correspondent of the *English Mechanic*.

"This machine consists of an arrangement by which a perpetual current of electricity is derived from a combination similar to the electrophorus. The machine I have constructed is represented in the figure, the moving parts being marked with numbers, and the fixed parts with letters.

"A is the base of wood (or cast metal)—mine is of walnut—1½ in. thick and 16 in. square. B and C are two round pillars of wood (or ebonite), B being 10 in. and C 17 in. long; they are both 2 in. in diameter. These pillars pass through the base, and have nuts below to fix them securely. E is a round ebonite (or glass) rod 1¼ in. in diameter and 16 in. long *plus* the piece of it screwed into B. The rod D is of glass or ebonite, 8 in. long, and the same diameter as the other, with a piece 1 in. long at the lower end fitted with cement into C, and a piece 2½ in. long at the upper end going up into the prime conductor F. The conductor is a cylinder of tin



CARRE'S ELECTRICAL MACHINE.

plate lacquered black, with two brass spherical ends fitted into it, one of which has a pipe soldered into it, up which the end of the glass rod, D, goes and fits tight. The rod, E, has a hole, tapped with a screw-thread in the upper end, and a screw is put down from inside the conductor into this, and secures the conductor to the rod.

"1 and 2 are discs of ebonite—1 being 12 in. and 2 being 8 in in diameter. They are fixed to the axes 4 and 3 respectively. 4 is turned by the pulley-wheel and handle 5, and this pulley-wheel drives 2 at a rate six times as fast as 4 goes round. The rate of the upper disc may be more than this, but should not be less. The lower disc is 1-8 in. thick, the upper one a full 1-16th. The axes are of wood, with brass fittings at the ends.

"The band in the figure is represented as crossed, but it is no matter which way 2 turns. At G is a collar of brass, with a pinching screw to hold it on the rod E, and this collar carries the pin at the end of the axis 3, on which it turns. H is a brass pipe carried by a similar collar, and carrying the comb for collecting the electricity as near as possible to the surface of 2; at the other end is a ball, K, capable of rotating stiffly on its axis, carrying the brass wire, J, with a ball at the top, which can be thus made to touch the conductor or to be fixed at any distance from it. At I is a comb attached to the conductor; and on the other side at O a piece of ebonite about 2½ in long and 1 in wide is attached to the conductor parallel with the disc 2, and having on the side next the disc a piece of varnished paper cemented to it with four or five points cut on the edge of the paper, which is somewhat wider on one side than the ebonite plate, so that these points are projecting in the direction in which the disc 2 is turning. I may say that I have put this apparatus to my instrument as a matter of faith; it seems to work as well without it, and I do not in the least understand what its office is. Lastly, at L L is the rubber, consisting of two cushions, which clasp the disc 1 closely, and are supported by two thin wooden springs, L L, fastened to a block of wood at the bottom, which slides on and off on a dovetail fixed to the base, A. The cushions are covered with thin leather, stuffed with horsehair; and the amalgam is bisulphuret of tin, called aurum musivum, rubbed on the cushions. The discs overlap by 4 in., and run as close together as possible. The discs should be carefully selected, without winding of buckles in them. When the machine is in action the comb at H is connected with the ground by a chain, and the ball at the top of J is brought away from the conductor till the striking distance is attained. This machine gives from 3 to 5 in. sparks easily and in torrents, with a condenser showing a square foot of surface. One or two of the sparks are enough for most people. There is a necessity for occasionally washing the discs, first with fluid magnesia and then with paraffine, as the ozone appears to turn the sulphur of the ebonite into a coating of sulphuric acid, which attracts moisture. This would be avoided by glass discs, but they produce much more friction. A piece of Bristol board well dried, and when dry well coated with shellac, might be tried for the disc 2 If glass rods are used for E and D, they should be coated with shellac, as the machine is much inclined to blow and leak everywhere."

ON TASTE IN COLOR.

Notes of an address by Mr. D. Winfield, at the Architectural Association.

In rooms to be lived in, avoid simple white for color of walls and paint (as in too many drawing-rooms), avoid also any extremely dark treatment. The walls of rooms should be such backgrounds as will best suit the complexions and dresses of the larger number of people. Delicate white intensifies by contrast any unpleasantness or want of perfection; extreme dark would make people look white and ghastly. Neutral colors will be found the best,—generally some gray or cool color that will constrast with warmth of complexions. On no account let an absolutely pure color be used for general surfaces. Nature provides no such color in pigments. Her yellows are greenish or reddish, and so on. Nor does she use it to any extent in inanimate nature. So much so that you will find that if you have much difficulty in describing a color, you may be certain it is good: the more difficulty the more beauty. Nature trusts mainly to gradations of tone, using vivid color in small quantities only, as in the touches on bright flowers and butterflies. This teaching of nature will be found seconded in the pictures of the greatest artists, and in the good old decorated interiors of, for example, Italy and Flanders. In following such teaching, you will, however, need to consider the object to which (in domestic work, say) the rooms are to be devoted. A drawing room, it is agreed, should be light, festive, and gay; a dining-room at once more sober, and with more depth and warmth, as befits its uses. You must also consider the light and shade; openings, and the positions of them; for these may (or may not) effect for you contrast of tone, and may even touch the question of the good sense of your whole scheme of decoration.

Mr. Wynfield gave suggestions for treatment of,—

1. A Drawing-room—Walls.—A light neutral gray, fawn color, or pale green (not dark, but not white). Dados are suitable for all rooms, even drawing-rooms. They may be made of wood, painted as the room doors, or of stamped leather, or of the French paper imitations of stamped leather. A frieze does not interfere with the heads of sitters, and adds much interest if it has its sentiment or story. If flowers form part of your decorations, have no relief, no imitation of Nature's light and shade. A wall must be a wall: if, neglecting this, you introduce illusions to the eye, the sense of solidity will not be suggested. The Japanese decorate on correct principles, with truth to the idea derived from nature, and truth in art, adaptation of representation to materials and method. Woodwork.—Have no graining anywhere; its aspect, however well executed, is repulsive. Real woods are always beautiful. Plain painting may be darker or lighter than the general wall surfaces; both will look well. The doors may have stencilled decorations in angles of panels—birds, or butterflies, or plants, or any beautiful natural objects will supply motives (a decoration used in rooms by Mr. H. S. Marks, Mr. Leslie, &c) Ceilings should rarely be wholly white, except of halls or where the light is defective. Papered ceilings look well. The use of gold is generally satisfactory, it reflects a warm tone on everything below. Put a good amount of color on a ceiling,—not, however, making it so dark as to bring it too close to the eye. The carpet must be either lighter or darker than the walls. It is always lighter at a ball, where white dresses abound. This is following out the artist's rule, to make either background or foreground run into the figure. If this is not done in painting, a woman in white satin, for instance, against a dark floor and dark walls will look like a cut-out figure stuck on, and the same sort of result would occur in rooms. As in ordinary life, dresses are dark in color; where a light wall tone has been recommended, the carpet, will have to be darker than the walls, Not too vivid in color, however, and, of course no flowers, ferns, birds's nests, and such like fearful things. Furniture and hangings should not be too much alike in color; have, say, the carpet one tone, the coverings of the furniture another, and the curtains and other hangings a third. Have summer and winter hangings and furniture coverings: those for the former light and cheerful, the others with more warmth, and suggestive of comfort and home life. A tablecloth, occasional chair, or a rug, may supply a bit of effective contrast with prevailing hues of hangings, &c., and a spot of vivid color in a vase or some small hanging will complete the formal decoration of the room.

2. In a Dining-room,—used for its principal purpose mainly by gas or lamp light,—the living figures are seen in more detail around the lights. And decorated walls and woodwork will thus be sunk into the background among half-lights. More pronounced decoration will be allowable in consequence (and deeper, warmer tints are pleasanter here.)

THE PATHOLOGY OF PEARLS.

In a recent number of the Journal of the Linnæan Society are some interesting remarks, says *Science Gossip*, by Mr. Garner, F.L.S, "On the Formation of British Pearls and their possible Improvement." Every one is aware than an oyster or a mussel, as the case may be, when irritated by a foreign body is reduced to the necessity of toning down the annoyance of the intruder by shedding around it, through the agency of its "mantle," layer after layer of lovely "nacre," or mother-of-pearl. Such is the origin of those pearly concretions which may be found adherent to the inside of the shells of the above-named molluscs. The rounder and more valued pearls are said to be formed in the soft parts only of the animal, of which a good example may be seen in the educational series in the Museum of the Royal College of Surgeons, in the shape of a round pearl imbedded in the foot of a *unio*, or a fresh-water pearl-mussel Mr. Garner has found reason to abandon the generally received idea of the grain of sand which plays the part of the crumpled rose-leaf to the molluscous sybarite, and concludes, from observations made on the marine mussel (*Mytilus*), his conclusions being supported by the independent researches of Signor Antonio Villa, in Italy, that the exciting cause is no inorganic particle, but is actually a minute parasitical entozoon (a species of *Distoma*) in the *Mytilus*; while in the *anodon*, or fresh-water mussel, it is a minute mite, or acarus (*Atax*)—in fact, an itch insect. The presence of such parasites as a nucleus he has proved by treating the pearls with a dilute acid. Mr. Garner then hints at the possibility of setting on foot a kind of pearl nursery, so to speak, where the cultivation of this precious ornament may be carried on, citing the Chinese as an example, who, as is well known, not only introduce metallic figures of Buddha between the shell and mantle (there to be pearl-washed by the mollusc for the ultimate benefit of the faithful), but even go so far as to bring about what may be termed a 'margaritiferous" diathesis, by contaminating the water inhabited by the mussel. With regard to such diathesis, it may be interesting to mention a theory of a celebrated French zoologist. M. Lucaze-Duthiers put forward some years ago, in the *Annales des Sciences Naturelles*, that a mollusc so affected is in the condition of a calculous or gouty subject, its blood being highly charged with the material which goes towards the secretion of pearly substances; the excess of which over and above what is required for the nacreous lining of the shell is precipitated in the form of a pearl, much as in the analogous case of a man a calculus is formed in the kidney or bladder or a concretion of urate of soda above the knuckles.

The number of stars visible to the naked eye in the entire circuit of the heavens has been usually estimated at about 6000. An ordinary opera glass will exhibit something like ten times that number. A comparatively small telescope easily shows 200,000, while there are telescopes in existence with which, there is reason to believe, not less than 25,000,000 stars are visible. And yet when all of these are seen and numbered, the eye will have visited but a mere speck in the illimitable bounds of space.

SCIENTIFIC NEWS.

[*We should be glad to receive scientific news, suitable to this part of our paper, from any of our correspondents.*]

CINCHONA.—A careful analysis by P. Carles of the ashes of cinchona bark, from which the well known medicine quinine is obtained, shows that the bark contains the following subtances: Insoluble silica, soluble silica, alumina, iron, manganese, lime, magnesia, potash, soda, copper, carbonic acid, sulphuric acid, phosphoric acid, chlorine.

According to Dr. Bottger, an excellent marking ink can be obtained from the anacardium nut (*a. orientale*). The juice, it appears, contains an oily matter which becomes black on exposure to the air, and is proof against all known detergents and decolorisers, acids and alkalies, cyanide of potassium, and chlorine. If linen be marked with this natural ink, and then moistened with a little ammonia, the black becomes very intense and is perfectly permanent.

POTASH IN PLANTS.—A correspondent of the *Country Gentleman* gives the following table, showing the amount of potash contained in 1,000lb. of ashes made by burning different kinds of wood: pine, ½lb; poplar, ¾lb; beech, 1½lb.; maple, 4lb.; wheat-straw, 4lb; corn-stalks, 17lb.; oak-leaves, 24lb.; stems of potatoes, 55lb.; wormwood, 72lb.; sunflower stalks, 19lb.; oak, 2¼lb; beach bark, 6lb The remainder portion of the ash, consisting of carbonate and prosphate of lime, iron, manganese, alumina, and silica, is an excellent fertiliser.

FOR the purification of hydrochloric acid, Mr. Engel introduces, in 1 06 quarts of hydrochloric acid, sixty to seventy-five grains of hypophosphite of potash dissolved in a little water. After an hour or two the liquid becomes yellow and then brown, and a precipitate is deposited more or less abundant according to the degree of impurity of the acid. At the end of about forty-eight hours the deposit ceases, and the clear liquid above is decanted off and distilled. The acid thus obtained is completely free from arsenic.

The employment of soluble glass in the chemical and industrial arts is constantly increasing, and its value is now fully established. Recently a cement of great hardness and various applicability has been produced by mixing different bases with this singular substance. It is found that, combined with fine chalk and thoroughly stirred, it will produce a hard cement in the course of six or eight hours. With fine sulphate of antimony, a black mass is produced which can be polished with agate, and possesses a superb metallic lustre. Fine iron dust gives a gray black cement. Zinc dust produces a gray mass exceedingly hard, with a brilliant metallic lustre, so that broken or defective zinc castings can be mended and restored.

The normal heat of the body being taken at 98 deg., fever heat commences at 100 deg., and the extreme limit of fever heat may be taken at 112 deg. Dr. Thudicum has concluded from experiments on his own body at high temperatures, that at a heat of 140 deg., no work whatever could be carried on, and that at a temperature of from 130 deg. to 140 deg. only a very small amount of labour, and that at short periods was practicable, and, further, that human labour, daily and during ordinary periods, is limited by 100 deg. of temperature as a fixed point, and then the air must be dry, for in moist air he did not think men could endure ordinary labour at a temperature exceeding 90 deg. Dr. Sanderson has added useful testimony in detail leading to similar conclusions, observing that gymnastic exercises can be practised by men in high temperatures up to a certain point, but that immediately the temperature of the body rises to 102 deg. or 103 deg. Fah., then all capacity for further exertion ceases. A case in Cornwall has been instanced of the excavation of mining galleries where the air was heated by a hot spring to a temperature said to amount to 117 deg. Dr. Sanderson visited the mine and found the temperature to be 114½ deg. Fah., and the total duration of each of the men's work who were then engaged was less than three hours in the twenty-four. Dr. Sanderson fixes the limit of temperature consistent with continuous healthy labour during five hours at a time at 90 deg. Fah., but that even at this temperature the loss of working power would be very considerable.

MISCELLANEA.

A cement of great adhesive quality, particularly serviceable in attaching the brass mountings on glass lamps as it is unaffected by petroleum, may be prepared by boiling three parts of rosin with one part of caustic soda, and five parts of water, thus making a kind of soap, which is mixed with one-half its weight of plaster of Paris. Zinc white, white lead, or precipitated chalk, may be used instead of the plaster, but when they are used the cement will be longer in hardening.

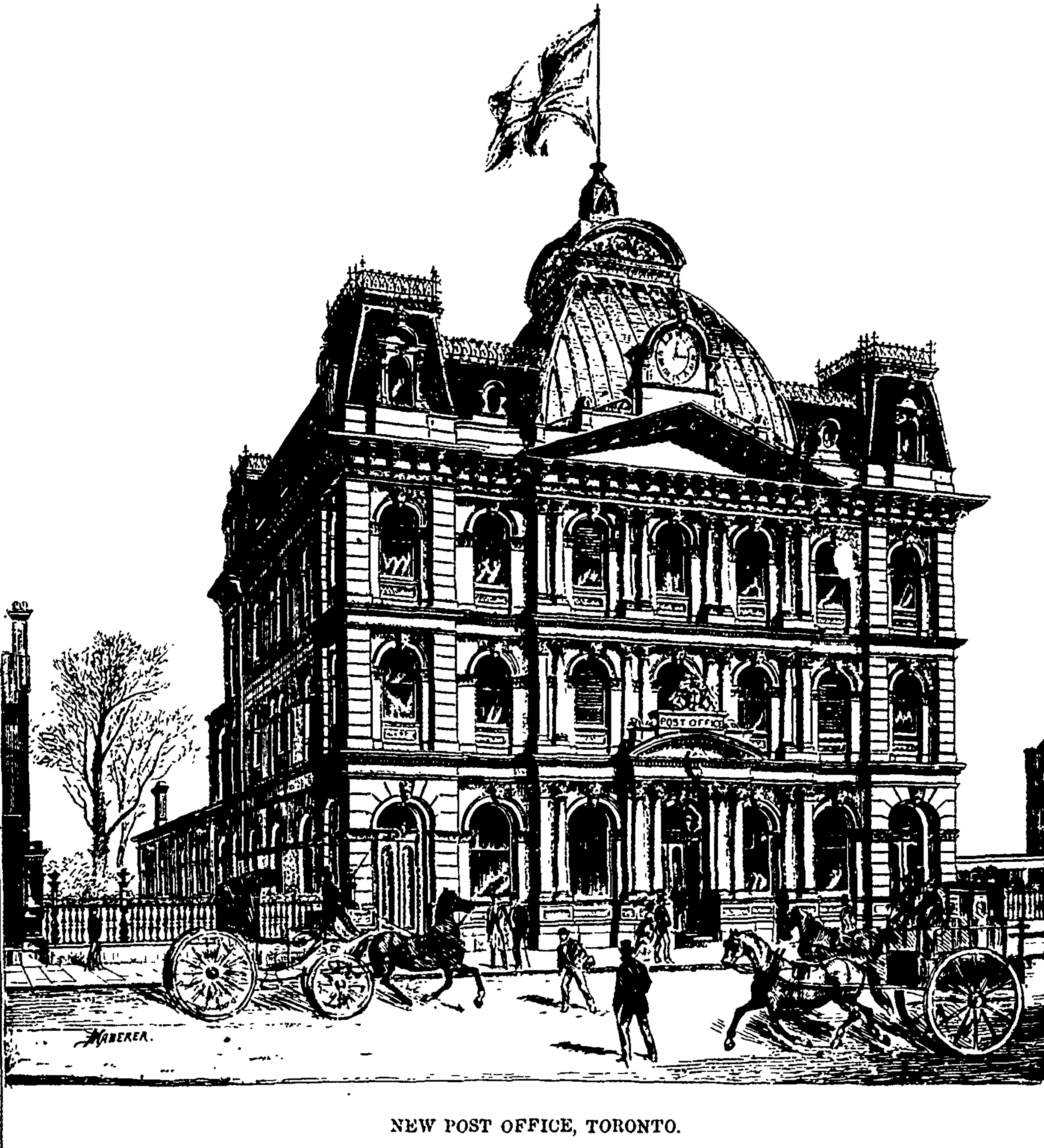
A WONDERFUL MODEL.—An elaborate model of a harbor ordered by the Senate of Hamburg to be constructed for the Vienna Exhibition has been completed in due course. The model is 17 ft. by 6 ft. in dimensions, and it exhibits the ships moored to the wharves, and the laborers employed in their different occupations. On the side of the dock is a railway with a freight train to receive goods from the ships. The vessels are of all sizes from the huge steamer down to the smallest yawl. The whole represents, with pleasing accuracy the busy life of a sea-port.

VARNISH FOR LABELS.—Never varnish a label for acid bottles, but use paraffine instead The only thing necessary is to brush the paraffine on as hot as possible, so as to get a thin, even coating. It looks as well as varnish, and stands a great deal better. It saves a good deal of trouble in sizing and varnishing, and five minutes after the bottle has been brushed it is ready for use Instead of sealing the tops of bottles—sample bottles of bleaching powder, and for other purposes—it is very convenient to have a small porcelain dish with paraffine always ready, which can be placed upon a lamp, and, as soon as warm, dip the top of the bottle in it, which gives as good a sealing-wax, or better, and causes very much less trouble.

SUGAR A TEST FOR POTABLE WATER.—From an article on "The Discrimination of Good Water and Wholesome Food," in the *Pharmaceutical Journal and Transactions*, we find the following simple directions given for testing water, whether it is good and drinkable:—"Good water should be free from colour, unpleasant odour, and taste, and should quickly afford a good lather with a small proportion of soap. If half a pint of the water be placed in a perfectly clean, colourless, glass-stoppered bottle, a few grains of the best white lump sugar added, and the bottle freely exposed to the daylight in the window of a warm room, the liquid should not become turbid, even after exposure for a week or ten days. If the water become turbid it is open to grave suspicion of sewage contamination; but if it remain clear, it is almost certainly safe. We owe to Heisch this simple, valuable, but hitherto strangely neglected test."

SOLAR HEAT AS A TOOL.—During the recent building of a bridge in Holland, one of the traverses, 465 feet long, was misplaced on the supports. It was an inch out of line, and the problem was how to move it. Experiment proved that the ironwork expanded a small fraction of an inch for every degree of heat it received. It was noticed that the night and day temperature differed by about 25 degrees, and it was thought this might be made to move the bridge. In the morning the end out of place was bolted down securely, and the other end left free. In the heat of the sun the iron expanded and towards night the free end was bolted down, and the opposite end was loosened. The contraction then dragged the whole thing the other way. For two days this experiment was repeated, till the desired place was reached. We find no record that the heat of the sun has ever been employed in this way before, but the contraction and expansion of iron bars by fire-heat has already been used to move heavy weights over short distances. Broken walls and strained roofs and arches have been brought into place by simply heating iron rods till they expanded, then taking up the slack by screws and nuts, and allowing contraction by cold to pull the wall or roof into place.

HOW TO MAKE CHEAP FRAMES.—Cut strips of stiff pasteboard about an inch wide the desired length, clip the ends to a point, and cover with any nice black cloth, like broadcloth or fine casimere; lap the ends at the corners of the frames and fasten with a white or gilt button. Bind your picture and glass together with strips of gummed paper and glue, on to the frame. Hang against a white wall. Bronzed paper, which can be bought for eight cents a sheet, may be used instead of cloth, in which case a short strip across the corners of the frame is a great addition to its comeliness.



NEW POST OFFICE, TORONTO.

Wisdom of Art Knowledge.—The man who keeps his thoughts and labours in one unvaried groove is like the mechanician who never oils his machine. But the man who has the happy facility of closing the door of his office or workroom on his toil, takes the surest method of keeping his own powers in the best working order. This is the great use of what we call a hobby. And there is a very special advantage in some knowledge of art. We do not speak now of any general art education. What we mean is rather the intelligent cultivation of taste, by the study of some particular detail or branch of art. One man may take a special interest in pottery. From the long range of fictile art he may select some one shelf, so to speak, which he may have special facilities for filling. He may be an admirer of Wedgwood ware; a collector of old Worcester or old Chelsea; a purchaser of eggshell porcelain, or of Japanese lacquered ware. He may carve a little in wood. He may collect carvings in ivory. He may group together photographs illustrating a particular style of sculpture. What the study may be matters little. It will depend partly on taste, and partly on opportunity. But the great point is, to have a pursuit, agreeable to the mind, to which it will revert with pleasure as a relaxation from bread-winning anxieties. In fact, a new education is thus commenced. But it is the education of a faculty that would otherwise be dormant, and is pursued, not only without undue labour, but with delight.—*Art Journal.*


J. A. EGGINTON.
GLASS CUTTER