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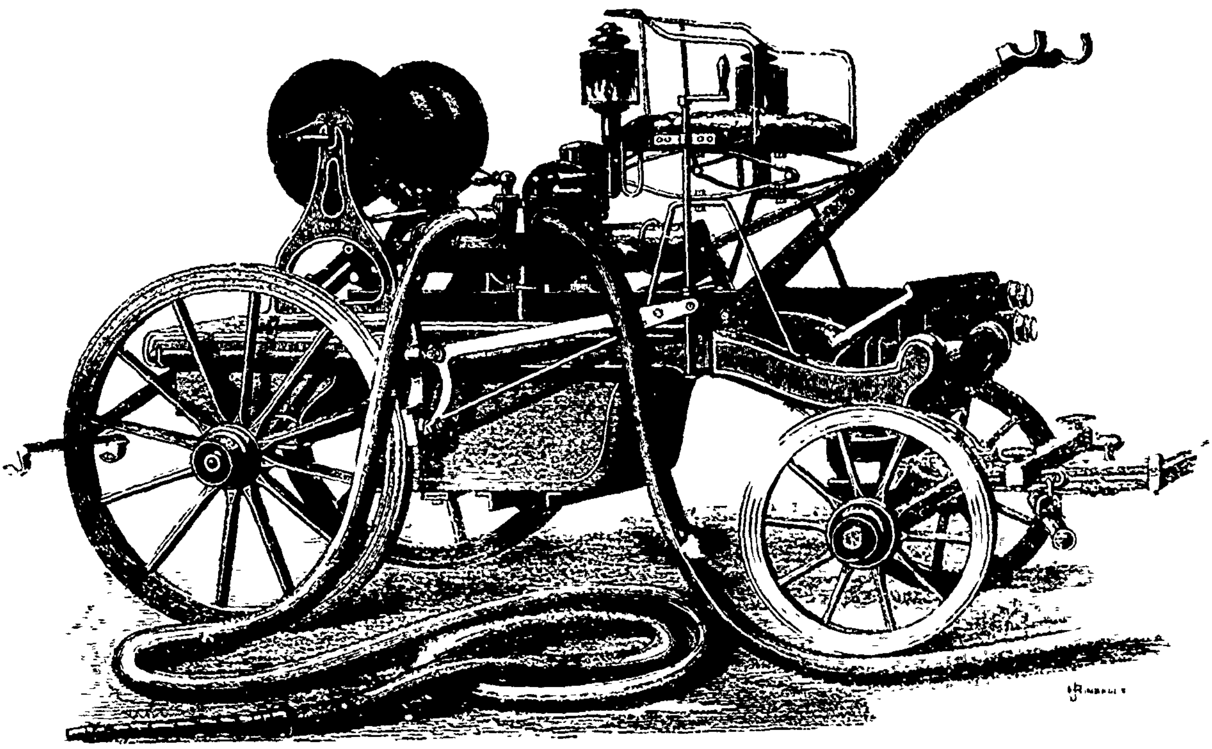


FIRE ENGINE AT THE VIENNA EXHIBITION

MR. J. H. REINHARDT, of Wurzburg, exhibits at Vienna two hand fire engines, one of which is fitted on a four-wheeled carriage, to be drawn by horses, whilst the other is fixed to a two-wheeled hand truck. The former of these fire engines we illustrate above, while on page 84 we give engravings of details. The other engine we shall illustrate on a future occasion. Both engines are double-acting, and the larger one has two plunger pumps with barrels $4\frac{3}{4}$ in diameter (122mm) with a stroke of $8\frac{5}{8}$ in. (218mm.) the corresponding dimensions of the smaller engine being $4\frac{5}{8}$ in. (92mm.) and $7\frac{7}{8}$ in. (200mm.) The chief peculiarity in the construction of these fire engines consists of the arrangement and handiness of the valves and the inner spaces of the cylinders, the former can be taken out without the aid of any tool and without emptying the water tubes, and can be cleaned and put in again within but a very brief delay, a considerable advantage when any sandy or impure water has to be pumped.

The arrangement of the pumps and valves is shown in sections and plans in Figs 1, 2, 3, 4, and 5 on page 84 and consists of the box, K, containing the barrel of the cock, *g*, and to which are fastened the two cylinders, C C, the air vessel, W, and the admission and delivery pipes. The box, K, is connected with the iron frame, *a*, by means of the four bolts, *v*. The plug of the cock, *g*, is hollow and contains the two admission valves, *e*, and the two delivery valves, *d*, and by means of turning the cock 180 deg., and bringing the opening, *o*, to the one side or the other, the pumps are made to draw the water either through the pipe *q*, or the pipe *r*.

The pipes, *q* and *r*, are fastened to the box, K, which is cast, as will be seen from the engravings, in one piece, and to which is also fastened at the bottom the air vessel, whilst the delivery pipe is at the upper end of the box. The plug of the cock, *g*, is pressed down in its place by means of the lever, *s*, which is provided at its end with an eccentric nose acting against the stay, *b*. This stay can be turned down (the screw bolts, by means of which it is fastened to the box, K, acting as pivots), and this being done, the barrel of the cock, *g*, with the valves, *d* and *e*, can be at once taken out, and easy access is obtained to all working parts of the pumps. It would, however, we think be an improvement to increase the height between the suction and delivery valves, and to raise the pump barrels, so that the latter might more readily clear themselves of any sand which might get into them. The parts above described, it will be noticed, are placed above the water tank, so that any leakage is found out at once. The arrangement offers also great facilities for the cleaning of the valve, and for warming in case of freezing in of the water.—*Engineering.*

GRAMME'S MAGNETO-ELECTRIC MACHINE.

We illustrate on page 88 a magneto-electric machine, which is attracting a great deal attention not only from peculiarities in its construction but also from the important results anticipated from its use. The machine is described as follows by *Engineering*:

This novelty, which has quite astonished some of our leading men of science, is the magneto-electric apparatus invented by M Gramme of Paris. It will be remembered that in 1871 this gentleman succeeded in producing a machine which gave a continuous induced current. Since then, he has introduced several important modifications, which render his invention one of the most remarkable of the age.

From the time of Faraday's great discovery, devices of all kinds have been contrived for the conversion of mechanical work into proportionate electrical effects. It is interesting to examine these instruments, and to remark by what nice and gradual steps improvements succeeded one another, until the small contrivances of Pixii and Clarke gave way to the powerful machines of Nolet and Ladd. But ingenuity did not stop here; it has no "ultima Thule," and it was reserved for M Gramme to inaugurate a new era by a new application of a well-known principle. This he has done, and well done, as the apparatus now on view in the works of Messrs. Whieldon and Cooke abundantly proves.

In our issue of March 14th, we published three engravings which help to give a good technical idea of the Machine. Referring our readers to the engraving, we shall call the front view Fig. 1; the side view, Fig 2; and the horizontal section, Fig. 3. The uprights represented in Fig. 1 are cylinders of soft iron coiled round with insulated copper wire. There are six of these as shown in Fig. 2. They are 3 ft. 7 5-16 in. high and 3 5-16 in in diameter, and are connected at the upper end by a square plate of cast iron, and at the lower by a socketted base plate 31½ in. by 31½ in. When the machine is in operation, these cylinders become electro-magnets, and thus form an intense magnetic magazine. The broad circular disc (Fig. 1) is a bobbin of peculiar construction rotating between the poles of one of these electro-magnets. The poles extend over one third of its circumference. Two metallic brushes shown also in Fig. 1 are in contact with the arbor; they collect the current as it is generated, and transmit it to two large nuts, which serve as the terminals of the machine. One of the coils, the first on the left in Fig. 3, excites the electro-magnets; the other two, are connected together and produce the current to be utilised externally. The bobbin consists of a ring of soft iron, round which insulated copper wire is wound by lengths of about 10 yards. The contiguous ends of these lengths, represented by two radial lines in Fig. 1, are joined at the circumference of the ring to copper strips, which connect them with the same number of copper conductors, placed longitudinally on the arbor. These conductors are insulated from one another, and it is from them that the brushes collect the current. Thin wire is used when tension is required; and thick, when quantity.

We shall now turn from these descriptive details to the generation of the electric current. Faraday has shown that when a magnet is brought near a wire a current is induced in the latter, as shown by the deflection of a galvanometer, and that a current opposite in direction will be induced when the magnet is withdrawn, the continuance and tension of the current depending in both cases on the duration and velocity of the motion. The same effects may be rendered still more striking by inserting a bar of soft iron within the coil and alternately approaching and withdrawing a pole of a magnet. It thus appears that variations in the magnetic state of a bar are sufficient to induce corresponding currents in neighbouring conductors. Lenz has given a law by which the direction of these currents may be determined. It is plain the same results may be obtained by fixing the magnet and moving the wire-covered core. We may go further, and for the iron bar substitute an iron ring. Coiling our wire around this annular core and making it rotate uniformly near a magnet we shall obtain a uniform and continuous flow of electricity. Indeed, there is no interruption whatsoever, the currents are absolutely unintermittent. The idea of the ring belongs to M. Gramme; it is the characteristic feature of his machine. Its introduction marks an epoch in magneto-electricity. But in the Gramme machine there are no permanent magnets and no voltaic current is ever used; where, then, is the exciting source?

This is readily found in the very minute trace of magnetism induced in ordinary soft iron by terrestrial action, especially when, as in the present case, it is maintained in an upright or vertical position. It was such a Combination of circumstances, as we call a happy accident, that enabled M. Gramme to dispense entirely with the voltaic battery. In Wilde's, Siemens', and Wheatstone's, and other similar machines, it is usual, once for all, to send a current round the electro-magnets, the small amount of residual magnetism sufficing to work the machine on subsequent occasions. It appears that before M. Gramme had finished his battery arrangements the machine was set in motion by an assistant, and when he came to make connexion he found, to his great astonishment, the apparatus in perfect working order, and evolving a powerful current. This was a step beyond the simultaneous discovery of the reaction principle by Siemens and Wheatstone.

When the coils begin to rotate in presence of this infinitesimal power, a strong current is at once induced in the wires, which, in virtue of the rotation and consequent mutual reaction of the poles and coils so rapidly augments in strength that after a few seconds—almost an inappreciable period of time—the soft iron cylinders are converted into powerful electro-magnets, by the current of the left-hand bobbin (Fig. 3). The other two coils produce the current employed. But the reader familiar with the machines of Holmes, Ladd and Wilde, may ask where is the commutator? To this pertinent question, we should answer there is none; and this is not one of the least interesting and important features of this beautiful invention. To illustrate the manner in which this sometimes troublesome appendage is dispensed with, let us consider the electrical state of one of the coils. The two adjacent poles develop, in the parts coming immediately under their influence, currents which flow in contrary directions in the opposite portions of the circuit. These currents are led, in the manner already explained, to the arbor of the apparatus, where they may be collected by suitable metallic pieces at the neutral points. In the present apparatus, this is effected by brushes of silvered copper wire held together by adjusting screws. It is obvious that the currents require no reversing as in other machines, and hence there is no necessity for a commutator. This is decidedly a great improvement, as is everything which simplifies mechanism without diminishing effective power. The rotation given to the coils is 350 revolutions per minute. The driving power required is from two and a half to three horse power. The current developed equals that of 525 large-size Bunsen cells.

The luminous and calorific effects are quite astonishing. A light has been obtained whose brilliancy was nearly equal to that of 1000 Carcel burners (5600 sperm candles); and a light equivalent to 900 burners was emitted during a series of experiments extending over several hours. The spectrum afforded by such intense illumination exhibited several interesting features in various lines never before observed. For lighthouse purposes, this machine has many advantages over that of the Alliance Company, generally employed. It takes up one-fourth the room, gives twice the light for the same expenditure of power, and for the same light is only half as expensive. Wilde's machine, driven by a fifteen horse power —the armature making from 1600 to 2000 revolutions a minute, a rapidity that gives rise to several inconveniences—achieved a great feat when it fused a platinum bar 2 ft. long and 25 in. in diameter. We have seen the Gramme machine which we have been describing, driven by a three-horse power, the coils rotating at the rate of 350 revolutions per minute, fuse almost instantaneously an 18 gauge platinum wire 8 ft. long. A copper wire, 22 ft. long and of 96 per cent. conductivity, being stretched between the terminals was fused in less than two seconds. A piece of a round file ½ in. in diameter and 4 in. long was burnt away in five minutes, and a piece of diamond was volatilised in less than as many seconds. These facts speak more eloquently than all the words we could string together in elucidation of the vast heating energy of this machine.

But however valuable the apparatus may be by its illuminating power, it is still more so in its applications to electro-chemistry. In this branch, it will no doubt be productive of very great results. The high cost of other like machines precludes the possibility of using them with advantage. There is here an extensive and commercially important department, and we are glad to say that it is in the hands of so able a chemist as Mr. Werdermann. We are informed that Mr. Werdermann is devoting much attention to this subject, and he is already cheered in his researches by satisfactory results and equally encouraging anticipations. He expects to produce chemically pure copper at the price of the ordinary commercial; aluminium for about half, potassium and sodium for less than half their current prices; and other metals, such as calcium and magnesium at rates which may bring them into the chemistry of commerce. He expects to purify 2 tons of pig iron in 20 minutes at a saving of two-thirds the fuel. We shall not even be surprised to see Mr. Werdermann unlocking further secrets of nature, and adding a few more names to our list of metals.

We have already stated that Mr. Werdermann has introduced this invention into England. Though the patent was taken out some three years ago, it was only last November that this gentlemen found in Messrs. Whieldon and Cooke a firm able and willing to make the machine. We can scarcely blame people for being slow to believe startling novelties, as we are all more or less conservative, and often yield only to ocular conviction. Mr. Conrad W. Cooke, who unites the qualities of electrician to those of mechanical engineer, is well fitted for the undertaking. He has now in course of construction two of these machines of very large dimensions. In them several valuable improvements are introduced.

The simplicity of the principle embodied in this magneto-electric machine, as well as the marvellous effects obtained from it, lead us to think that it is destined to play an important part in the development of the various branches of electro-chemistry and metallurgy generally. On the other hand, it is a striking example of the transformation of mechanical into electrical energy. In the steam engine that drives the coils, we see heat developed into a gigantic motive power, whilst in the machine itself we see this motion instantly converted into a continuous stream of electricity. We are gradually finding our way to a comprehensive and complete dynamic theory, and it is pleasing to notice that the great tendency of modern science is to establish the general correlation and unity of physical forces.

THE "LEVEY ENGINE."

(See page 68.)

This invention was noticed in our list of Patents in the first number of this work, but the advantages of the improvements patented are of such importance to all who use steam power that we think it worthy of a much wider and fuller publicity.

A glance at the two girders, or bed plates, shown above will convey an idea of one very great advantage the "Levey Engine" possesses over those of ordinary construction. The lines *a, a, a, a*, may be considered to represent the centre lines of the two piston rods, and consequently the lines of strain, in two Engines, and the lines *b, b, b, b*, to represent the lines of resistance in the same engines. Girder A represents an engine of the ordinary construction, and girder B a "Levey Engine." In A it will be observed that the strain is acting between two levers, the length of which is determinable by the distance from the top of engine bed to the centre of the cylinder at one end, and from the top of the bed to the centre of the shaft at the other. While in B the line of strain is in the same place as the top of the bed which is also the centre line of the Engine.

The frame of the engine is enlarged at C to facilitate the removal of the cylinder cover or the packing of the gland. The cylinder is made in sections divided in the direction of its length or entire, and fitted with slide or rocking valves at the option of the purchaser.

In either case the face of the bed is the centre line and the parts are so arranged that it is impossible to put the engine out of line.

There are some other very important improvements in the engine which we have not space to notice.

Chas. Levey & Co., of Toronto, are the Patentees and manufacturers.

HUNTER'S COMBINATION RAIL.

(See page 68.)

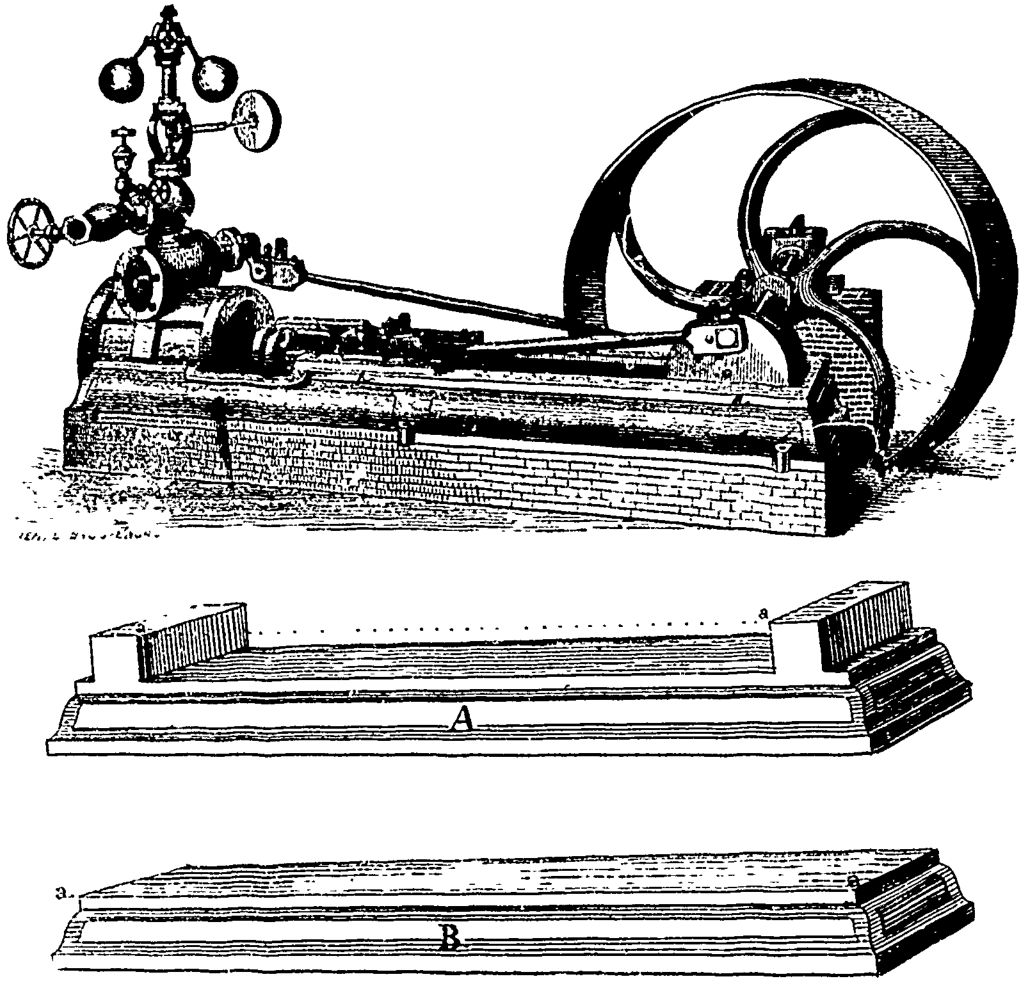
Our last issue contained a notice of the above recent invention. We are able, however, in the present issue to describe it more thoroughly with the aid of the accompanying illustration. The rail is a combination of iron or steel, and wood. As shewn in the illustration, the steel and iron portion is held throughout on wood, and kept in position by means of bolts passing through the web, the wooden rail and the chairs, which secure the latter to the ties; the web fitting the groove of the wooden portion, and the jaws rolled on the head of the iron rail securing its lateral position perfectly. The chairs or fastenings may be spiked or bolted to the ties as desirable.

The rail is rolled in the shape of an old-fashioned (or English) letter T with the "foot" taken off. The *web* is calculated to give the rail the proper vertical rigidity, it being almost impossible to curve or bend it upwards, upon the same principle that it is exceedingly difficult to bend even a very light board edgewise,—i. e. in a direction parallel to its plane. The bolt-holes through the web are slotted so as to allow for contraction and expansion. The face of the rail from its peculiar form (as shown by the cut), for the same reasons which enable it to resist a vertical strain, preserves adequate strength against any lateral strains to which it may be subjected.

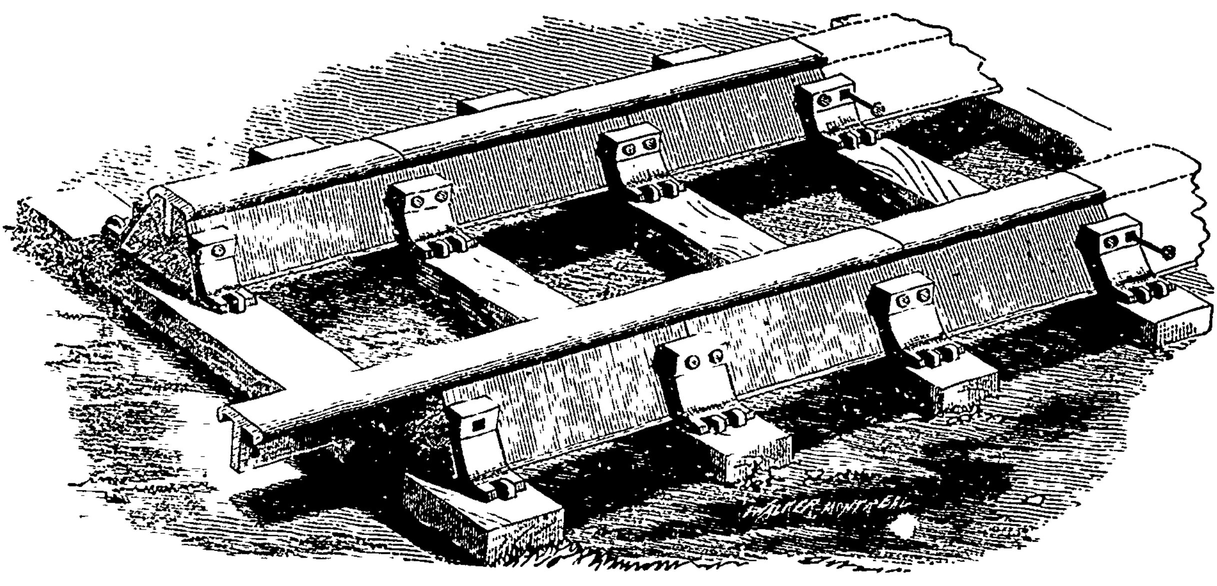
The economy resulting from the use of this rail is believed to be demonstrable. The saving in metal where a 56-lb rail is ordinarily used, is fully four-sevenths. At the same time the metal being supported entirely throughout on an elastic rail or cushion of wood, resting on wooden ties, a road perfectly easy and free from jar and vibration is obtained, the bearing capacity of which is fully equal to that of the heavier iron rail. Another advantage gained in the combined form of this rail is its perfect continuity; the iron and wood breaking joints alternately, and consequently another important feature is its perfect immunity from fracture by frost, which is now the cause of so many frightful disasters; for even if the rail should break (which seems hardly probable), there would be strength enough in the stringer to maintain a passing train of cars in place. And again, the combined rail being bolted through and through the chairs, prevents their sliding or "creeping" down grade, and thus throwing the road out of line and gauge.

In the number of ties to be employed at least 25 per cent. is saved, computing in the same ratio the expense of the stringers to be used. The cutting of the slot in these is a quick and cheap process, and may be effected either at the mills where they are manufactured, or in the woods, or even by very simple machinery carried along the grade as they are laid. It is apparent at a glance that all the material being so light it is far easier to handle than the old patterns, and hence that this kind of track may be laid more rapidly, especially when it is remembered that no such nice adjustment of chairs or fish-plates, with a multiplication of nuts, washers, "stops," etc., is required as in the old system.

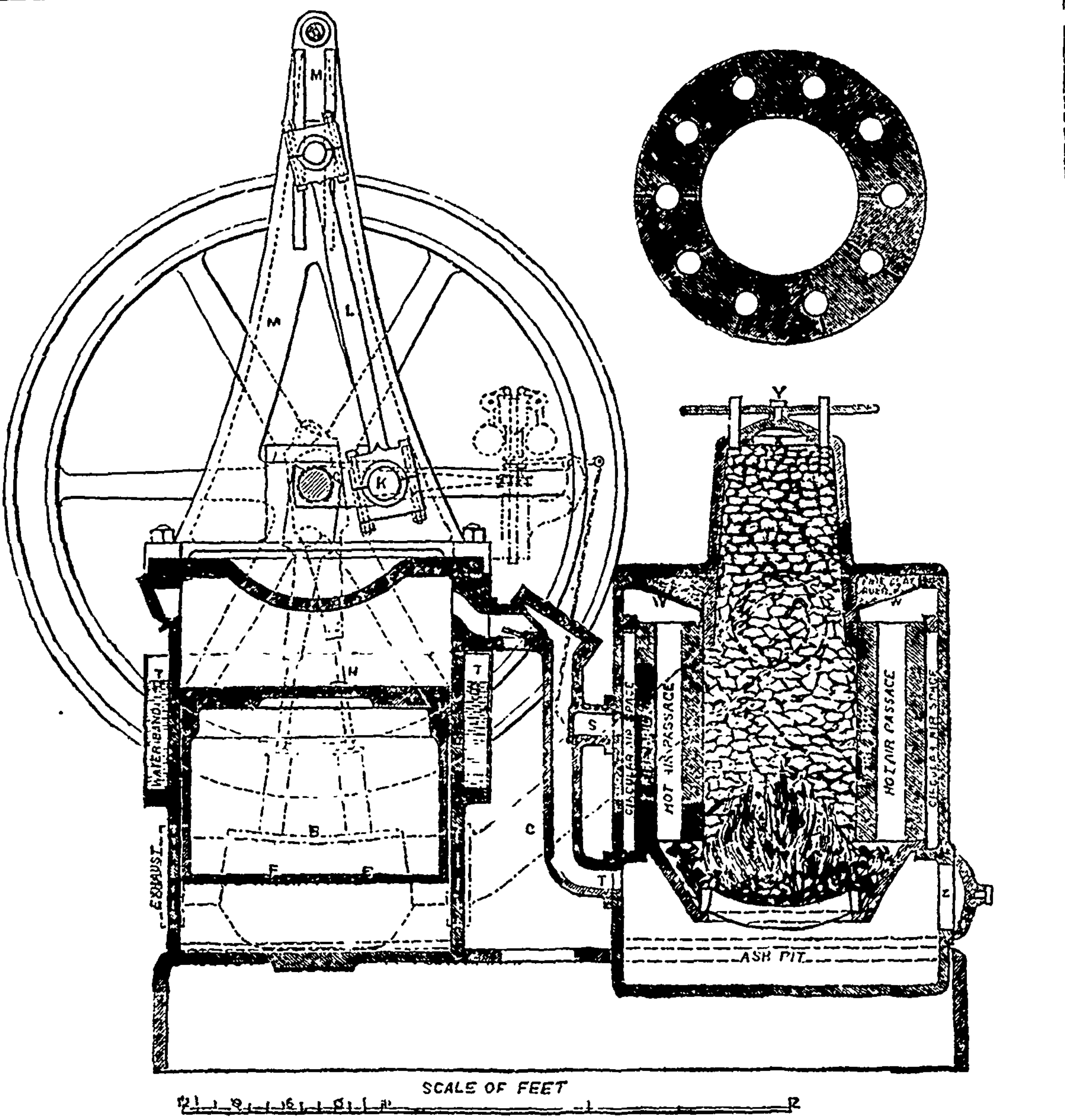
One admirable feature of the invention is the ease with which a rail may be reversed after the "flange side" has be-



LEVEY ENGINE.



HUNTER'S COMBINATION RAIL.



WENHAM'S HEATED AIR ENGINE.

come worn. It is confidently expected that experience will demonstrate that this track and rail may not only be more easily adjusted in the first place, but once down, will be less liable to get out of adjustment than any of the old forms employed It hardly seems possible that there should be wear enough by the metal on the stringers to make any essential alterations in their positions, while between these stringers and the cross-ties the wear may be taken at zero. When the rails rest directly on the cross-ties, it is every day's experience how rapidly they *saw* their way into the wood; and hence the advantages claimed in Mr. Whitman's invention, where the tie is mortised and another block inserted as a "deadener" between the rail and cross-tie The advantage thus gained is limitted, but by Mr. Hunter's invention the mortising is entirely dispensed with.

In conclusion, this invention seems to commend itself to the earnest and thorough attention of railway managers as comprising many important and valuable features, with regard to economy in first cost and maintenance, durability, safety and comfort.

INSTITUTION OF MECHANICAL ENGINEERS, ENGLAND

The annual meeting of the above association was held on the first of May last in London. The first paper read was one by Mr. F. W. Kitson on the "Huntoon Governor." The second paper was by Mr. Conrad W. Cooke "On Mr. F. H Wenham's Heated Air Engine." The following description and our illustration of this engine are from *The Engineer:*

"This albe paper on an interesting subject, began with a sketch of the history of heated air engines, dating from the first, by Sir George Cayley, in 1807, followed in 1816 by the more celebrated engine of the Stirlings, of Dundee This latter embodied the beautiful idea of the regenerator, which makes its reappearance in the common mouth respirator, in Siemens' furnace, in Kirk's ice machine, and other apparatus. A diagram was shown of Stirlings' latter engine, with its two heating vessels, having their lower ends exposed to the fire, their upper ends kept cool by water and two plungers attached to the opposite ends of a horizontal beam oscillated by a crank and connecting-rod attached to the engine. In the working cylinder was a close-fitting piston, the top of this cylinder being in communication with one heating vessel, and the bottom with the other end. As the displacers moved up and down the air in the heating vessels was displaced and sent alternately to the top, or cool part, and to the bottom, or heated part, of the vessels. The air being heated or cooled as the plungers were respectively at the top or bottom of their stroke, a difference of pressure ensued in the spaces above and below the working piston. Two engines of this kind were constructed, one of 45 horse power, working for upwards of three years in driving the works of the Dundee foundry. It was, however, ultimately laid aside, owing to the failure of the heating vessels under the exposure to the great heat.

This was in 1845, and some time afterwards Captain Ericsson came forward with his so-called caloric engine, which was carried out on a large scale in the form of a pair of marine engines of 600-horse power. To all these engines was applied the Stirling regenerator consisting of a passage chamber filled either with thin metallic grating, with copper wire gauze or with thin metallic tubes. The spent heated air exhausted through them, left behind a portion of its heat, which was picked up by the incoming cold air on its passage in the opposite direction. Using as much as 4900 square feet of heating surface, Ericsson seems to have expected to get back with the incoming air all the heat expended in working the engine. Mr. Cook showed a large diagram of Ericsson's form of air engine—too well known and too much resembling in principle Stirlings' to need recapitulating its points.

Mr. Wenham's hot-air engine belongs to the class in which the fire is enclosed and fed by air pumped in beneath the grate to maintain the combustion, the larger portion of the air entering above the fire to be heated, the whole—together with the products of combustion—being made to act on the piston. Sir George Cayley, as stated, first brought an engine of this kind to work. The air pumped in could be conveyed above or below the fire at will. It first passed round a casing surrounding the furnace to keep it cool, and the cylinder was surrounded by a water belt. Such an engine was at work for months, but its joints gave great trouble, and the cylinder and piston packing were quickly destroyed by the dust and grit from the fuel. An attempt to filter the air by passing it through sheets of wire gauze failed through their choking up.

The next step forward with this kind of engine was the invention of the protecting drum—first brought out in America—for a single-acting vertical cylinder, in which the working pressure acts on the under side only. The drum is a prolongation of the piston, and, its length slightly exceeding the stroke, its diameter being slightly less than that of the cylinder, and the packing ring being near the top, the working portions are thus very ingeniously protected.

The engraving gives a sectional view of Wenham's engine of 1-horse power. A special feature is the furnace shown at A, in which perfect combustion is obtained from ordinary bituminous coal, which is generally preferred for this engine. The space under the grate is separated from the upper part by a moderately air-tight diaphragm, and above the grate is an annulus of segmental fire-bricks (as shown) with semi-cylindrical grooves at their joints, so that when placed together the centre forms a cylindrical hopper containing a store of fuel sufficient for several hours' work, and the grooves at the joints form a series of vertical flues through the bricks. The column of coal descends as it is consumed on the furnace bars, and the air, coming into contact with nothing but coal in a state of intense ignition, all the products of combustion must pass through the ignited portion. The channels in the fire-bricks that serve as flues being also white-hot, no unconsumed fire gases can pass through.

The furnace has a cover by which it can be hermetically closed in front of the ashpit, shown at Z, and there is a similar cover for filling the coal hopper at Y. The products of combustion after leaving the channels of the bricks are met by a baffle-plate W, lined with fire-clay, which prevents the cover of the furnace from getting unduly hot. The fire-bricks are separated from the outside shell of the stove by a ring of powdered brick or ashes. There are two cold air supply inlets to the fire, the one below the fire at T, and the other above the fire at S, and there is a swing valve, by which more or less of the air supply is directed below or above the fire. If all the air be directed *below* the fire the combustion becomes very intense, and the heat, and consequent expansion of the air, correspondingly great, and the engine will gain in power and speed. If, on the other hand, all the air be directed *above* the fire through the passage S, a very dull fire will be the result; the air will be comparatively cool with less increase of volume, and there will be a diminution in the power of the engine. This difference of power serves as a very effective means of regulating the speed of the engine, and the governor was consequently attached to the lever of the swing valve at S. No other regulation for speed is required, giving this advantage that the combustion of the coal is exactly proportioned to the amount of work performed.

The engine is of the "steeple" form, having two piston rods placed diagonally, with the main or crank shaft running between them; and in order to make the cylinder as compact as possible the cylinder cover is provided with a segmental chase or depression, in which the crank passes. The engine is single-acting, the air pressure acting on the underside of the piston only, the air is admitted from the heater by means of a "poppet" valve E, moved by a cam at G on the main shaft. There is a similar valve, also moved by a cam, which opens from the cylinder to the exhaust. This valve is shown at F.

The chief peculiarity in this engine is the method by which the top of the cylinder serves as the air pump, and is made to convey into the heater for expansion the reduced bulk of air required for the due performance of the engine. The top of the piston does not reach the cylinder cover, but there is a clearance space left between them. The result is that the pressure in the heater should never exceed 15 lb. on the square inch, the extent of this pressure is obtained entirely by the amount of clearance space above the piston the action of which may be thus explained. The piston rises until it compresses the air contained in the air pump to half its volume, or to a pressure of 15 lb. per square inch, and not till then does there exist equilibrium between the air in the air-pump and that in the heater. The pump valve Q then opens, and during the remainder of the stroke air is pumped into the furnace. At the end of the stroke the valve Q closes, leaving still 15 lb. pressure in the space above the piston. As there is no further escape for this, it acts upon the piston during part of the down stroke and equalises the action of the engine, a small fly-wheel only is therefore required.

This, is of course, not any advantage in power, for whatever power is required in order to obtain this pressure of 15 lb. above the piston, must be deducted from the force of the up-stroke, it is only transferred from the lower side of the piston to be utilised above by the subsequent expansion of the compressed air. After this expansion has ceased the inlet air-pump valve below Q opens, and admits the quantity of cold air required for the next stroke of the engine.

KASTENBEIN'S TYPE COMPOSING AND DISTRIBUTING MACHINES.—(See page 73.)

Machines for composing and distributing type have occupied the minds of inventors for many years and there does not seem to be any reason why a satisfactory solution of the question should not some day be arrived at. The probability is that like many other similar things the machines will improve gradually by the independent labor of different minds. The machines which we illustrate, from *The Engineer*, on page 73, have been adopted by the proprietors of the *Times* and are now used in several printing establishments. Many improvements yet remain to be made but the machines are certainly useful and extremely ingenious.

Considering that nearly a hundred different characters, ninety-six in fact, have to be composed and distributed with speed, the parts of the machines are necessarily complicated in number if not in form, but we hope that with the aid of the accompanying engravings all the main parts will be made intelligible to our readers.

Figs. 1 and 2 represent front and side elevations of the composing machine. Each letter, or other character, has its own receptacle, or type box, in which the characters lie on their sides and one upon the other; these type boxes, which are generally about 15in. in length, are mounted on the top of the machine, and are marked *a* in the engravings. The boxes are without bottoms, which are replaced by a plate in the machine, from which the lowest of the types is pushed when wanted by means of a slide, when this slide recedes, the type falls in a vertical position, face upwards, into a notch in the lever *p*, which has a reciprocating motion on its axis, and finally falls down one of the grooved passages *c* to the delivery point *d*. These channels are cut by means of a grooving machine in a thick metal plate, and the front of the plate is covered by a glass door, which allows any sticking type to be seen and relieved at once It will be seen that those passages are arranged in fan-like form, all tending to *d*, but their number makes a special arrangement necessary; a few of the passages are continuous, but the majority end in one or other of what may be called main arteries, and the type continues its course at an altered angle. The passages are opened by the operator touching the keys, D, D, which act upon the levers *h*, *h*, and the bell cranks *i i*, which move the slides already mentioned beneath the type boxes; the type instantly descends and finds an exit at *d*. One passage is, however, made to serve for italic as well as roman characters, so that half the number of passages is saved; to effect this a secondary keyboard is placed above, see *u*, *u*, Fig. 2; these keys are pressed in horizontally, while the others are pressed upon vertically, and act on the sides of the italic type boxes in the direction opposed to that of the roman type slides, and both descend by a common passage.

When each type arrives at the delivery spout *d* it is caught by a spring slide *f*, Fig. 1, which is set in motion by the cam B and the treadle C, and presses the type into the receptacle *e* which represents the printer's composing stick; and as each key is touched the spring slide *f* recedes and advances, introducing another character into the channel *e*. This channel, which is vertical where it receives the type at *d*, is horizontal at the other end towards A that is to say, it has a quarter turn in its length, like the rifling of a gun, and the types which enter it upright are delivered with their faces towards the back of the machine.

Two men are employed to work this machine, the second being the "adjuster" As soon as a line of type of the required length is formed in the channel *e*, the adjuster touches the second treadle C[1], and by a very simple arrangement the line of type is received in the composing frame A, which is a rectangular box; the justification, insertion of spaces, &c., is then made, while the machine is preparing a second or more lines of type.

The distributing or sorting machine, Figs. 3, 4, and 5, may be roughly described as the composing machine inverted, but there are some interesting differences in the parts. Fig. 3 is a side elevation, partly in action; and Fig. 4 a view of the back of the channelled plate with its glass door. The type to be distributed is placed in the receptacle E, which is simply a flat iron box like A in the composing machine; the type is pressed up towards the front by means of a simple bar and ratchet slide; and by a very simple arrangement the line of type nearest to the working part of the machine is raised up and brought well under the eye of the operator, who is assisted, if necessary, by a small mirror placed so as to reflect the first letter on the left of the line of type. This first letter stands over an orifice which leads to the distributing channels, and the instant one type has been allowed to drop through the line is advanced one step by means of a rack motion acted upon by the pressure of the finger keys *g*. The operator touches the key corresponding with the letter presented to his eye; the key acts upon rod *h*, and the bell crank *i* moves back the slide *j*, and opens the lower aperture of the corresponding channel, which leads into the proper type box. These boxes are arranged side by side and in two rows on the table beneath, D, Fig 3. Were this the whole, the machine would be very simple, but in order to keep the parts within moderate compass two special arrangements are made. In the first place, as in the composing machine a large number of channels had to be made to terminate at one given point, so in the distributing machine the type falling into the leading channel has to be discharged into a large number of receptacles, and this is done by a very pretty arrangement shown in Fig 4. Each character falls first into one of three main lines, and is then shunted into its own side line by means of a switch This is effected in the following manner:—Each connecting rod *h* has a small lug, shown at *l*, Fig. 5, which acts upon the bell crank *m*, *m*[1], *m*[1]; and turns the switch *n*, closing the main line and opening the proper branch. The action of the finger itself lifts a vertical bar, withdraws a slide, and allows the type to fall into the main channel. Secondly, there are ninety-six type boxes to be filled, but there are only half that number of finger keys and channels, each key and each channel being made to supply two type boxes, and this is effected by the application of switches, or traps, similar to those described above, inserted in the lower ends of the channels. A channel is just twice as wide as a type box, and the switch, flat in this case, usually covers the entrance to the type box on the left hand; when, therefore, a key is touched the type usually falls into the type box on the right hand side. If, however, the operator presses his foot upon the treadle F, the switches are reversed for an instant and the type falls into a left-hand box. In order to simplify this arrangement as much as possible each key serves for two letters, one in frequent use, and the other much less so, such for instance as *b* and *j*, and the treadle is only called into requisition in the case of the latter. It should be mentioned that the upper or feeding orifice of the channels can be instantly widened or narrowed according to the size of the type to be sorted, by means of two keys.

STEVENS INSTITUTE LECTURES.—SUNLIGHT AND ITS SOURCE.

The spring course of lectures at the Stevens Institute, opened on Tuesday, April 15. We are indebted to the columns of the *Scientific American* for the following summary of the opening lecture, delivered by President Henry Morton:

"For the purpose of measuring lights of different brilliancy, the light of a candle serves as a standard of comparison. An ordinary gas flame is equal to the light of fourteen to eighteen candles, a fact we do not generally appreciate until the gas gives out and we are obliged, as in New York city lately, to substitute candles for it. While the shadow of a gas flame is much more sharply defined and more opaque than that of a candle, it is surpassed by that produced with on oxyhydrogen lamp, the latter by a magnesia burner, this again by the lime light, and so on, until we finally come to the electric light, the most intense artificial illumination we are able to produce. All these lights were exhibited by means of the shadows of objects they cast upon the screen, and it was stated that the brilliancy of the electric light was equal to that of five hundred and seventy-two candles. The intensity of sunlight, however, is so very much greater than the latter that it would take a body many times larger than the sun, composed of incandescent carbon points, to give us the same amount of light.

"Next to this brightness of the sun, the whiteness of his light strikes us as a prominent characteristic. Now, this whiteness is due to a harmonious blending of lights of all colors in proper proportion, as is seen in the spectrum, where a ray of white sunlight is broken up by a prism into its component colors. By reason of its composition it has the property of exhibiting all colors with equal effect, a property not shared by colored lights. The lecturer exhibited a large burner in illustration of this fact. It was covered with disks of green, blue, and purple, purposely selected on account of their dullness by gas light. When illuminated by the electric light, they became very brilliant. When light of any color other than white is passed through a prism, its spectrum is not continuous but composed of alternate bright colored and black bands. These vary with the source of light, and are so characteristic as to enable us to tell what substances give the light.

"A piece of brass burned in the electric arch showed upon the screen the bands due to its components, copper and zinc. This is the principle of spectrum analysis. Now, on examining the spectrum of sun light, we notice that it is full of dark lines. Kirchoff was the first to indicate the connection between these and the bright lines produced by the vapors of burning substances. He observed that some of them, for example nickel, iron, and hydrogen, produced bright lines exactly coinciding in position with certain black lines in the solar spectrum, and he concluded that these substances were present in the sun. But why should they produce black lines in this case? It is because light passing through vapors is deprived of certain portions of its rays, which are absorbed by these vapors. This was beautifully shown by causing the spectrum of the electric light to be formed on the screen, and then interposing the vapor of so-

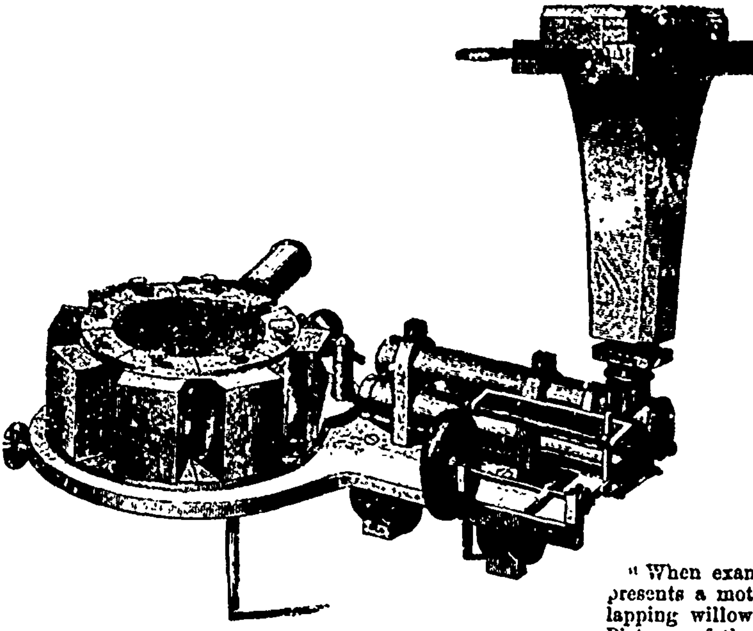


FIG. 1.—DR. DRAPER'S APPARATUS.

FIG. 2.—SOLAR FLAMES.

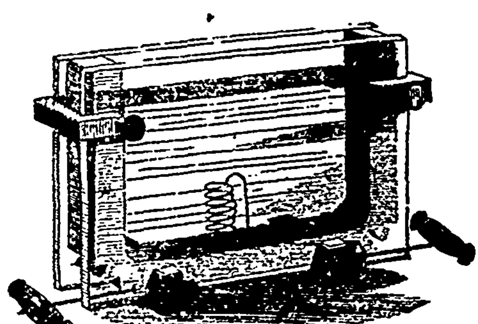


FIG. 3

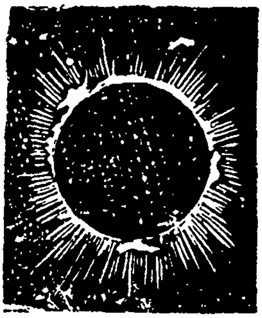


FIG. 4

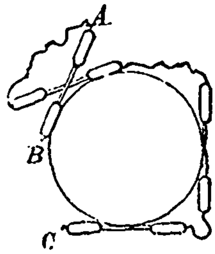


FIG. 5.

dium to its passage; a black line was immediately produced in the yellow part of the spectrum, an this line corresponds to the sodium line in the solar spectrum. Transparent solutions similarly blot out portions of the light by absorption. Some substances produce a great number of lines: iron, for example, about 200. These have been carefully studied. Mr. Rutherfurd, of New York city, who, in appreciation of his eminent services to science, has been recently elected a member of the Royal Society, has produced beautiful photographs of these lines, and Dr. Draper has obtained unparalleled photographs by means of diffraction plates.

" This apparatus, represented in Fig. 1, consists of a series of prisms, by which the light entering from the right is made to pass twice around the prisms, and is finally photographed in the solar camera on the right. These photographs, extending far beyond the visible spectra, have never been equalled.

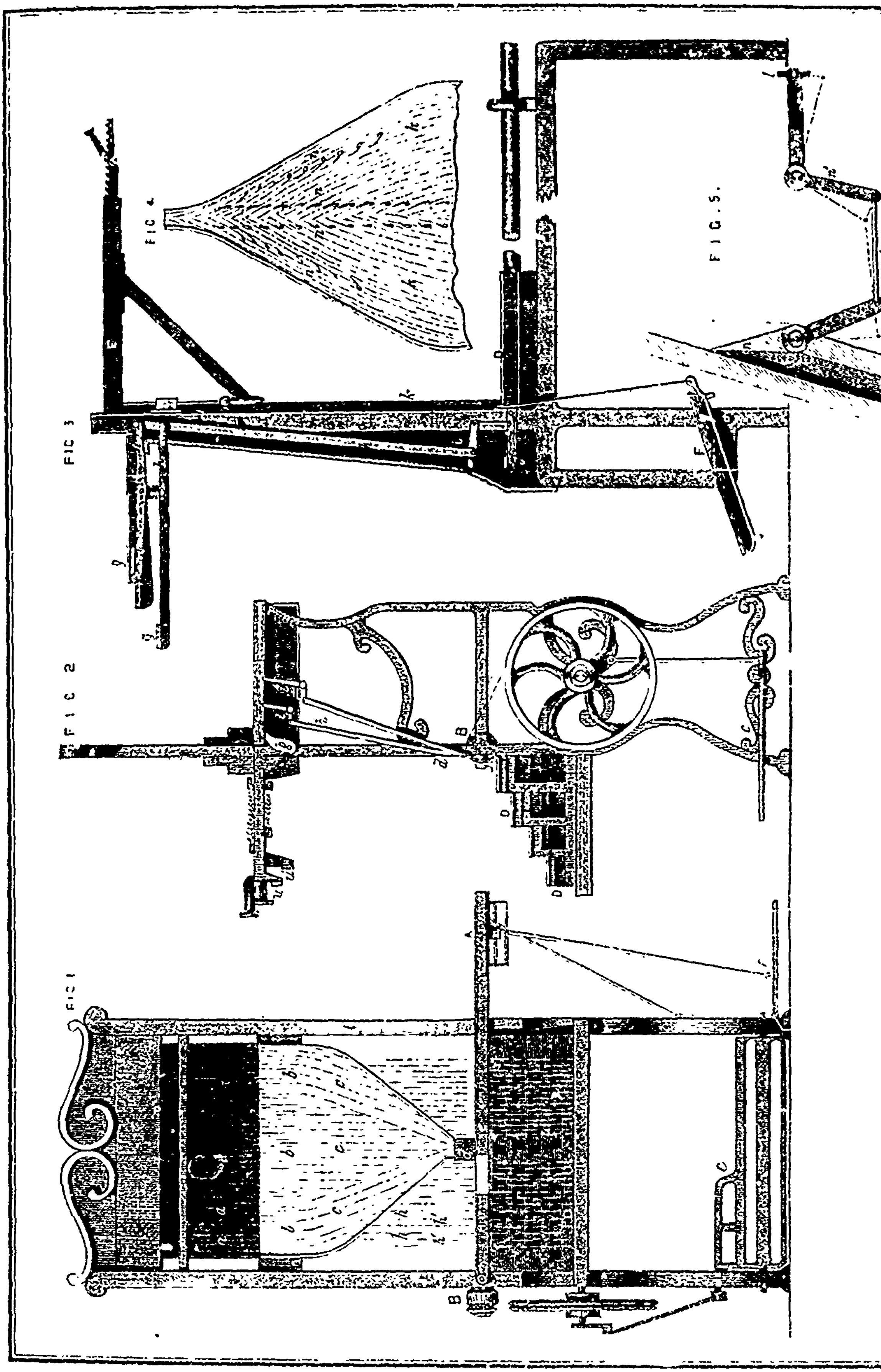
" The lines in the solar spectrum are the means by which we can recognise the substances of which the sun is composed.

" When examined with the telescope, the surface of the sun presents a mottled appearance, likened by Nasmyth to overlapping willow leaves, and by Father Secchi to rice grains. Pictures of their drawings were exhibited upon the screen, as was also a photograph taken in the 1-500th of a second during the total eclipse of August 7, 1869, at Ottumwa, Iowa, just as the " nose of the moon touched the sun's disk."

" The spots on the sun gradually travel over its surface, appearing foreshortened as they approach the edges. Over and near them are sometimes visible very bright clouds or faculæ. An ingenious apparatus, invented by Professor Morton, enable him to represent the passage and the foreshortening of a solar spot over the surface of a disk representing the sun. It consisted simply of an image of the spot upon a rotating glass cylinder placed before the lantern and having before it a screen with a circular hole. The spots also cahnge their shape, and photographs have been taken by Mr. Rutherfurd and others of the same spot in different phases. Some of these were exhibited on the screen.

" When the edge of the sun's disk is examined by means of the spectroscope, red hydrogen flames of different shapes are observed. These have been the subject of considerable study. A Society of Italian observers, composed of Father Secchi, Respighi, Tacchini, and others, have mapped out simultaneously, at different stations, the whole edge of the sun's disk; but the most remarkable observation ever made of them is the following by Professor Young. He observed a large flame, much resembling a grove of trees, for some time, when his duties called him away for about half an hour. When he returned, he found that the flame had been blown literally to shreds, some of which were ascending at the enormous rate of 166 miles a second. Their velocity at starting must have been double or triple.

" Fig. 2 represents some solar flames, two of them in contact with the sun's disk, and one separated from it. It is supposed that the interior of the sun is in a liquid state under enormous pressure, and that from it the flames burst through the surface with a terrific explosion. The lecturer represented them by means of the apparatus represented in Fig. 3. A glass tank placed in the lantern is filled with a red solution below and cold water above. The coil of wire seen in the engraving is heated by means of a battery, and causes the red fluid surrounding it to ascend. The effect is strikingly like that of the red solar flames. Formerly these could only be observed during total eclipses, at the moment the sun's disk was totally covered by the moon. Thus the corona of red flames flashes out with the appearance shown in Fig. 4. This was beautifully shown in its natural colors by placing behind the perforated screen, of Fig. 4, hydrogen tubes, represented in Fig. 5, through which the electric spark was caused to flash. This ingenious experiment elicited much applause. Proctor's theory is that the heat of the sun is maintained by the enormous heat generated by the impact and combustion of meteoric bodies constantly at-



KASTENBEIN'S TYPE COMPOSING AND DISTRIBUTING MACHINES.

tracted into the liquid mass of the sun. Such impact would cause a grand explosion, carrying with it the propulsion of liquid and gaseous masses thousands of miles upwards, and would account for the solar spots and the flames rushing out from the edge of the disk. Bodies leaving the sun with a velocity of 300 miles a second would get beyond his attraction and never return. Some of these strike the earth in the form of meteorites, and prove their solar origin, according to Graham, by the hydrogen contained in them. The fact that most meteorites fall in the day time, more especially at noon, when the sun is towards us, tends to confirm this opinion."

CANADA PACIFIC RAILWAY.

Mr. Langevin, during a recent discussion in Parliament, read the following report from Mr. Sandford Fleming:—

"It was considered important that the main trunk line, from its eastern terminus near Lake Nipissing, should touch in its course the navigable waters of Lake Superior, at a point as near as possible to the Province of Manitoba. The explorations of 1871 were conducted with a view to this, but insurmountable difficulties were found to exist, in the section of the country extending along the North Shore of Lake Superior, south and east of Lake Nepigon. Measures were therefore taken, during the past year, to explore for a line further north, which, passing north of Lake Nepigon, and avoiding the unfavorable section of country above referred to, should connect with the previous year's work, in the neighbourhood of Moose River. A portion of the line ran between the Nepigon River and the Lake of the Woods also explored in 1871, proving impracticable and the country to the south not appearing more favourable, a line was explored last summer farther north connecting with that passing to the north of Lake Nipissing; and at the same time a survey was undertaken for a branch line to connect the main line with the navigable waters of Lake Superior at Nepigon Bay. The results of this survey may be briefly stated as follows:

"1. A chain of instrumental measurements has now been completed the whole way between the eastern terminus near Lake Nipissing, the Ottawa district and north of the Red River in the Province of Manitoba.

"2. A practicable and indeed a favourable route, from the prairies of the interior to Lake Superior, and also to the valley of the Ottawa.

"3. The route referred to will necessitate building the main trunk line past the north side of Lake Nepigon and a branch will be required to Lake Superior.

"4. The distance to the main line from the point where it will cross Red River to the Eastern terminus will be about 965 miles, and to Nepigon Bay and Lake Superior the distance will be about 445 miles.

"5. Adding to the length of the main line from Red River, to the Eastern terminus, the number of miles from the latter point to Toronto, Ottawa and Montreal, and comparing the Canadian Pacific route with other routes, we have the following interesting results. A common point on the Red River in Manitoba is more than 300 miles nearer Toronto by the Canadian Pacific route than by the most direct existing railway, viz: by St. Paul, Chicago, Detroit, &c., and it is fully one hundred miles less by the Canadian Pacific Railway route, from Red River to Toronto than by Duluth; and the shortest line that can be built along the south side of Lake Superior, Sault Ste. Marie, and along the north and east side of Georgian Bay, Red River is 570 miles nearer Ottawa and Montreal by the Canadian Pacific line than by the most direct existing railway. Red River is nearly 200 miles nearer Ottawa and Montreal by the Canadian route than by Duluth, and the shortest line that can be built along the south side of Lake Superior and the north side of Lake Huron coursing at Sault Ste. Marie. Not only is the distance nearly 200 miles less by this Canadian Pacific route to Ottawa and Montreal than by the route last mentioned, but the length of railway yet to be built east of Duluth is about 1,020 miles, while the whole distance between Red River and Ottawa is under 1,150 miles by the Canadian Pacific route. The distance from Red River to Lake Superior at Nepigon Bay is about 445 miles, while to Duluth it is 477 miles.

"The Western Section Surveys have been vigorously prosecuted during the past year between the Eastern slope of the Rocky Mountains and different points of the Pacific coast. A continuous chain of instrumental measurements has been completed from the Yellow Head Pass to tide water on the Fraser River as well as to Vancouver's Island *via* Bute Inlet. A practicable line across the Mountains and to the coast has been found, but the cost of some sections of it will be very heavy, and it would not be advisable to recommend its adoption, until more exhaustive surveys have been made with the view of discovering a more favourable route. No time whatever had been lost in connection with the surveys in British Columbia, and no efforts or expenditure have been spared to gain all the information necessary, to arrive at a decision with regard to the most eligible line for the railway. The field of enquiry is, however, a most difficult one, and it would be extremely unwise to decide finally as to the railway route, without fuller information than is yet obtained. In addition to the exploration referred to, in the Eastern and Western sections of the line, the writer travelled during the past season over the whole extent of country intended to be traversed by the railway, and made a personal examination of its general features. He also sent a branch expedition across the mountains by the Valley of Peace River to the Upper Fraser, and by the Steena River to Nassee Harbour, on the Pacific. A great deal of useful information has thus been obtained, but the distances are so great, and the means of communication so imperfect, that returns from all parts of the survey are as yet incomplete. When full information is received, the whole will be submitted in the form of a report."

A writer in an English paper says: By the way, speaking of waterproofs, I think I can give travellers a valuable hint or two For many years I have worn india-rubber waterproofs, but will buy no more, for I have learned that good Scottish tweed can be made entirely impervious to rain, and, moreover, I have learned how to make it so, and, for the benefit of your readers, I will give the recipe:

In a bucket of soft water, put half a pound of sugar of lead, and half a pound of powdered alum; stir this at intervals, until it becomes clear, then pour it off into another bucket, and put the garment therein, and let it be in for twenty-four hours, and then hang it up to dry without ringing it. Two of my party—a lady and gentleman—have worn garments thus treated in the wildest storms of wind and rain, without getting wet. The rain hangs upon the cloth in globules. In short, they were really waterproof. The gentleman, a fortnight ago, walked nine miles in a storm of rain, and wind such as you rarely see in the south, and, when he slipped of his overcoat, his underware was as dry as when he put them on. This is, I think, a secret worth knowing; for cloth, if it can be made to keep out wet, is, in every way, better than what we know as most waterproofs.

New Nickel Pop Valve for Boilers.—A trial of this newly-patented valve was made on the 14th inst., at the iron ship-building yard of Messrs. Harland and Wolff, Belfast, and was found to be very successful. It is styled the "pop valve," from the suddenness with which it springs open under the influence of the steam pressure from the interior of the boiler. It is composed of an alloy consisting mainly of nickel, which is almost as hard as steel, and possesses the additional advantage of not oxidising by moisture. The valve in ordinary use generally fails to indicate the exact degree of steam pressure on the interior surface of the boiler, as, from the moment it commences to open, the escaping gas renders the pressure on the valve surface less than that on the rest of the boiler, on which the pressure has frequently risen to a degree sufficient to cause an explosion, even when the valve remains open. In the pop valve the machine is so contrived as to equalise the pressure on the valve to that of the boiler. So effectually does this appear to have been secured that in the tests to which the invention has been subjected in America, where the limit of pressure on the boiler was fixed at 50, the utmost increase in the generation of steam failed to raise the pressure on the valve, and consequently on the boiler, to more than 51. The valve can be applied both to stationary and locomotive engines.

RAILWAY MATTERS.

A train on the Memphis and Little Rock Railway was stopped for an hour lately by the multitudes of caterpillars on the track.

A REMARKABLE engineering feat is now being accomplished in the crossing of the Andes by the Senia Oroya Railroad. The mountain chain will be crossed at an altitude of 15,000ft. by a tunnel 3000ft. in length. The grades are the steepest known on any ordinary railway. The workmen employed are Cholos Indians, the only operatives who can endure for a prolonged period the rarefied atmosphere at this great elevation.

AUSTRALIAN TRANSCONTINENTAL RAILWAY.—A large portion of the area proposed to be traversed by the projected Australian Transcontinental Railway is a dead level, and the cost of construction is estimated in consequence at not more than 3500*l*. per mile. This would give a total outlay upon 1800 miles of 6,300,000*l*., exclusive of rolling stock. The cost of hauling trains over the 1800 miles would, however, be very considerable, while the traffic to be accommodated must long be small. At the same time the line would probably prove extremely useful as a means of helping forward the colonisation of Australia.

IT is understood that Hudson, U. S., is to be selected as the location for a new manufacturing enterprise to be known as the "Paper Car Wheel Company." Messrs. R. N. Allen & Co., of Brandon, Vermont, are the patentees of a new car wheel made of compressed paper, which is alleged to possess great superiority over iron or wood. These wheels have been in use on a Pullman palace car long enough to prove them, and it has been decided to establish a large manufactory at some favourable point. Hudson was chosen, and the machine works of R. H. Mitchell and Co., have been secured, with adjacent property, for the location of the new works.

AN inventor in Toledo, United States, has just received a patent for a new and useful invention recently completed by him for an improvement consisting of a combined seat and desk for railway cars. The device comprises a stiff spiral spring, situated in the base of an ordinary-shaped stool, in such a manner as to receive the full weight of occupant of the stool without permitting it to touch the floor. The spring serves to break all the jar and jolt caused by the motion of the train, thus affording a perfectly steady position to the small desk attached to the front of the stool. It is claimed by the inventor, after giving a careful test to his invention, that the occupant may write letters or make reckonings, while travelling at the rate of thirty miles an hour, with all the ease and legibility attainable in his own counting-room.

GREAT WESTERN DOUBLE TRACK.—The contracts for building the double track on the Great Western from Glencoe to Windsor have been let, in four sections, and the contractors for each section are preparing to commence work at once. The contractors for the sections between Chatham and Glencoe are Messrs. Carpenter, Seymour & Bowles, of Chicago. Chatham will be the headquarters of the firm while they are prosecuting the work. It is said the Company find some difficulty in arranging with owners of land through which the line passes, for the extra twenty-five feet right of way required for the double track, $200 per acre being demanded in many cases. The Company refuse to pay any such figure, and, where parties refuse to come to terms, propose to take possession, and allow the owners of the land to seek their remedy in arbitration or otherwise. It is the intention of the Company to have the double track ready for traffic this fall.—*Chatham Banner*.

At a railway meeting held at Dartmouth on the resolutions were passed to urge upon the consideration of the Governor-General the claims of the eastern section of the County of Halifax; that the town of Dartmouth furnishes the most commodious and most advantageous site for the terminus of the Intercolonial Railway; and that a petition to the Governor-General be prepared and circulated for signature, praying that before any money is expended in bringing the railroad further into the city of Halifax, steps may be taken to ascertain the advisability and practicability of bringing the railroad through the eastern part of the county, and the eligibility of Dartmouth as the terminus of the Intercolonial Railway. A committee was appointed to carry out the object of the resolutions.

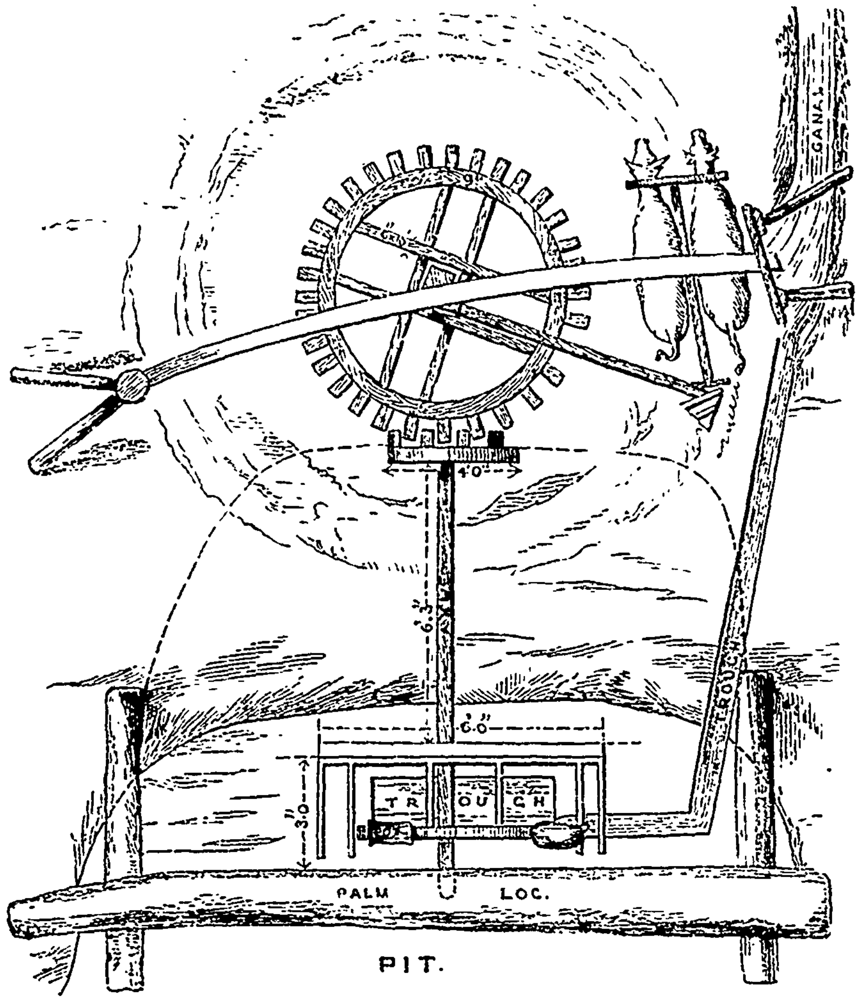
THE ST. GOTHARD RAILWAY.

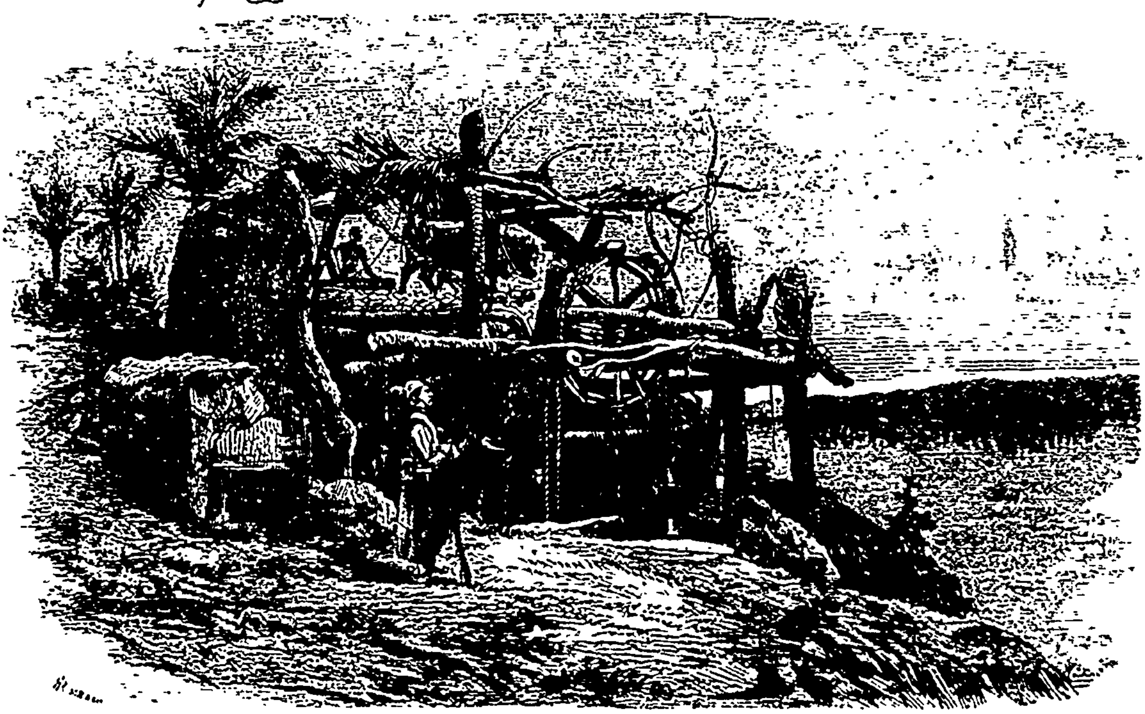
The machinery to be used for piercing the St. Gothard is now in a forward state. The large turbines for driving the air-compressors are being made by Messrs. Escher, Wyss & Co., the well known engineers of Zurich, who are also constructing the heavy portions of the air-compressors, whilst the more delicate parts are in the hands of M. Plainpalais, of Geneva. The erection of the temporary machinery, made in Belgium (which will be used until the permanent machinery is ready), has been somewhat retarded on account of the heavy floods during the last few months. The experiments with some Anglo-American tunnelling machinery at Geneva are said to have given most satisfactory results, and there seems to be no doubt of its being adopted for the tunnelling of the St. Gothard. The question respecting the purchase of the machinery and plant used at the Mont Cenis Tunnel seems at last to have been satisfactorily arranged on both sides, M. Favre, the contractor, being exonerated from the agreement by which he was bound to purchase all the plant from the Italian Government. It appears now that it is thought advisable to retain the air-compressors at Bardonnèche and Modane, and M. Favre has agreed only to take a quantity of pipes that were used for the transmission of the compressed air, the reservoirs, earth wagons, and some of the old tunnelling machines. The advancement in the tunnel at the north side, at Göschenn up to the 31st December, was at the rate of only 0.30 per day, the heading here driven in the hardest granite, the total length driven up to that date being twenty metres. The number of persons employed at this end is about 100. At Airolo the rock met with is somewhat softer, and 102 metres were tunnelled up to the close of the year. At this end the masonry is also begun, and from 170 to 200 persons are employed. Specimens of every description of rock that is met with during the excavation of this tunnel will be kept, so as to form ten collections, sets of which will on their completion be given to the Italian and German Governments, and to some of the technical schools of Switzerland. At the offices at Göschenn and Airolo a complete geographical record of the strata met with during the tunnelling operations will be kept, as also a register of the daily meteorological observations that are taken.—*Journal of the Society of Arts*.

THE SOUDAN RAILWAY EXPEDITION.

(*Continued from page 55.*)

One of the most interesting subjects connected with the country is the means adopted to promote cultivation in the comparatively narrow strip of land available for the purpose, and which is wholly dependent on the Nile for its water supply. The Yooseff Canal is an important feature in the system of navigation; it starts near Soohag and runs along the western side of the Nile valley, forming generally the boundary of the cultivated land, which lies between the river and the desert. It was chiefly used for carrying off the water from the flooded land, and is emptied into the lake El Targoon. When the supply of cotton was cut off from the United States by the civil war, attention was turned to Egypt as a profitable field for cotton cultivation, and much money was expended in creating new and more effective means of irrigation; stationary pumping engines were erected in various localities and a new system, such as had never before been dreamed of in Egypt, was introduced. It was, however, found after a short experience that the constant changes which take place in the course of the Nile, rendered the sites selected quite unsuitable, so that the machinery erected became almost useless; moreover, the amount of water raised was insufficient, and the cost of pumping was very great, owing to the enormous price of fuel. This failure led to the construction of the Ibrahimieh Canal, which starts from Siout and extends to Fesha. This canal is now





SOUDAN RAILWAY EXPEDITION.

THE SHADOOF.

being enlarged for the purpose of irrigating the sugar-cane growing districts, which are now being extensively cultivated.

In the Delta and other parts of Lower Egypt, two crops a year are generally obtained; here the water is raised by steam power to a great extent, where the inundation of the Nile, does not save the trouble and expense.

Further north, and at low Nile, where the banks of the river are so high as to render mechanical irrigation necessary, the fertile land, from Thebes, or a short distance above in to Khartoom, is tended by the majority of the population, which, except in towns, follows the pursuit of agriculture, the hardest and most constant labour consisting, not in the tillage of the ground, but in the raising of water in sufficient quantity to irrigate it.

The two native methods most generally employed for this purpose are the Zakieh and the Shadoof.

The first-named machine, which is worked by two oxen, is shown in the sketch on page 76, and with it the greater portion of the land in Upper Egypt and Nubia is irrigated. In constructing a Zakieh a hole about 20 ft. square is dug in the bank of the river, to form a kind of well, over the top of which the trunks of palm-trees are laid, forming a kind of platform; the outer bearing of a shaft carrying a wheel and buckets is formed in a palm trunk supported at the ends, as shown in the plan.

The bucket wheel carries the rope to which the buckets or earthen pots are attached, and which is of sufficient length to reach below the water level of the river. Two timber or mud piers support another palm trunk, which forms the upper bearing for the vertical shaft, on which is fastened a large horizontal toothed wheel of the rudest construction. Gearing into this is a crown wheel of similar workmanship, fastened on the same shaft that carries the wheel and buckets. A long spar is lashed to the vertical shaft, and to the end of it two oxen are yoked, a board being provided for a driver who, seated on it, urges the animals upon their monotonous revolutions. Like most other things Egyptian, the Zakieh is of an uncertain antiquity, and must have been handed down through almost countless generations exactly as it exists to-day.

It has probably never been improved upon, because had it ever existed in a much more imperfect shape, it would not have raised water at all. These structures are made entirely of wood, and generally being out of order, produce more noise than work. As, too, they are worked incessantly when irrigation is required, and are often quite thickly clustered together, it may readily be imagined that the natural silence of the river is considerably broken. At least 20 per cent. of the water is wasted before it is discharged from the pots into the channel that carries it to the land, and nearly all the power of the animals is absorbed in overcoming the friction of the apparatus.

On the other hand five-year old Arabs, male or female, generally fill the post of drivers, and as the oxen cost but little to keep, the Zakiehs hold their own, being apparently suited to the means and ideas of the small cultivators or capitalists. The duty of one of these machines in perfect order is, not to speak too accurately, a few gallons raised twenty feet high per minute, but it is needless to add that few come up to this standard. The main channel into which the water from the Zakiehs is emptied, is never placed far from the bank. As a rule the land falls slightly from the side, so that the distribution of the water is effected by gravity. When the width of land exceeds from a quarter to half a mile from the bank of the Nile, wells are sunk, perhaps to the depth of 20 feet through the soil, and the water filtering through from the river is raised as already described. This secondary system of irrigation occurs, however, for the most part far higher up the river, between the fourth and fifth cataracts, and where the strip of cultivated land extends for more than three-quarters of a mile before it joins the sandy plains on the western side.

The second native mechanical appliance employed on the banks of the Nile in raising water for irrigation, is the Shadoof, shown in the sketch. This apparatus is always worked by hand, and consists of two timber uprights, about 5 ft. high, and 3 ft. apart, connected by a crossbar at the top, to which is suspended a light bar about 12 ft. long, hung at about one-third of its length; the shorter part, having attached to the end a balance-weight made of Nile mud, while near the other end is fastened a rope or rod, to the bottom of which a leathern bucket, upon a circular frame, is hung. The height of lift averages about 6 ft., and the man in attendance can make about thirty lifts a minute; the water raised is discharged into a channel, whence it is distributed over the land by conduits. When the Nile begins to fall, it is necessary at each Shadoof station to erect additional apparatus close to the new water level, so that at low Nile the water is raised to the required height by a succession of lifts—five or six Shadoofs often working at varying levels. The implement is sometimes formed with two buckets, in which case two men are required to work it.

MECHANICS' MAGAZINE.

MONTREAL, JUNE, 1873.

ILLUSTRATIONS:

CONTENTS:

Before very long the well-organized attempts which are now being made to establish a new industry in Canada, the cultivation of the sugar-beet, will have proceeded so far that some idea may be formed of the probabilities of success. The industry has attained to vast proportions in Europe, and it would be hard to over-estimate the services rendered by it especially to France. Those who speak with authority on the subject say that the soil of Canada is highly favourable to the cultivation of this plant, the alluvial sandy soils, clay lands and calcareous clays of the St. Lawrence valley being just such soils as the beet thrives in in Europe. Our climate, too, will suit the beet well, so far at least as may be judged from the fact that meteorological observations as made in Montreal shew the conditions of heat and moisture to be perfectly fulfilled. Last year also trials of actual cultivation were made at Montreal, Quebec and St. Hyacinthe which furnished results of the most promising nature. The low degree of temperature in winter is said to favour very greatly the preservation of the root, which is liable to ferment with a sudden rise of temperature and so lose its saccharine qualities. It is to be hoped that our farmers will unite to give the new industry a fair trial. The greatest drawback to be found is an insufficient supply of raw material; beyond a certain amount the proportion of profits increases with the increased supply, but there can be little doubt but that the company will succeed in securing the amount required, between ten and twenty million pounds weight of raw material, unless they should be very unfortunate in their first harvest. Should the cultivation reach the extent with us it has reached in other countries it cannot fail to be a great benefit in many ways, and the greatest, perhaps, of them will be the establishment among us of a branch of industry which will require throughout the entire year the labour of that large part of our population which at present fluctuates between the farms of this province, the shanties of the lumbermen, and the brick fields of the United States.

Inventors, mechanics and in fact all interested in those matters which are now before the world at the Vienna Exhibition, find their attention drawn more than usual to the present condition of the laws of European countries relating to patents. The subject of patents is certainly a very difficult one to legislate upon, and a perfectly satisfactory law on this subject is perhaps unattainable. The greatest fault, however, is found with the system as it exists in Prussia and the other German States. It is stated that it is almost impossible to procure a patent in Prussia, and further, that when granted it may be withdrawn if the invention be shown to the satisfaction of the commissioners not to be novel. The Prussian Patent Office consists of nine gentlemen, chiefly professors and theoreticians, unacquainted with practical life. They are thus unable to distinguish what is really new in practice from what is old only in principle. Then they have not much time to spare for patent business, having already plenty of private and professional business on their hands.

The repressive action of these laws and their interpretation by the commissioners is stated to lessen rather than increase the number of inventions, not only with regard to Prussia itself but as respects German patents taken out in other countries, there being about twenty applications for patents in England from France to one from Germany.

COLLIERIES AND SOME OF THEIR DANGERS.

It seems that sometimes, and under certain circumstances the human mind becomes careless in presence of acknowledged danger, and that repeated calamities only serve to deaden the feelings of those exposed. The existence of the risk becomes looked on as a necessity, an familiarity in these cases also is accompanied by contempt. In no case, perhaps, is this state of affairs more clearly shown to exist than in collieries. It has always been difficult to cause improvements to be made in the manner of working and ventilating the mines; and the colliers themselves, the special subjects of danger, have proved the truth of the statement advanced above by almost incredible perseverance in recklessness. Our remarks, of course, have special reference to the recent explosion at the Drummond colliery in Nova Scotia. The mining there, however, was not characterized by any special rashness, and the mine is said to have been carefully worked. Still there is no doubt but that improvements are needed in the working of all coal mines. That this is the case in Great Britain may be gathered from the fact that during the present century about forty thousand valuable lives have been lost by accidents in collieries. In order to give our readers some idea of how the mining is generally carried on, and how these accidents occur, we purpose giving a brief sketch of the manner in which the work is carried on, alluding to some of the principal sources of danger. The usual method of getting coal is to sink a circular shaft which is subsequently divided by wood-work into two or more compartments, which are devoted to the pumping and ventilating arrangements, and to the raising of the coal. The ventilation is carried on by means of two shafts, one called the *down-cast* and the other the *up-cast*. A stream of fresh air (Fig. 1) is continually passing down the former, and after performing its office of ventilation escapes again up the latter or *up-cast* shaft. This constant current is maintained by means of a furnace kept burning at the bottom of the mine, the heated air from which ascends the *up-cast* by the force of gravity. This air from the mine being thus removed, fresh air to replace it rushes down the *down-cast* shaft and is distributed through the mine. When the volume of air reaches the base of the *down-cast* shaft it is split into two or three smaller currents, and these by means of doors and other barriers are conveyed simultaneously to all parts of the mine. A large mine will consume 100,000 cubic feet of fresh air every minute. The accompanying illustration (Fig. 2.), will serve to show how the currents of air circulate in a portion of a coal mine. The dark portions of this ground plan of the pit represent the solid pillars left for support, and the long passages, *a, b, c, d,* shew the waggon-ways and galleries in the long direction, while the short transverse passages are the means of communication between the long galleries. All these longitudinal and transverse passages are presumed to have free inter-communication, the only obstacles being the partial stoppages set up for directing or diverting the currents of ventilating air. In the illustration dotted lines represent such stoppages, and these are here employed arbitrarily in order to explain the different devices.

In the first long passage, *a*, no stopping is shown in the length, and therefore the air, signified by arrows, rushes straight onward to the end.

In the second long passage, *b*, a dotted line runs along to *e*, where there is a full stopping and where therefore, the arrows turn round the dotted line and shew the air current (which had been split by the partition or dotted line into two currents) returning to *b*.

In the passage *c*, the same kind of longitudinal division, or dotted line, is carried as far as *f*, and there the split current of air turns round towards *c*. But at *f*, there is a door which, when shut drives the air round the dotted line, and when open, permits the air to rush inward to *g*. Such doors are frequent in pits, and answer the purpose of allowing the transit of coal or waggons and men, and of driving back the in-rushing air immediately afterwards, and making it go back towards *c*. In the fourth passage *d*, a longitudinal division is erected for the whole length, and therefore causes the divided current to start from *d*, and when it arrives at *h*, to turn round and come back to *d*. As there are no stoppings in the transverse passages on its left, a portion of air runs up those passages, and would go on but for the stoppages at their ends. It is thus manifest how a large pit (which is but a multiplication of such portions as that illustrated) may be thoroughly ventilated in every part by the devices of stoppings and doors and other longitudinal and transverse obstacles. In the case of fiery pits (those peculiarly liable to explosions of fiery gases) a larger amount of air is necessary. The *fire-damp* or exploding gas in these mines is a light carburetted hydrogen. The precise condition in which it exists in the coal itself has not been scientifically determined. It is known, however, to exist therein in a high state of tension. Some seams, and those commonly the best for household consumption, contain it in large quantities. Hence it happens that the fiery seams are those most wrought and that particular pits have a succession of explosions in them. Still, even in the worst pits the cost of ventilation is not so great as would be supposed. It is estimated that the most dangerous pits can be thoroughly ventilated at a cost of about two cents per man per day and that in well constructed furnaces the consumption of one ton of coals per day at the bottom of an up-cast shaft w[illegible] enable each collier to cut one ton of coals more per day with the same amount of exertion.

The manner of cutting the coal varies with the thickness of the seam and the nature of the coal. Where the coal is thick as in the great Dudly-thirty foot seam in England (Fig. 3) the men work in comparative comfort. In such cases it is usual for the pitmen to contract to remove so many cubic yards. They commence by digging away the base of the cube which is then propped up by timber; in the next place they cut away the sides and top, leaving only the back, which is finally charged with gunpowder and connected with a slow match. On a proper signal being given all men in its vicinity remove to safe quarters, the mine explodes and down falls the great cubical mass of coal, which is soon shovelled off and conveyed to the pit's mouth. But this is an exceptional state of affairs. The ordinary run of seams vary in thickness from nine inches to three or four feet. In such cases the work is performed by hand with the pick and our cut (Fig 4) offers some idea of the numerous tiring and painful positions the miners are obliged to assume, kneeling, stooping and lying down; great activity, also is required to change the position rapidly in order to get at the coal. Burrowing thus the miners do not remove the whole of a seam of coal but divide and intersect it by roads and passagers as shewn in (Fig 2) leaving pillars of coal to support the superincumbent strata.

This method of working is called the post and stall system. The seam is divided by what are variously called "partings," "backs," "faces," "cutters," and "ends." Besides the chief partings at the roof and floor of the coal seam, there are intermediate lines of parting or planes of cleavage, parallel to the chief partings. A reference to Figs. 4 and 5 will render this mode of working clear. The letters A, B, C, D, E, F, G represent a mass of coal, being a portion of a regular coal seam, and they are the chief partings at the roof and flooring respectively; Q, Q, Q, the intermediate "partings," or planes of cleavage; ZZ, ZZ, ZZ, the "backs"; PP, PP, the "cutters." It thus appears that a bed of coal according to the number of these planes of cleavage may be broken or subdivided into solid, cubical blocks. In this manner pillars of coal are left to support the roof, and these are subsequently removed when the whole coal field has been worked out in this form.

After driving the main levels in opposite directions upon the engine shaft, narrow mines or galleries called "bays" are drawn out of the main levels at regular intervals, at right angles to the backs, "cross-roads" or "cut-thro's" are then driven at right angles to them at every five or six yards—thus on Fig. 5 LL represents the main level; *o, o, o, o, o, o,* the pillars of coal supporting the roof; P, P, P the gallery; Q, Q, the cut-thro's.

The galleries are not usually at right angles to the main levels, but sometimes meet them at acute angles. This, then, is the most common manner of obtaining the coal. We alluded above to a gas which escapes in vast quantities from some species of coal and which is called by the miners fire-damp. It is from this that the greatest danger in coal-mines proceeds. This gas is extremely inflammable and when mixed with a certain proportion of air explodes with fearful violence upon ignition. It is liable to issue from the coal at any moment during the work of the hewer, who may suddenly strike his pick into a cavity where the fire-damp has been pent for ages. It rushes out with great violence and is then termed a "blower." If the ventilation is good and the men are working with safety lamps, little or no danger may be apprehended; but if naked candles are used and the current of air in the mine is sluggish, the mixture of fire-damp and air accumulating, is fired at some point and explodes with fearful violence, blowing everything before it. Those who have visited pits after one of these calamities, state that the wood-work is broken and splintered like twigs in the hands of a

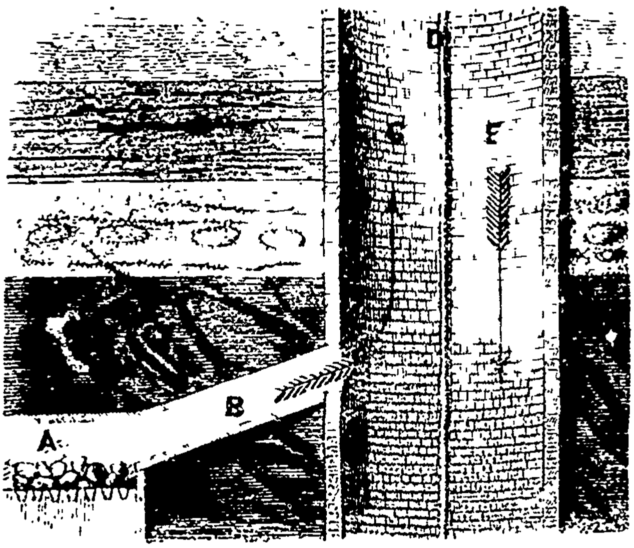


Fig 1

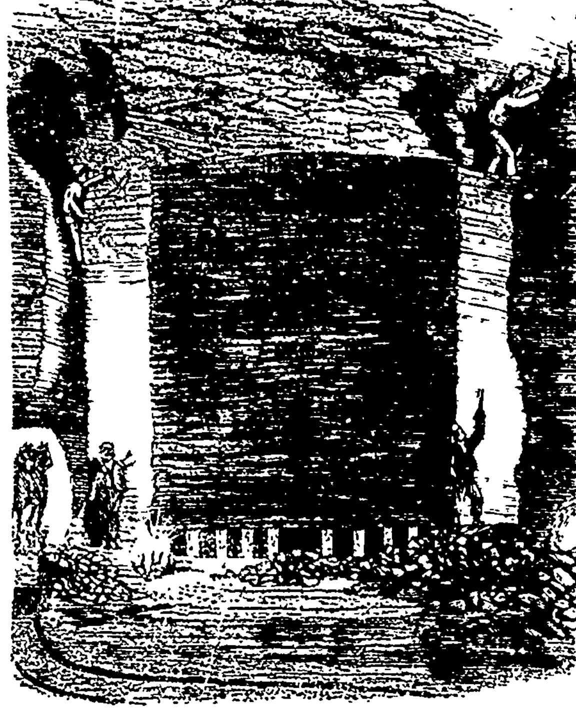


Fig. 3

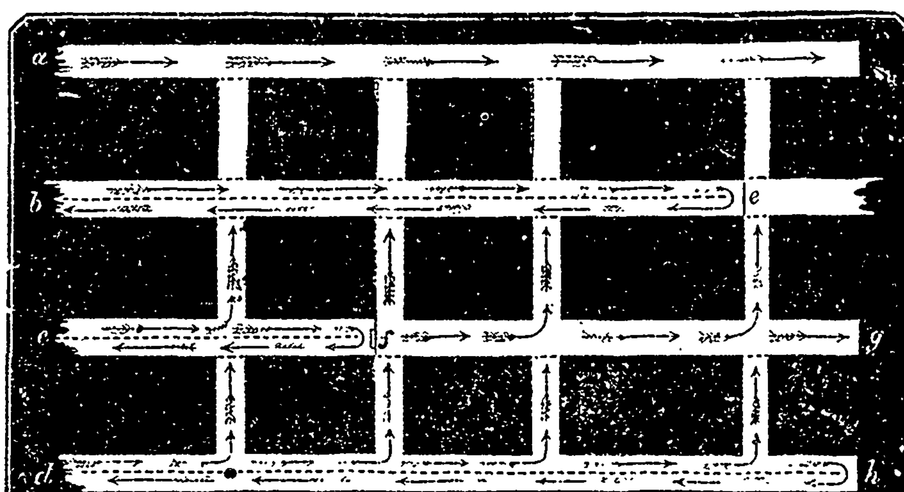


Fig. 2

child, and living beings are projected bodily through frameworks of wood just as if they were solid inanimate substances The destruction of life, as it were in a moment, is frightful, one or two hundred lives being sometimes lost on these occasions. There are two remedies—ventilation and the safety lamps The former we have already discussed. The latter, as is well known consists merely of a lamp whose flame is enclosed within a framework of fine wire gauze, about 400 apertures to the square inch of surface. Even with the most improved lamps of this description the danger is not entirely removed The same fall of coal which releases the gases may break a lamp and expose the flame, and thus cause an explosion.

The principal danger, however, arises from the men removing the wire gauze from their lamps in order to light their pipes or to see the better This has been the cause of many accidents, and several lamps have been constructed specially adapted to prevent the possibility of their being tampered with or opened by the miner without first extinguishing the light, thus preventing all risk of explosion in the mine from the exposure of the naked flame Fig 6 represents one of the latest of these inventions, Yate's Patent safety lamp There

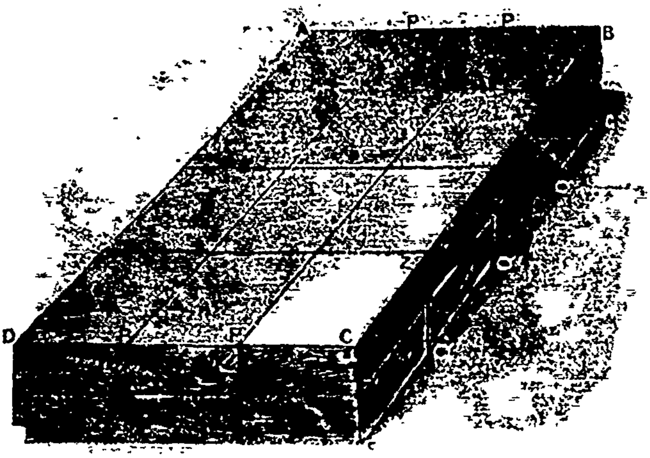


FIG. 4

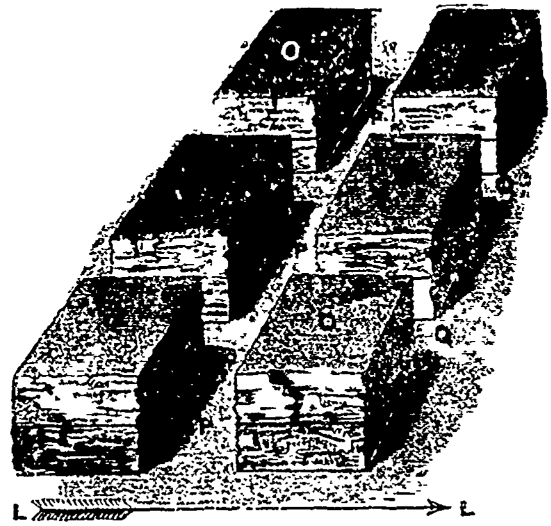


FIG. 5

FIG. 6

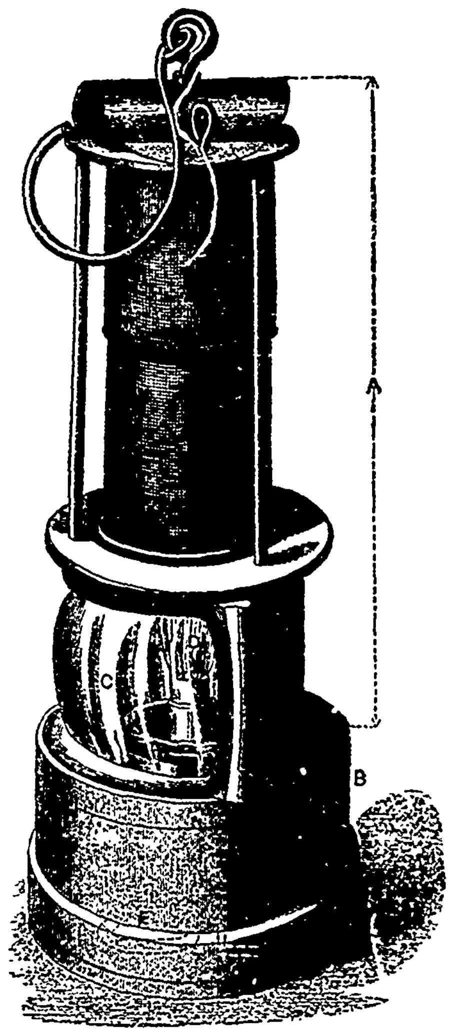


FIG. 7

is adapted to the body of the lamp a locking bolt, which will prevent the lower part from being unscrewed or detached from the upper part until such bolt is drawn back. This locking bolt is constantly kept pressed forward by means of a particular spring, and is provided with an arm which bears against a shoulder or block on a screwed pin which works the wick carrier up and down; this screwed pin is provided outside the lamp with a milled head, whereby it can be turned. When the lamp has been trimmed and lighted, the oil reservoir must be screwed into its place in the upper part, the locking bolt will then bear against some ratchet teeth; the upper end of this bolt will run over these special teeth as the lamp is screwed in, but the bolt will effectually prevent the lamp from being unscrewed and taken apart until the bolt has been withdrawn in the manner previously described, but the light will have been meanwhile extinguished before the upper and lower portions of the lamp can be separated, and therefore all danger from any exposure of a naked flame is absolutely impossible.

In our illustration, A is the upper portion of lamp, comprising wire gauze column, lens, C, reflector, D; B, lower portion, comprising the oil reservoir and extinguishing apparatus, and the screw for unlocking the lamp, E; C, the lens; D, the reflector; E, unlocking screw.

In conclusion we may assume that it is perhaps impossible to entirely prevent accidents in coal mines. Explosions and other sources of catastrophe will happen here as similar accidents in any other branch of industry. The only true manner to reduce these calamities to the minimum, is to establish and maintain a system of careful inspection by competent and unbiased officers who should be possessed of authority to enforce the adoption of well-founded rules and precautions.

REVIEWS.

Bulletin of the National Association of Wool Manufacturers; January-March 1873. Edited by John L. Hayes, Boston:

This is a very neatly got up journal of 116 pages devoted to the interest of Wool Manufacturers. [illegible] a preliminary note the purpose is stated of giving a wider range to the journal and thereby rendering it, not merely the organ of the National Association of Wool Manufacturers primarily devoted to the interests implied in the name of that institution, but also a journal of Science, economical and technical, applied to the textile industry of the country,—embracing in its scope the discussion of those principles and topics which Dr. Uere includes in the term "Philosophy of Manufactures" but specially applied to the scientific, moral, and commercial economy of the textile industry of the United States. The nature of the subjects considered in this *Bulletin* and the manner in which they are treated fully bear out the above promises and give some idea of the vast proportions already attained by these industries in the neighbouring republic.

Fourth Annual Report of Turbine Tests: By James Emerson, Holyoke, Mass.

This report contains the tabulated results of trials of various turbine wheels at the testing flumes of the author, with remarks on the results and on the peculiarities of the wheels. Among the wheels tested are the "Thomson and Holcomb," "Leffel." "Tuttle," "Risdon" and other well-known wheels.

There is no doubt but that the practice, which is now gaining ground of selling such wheels by reliable test is a step in advance and satisfactory both to purchasers and to good builders.

CORRESPONDENCE.

[*We do not hold ourselves accountable for the opinions of our Correspondents.*]

PATENT LAW.

To the Editor of the Mechanics' Magazine,

Sir,—My correspondence on this subject, in your last issue, concluded with the 18th section: the intervening clauses between that and the 28th section are sufficiently reasonable to pass unnoticed in the present article, as it is only my intention, on this occasion, to bring before the notice of your readers the most serious objections and injustices and endeavour to interest them to exert themselves to have them removed, after which minor faults in the law can be easily dealt with.

The 28th Section is as follows:

"28. Every patent granted under this Act shall be subject "and expressed to be subject to the condition that such Patent "and all the rights and privileges thereby granted shall cease "and determine and the patent shall be null and void, at the "end of two years from the date thereof, unless the patentee, "or his assignee or assignees, shall, within that period have "commenced, and shall, after such commencement, continuously carry on in Canada the construction or manufacture "of the invention or discovery patented, in such manner that "any person desiring to use it may obtain it, or cause it to be "made for him at a reasonable price, at some manufactory or "establishment for making or constructing it in Canada, and "that such patent shall be void if, after the expiration of "twelve monhts from the granting thereof, the patentee, or his "assignee or assignees, for the whole or a part of his interest "in the patent, imports or causes to be imported into Canada, "the invention for which the patent is granted; and provided always, that in case disputes should arise as to whether a "patent has or has not become null and void under the provisions of this section, such disputes shall be settled by the "Minister of Agriculture, or his deputy, whose decision shall "be final."

Before proceeding to examine this section, which must be a very interesting one to inventors and manufacturers, it may be well to see how it came to be made.

There can be no doubt that the first clause of this section is a modification of the 28th section of the "Patent Act" of 1869, but in that act the time to begin manufacturing was *three years*, and eighteen months was allowed during which the invention might be imported.

The country at large is indebted for this clause in a great measure to the influence and short-sightedness of manufacturers both in and out of the Houses of Parliament, many of whom exerted their utmost endeavours to get the period in which the inventor would be compelled to commence manufacturing abridged to one year. Some of them explained their views and ideas on the subject, giving as their plea that foreign inventors might obtain patents in Canada for the purpose of preventing Canadian manufacture. They knew that such a reason would be at once snapped at by the public and Parliament, but they at the same time, exhibited in private their true reason for wishing to have a restrictive clause to that effect.

They said "If we can get this clause, no doubt many foreign "inventors will, for the many reasons that impede an inventor, "after getting his patent, be unable to commence manufacturing within the prescribed time, and thus we shall have a "chance of purchasing many very valuable inventions at a "mere nominal price compared with their worth;" but they must have reckoned without their host, for the least penetration would have told them that "where there is life, there is hope," and the inventor would go on hoping till the time had passed and the Patent Right was lost to both him and them.

What should have been done by our Government would have been to impose such a duty on patented articles that inventors would, for their own interests, be forced to manufacture in Canada The part of the clause with regard to the voidance of the Patent if the article is imported, would also have been quite sufficient for the purpose of causing the manufacture in Canada; but this also in the form in which it is put is most objectionable. It would almost be reasonable to suppose it was made for the especial benefit of rogues, knaves, and foreign manufacturers and capitalists, who, when they wish to nullify a valuable patent for the purpose of importing the ready-made invention to compete with the Canadian manufacture, have only to cajole the unwary inventor into assigning to them some very small fractional part of the interest in the patent, (thereby legally constituting them assignees of a part of his interest) and such persons can at once crush the whole patent right.

This also gives the unprincipled inventor an opportunity of "blackmailing" the purchaser of his right.

Let us take a case.

Suppose A sell to B the right to the whole Dominion of Canada with the exception of a small town, or two or three counties in one of the Provinces, (say Manitoba,) for $1000. B then goes to work, builds a factory and puts up machinery to the value of $20,000 to manufacture the invention. A then says to B: "unless you purchase these three counties that I have in Manitoba, and give me $5000 for them, I will throw the invention open to the public by importing." What can B do? Nothing There is no law to prevent A from acting in this manner, there is nothing illegal in his demand, and B must therefore comply.

If the inventor have a property in his invention at all, he has a right to expect that that property shall not be hampered with restrictions which in many cases he is utterly unable to comply with. This idea seems in a measure to be felt by the Government, as we see by the 2nd clause of the section in question, power is given to the Commissioner to extend thetime.

The inventor has also a right to expect that pit-falls shall not exist in the law, by which he will be called to account for the actions of others. Many are of opinion with me that a more ill-considered piece of legislation could not have been promulgated; at the idea of punishing one man for the faults of another, many of the cannibals of Oceanica would pause before committing so unjust an act, and yet we expect other nations to respect us as a high-minded, civilized and liberal people.

There is no power given, should the Commissioner, from personal interest or other feeling, decline to exercise his prerogative whereby the inventor may compel him to do so, supposing the action to be unjustly refused. At present there is very little fear of injustice being done, but as the Commissioner is a member of the Government, and as the person who fills the office is often changed, there is no accounting for what his successors may do.

Nothing could be more brainless than that part of the section which refers to the Commissioner deciding at what price the invention must be sold. Consider for a moment the varied subjects of invention; no one person can be versed in more than one or two of them, therefore the Commissioner, when called upon to decide, will be obliged to rely upon the evidence of experts in the branch of business to which the invention belongs. The true value of anything is the price it will sell for in a fair market, and what to one man is worth a thousand dollars may not to his competitor in the same line of business be worth one cent. With conflicting evidence before him of this sort how is the Commissioner to decide on a subject he is himself ignorant of?

For instance, suppose a machine is invented for performing a portion of the work of manufacturing boots and shoes, and that this will do the work at five cents a pair less than any of the machines at present in use. The first difficult question to be solved is what the machine really does save, and no doubt very conflicting evidence would be given on this very point, but I will take it at the above rate.

What would a man who made only from one to ten pairs per day swear the machine was worth? And what would a man who made a thousand pairs a day swear it was worth?

Again, supposing that the machine were only adapted for "trade work," what would a man who did a "custom" business (*i. e.* to order) value the invention at? and what would a "trade work" man value it at?

The first would in all probability swear (and with a clear conscience) that, considering the first cost of the machine and the trouble of working it, it was worth nothing.

The second would in all probability acknowledge that it was worth something, but as he is the person who wishes to use it, his mind is influenced and he is not a proper person to give evidence from which the Commissioner must form his decision, and, as all other persons in that line of business are interested in getting the invention at the lowest possible figure, what chance is there of the Commissioner having the proper evidence placed before him to lead him to a just conclusion.

If you will, the inventor can bring forward evidence, but whom is he to bring? Either men of no standing, or men who wish to purchase and use.

Men are to be found who will act fairly against their own interests, but I am sorry to say that they are few in number now-a-days.

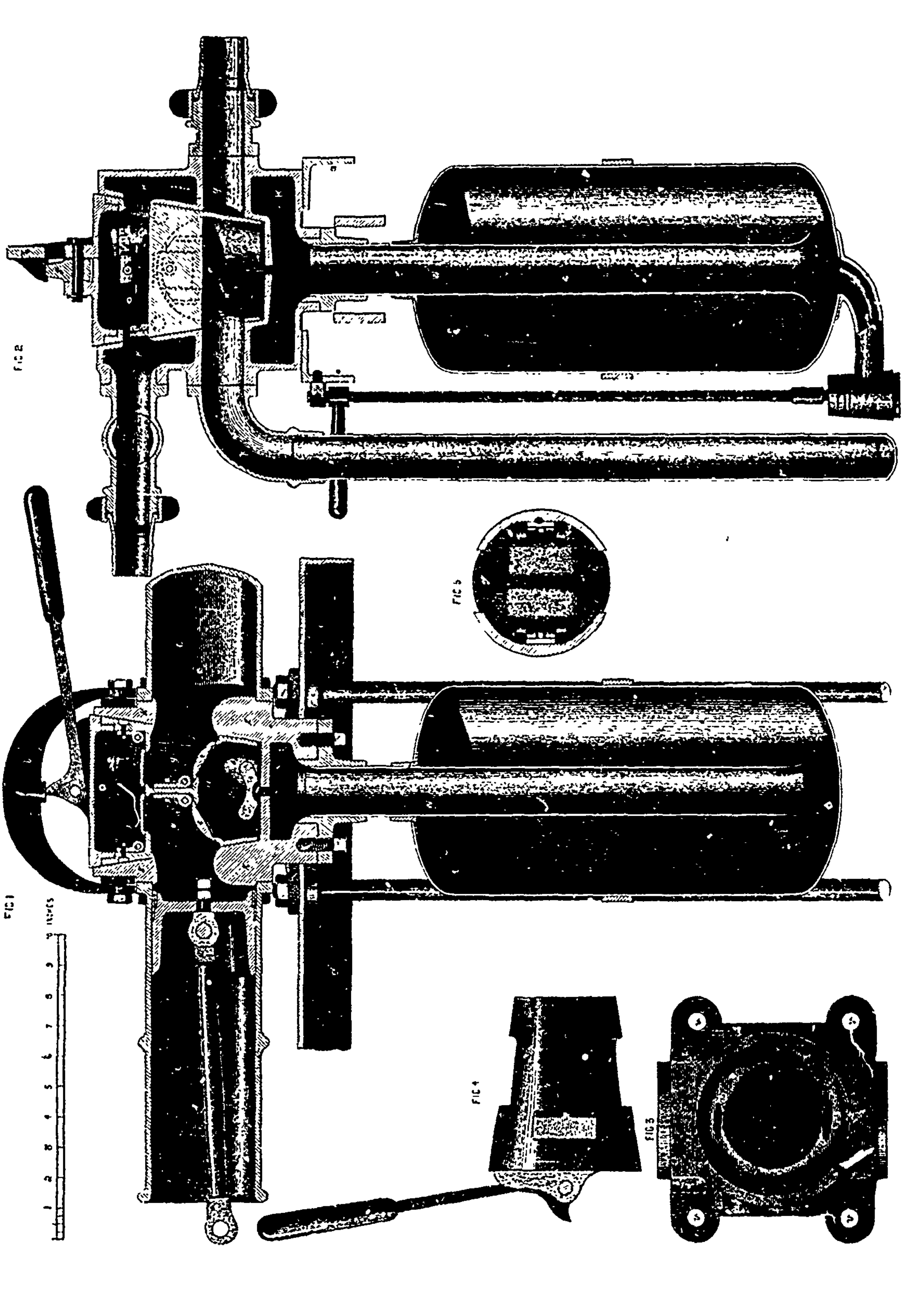
If ten men of good standing swear an invention to be in their opinion worthless, and ten others of equal standing swear it is worth a thousand dollars, the award will in all probability be five hundred dollars.

I would ask each of my readers, which one, having a house for sale, would like to be obliged to sell it at the price an umpire may put upon it, and that umpire to be guided in his decision by the evidence of the man or men who intend to purchase?

Who is to say what the Electric Telegraph, Steam engine Rubber manufacture, Sewing machine and many other inventions are worth to mankind? and who can allot to each inventor his due proportion for the improvements he has made. The wisdom of King Solomon was taxed to its utmost to find out between two women which was the mother of a child, and it was only by stratagem that he arrived at a satisfactory conclusion of the simple question.

In the present case a much greater amount of wisdom would be required to give perfect equity, and these are cases in which no stratagem could be employed.

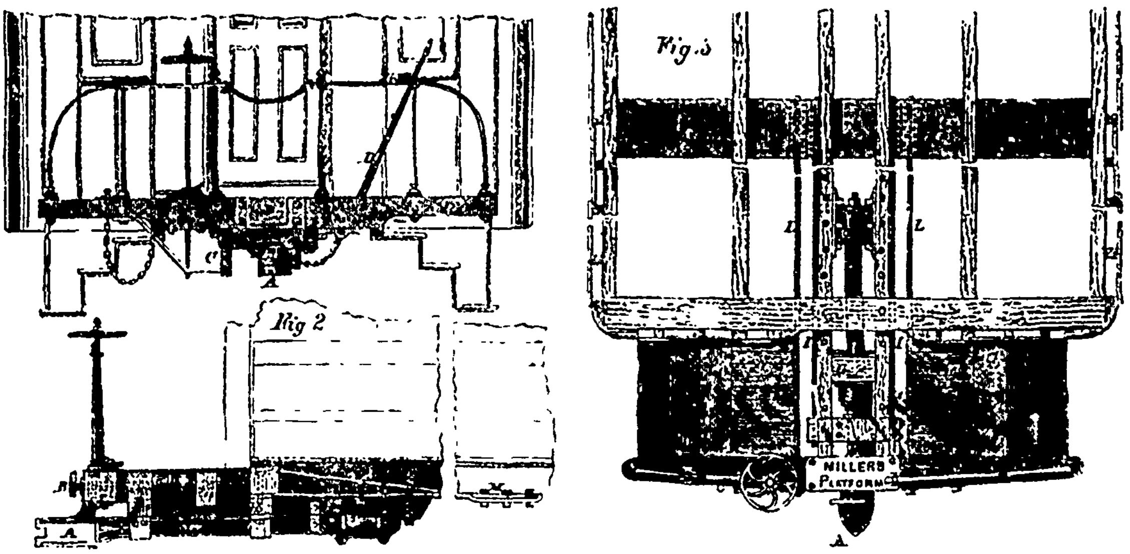
It must be remembered that the value of an invention or machine or any article is in a great measure governed by the demand and it often takes the inventor six or seven years and sometimes more to create this demand. If therefore the Commissioners of Patents is called upon to give his decision in the commencement of the inventor's operations, or rights, what chance is there of his doing justice to the inventor?



DETAILS OF FIRE ENGINE PUMPS AT THE VIENNA EXHIBITION.

CONSTRUCTED BY MR J. H. REINHARDT, ENGINEER, WURZBURG.

(*For description. see page 65.*)



MILLER'S PATENT CAR COUPLING.

(*For description, see page* 94.)

The Patent Office does not pretend to be able to judge of the utility of an invention, and I think I have clearly shown by the foregoing remarks that the evidence of experts in the case is utterly unreliable, not only as interested persons but also taking into consideration the demand, what it is at the time and what it may become.

To those who would answer that after a trial its utility could be ascertained and its value arrived at, I would ask .

After Robert Stephenson's locomotive was tried what would have been the value of his patent? (if he had had one,) what would the Patent have been worth for the last year before it expired, and furthermore what would the patent be worth now if it could be extended for five years from to-day?

Many of your readers would no doubt answer that, if a patent could be obtained by which the exclusive right to make and use the Locomotive railway steam engine for five years could be obtained, it would be worth millions upon millions of money.

How can they say so?

How do they know that a man has not already invented something to supersede that machine, and that, in less than a year the whole of them will not be placed at as great a disadvantage as the old stage coach was with the locomotive engine.

After steam-ships had been made and used for some years, what was Dr. Lardner's opinion of attempting to cross the ocean in them? If he had been Commissioner of Patents at the time under the present law, what would he have adjudged the enterprise worth if a Patent could have been granted for it?

Many valuable inventions are before the age, and therefore at the time of patenting are of no value; why then is a man, who is far-sighted enough to be able to look more than two years ahead of his fellow-men to be adjudged a chimerical inventor and have his patent taken from him.

Before closing my remarks on this clause, I have a few words to say to inventors with regard to the requirement of manufacturing within two years. The Government have endeavoured to compel you to manufacture, or that you shall arrange with others to manufacture, as they can hardly bind you to perform the work with your own hands. Now what is the consequence? If any one of you should find yourself in the position that you are not able to manufacture within the given time, I would not recommend you to apply for the extension mentioned in the second clause of the section, as such application may be refused, but you should instead make a *bonâ fide* arrangement with some manufacturer in the line of business to which your invention belongs, to make the invention for any person desirous of obtaining it, the manufacturer keeping an account of all time, material and other expenses, to which he will add, his profit as manufacturer and a certain amount for your profit as inventor. You should then advertise in three issues of the *Canada Gazette* and some local paper in the town in which the manufacturer lives, that persons wishing to use your invention should call upon the manufacturer (giving his name and address) and that he will make it for them. As business men and the public generally are not in the habit of reading the *Canada Gazette*, and the matter will not be pushed, there is little fear of the manufacturer being troubled with orders. Your patent will thus be held good although no actual manufacturing has taken place.

Should you not reside in Canada, and find it inconvenient to come here, the necessary arrangements can no doubt be made by your solicitor.

Trusting that the above remarks may be useful to some of your readers, and that our Members of Parliament may awake to a sense of the disgrace this section of the law has cast upon us as a people,

I have the honour to be,
Sir,
Your obedient Servant,

C. G. C. SIMPSON.

(*To be continued.*)

EDITORIAL NOTE.—If any of our readers who may entertain views differing from Mr. Simpson's, will favour us with a communication tending to promote the right intelligence of our Patent law, and its amendment if needs be, we will be happy to insert it. We recommend moderation in tone, and brevity in expression, to all correspondents.

QUALITATIVE ANALYSIS FOR AMATEURS.*

The fascinating science of chemistry has interested many an ingenious youth, and coaxed the pennies from his pocket to buy the reagents for some beautiful experiment. . . . . . The drug clerk of a country store, the amateur or empiric photographer or artist, the apprentice in a machine-shop, the "devil" of a printing-office, or the ambitious teacher of a rural school, desires to repeat the experiments he has so often heard of but never seen. When he has gained a more thorough knowledge of chemistry, and a deeper love for the science, he wants to analyse something. He picks up an alloy, the composition of which he would like to know; he wants to test the purity of salt he is using; or he is curious about the effects of certain chemicals upon the materials he works with; or, accidentally, he produces some beautiful salt to which he is a stranger, and he desires to analyse it. If he is able to buy or borrow the huge treatise of Fresenius, he is discouraged by its apparant intricacy, and the long, tedious methods. If a cautious teacher lead him slowly through a systematic course of recitations, opening but one avenue at a time to his eager gaze, he would slowly and more surely master it than by spasmodic efforts to embrace the whole. One of the greatest drawbacks to self-instruction is this tendency to advance too rapidly, skimming over or skipping the uninteresting, but essential details. By presenting each month a few accurately described, and very simple reactions, followed by examples for practice, we hope to enable those who cannot have the advantages of teacher or laboratory to gain an insight into mysteries of qualitative analysis.

Let us first consider what is needed in the way of

Apparatus and Chemicals.

The following list includes all the most important items:— Alcohol lamp, or Bunsen burner for gas, funnels, test-tubes, test-tube stand, test-tube brush, filter paper, glass tubing, empty bottles for reagents, ammonic carbonate, 2oz.; ammonic chloride, 2oz.; ammonia (aqua), 4oz.; baric chloride, 2oz.; baric nitrate, 1oz.; hydrochloric acid, 8oz.; nitric acid, 8oz.; potassic hydrate, 1oz.; sulphuric acid, 8oz.; ferrocyanide of potassium, 1oz.; potassic bichromate, 1oz.; phosphate of soda, 1oz.; oxalic acid, 1oz.; sulphur and paraffine. All, except the acids, may be kept in ordinary cork-stopped bottles to be found about the house, if well cleansed and furnished with new corks. An ordinary candle, which affords heat enough for many operations, or a kerosene lamp, made to burn without a chimney, can be used instead of alcohol, but deposits much soot. If gas is to be had, a piece of gas-pipe 3in. or 4in. long is to be fitted with a cork. Into this cork insert a glass-tube drawn out at one end, and bent at right angles, and with the fine end projecting into the gas-pipe. Two other pieces of glass tubing, bent at right angles, but not drawn out, are to be inserted in the same cork, so that the three form a tripod to support the piece of gas-pipe vertically. A piece of rubber tubing, from the outer end of the first tube to a common burner, supplies the gas. By varying the length of tube and size of opening, a colourless flame, burning only at the upper end of the gas-pipe, is obtained. This substitute for a Bunsen burner gives great heat, and deposits no soot.

Test-tubes should be 4in. to 6in. long, and a dozen will answer to begin with. A stand to hold them upright is easily made of wood or tin. A box 3½in. to 5½in. deep, with holes in the lid, can be used if necessary. A rag on a stick supplies the place of a brush to clean test-tubes.

Funnels should be of glass or porcelain. If tin is used, it should be protected by a film of paraffine.

Filter paper resembles blotting-paper, being unsised, and allows a solution to flow through, but keeps back solids. It is cut in circles, folded twice to form a quadrant, then opened so that it fits the funnel, there being three thicknesses of paper on one side, and one on the other.

We are now ready to proceed with the *Analysis of Metals.*

First Group.

Lead, mercury, and *silver* are the only metals whose chlorides are not soluble in acids. Dissolve a piece of lead pipe, a bullet, shot, or type, in nitric acid (which must be *pure*) in a test-tube. Filter the solution by lining the inside of your funnel with filter-paper and letting the solution, diluted with water, flow through it. The portion that goes through the filter is called the *filtrate.* Divide this into four parts: to one add hydrochloric acid, to the second sulphuric acid, to the third potassic bichromate. Make a note of the results thus:—

	HCl.	H^2SO^4	$K_2Cr^2O_7$
Plumbic nitrate.	White precipitate.	White precipitate.	Yellow precipitate.

Pour off the acid from the white precipitate formed by hydrochloric acid, and water and boil in a test-tube; the precipitate dissolves in hot water.

Dissolve a small bit of real silver, or an old fashioned ten-cent piece, in nitric acid; dilute, and filter. The blue colour is due to copper. Divide the filtrate into four parts, and add the same reagents as before, and note the results under the others. The precipitate with hydrochloric acid is also white, and dissolves in ammonia, but not in boiling water.

Scrape a little of the amalgam from the back of a broken mirror and dissolve slowly in cold dilute nitric acid; filter and proceed as before. Again a white precipitate is formed by hydrochloric acid, but this time it is insoluble, both in water and in ammonia.

Mix the solutions of the three metals; filter if cloudy, and add hydrochloric acid; a white precipitate. Filter and preserve the precipitate. Pour water on it; boil and filter; to the filtrate add potassic bichromate or sulphuric acid. The one produces a yellow, the other a white precipitate, indicating lead.

Wash the residue on the filter; put it in a clean test-tube; add ammonia to dissolve the silver; boil and filter. To the filtrate add nitric acid, and the white chloride of silver reappears. The black, insoluble residue is mercury.

These reactions, and the method of separating lead, silver, and mercury (sub-oxide salts), are briefly expressed in the following table:—

Separating Metals of Group 1.

Precipitated by hydrochloric acid: chloride of lead, silver, mercury. Add water and boil.

Solution:	Residue:
Lead. Add $K^2Cr^2O_7$ Yellow precip.	Silver and Mercury. Boil with Ammonia.

Solution:	Residue:
Silver. Add HNO_3 White precip.	Mercury Insoluble.

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

ON ENERGY.

By Professor Robert Stawell Ball, A. M., LL. D.

The science of Energy, which has been developed within the last twenty-five years, appears to have a grand future, as intimately connected with astronomy, mechanics, light, heat, magnetism, electricity, even with life itself: it leads us back through periods, compared with which, geological time is nothing, and looking forward like a time-telescope, points out the ultimate destiny of the universe.

Energy is the capacity for raising weights. The distinction between force and energy is that:—Energy is the product of a force and a distance. The unit of energy is the energy required to overcome the unit of force through the unit of distance. Energy can be stored in a rapidly moving fly-wheel, as can be demonstrated by experiment. Energy is also stored in any body moving rapidly, as, for example, a cannon ball; energy of this kind is termed "kinetic energy." A steam-engine is a means of turning into mechanical work, a portion of the energy contained in the coal consumed in the furnace. Heat may be turned into mechanical work in other ways; for example, by a thermo-electric battery. The energy stored up in coal, gunpowder, or a compressed spring, is denominated "potential energy." Food and fuel are both forms of potential energy; but the former has to replace the wear and tear of the machine which consumes it, which the latter has not.

Energy can be changed from one form into another. The potential energy of the body may be converted into mechanical work by raising a weight, into kinetic energy, by setting a wheel in motion, heat by friction into electricity, heat, and light, by Wild's electrical machine.

A piece of zinc may be burned in a stream of oxygen. The potential energy becomes light and heat, but it might have been more slowly burned in a battery, it would thus develope electricity, which might be turned into kinetic energy by an electro-magnetic engine, or into light, sound, and heat, by a Ruhmkorff's coil.

Energy is indestructible. If it disappears in one form, it is only to reappear again. A hammered nail on an anvil becomes hot, the energy which moves the hammer is transformed into heat in the nail, it is not lost. Friction appears to consume energy, but this is not so, for if proper appliances are used sufficient heat can be collected to boil ether or even water. Savart's apparatus is another instance, the kinetic energy of a rotating toothed wheel being by it transformed into sound.

Perpetual motion is impossible, because some energy is always uselessly expended in friction in every machine, and energy cannot be created. No water-wheel could pump up sufficient water to supply itself.

It has been (fallaciously) proposed to work a magneto-electric machine by a steam-engine; to decompose water with the electricity, and sustain the action of the steam-engine by the heat developed by burning the oxygen and hydrogen produced by the decomposition. It would be impossible for the steam-engine to decompose enough water for the purpose.

Since, therefore, energy cannot be destroyed, and cannot be created, the quantity of energy in the universe must remain constant. This is the principle of the conservation of energy.

All the different forms of energy in the earth, whether derived from food, fuel, wind, or water, can be traced to the heat radiated from the sun. The heat is sustained in the sun by the transformation of potential energy into heat due to the sun's contraction. If the diameter of the sun diminished 1-10,000th part, heat sufficient to supply the present loss by radiation for 2000 years would be produced.

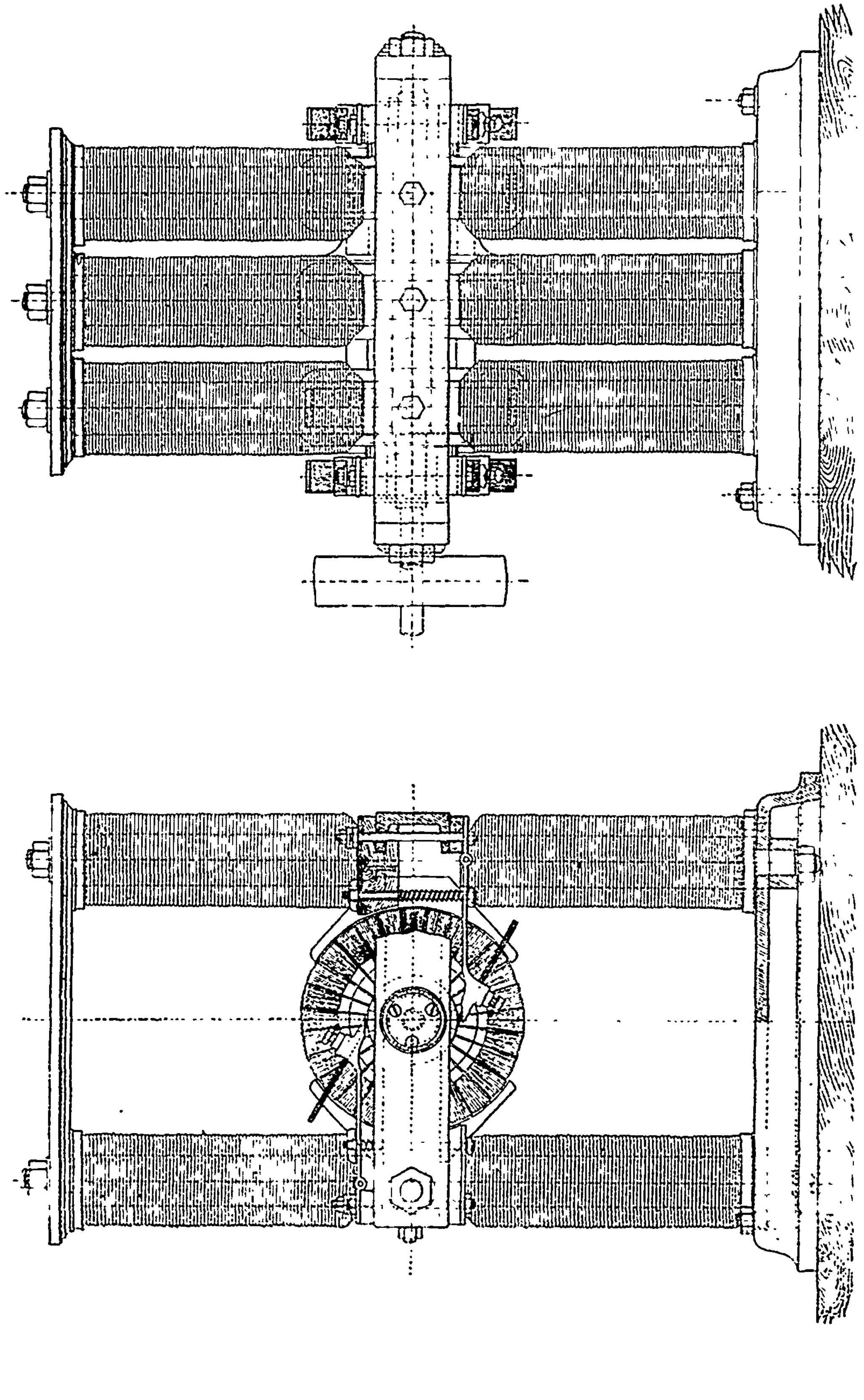
The heat of the stars represents a prodigious quantity of energy. The earth has a store of potential energy due to its distance from the sun; this energy is equivalent to as much heat as would be produced by the combustion of 6000 globes of coal, each as large as the earth. Beyond this, it has an amount of energy due to its velocity in its orbit, equal to that which would be produced by the combustion of 14 globes of coal of its own size. To this must be added a quantity of energy due to its rotation on its axis.

A period of rest, however, must at length come. The planets, since they are not rigid bodies, must ultimately fall into the sun. Heat diffuses itself, but heat cannot be turned into mechanical energy, except when transferred from a hot body to a cold body. When, therefore, by the diffusion of heat, the temperature is uniform throughout the universe, mechanical work must cease.—*Iron.*

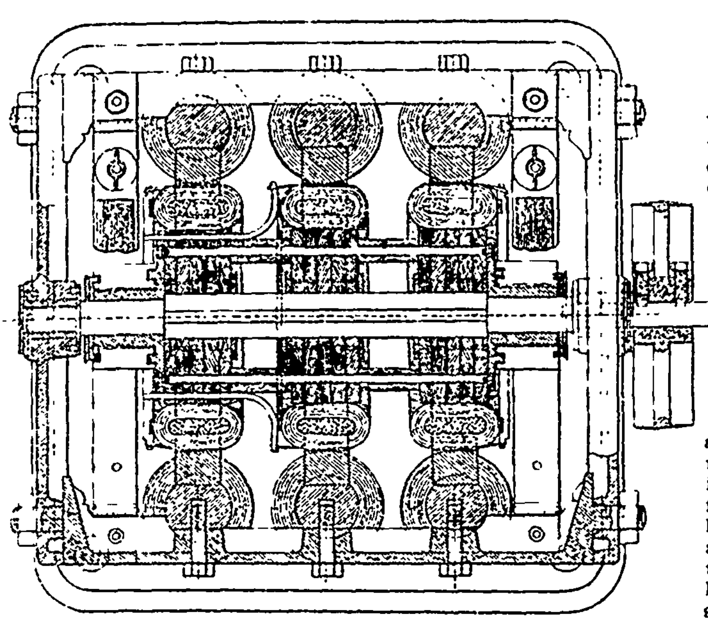
Pre-historic Culture of Flax.—Dr. Oswald Heer, the eminent botanist, and one who has devoted so much attention to the structure and history of fossil plants, publishes an article upon flax and its culture among the ancients, especially the pre-historic races of Europe. His memoir may be summarised as follows: First, flax has been cultivated in Egypt for five thousand years, and that it was and is one of the most generally diffused plants of that country. It occupied a similar position in ancient Babylonia, in Palestine, and on the Black Sea. It occurred in Greece during the pre-historic period, and at an early date was carried into Italy, while its cultivation in Spain was probably originated by the Phœnicians and Carthaginians. Second, it is also met with in the oldest Swiss lacustrine villages, while, at the same time, no hemp nor fabrics manufactured from wool are there to be found. This is considered a remarkable fact, since the sheep was one of the oldest domestic animals, and was known during the stone period. The impossibility of shearing the fleece by means of stone or bone implements is supposed to have been the reason why woollen fabrics were not used. It is thought probable that the skin, with its attached wool, was probably made use of for articles of clothing. Third, the lake dwellers probably received flax from Southern Europe, from which section fresh seeds must have been derived from time to time. The variety cultivated was the small, native, narrow-leaved kind from the coast of the Mediterranean, and not at all that now raised in Europe. It must, therefore, have been cultivated also in Southern Europe, although Dr. Heer could not ascertain among what people and at what age this took place. If this could be ascertained it would be an important point in the determination of the antiquity of the lake dwellers. Fourth, at the time of the empire both summer flax and winter flax were cultivated in Italy, as now, but in what form it was grown in ancient Egypt is not determined. It is thought probable that the narrow-leaved variety was first introduced, and after that the Roman, and then the common varieties followed. The common plant has doubtless arisen from the cultivation of the narrow-leaved, while the Roman winter flax and the *Linum ambiguum* constitute the intermediate stages. The original home of the cultivated flax was therefore along the shores of the Mediterranean. The Egyptians had probably cultivated it, and from them its use was doubtless disseminated. It is possible that the wild variety and the winter flax were grown elsewhere at the same time, when the cultivated variety had long since driven them out of use in Egypt.—*Nature.*

Among the rarer and more interesting remains found in the mounds of the west of America, are plates of mica cut into different shapes, and evidently preserved as objects of great rarity and value; and, in the absence of this mineral in the Mississippi Valley, the question has frequently arisen whence the material could have been derived. A recent communication from Prof. W. C. Kerr, the State Geologist of North Carolina, tends to throw some light on this subject, and to open an interesting chapter in regard to the American prehistoric man. The work of collecting mica is at present carried on upon the largest scale in the high and rugged region between the Black Mountain, the Roanoke and the head waters of the Nolachuchy, principally in Mitchel County, North Carolina. The region in question has long been known for the existence of numerous open works and tunnels, which at first sight, were supposed to have been made in the search for silver or some other valuable metal. Prof Kerr, in his capacity of State Geologist, was led to investigate this question, and very soon found, in every instance, that the excavations referred to were much older than the earliest discovery of the country by the Spaniards, and that in all cases they were found in ledges of coarse granite, which contained nothing but large patches of mica. Prof Kerr has been satisfied for some time that in these mines we have the work of contemporaries of the mould builders, and the localities whence they derived the mica. What use they made of it we cannot say; but it is suggested that it may have served the purpose of mirrors, or possibly have been used as windows, as well as for ornament. The number and size of these mines is remarkable, some of the open cuts being more than 100ft. in diameter, and 20ft. or 30ft in depth, even after the caving in and filling up of centuries of weathering. The tunnels often extend inwards several yards, but are said to be too small for a man of ordinary size to work in. These show distinct marks of the tool in the granite wall, as if made by a chisel-shaped instrument about an inch broad. Numerous plates of mica are found in these tunnels and excavations, some of them trimmed to particular shapes. *Nature* observes that these facts open up a new chapter in the history of the American aborigines, illustrating the character of the commerce carried on at a very remote period, and showing the magnitude of the operations, and the extended period of time over which they must have been prosecuted, to enable a people furnished with nothing better than wooden and stone tools to produce excavations of so great magnitude.

Alexandria, Egypt, May 20.—The present party of the Oriental Topographical Corps from New York, for the exploration of the Bible Lands, have gone from Egypt to Syria and Asia Minor. A scale photograph of the Nile, devised by one of the corps, has been taken, which it is claimed will definitely settle the vexed cubit question. A plan of rapidly taking altitudes of ruins, pyramids, &c., invented by one of the party, is said to work admirably.



THE GRAMME ELECTRO-MAGNETIC MACHINE



In 1822 Mr. Burton discovered an iron mine at Hammami, between the Nile and the Red Sea, which had been worked by the Egyptians. Kenrick states that in the sepulchres of Thebes he has remarked butchers sharpening their knives on a round bar of metal attached to their aprons. The blue colour of the blades, and the distinction between the bronze and steel weapons in the tomb of Rameses III., one being painted red and the other blue, leaves no doubt but that the Egyptians of an early Pharaonic age were acquainted with the use of iron.

The minuteness and finish with which the hieroglyphics are sculptured on obelisks, and other granitic monuments, may also be adduced as strong arguments that the workmen must have been possessed of steel chisels, quite as finely tempered as any we at present can manufacture.

The amount of metallurgical skill the first smelters possessed was not very great; probably much more pains were bestowed on the manipulation of the metal after they had obtained it in a crude state, than upon getting a fair return from the ore smelted As in this country at the beginning of the present century, the waste heaps at the mouth of lead mines were eagerly reworked to obtain the lead and silver which our ancestors had failed to extract; so the Egyptian mines of silver, gold, and iron, may probably, ere long, be hunted for, and the *débris* from them prove a treasure trove to those who are so fortunate as to hit upon them.

THE IRONWORKS OF THE PHARAOHS

By Chas W. Vincent

Copper and its alloys were held in high favour with the earliest civilised nations of the world long after the discovery of iron, and even after it began to be really utilised—of this there can be no doubt. The bronze age in every part of the old world preceded the iron age. The change was not, however, a rapid one; the replacement of copper by iron was gradual, and in this country did not take place for many centuries, perhaps decades, after its introduction and general use in the East—the birth-place of material civilisation, as well as the starting-point from whence has swept over the world, as with a mighty wave, those aspirations for better and more lofty things, from which will proceed all that is moral, intellectual, or noble in man as he now is, in whatever part of the globe, or under whatever conditions of life he may be.

I think, however, that we are apt to date the use of iron at too late a period, we are too ready to take the tardy civilisation of the north of Europe as being the origin of all our present knowledge, and to ignore the fact that in the East and South were nations possessing, thousands of years before that time, an intellectual vigour, it may be even in excess, of the average of our age. The comparative endurance of the metals iron and copper may also have helped this mistake. As soon as it came into general use iron would be much less costly than copper, and, consequently, would not be preserved with so much care, so that, being very readily oxidizable, few implements or weapons can remain to us, except where they have been kept from access of air. Hence the comparative abundance of copper and bronze articles, and the paucity of iron may have been much misconstrued. Stone chisels, tools for wood cutting of all kinds, knives, &c., were made of an alloy of copper and tin.

On the testimony of Homer, Thrasyllus and others, iron was in use long before the Trojan war In the Bible, Tubal Cain is named as "the instructor of every artificer in brass and iron," but, nevertheless, no mention is made elsewhere of iron weapons or implements till after the exodus. Iron rings have also been frequently discovered in Egyptian tombs. Moses compares Egypt to an iron furnace (Deut. iv. 20), and Job speaks of smelting processes (xxviii. 2): "Iron is taken out of the earth, and brass is molten out of the stone." From the foregoing if appears, in spite of the arguments of the difficulty of smelting it, and rendering it malleable, adduced against the early use of this metal, that it was largely in use at a very early period

An intimation that something of this kind is even now being done was made at a recent meeting of the Society of Antiquaries. Mr. Hartland described his visit to the wells of Moses by the Red Sea, the Wilderness of Sin, and the monotonous three days' march across the sandy desert, under a vertical sun, to the delicious palm-tree groves of Wady Cherundel, and the defiles leading to Sinai.

An English gentleman, whose name is withheld, travelling in these parts, was struck with the small blue stones he discovered in the dried up watercourses, which in the rainy season convey the thousand streams that hurry to the sea, and, having the curiosity to bring some home, he soon discovered that they were turquoises of no common order.

This determined him to make further researches Eventually he has built a house near the junction of the Wady Kenueh, the Wady Mokatteb, or the Written Valley, and the Wady Megham. Here, aided by the friendly tribes he has taken into his pay, he has discovered the old turquoise mines of the ancient Egyptians, the rocks that they worked for the stones, the very tools they used, and their polishing and grinding places.

Being a man of much energy, he has brought to bear upon this fortunate discovery, the advanced knowledge of our times, and he is obtaining and sending over to this country some of the finest specimens of turquoises that exist.

In such a lonely spot, he naturally has not confined his attention to this subject only, but has traced out the system of fortifications by which the Pharaohs protected their works and workmen, and, what is still more wonderful, has come upon the remains of vast iron works, so vast indeed, that many thousand people must have been employed upon them, unless the plant used was on quite as grand a scale as that of our largest furnaces in the north of England.

These works stand adjacent to the mines, on some hills at a placed called Surabit-el Khadim, and were evidently conducted on the Catalan system (in the opinion of their discoverer). The ore was very imperfectly extracted—slag brought over to this country, from the immense heaps that, like mountains, are piled around, contained as much as fifty-three per cent. of iron.

These works were commenced in very early times: each Pharaoh, as he continued them, added a large engraved stone, not unlike our tomb-stones, to state his work. It is to be hoped that rubbings of these stones may be sent to some of our skilled readers of hieroglyphics, since much valuable historical information respecting the Egyptian metallurgy may have been by thempreserved for our enlightenment, and to show how little the mind of civilised man has really developed during 3000 years.

In the neighbourhood a small temple was erected for the use of the workmen, and here also was a barrack for the soldiers who protected, or kept them in order.

This district has remained unexplored, probably, on account of its being quite out of the beaten track, and in an unknown country there is no temptation to stray, particularly as the guides and dragomen discourage any explorations which may add to the risk of the journey. It is, however, much to be desired, that now that attention is directed to the locality, and moreover, since the thorough investigation of its sites is likely to prove exceedingly profitable, that the enterprise and desire for knowledge of our scientific explorers may find help from the ready hand of some of our commercial magnates, and thus, that a past book in the world's history may, by English perseverance, be re-opened.—*Iron.*

THE ASSYRIAN EXPEDITION.—Mr. George Smith, of the British Museum, who has gone to Assyria as the special correspondent of the *Daily Telegraph*, for the purpose of making explorations, has sent a telegram from Mosul, in which he says:—"I am happy to inform you that my researches up to the present time in Mesopotamia have been crowned with much good fortune, and that I have obtained results of real value and interest. . . . I have recovered part of the series of tablets containing most curious and ancient Babylonian legends, as well as syllabaries of great utility, a bilingual collection of proverbs, and some astrological and mythological tables. . . . I excavated at Nimroud for seventeen days, and explored there the North-west Palace of Esarhaddon, the Temple of Nebo, and also some entirely untouched portions of the South-east Palace. I found spacious halls and fine chambers, the walls of which were ornamented with bands of plain colours. One of my most recent discoveries is that of a perfectly new text of the annals of Tiglath-Pileser. I am at present digging hard to obtain, if possible, the remainder of this highly important piece of history."

THE MORTAR OF THE GREAT PYRAMID.

At the last meeting of the Chemical Section of the Philosophical Society of Glasgow, the President, Dr. Wallace, F. R. S. E., read a paper in which he gave a number of interesting details regarding the mortar employed in building the Great Pyramid, and incidentally referred to the composition of some mortars than he analysed a few years ago, including two from the interior and exterior of the Great Pyramid, two specimens of very ancient Phœnician mortar from the Island of Cyprus, two from ruins at Athens, and from Rome and other places in Italy. It was most interesting to observe the remarkable differences between the mortars of the various ancient peoples. By going to Balbec and other ruined cities of Turkey in Asia, buildings might be found constructed of immense blocks of stone jointed with such excessive nicety that even the blade of a penknife could not be pushed between them, but without a vestige of mortar. In the structures of the ancient Egyptians, on the other hand, taking the Great Pyramid as an example, mortar was freely employed, but consisting almost entirely of gypsum or sulphate of lime. A specimen was examined from an ancient Phœnician temple, the highest stone of which was, a few years ago, five feet below the level of the ground at the time the specimen was taken. It was something like that found in some of the baronial castles in this country, and was like a piece of solid rock. The gentleman who brought it home supposed it to be the very oldest mortar in existence. If it were so, Dr. Wallace said that it was most remarkable, inasmuch as it was as perfect in constitution as it could possibly be, having been made, evidently, of burnt lime, fine sand, coarse sand, and gravel. It might be called concrete, rather than mortar. At any rate, one thing was certain—namely, that the lime in it had become completely carbonated; and another specimen of the same age exhibited the same phenomenon, thus satisfactorily settling a point which was long in dispute. The ancient Greek mortars from ruins in the vicinity of Athens were also very perfect, but contained more lime than that from Cyprus, and no gravel. The mortars from various ruined buildings in Herculaneum, Rome, and its neighbourhood appeared to have been made from burnt lime and puzzuolana, or what is called by geologists volcanic ash. Dr. Wallace stated that he had had some correspondence with Professor Piazzi Smyth regarding the mortar of the Great Pyramid, some portion of which he read, and he gave the following analysis of a specimen which he had recently examined:—

Hydrated sulphate of lime	92·83
Carbonate of lime	4·63
Carbonate of magnesia	1·66
Alumina and traces of oxide of iron	·24
Silicon	·88
Water (hygroscopic)	·07
	100·31

The following are analyses of two specimens examined a few years ago:—

Hydrated sulphate of lime	81·50	82·89
Carbonate of lime	9·47	9·80
Carbonate of magnesia	·59	·79
Oxide of iron	·25	·21
Alumina	2·41	3·00
Silica	5·30	4·30
Water (hygroscopic)	—	—
	99·52	100·99

In reply to a question, Dr. Wallace stated that he believed the sulphate of lime, which is abundant near the Pyramids, had been partly calcined to drive off the water of hydration in the mineral before being used in making the mortar. There was very little cohesiveness in the samples exhibited.—*Iron.*

THE following account of the first meerschaum pipe has been published by Messrs. Pollak and Son, pipe manufacturers, in New-York:—In 1723 there lived in Pesth, the capital of Hungary, Karol Kowates, a shoemaker, whose ingenuity in cutting and carving on wood, &c., brought him into contact with Count Andrassy, ancesior of the present Prime Minister of Austria, with whom he became a favourite. The Count, on his return from a mission to Turkey, brought with him a large piece of whitish clay, which had been presented to him as a curiosity, on account of its extraordinarily light specific gravity. It struck the shoemaker that, being porous, it must naturally be well adapted for pipes, as it would absorb the nicotine. The experiment was tried, and Karol cut a pipe for the Count, and one for himself. But in the pursuit of his trade he could not keep his hands clean, and many a piece of shoemaker's wax became attached to the pipe. The clay, however, instead of assuming a dirty appearance, as was naturally to be expected, when Karol wiped it off, received, wherever the wax had touched, a clear brown polish, instead of the dull white it previously had. Attributing this change in the tint to the proper source, he waxed the whole surface, and, polishing the pipe again, smoked it, and noticed how admirably and beautifully it coloured; also, how much more sweetly the pipe smoked after being waxed. Karol had struck the smoking philosopher's stone; and other noblemen, hearing of the wonderful properties of this singular species of clay, imported it in considerable quantities for the manufacture of pipes. The natural scarcity of this much esteemed article, and the great cost of importation, in those days of limited facilities for transportation rendered its use exclusively confined to the richest European noblemen, until 1830, when it became a more general article of trade. The first meerschaum pipe made by Karol Kowates has been preserved in the museum of Pesth, which by the way, was the native city of Mr. Pollak, sen.

ENAMELLED BRICKS.—Works are now being erected in Pittsburg to manufacture pressed bricks with enamelled facings. The enamel is made of various colours to suit the tastes of architects or builders, and as it is impervious to water or acids, having a surface that can be cleaned like glass, it is supposed well adapted for building purposes in the smoky cities of the West. The advantage claimed for the enamel is to increase the strength and durability of the bricks, while giving all the beauty of surface to be obtained from stone or marble. The cost is said to be twenty dollars per thousand over the common pressed brick of the United States.

MISCELLANEA.

THE PRODUCTION of pig-iron in the United States in 1872 is estimated at 2,388,250 tons (of 2,000 lbs. each), and the number of new furnaces built during the same year is reported as 100.

A bill has passed one branch of the legislature of Michigan, establishing a Commission of Fisheries and appropriating ten thousand dollars for two years for purposes connected with the increase of good fish in the State.

A very valuable deposit of bismuth is said to have been discovered in the vicinity of Salt Lake City. Little reliance, however, can be placed on reports from the mining districts of Utah. A reported discovery of tin in Missouri turns out to be, in reality, a deposit of cadmium.

Catoptric Street Lamps are now placed with advantage on the terrace in Trafalgar Square London, opposite the National Gallery. The inventor, Mr. Skelton, has also here exhibited his patented improvement for opening the bottoms of street lamps, which is simple and efficient, and gives far less shadow on the pavement than the ordinary plan now in use.

The United States Naval Observatory will shortly issue the largest catalogue of stars yet published in America. The work will be the result of more than fifteen years' labour of Professor Yarnall and assistants, and will be based on more than 50,000 observations of upwards of 10,000 stars, many of which are of course too far south for observation in latitudes more northerly than Washington.

IN preparing acetic acid by synthesis M. Thénard placed in a glass receptacle a mixture of carbonic acid, CO^2, and protocarburet of hydrogen, CH^2 through which the electric current from a Ruhmkorff coil was allowed to pass. Under the influence of the electricity, the absorption of the gases commenced almost immediately, became more and more marked, and finally gave rise to a colourless liquid which could be none other than acetic acid, C^2O^2.

WATERPROOFING CLOTH, &c.—A solution of aluminum acetate is prepared by dissolving equal weights of alum and lead acetate in warm water, mixing the solution and straining off after settling. This solution is added to an aqueous solution of isinglass, and the articles to be waterproofed steeped in the mixture for twelve hours, after which they are dried and pressed. Cloth thus prepared, though impervious to water, does not interfere with perspiration.

SCREWS IN PLASTER.—It sometimes becomes desirable to insert screws in plaster walls, without attaching them to any woodwork, but when we turn them in, the plaster gives way and our effort is vain. The plan suggested is to enlarge the hole to about twice the diameter of the screw, fill it with plaster of Paris, such as is used for fastening the tops of lamps, and bed the screw in the soft plaster. When the plaster has set, the screw will be held very strongly.

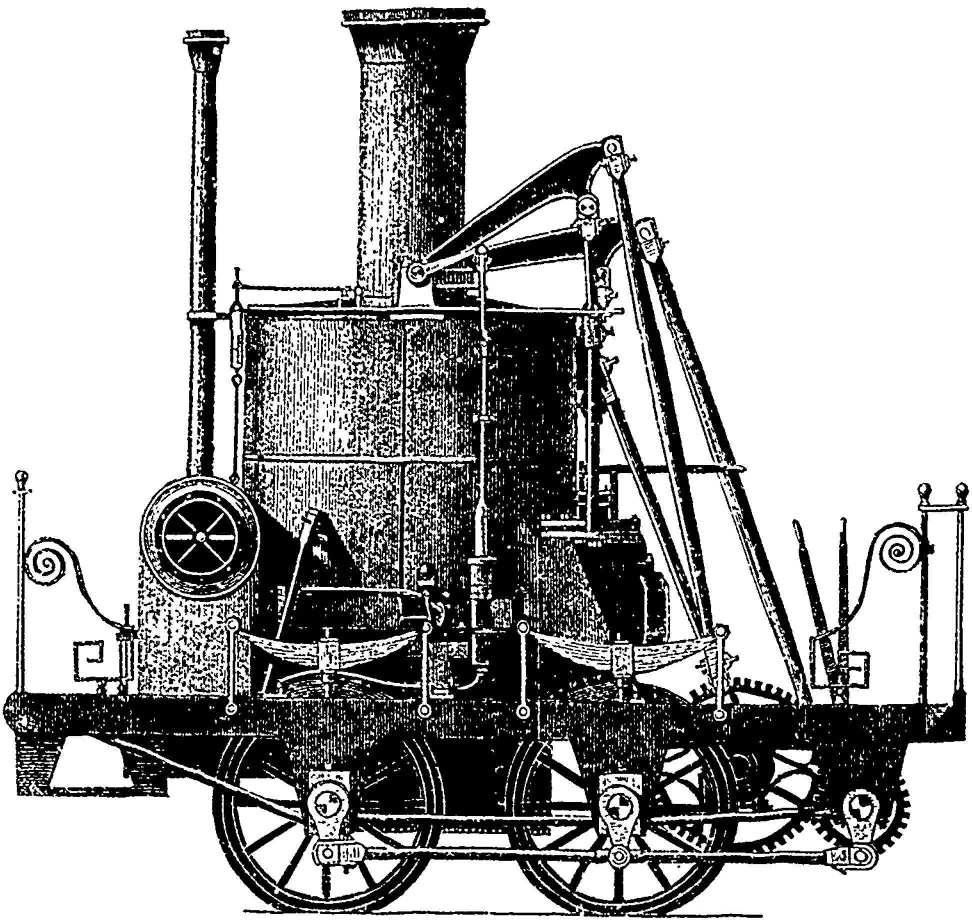
A practical trial recently took place in Brooklyn of Edward W. Morton's machine worked by the rise and fall of the tide, the power thus derived to be utilized for mechanical purposes. The contrivance was tried at the foot of South Tenth street, East River, before a large number of persons interested. The machine works by means of a "float," which as it rises and falls with the waves or the tide, propels the machinery to which it may be attached. At the trial it was geared to a saw, and worked with the full rapidity of a circular saw run by steam power, although, perhaps, not quite so uniformly.—*Scientific American.*

PLATINUM COINAGE.—At a time when gold is said to be rising in value, and when nickel has come to be in great demand for coinage, the claims of platinum, as a useful material for the same purpose, may fairly be reconsidered. In many of its qualities it is fully equal to gold and silver. It is scarce, therefore intrinsically valuable; it is quite as refractory as gold to ordinary chemical agencies and far less fusible; it stands wear very well; and its high specific gravity renders it even less liable than gold to imitation by base alloys. Apart from all abstract reasons, however, is the fact that platinum was actually used in Russia for coining purposes, and its use was abandoned in 1845, only because of the difficulties of working which then existed. Now, however, when comparatively large ingots are manipulated by modern improved methods, such an objection can no longer be urged.

The annual inquiry for a good whitewash has commenced, and the following may be found useful.—Take half a bushel of freshly burned lime, slake it with boiling water, cover it during the process, to keep in the steam. Strain the liquid through a fine sieve, and add to it 7 lbs. of salt, previously well dissolved in warm water; 3 lbs of ground rice, boiled to a thin paste, and stirred in boiling hot, ½ lb. of powdered Spanish whiting, and 1 lb of clean glue, which has been previously dissolved by soaking it well and then hanging it over a slow fire, in a small kettle within a large one filled with water. Add five gallons of hot water to the mixture, stir it well, and let it stand a few days covered from dirt. It must be put on quite hot. For this purpose it can be kept in a kettle on a portable furnace. About a pint of this mixture will cover a square yard.

M. FELIX PLATEAU describes in *Les Mondes* an ingenious process, of his own invention, for drawing on paper white lines on a black ground—a method so frequently used for scientific illustrations—by means of which both author and artist will be able to judge of the effect of such an illustration before putting it into the hands of the engraver. A piece of thickish paper, as smooth as possible, a little larger than the intended illustration is heated, say by laying it, with proper precautions against being injured, on the top of a stove, and a piece of bees-wax is rubbed over it until the paper is completely covered with a thin coating. A piece of glass, the size of the paper, is blackened by being held over a candle, and when thoroughly cooled it is laid on the waxed paper and rubbed firmly with the fingers, the result being that a blackened surface is produced on the paper on which any design can be traced with a needle for the finer lines, or the back of a steel-pen for the thicker ones.

THE discovery that mashes, especially of Indian corn rye, and wheat, yield more alcohol when treated with sulphurous acid than when merely treated in the ordinary way, is due to the Brothers Fleischmann, of Olmutz, Austria, and was made in 1860. The starch granules in the grain are, as is well known, enclosed in integuments, which are only partially broken by grinding, so that only part of the amylum is thus exposed. In order to overcome this difficulty, it had been suggested to steep the flour in water. However, it was found that steeped flour soon becomes sour, especially in warm weather, so that in the process of mashing less sugar was formed than heretofore. Here the preserving quality of sulphurous acid suggested itself. It was found that it acts by dissolving the husky coverings of the granules, and that it alters the fermentation of the corn in such a manner that the mashes never flow over in fermentation. Moreover, the formation of lactic and acetic acid, which always causes a loss of alcohol, is entirely prevented by the use of sulphurous acid gas. And what is also an important item, the gyle tun need not be so constantly scoured and washed. Sulphurous acid gas is readily absorbed by water, which accordingly increases its specific gravity, so that its strength may be determined by the saccharometer. Formerly sulphurous acid was produced by heating a mixture of charcoal and oil of vitriol. The latter loses thereby part of its oxygen, which combines with the carbon, while sulphurous acid escapes in a gaseous form. When used in distilleries, it was prepared in a vessel lined with lead and conducted into the contents of the mash tun; but as the process was expensive and troublesome, it was suggested that the gas be produced by burning roll sulphur and passing the smoke into water. The *Journal of Applied Science* says that an apparatus has been prepared for this purpose, which is in use on the Continent. For 5340 lbs. of wheat flour, about 5 lbs of roll sulphur are required. Indian corn requires one-third more, but 1 lb. is sufficient for 540 lbs. of potatoes. Rye or wheat malt are steeped while the sulphurous water is cold, covered, and left for twelve hours; then steam is introduced and the mashing machine is set in motion. Indian corn requires twenty-four hours' steeping, but potatoes may be mashed at once. It is proper to retain from potato mashes a portion of the sulphurous water for the cooling vat. Indian corn will yield 20 per cent., rye and wheat 15 per cent., and potatoes 10 per cent. more alcohol, if treated by the process above described.



GRASSHOPPER LOCOMOTIVE

A letter which appeared lately in the *American Railroad Gazette*, from Mr. Benjamin H. Latrobe contains an interesting account of the locomotive which we illustrate above. The Baltimore and Ohio Railway Company having advertised in 1831 for an engine which would, upon a level grade, draw a gross load of fifteen tons at a speed of fifteen miles per hour upon their road as then constructed with a strap rail and frequent curves of 400ft. radius, upon which the successful experiments of the previous year with the Peter Cooper locomotive had satisfied them that steam power could be employed.

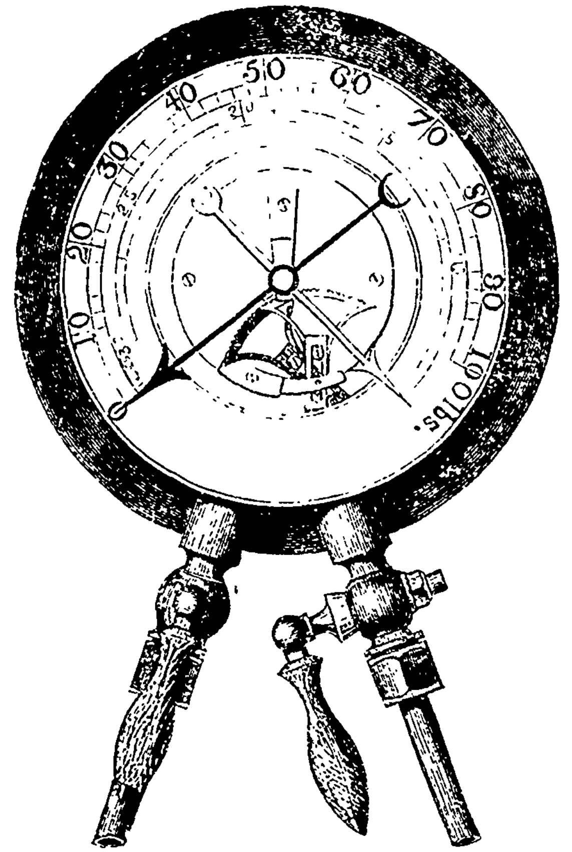
Four engines of various models, among them a *rotary*, entered into the competition; but the only one of the four which proved equal to this moderate performance was that of Davis and Gartner, two machinists of York, Pennsylvania. From their labours grew up about 1836 the finished "grasshopper engine," which we illustrate. It will be seen that a separate axle is placed on the frame which carried the pinion as well as the spur wheel, and they thus worked smoothly with each other; and, there being cranks on the end of the axle, and connecting rods coupling them with the driving wheel cranks, as shown, the difficulty encountered in the first engine, in which the spur wheel was on the driving axle, and so could not be kept properly in gear with the pinion was obviated altogether. A fan driven by the exhaust steam, which operated on vanes upon the same axle with the fan, inclosed in a distinct chamber, and constituting thus a species of rotary engine attached to the back of the boiler, served to maintain the draught.

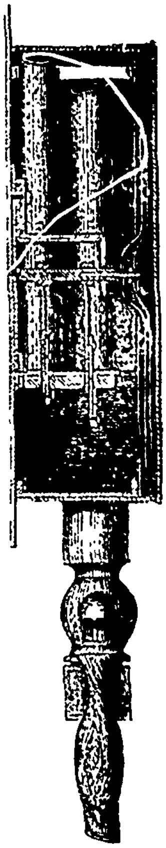
The pressure of steam was ordinarily 50lbs. to the square inch, about the same as that used in English locomotives at that time, which was sufficient to slip the driving wheels when adhesion was one-eighth of the weight upon them. The valves were worked by a cam so shaped as to cut off the steam at about two-thirds of the stroke. The daily expense of the round trip of eighty miles was 16 dols., which included one ton of anthracite coal, at 8 dols.; engineer, fireman and labourer, 3 dols. 50 cents, oil and packing, 50 cents; estimated wear and tear and interest on cost, 3 dols.; water station expenses, 1 dol. The engine did the work of forty-two horses, the daily expense of which was estimated at 33 dols., so that the cost of conveying passengers by steam, not including track repairs, was but half that of animal power, although the speed was nearly double. The first cost of the engine is not stated in the reports but is believed to have been about 4,500 dols., at that period of low prices of labour.

The boiler requires little description. It was of the well-known vertical tube type, and it is worth notice that instead of deposit setting on the tubes, they became polished by the action of the water on them. This was no doubt due in no small degree to the jumping up and down of the engine at high speed, the length of wheel base being but 4ft. The cylinders were 12in. diameter, 22in. stroke; the weight about $7\frac{1}{2}$ tons; the gross load was about 113 tons up grades of 20ft to the mile, at ten miles an hour.

Progress of the Hoosac Tunnel in April, 1873.—Heading from east advanced westward, 163 feet; heading from west advanced eastward, 136 feet; total penetration during April, 299 feet. Length opened from east end westward, 13,798 feet, length opened from west end eastward, 9,294 feet. Total length opened to May 1st, 23,092 feet. Length of the tunnel 25,031 feet. Leaving rock to be perforated, 1,939 feet, being 179 feet more than $\frac{1}{4}$ mile.

Patents have been taken out by Mons. Thuillier, of Desvers, near Boulogne, and Mons. Emile Gerard, engineer, of Boulogne, for a series of machines, jointly invented by them, for the manufacture of every description of cask and barrel by machinery.

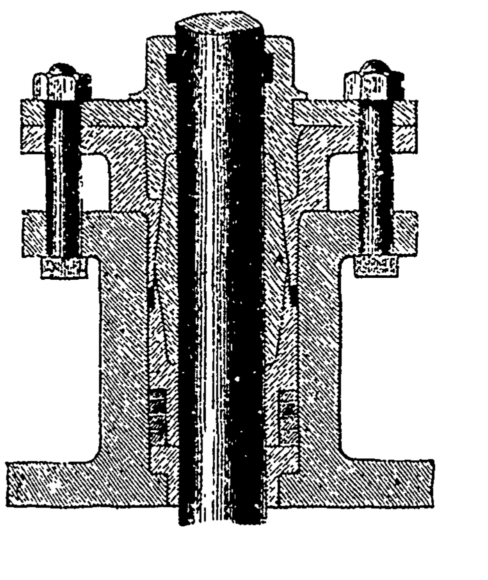




PATENT COMBINED PRESSURE AND VACUUM GAUGE

The gauge we here illustrate has been designed to secure convenience, compactness, and economy in cases where it is necessary or desirable to have indications both of pressure and vacuum in one situation, or in connection with one piece of apparatus. A single casing is used, of the ordinary circular form but it is made slightly deeper, so as to contain two Bourdon gauge tubes, which are in communication with separate stop cocks and pipes leading from the parts of the apparatus, the internal condition of which as regards pressure and vacuum, is to be indicated

The movement of the innermost gauge tube, which is that showing pressure, is communicated in the ordinary way to an index turning about a centre, and with its point sweeping over an outer circular scale on the dial. An index, the point of which sweeps over an inner circular scale, is fixed on a tubular spindle turning on the spindle of the other index, and receiving its motion by means of a pinion and segmental rack from the front gauge tube, which is, of course, adapted to show "vacuum" or deficiency of pressure below that of the atmosphere, when the other gauge tube is adapted to show "pressure," or pressure above that of the atmosphere. The difference between this gauge and others of the same description is that this one, as the drawing shows, indicates "pressure and vacuum" both at once, if necessary; "vacuum," of course, to the ordinary thirty inches, while "pressure" can indicate as high as required. In other compound gauges, where only one tube is used, the vacuum must be shut off while the pressure is being read, and *vice versâ*. There is no confusion in reading the indication, as pressure pointer and scale are painted black, and indicate from left to right, vacuum being painted red, and indicating from right to left. *Engineer*.



IMPROVED METALLIC STUFFING-BOX.

The accompanying illustration, represents an improved metallic stuffing-box recently patented by Mr Watteau, of Middlebrough. This invention has been applied in France to nearly one thousand locomotive engines, and stationary engines of every description are daily being fitted up on this system. In forge hammers, which soon burn their packing, the invention has been applied with great advantage. The metallic packing A, composed of an anti-friction metal, has a double conical shape, by means of the coiled spring B in the bottom of the box, it will always be forced against the piston rod, as it is made in halves. In locomotive engines the metallic packing has been found to last a year without being renewed, whilst the cost of maintenance is insignificant. After that time the metal can be remelted. It is stated that there is much less friction than with any other packing. After it has been at work for some time, both piston-rod and packing acquire a smooth and glassy appearance, and in no case has the metallic packing been found to damage the rods in any way.—*Iron*.

MILLER'S PATENT CAR-COUPLING.

(See page 85.)

There is probably no portion of an entire railway train which has been the subject of so many different inventions and patents as that which effects the coupling of the cars. Our illustration represents a new arrangement which by all accounts is a great improvement on the ordinary coupling. One of the greatest arguments in its favour is the fact that it has been taken up by the Pullman Car Company and is being applied to the cars used by them.

Figure 1 is an elevation, Figure 2, longitudinal section; and Figure 3, a plan of an end of a car to which the arrangement has been applied.

The letters refer to the same parts in all the figures A is the "Coupling Hook," B the "Buffer;" C the "Stop;" D the "Lever;" F the "Truss Beam;" G the "Spring Beam;" H the "Suspender Beam;" I the "Upward Trusses;" K the "Main Spring;" L the "Downward Trusses;" and M the "Car Bolster;"

The platforms, instead of being located below the centre line of the main sills of the cars, are placed in that line, and held there by the trusses I and L, so that the point of contact (in Buffers B) is in the said centre line and not below it.

The coupling "Hook" A is attached to the draw-spring the same as the ordinary draw-head, and at the same height above the track, but in such a manner that the outer end is free to move laterally and vertically a sufficient distance. The coupling hook projects beyond the platform. The stop C is to prevent accidental uncoupling. When two cars are brought together, the coupling hooks, from their shape, push each other aside, until the buffers B are compressed hard on the buffer springs, then, the points of the hooks having passed each other sufficiently far, the hooks are carried forward by their main-springs, and thus the "Coupling" and "Compression" are both effected automatically at the same time, and without the use of links and pins When two cars are thus coupled together, the head of the hook of each car is under the buffer beam of its opposite car, and the platforms are close together (about 4 inches apart) The effect of this is, one platform cannot be forced over the other, nor can a child fall between the platforms; the dust and rain are nearly all shut out; the "Compression" makes the train run steadily, and prevents all jerking in starting and stopping. The advantages gained by the use of these improvements may be summed up briefly as follows.

Description.

1 The platforms are held in a plane with the sills of the cars.
2 The platforms cannot be broken by an ordinary accident
3 Telescoping is impossible
4. Any required compression may be attained to prevent accidents by oscillation.
5 No links and pins are required, and no one is required to go between cars to couple them.
6. The platforms may be held as close together as desired.
7. By close coupling the train is shortened.
8. They will not accidentally uncouple
9. They may be uncoupled "without shutting off" to make flying switch.
10. They are strong; the train will not "break in two" at starting or while running.
11. They cause the train to move steadily and not jerk in starting and stopping.
12. They work well at great variations of height.
13. They will couple with all kinds of draw-heads and "couplers."
14. They are cheap and durable.
15. Injury to men when coupling cars is entirely prevented.
16. Injury to persons by falling between cars is entirely prevented.
17. Injury to persons and to cars by "telescoping" is entirely prevented.
18. Injury to persons and to cars by "oscillation" is entirely prevented.
19. The great steadiness of the cars, produced by compression, renders sleeping-cars much more desirable.
20. "Train Brakes" are rendered more valuable by the non-existence of "slack" in the train.

TELEGRAPH WIRES.

We notice that Messrs. C. J. A. Dick, of Pittsburgh, Pa., U. S. A., and G. A. Dick, of Cannon Street, London, have recently introduced and patented an invention for improvements in the manufacture of wires applicable to telegraphic purposes, which appears to promise material advantages.

The inventors state that as the soft ductile nature of copper permits of its use for telegraphic purposes (except in short lengths or for effecting connections) only when supported by other materials of greater strength and elasticity, they have been led to seek for some means of imparting additional strength and tenacity thereto, and so have discovered that copper alloyed with tin in limited proportions is a valuable substitute for the electric conductors hitherto used; and also that by adding a certain quantity of phosphorus to such alloys of copper and tin the resulting product acquires additional tensile strength and elasticity without material detriment to its conductivity Also that by adding a further proportion of tin or phosphorus, or of both, within certain limits, to copper, the wire drawn from such phosphorised alloys can be used with advantage for telegraphic purposes as a support for copper and other good conductors of insufficient tensile strength, and also for the manufacture of wire-rope, pianoforte-wire, bell-wire and for other purposes for which a strong and inoxidisable wire is desirable.

The object of this invention is, therefore, to produce wire of alloyed metal which has greater conducting capacity than the iron-wire now in use, while possessing great tensile strength and elasticity, and being therefore self-supporting, and not so liable to corrosion and deterioration as iron-wire, thus, in fact, offering all the advantages of a good and permanent conductor having great strength and toughness

In the treatment of metals composing the alloy of copper and tin, the prevention of the presence of oxides in the perfected alloy is effected by protecting the molten materials from contact with air during the smelting operation, or by the addition to the molten alloy of a reducing agent, such, for instance, as phosphorus wire drawn from such alloy will be found to be tougher, more rigid, and elastic, than wires formed of alloys in which oxides are present.

For these purposes alloys of copper containing from 2 to 5½ per cent of tin, and free from oxides are used, being cast in chill-moulds, as the homogenity and other qualities of the metal are thereby improved They are then rolled and drawn into wire in the usual way.

Phosphorised alloys of copper and tin are stronger and more elastic than those containing no phosphorus, and although the conducting capacity of the alloy is somewhat impaired by the presence of phosphorus, it has been found that valuable compounds for electrical wires may be made of phosphorised alloys of copper and tin when used within the following proportions.—1. When not more than 2 per cent of tin is used the component quantity of phosphorus may amount to not more than one-half per cent.; 2. When not more than 4 per cent. of tin is used the component quantity of phosphorus may amount to not more than 2-10ths per cent; and 3 When 5½ per cent. of tin is used the component quantity of phosphorus must not exceed ⅛ per cent.

For the manufacture of wire in the application of which conducting capacity is a less important consideration than great strength and resistance, from 3 to 6½ per cent. of tin with a maximum quantity of from 6-10ths to 2-10ths per cent. of phosphorus respectively, decreasing in inverse ratio to the quantity of tin, should be used The remainder of the alloy consists of copper.—*Iron.*

M. Boillot, on submitting pure oxygen and atmospheric oxigen alternately to the action of the electric current, has discovered that 58 cubic inches of pure oxygen yield but one-eighth of a grain of ozone, while the same amount of atmospheric oxygen gives one-fourth of a grain. Oxygen mingled in the air is therefore in a condition more favourable for its transformation into ozone.

It is proposed to economise the caffeine now wasted during the process of roasting the bean. A pound of coffee will yield on the average 75 grains of caffeine, and as the annual consumption in England amounts to 13,000 tons, the amount of caffeine that is wasted is 140 tons By attaching a condenser to the revolving drum it is thought that a great part of this can be saved.

A LARGE CASTING.

At the South Brooklyn Steam Engine Works, in Brooklyn, the second immense anchor plate for the East River bridge was recently cast. Four weeks were occupied in forming the mould alone. A circular excavation was first made, twenty-five feet in diameter and three feet deep, at the bottom of which was placed an iron plate. Upon this a course of brick, eight inches thick, was laid in a mortar of fine sand and fire clay, the upper surface was then leveled off and baked with charcoal. This surface served as the base of the mould, which was of loam, secured by brickwork and iron girders built in sections.

The anchor plate is of oval shape, seventeen feet six inches by sixteen feet in dimensions, with a thickness at the ribs of three feet. It weighs 47,000 pounds when cleaned, and its cost is $3,200. About 60,000 pounds of iron were melted, transferred to a huge tank, and thence allowed to flow into the mould. The casting took place without accident and was allowed one week to cool.—*Scientific American.*

Experiments on the Influence of Manures in Checking the Growth of Weeds.—A series of experiments has been made to determine this point, with especial reference to clover. It was found that when the land was totally unmanured, the weeds formed 57 per cent. of the entire yield. Nitrogenous manures effected but little improvement, phosphatic mixtures somewhat greater, whilst gypsum reduced the proportion of weeds to 1 9 per cent. only. But before any one assumes from this result that gypsum is a general antidote to weeds, and applies it accordingly on all soils and to all crops, he must remember that gypsum is a specific manure for clover, and gives it power to struggle successfully with the weeds and crowd them out. Secondly, it was evident that the soil was not naturally gypsiferous. Hence the peculiar weeds there present had an advantage over the clover. But a gypsum soil has its own assortment of weeds, which are as much at home there as clover. Hence the only legitimate conclusion is this.—Give a plant its favorite manure, and it will master weeds that do not relish such manure.

Killing Animals with Chloroform.—Many persons would be glad to know how to kill an animal without suffering, and we venture to give the benefit of our experience. We are constantly being called upon to destroy horses, dogs and cats, and have little difficulty in doing it. For horses we use a large sponge, say six inches in diameter, thoroughly saturated with chloroform, which is dropped into a bag, large enough to be drawn over the horse's nose. It is not desirable to have the bag "air-tight," for, if so, suffocation is likely to ensue In two or three minutes the horse is unconscious, and in eight or ten minutes dead, without suffering.

For dogs and cats, a similar process, using a small sponge and bag; or these animals, with the saturated sponge, may be put into a box admitting some air, when they soon "go to sleep." Seventy-five cents worth of chloroform will kill a horse, and twenty-five cents a dog or cat. If one saturation of the sponge does not complete the work, repeat it.—*Our Dumb Animals.*

At the recent session of the National Academy of Science at Cambridge, Massachusetts, Prof. Mayer gave some interesting information as to the effects produced by magnetism on iron. He states that he has discovered, by means of the Saxton comparator, that rods of iron suffered a permanent elongation by magnetisation of one hundred and fifty millionths of an inch. English refined iron gave the maximum of elongation, scrap-iron the minimum. Whether the current was gradually increased in intensity, or whether its full strength was developed at once, the degree of elongation was the same. With one cell, the elongation took place in six-tenths of a second; with twenty-five cells it took place in two-tenths of a second. Prof. Pierce thought that if the elongation of iron under magnetisation were invariable, it might produce an effect upon the earth in a manner which could be appreciated by an alteration in the length of the day. This could be readily detected by astronomy, for our modern instruments would readily enable us to determine a change in the day of seven-hundredths of a second.

DOMINION.

It is proposed to establish shortly at Halifax, N S, a School of Applied Science with special relation to mining and engineering.

The Air Line Branch of the Great Western Railway was re-opened for through business on 27th ult, with five trains a day each way.

A valuable copper mine is said to have been discovered within the last few days by Mr. Prudhomme, at Cantly, a few miles above Chelsea.

A silver works company has finally settled upon Oshawa as its place of business. Plans and specifications are being prepared for the works to be erected.

A coal seam has been discovered cropping out of the bank of Chilliwhack river, British Columbia. In quality it is said to be quite equal to the best Nanaimo.

A Big Stone.—A grindstone which weighed 5,850 lbs., was recently shipped from Grindstone City, on Lake Huron, being the largest ever shipped from that place. It was got up for a firm in Akron, Ohio.

The first instalment of 800 French emigrants from Alsace, to be employed on the Glasgow and Cape Breton coal and railway works, arrived at Sydney last week. The rest of the number are expected in August.

The Quebec iron works, for the manufacture of car wheels, railway gear, steam engines and general iron work are to be established at Levis. The company starts with a capital of $100,000 and expects to do an extensive and paying business with the various railways about to centre in Quebec and with the steam craft of the port.

A gentleman arrived on the *Prince Alfred* to examine the benches of Fraser River with a view to engaging in hydraulic mining. He represents a large company in California, who are encouraged by the liberal character of the mining laws which were forced through the House last session in spite of the opposition of the Government.—*British Colonist.*

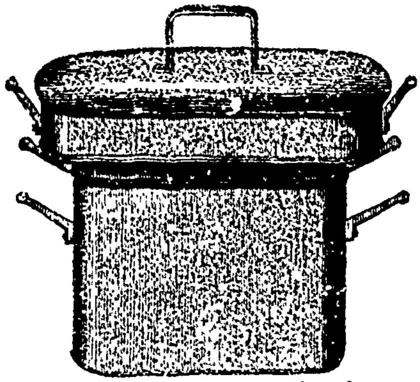
The amount of timber of all descriptions that is now passing down the Galt railway from the upper country is very large, heavily loaded trains passing the town continually. Squared timber, lumber, ties and rails constitute the chief portion of freight on these trains. It is also said that this description of freight will be largely increased when the Southern extension is opened.

The fine bridge known as the Nanaimo Lattice bridge, built last year at a cost of about $4,000, is reported as badly wrecked during the recent gales. The Government agent at Nanaimo has taken prompt measures to secure it, but it is still in a very precarious position, and Mr. Farwell, C E., of the Lands and Works Department, leaves per the steamer *Sir James Douglas* this morning to superintend its repair. It is said that should the late gales recur, the bridge must inevitably be blown into the river.

From an examination of the underground works at Lingan, C. B, colliery the fire is ascertained to have been of a more serious character than previously reported. The fire is now supposed to have originated from the flues of the underground engine, which is situated about fifteen hundred feet down the main slopes and was used for pumping. It is at present confined to the south side of the slope and near the bottom. Men were engaged up to Monday of last week trying to quench the fire, but the appearance of carbonic acid gas compelled them to leave. The mines have been sealed up and it is to be hoped that within a few days the fire will be extinguished.

The North-Western Boundary.— During June will be completed the survey of the north-western boundary between the United States and the British possessions. The engineers of the American expedition depart from St Paul during the present week for their labors. Last year the survey was completed with the aid of the British expedition from Fort Pembina to the Lake of the Woods, and it is hoped to finish it to the Rocky Mountains during the season. The work of determining the forty-ninth parallel, which is declared by treaty to be the boundary line, has been one of great tediousness and labour, owing to its being prosecuted almost wholly in a wilderness, yet is one that must be completed to avoid entanglements between the two countries.

BOLLARD'S IMPROVED COOKER.

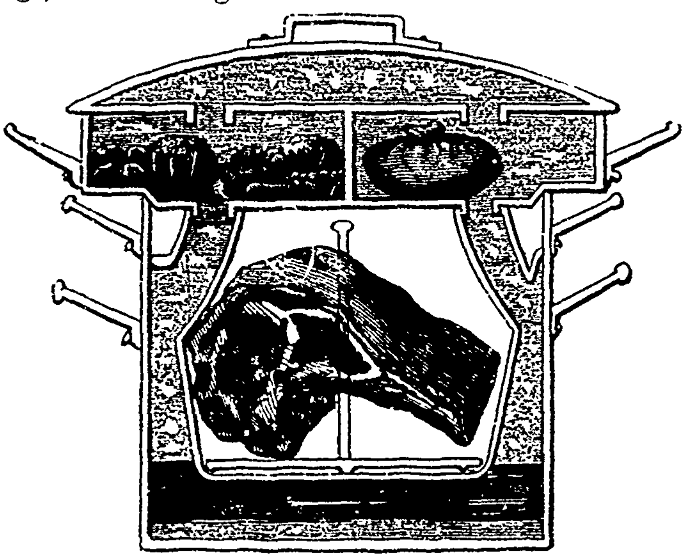


We illustrate on this page a new and improved apparatus for cooking Meat Vegetables, &c.

This system of cooking was first introduced by Captain Warren, of the English Navy and was intended for the preparation of food for soldiers and sailors The success which attended its introduction was so great that it was subsequently taken up by the trade in England, where it has given unbounded satisfaction.

The chief peculiarity of the apparatus consists of a tightly closed vessel containing the meat to be cooked This vessel is surrounded by steam except at the bottom, which remains in boiling water, and at a small portion of the sides which is exposed to the air. The meat rests on a false bottom, which prevents its coming in contact with that portion of the vessel which is in contact with the water at 212°. The exposure of sides that are not steam-jacketed causes a loss of heat that reduces the temperature of the closed vessel to about 210°, being two degrees less than boiling water As LIEBIG has demonstrated, this is the best cooking heat, and thus, while the full heat of boiling water coagulates the albumen of the meat in such a way as to render it hard, tough and stringy this lower temperature cooks it completely, and so far from making it tough, seems to make it more tender The effect may be illustrated by saying that the whole mass, after it has remained long enough in the vessel, is in the tender and juicy condition of the interior of a joint of meat baked in the ordinary way, or of meat that has been cooked by simmering at the back of the stove

The meat is cooked without the access of air, water, or steam, the juices and flavor being all preserved So far as the Cooker is concerned it is not a steamer, but a steaming chamber is added for vegetables, pudding, &c., &c. It is made of heavy tin plate, with copper bottom and can be used on any cook stove, range, box stove or gas burner.



The economy of this system of cooking is very important Cooking meat in the ordinary way produces the following results.

Roasting	Meat loses	5 1-3 oz.	to the pound
Boiling	" "	4 2-7 oz.	" "
Baking	" "	3 5-9 oz.	" "

When cooked by this improved system meat looses only 2½ oz. to the pound In addition to this it has been proved by repeated trials that meat, fish and poultry, when cooked in "Bollard's Improved Cooker retain those nourishing juices, which, if it had cooked in the ordinary method would have been thrown off in vapor, but by this mode become condensed and are retained in moisture. at a temperature sufficient to cook in the most perfect manner Thus none of the nutritious properties are wasted, the whole is retained in the most digestible and palatable form, and even the two ounces lost from each pound of meat, remain in the form of most delicious juices