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The Canadian Patent Office Record and Mechanics' Magazine

Vol. 3.—No. 6. JUNE, 1875. Price in Canada $2.00 per An.
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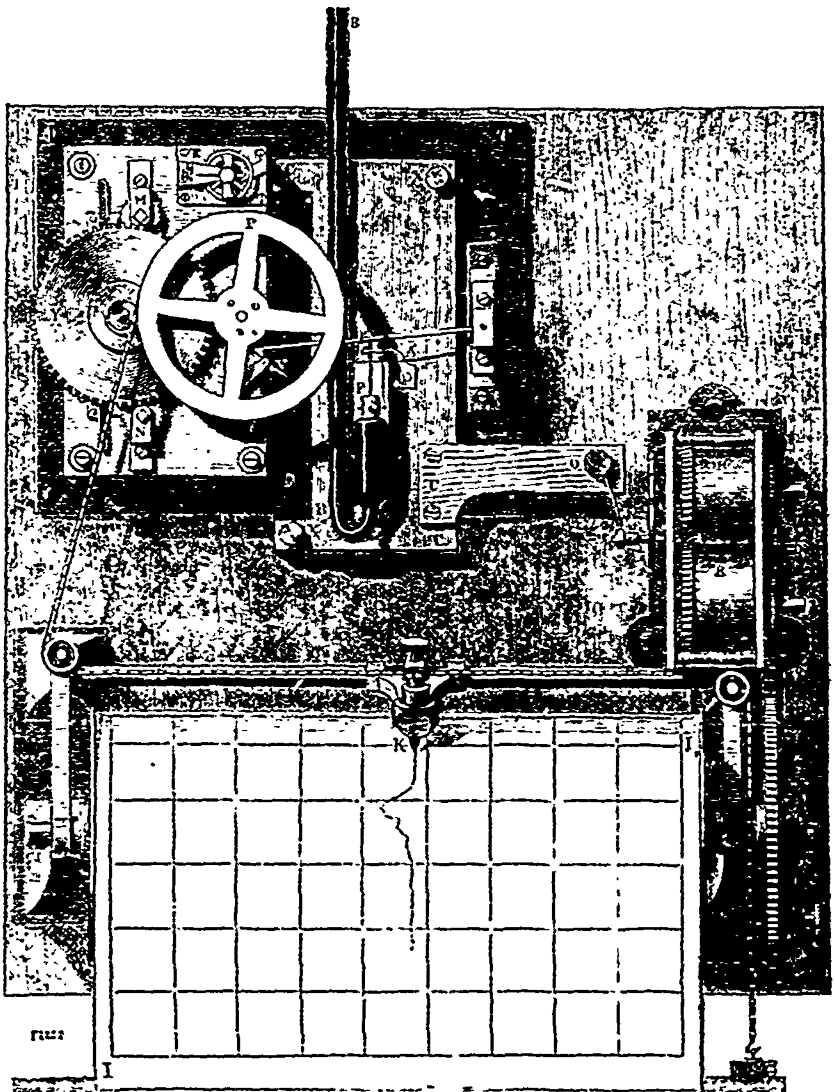


REDIER'S BAROGRAPH.—(See next page.)

REDIER'S BAROGRAPH

We give on page 161 an engraving of an instrument invented by M. Louis Redier, one of the Vice-Secretaries of the *Société Météorologique*, and constructed under his superintendence at the factories of Messrs Redier and Co, Paris, and exhibited at the rooms of the *Société Météorologique, France*, and at the last meeting of the Meteorological Society, England.

This simple and easily-managed instrument is well worthy of the closest inspection, and the engraving shows it to so great an advantage that, with the description we are able to give, from having seen it actually at work, and also from having inspected the curves of pressure produced by it, we do not despair of rendering the engraving and description perfectly intelligible to our readers.

The apparatus consists, in the first instance, of an ordinary siphon barometer tube B B, mounted on the slab C C, on which are two binding screws X, working in slots for allowing a vertical motion to be given to the slab carrying the barometer. This motion, by the action of an escapement at E driven by the train at M, which is always in operation, tends to draw the recording pencil K towards itself, and also to raise the slab C C, with its attached barometer B B. The upward movement of the slab C C is effected by the escapement at E through the medium of the pulley P the axis of which is worked by the toothed wheel Y of a differential train, not shown in the engraving. The connection between the recording pencil K and the pulley P is maintained by a chain which is always kept tight by the counterpoise Q.

Upon the surface of the mercury in the open leg of the siphon rests a very light ivory, F, which carries a very light vertical needle, on the top of which rests a very long but *extremely* light arm A, having a ratchet at its end, which, when in position, confines the fly V driven by the train at N. The float, needle, and arm together weigh but a few grains. As soon as the slab C C is raised sufficiently high by the train at M to release the fly V, the speed of which is twice that of E, the upward motion of the slab is arrested. It then descends until the motion of the fly is stopped by the ratchet of the arm A catching it. While this state of things continues—viz, the alternate upward and downward movements only—the pencil describes upon the recording paper I I a straight line. It will thus be seen that the actual work of recording is borne by the trains M and N, and that the barometer itself has nothing whatever to do in overcoming the friction of the pencil, which, so long as there is no change of pressure, retains its normal position as regards the paper. A careful inspection of the engraving will, however, show that another agency may come into play in releasing the fly V. A decrease of pressure raising the mercury in the siphon end of the tube will release the very light arm A, and release the fly; there will consequently be an additional action of the train N other than that of raising the slab C C, tending to displace the normal position of the pencil as regards the paper, and to show upon it the diminished pressure. On the other hand, an increase of pressure will lower the mercury in the open end, and this, in its turn, will shift the pencil as regards the paper in the opposite direction. By means of the barometric movement thus acting on the very light portion of the apparatus for shifting the positions of the pencil, the curves of pressure are described with perfect accuracy. In addition to the clock movements for driving the escapement E and the fly V, there are two others—R for driving the cylinder carrying the recording paper I I, and R1 for actuating at intervals the tapper O, for the purpose of overcoming any capillarity in the barometer.—*English Mechanic.*

LOUISBURG RAILWAY.

About midway between Louisburg and Cape Breton Collieries, the Mira River, or Canyon (a wide fissure through which the tide flows into a chain of lakes some 25 miles inland) crosses the line of railway, now nearly completed by the contractor, F. N. Gisborne, Esq., C.E., of London and Sydney, Cape Breton.

A light, elegant, though exceedingly strong lattice girder iron bridge now spans this river and on the 14th of January, a 36 ton Fairlee Locomotive with trucks, crossed it without producing any visible deflection or movement in the structure.

This being the most important bridge in Cape Breton, and probably the only example in the Province of an iron structure supported upon wrought iron cylindrical screw piles, the following particulars may prove of interest.

Length of bridge over all 336 ft; length of spans (4) each 72 ft; length of draw bridge or lift 30 ft.; length of wrought iron screw piles 70 ft, diameter of do, (shore piers) 2 in. each, 3 ft; diameter of do. (centre piers) 6 in. each, 2 ft. 4 in; depth of water with 7 knot current 22 ft.; depth of sand and gravel to rock bottom 10 ft.; height of lattice girders above water 48 ft.

The shore abutments spring from the sides of the ravine 21 ft. below rail level and are substantial structures of cut free stone.

The first pile was screwed down on the 20th of August last, and upon the 22nd of December, a period of four months only, the bridge was finished at a total outlay of $42,000.

The designers and manufacturers, (with whom Mr. Gisborne agreed for the structure under his contract with the Cape Breton Company,) are "The Hamiltons' Windsor Iron Works Company" of Birkenhead and London, and its erection was intrusted to their engineer, Mr George Earle, the Cape Breton Company being represented by A. H. LeBreton, president engineer.

Only last May was the first sod of the Louisburg railway turned and within a year 21 miles of one of the most varied and difficult lines in the Dominion will be nearly completed, including the crossing of Catalone Lake 1600 ft long with 15 ft. and 15 and 20 ft. of soft mud, — swamps which have to be piled 42 ft. deep, to support superstructures 25 ft. high and the great coal shipping pier at Louisburg, 600 ft. in length, 28 feet above tide water and with 34 feet water alongside.

Mr Gisborne and his able assistant engineers Messrs. A J Hill and T J. Ritchie may be congratulated upon the large amount of such varied work being accomplished within so limited a period.

NEW IRON BRIDGE OVER THE DESJARDINS CANAL.

This bridge was erected last fall to replace a bridge of the same material constructed in the United States which fell into the canal, last summer, carrying down with it in its fall two waggons, teams and drivers. The horses were drowned but the drivers escaped without fatal injuries. This is the sixth bridge that has been erected over this chasm. The first, an iron suspension bridge was blown down by the wind. The next a tressel wooden bridge was taken down having decayed and become dangerous. Afterwards the iron bridge previously referred to and the one shown in the sketch. The two first spanned the canal at the top of the heights, the two latter at a lower elevation. There have also been two drawbridges here for the G. W. R'y, one a wooden one destroyed by the memorable accident of 1857, and the present one shown in the sketch having been erected after the accident. This bridge (subject of sketch) was built in Hamilton, the work being done by J. H. Killey & Co., and Burrows Stewart and Milne, Engineers and Iron Founders. It is what is called a whipple, arch truss. The arch is 124 feet to centre of tressel work columns, which columns stand 60 feet above the level of the water and are placed on strong masonry abutments; the girders forming the approaches to the centre are 40 feet long each and rest on masonry foundations, the total span being about 200 feet. The weight of the bridge including cast and wrought iron is about 80,000 lbs. all the iron in its construction being tested by the builders to three times the strain ever likely to come on it. The cost of the bridge and its approaches which was defrayed by the G. W. R'y was $17,000.

The designer and engineer in charge of construction was J. K. Griffin, of Watertown. The view is from the west.

Simple Test for Lubricating Oils.—A simple method of testing for hydrocarbons or mineral oils in lubricators is to fill a bottle with the oil in question, moistening the cork and inside of the neck of the bottle, and then twisting the cork about its longer axis. The best lubricating oils produce no sound, but the more the oil is adulterated with hydrocarbons and products of dry distillation, the louder the noise produced. An oil that gives a loud cry is most unfitted for a lubricator.

SWORD MANUFACTURE IN BIRMINGHAM.

The manufacture of swords is one requiring great skill in all its departments. Success in this work depends upon the acquired skill, the long experience, the educated eye, the manipulative power, which seem to require many generations of workmen before they are attained in the higher excellence. The slightest mistake in working would make a sword-blade useless, and this applies to each of the three great processes through which it has to pass—forging, tempering, and grinding. From the necessity of all the work being skilled work, each part of a sword—the blade, the grip, the hilt, the scabbard—is made by hand, and the witnessing of the manufacture is thereby rendered especially interesting. For the excellence of his swords and for the skill displayed in every part of the work, no name in the history of the trade surpasses, and few, if any, rival, that of Mr. C. Reeves, of Birmingham, over whose works we shall now conduct our readers, in order that they may witness the making of a sword under the most favorable circumstances.

The first process is the forging of the blade. The steel comes from Sheffield in double moulds (the length of two blades), as it is called, and is the best steel, and is in strips, each strip being the length of two swords. The workman takes the strip, and first breaks or cuts it across the middle. The handle end of the blade is of iron, as this metal bears more knocking about, and can be used in a manner which would be fatal to steel. The iron end is then put into the fire, and the tang, or part to fit into the hilt, is forged. The blade is then passed through the fire a large number of times, and beaten out on the anvil in order to distribute the metal equally in every part. At the same time the furrow is worked up the centre of the blade, wide or narrow according to the pattern and size required. In those known as Scotch blades two furrows are beaten. This is a work requiring great care and skill. The future worth of the blade depends upon the skill of the forger. The slightest defect or inequality in the distribution of the metal makes the blade to that extent imperfect. With a skilful workman that is, of course, of rare occurrence. He knows precisely the amount of hammering required. It may be noted here that every blade passes through the fire no fewer than twenty-five times before it is completely forged.

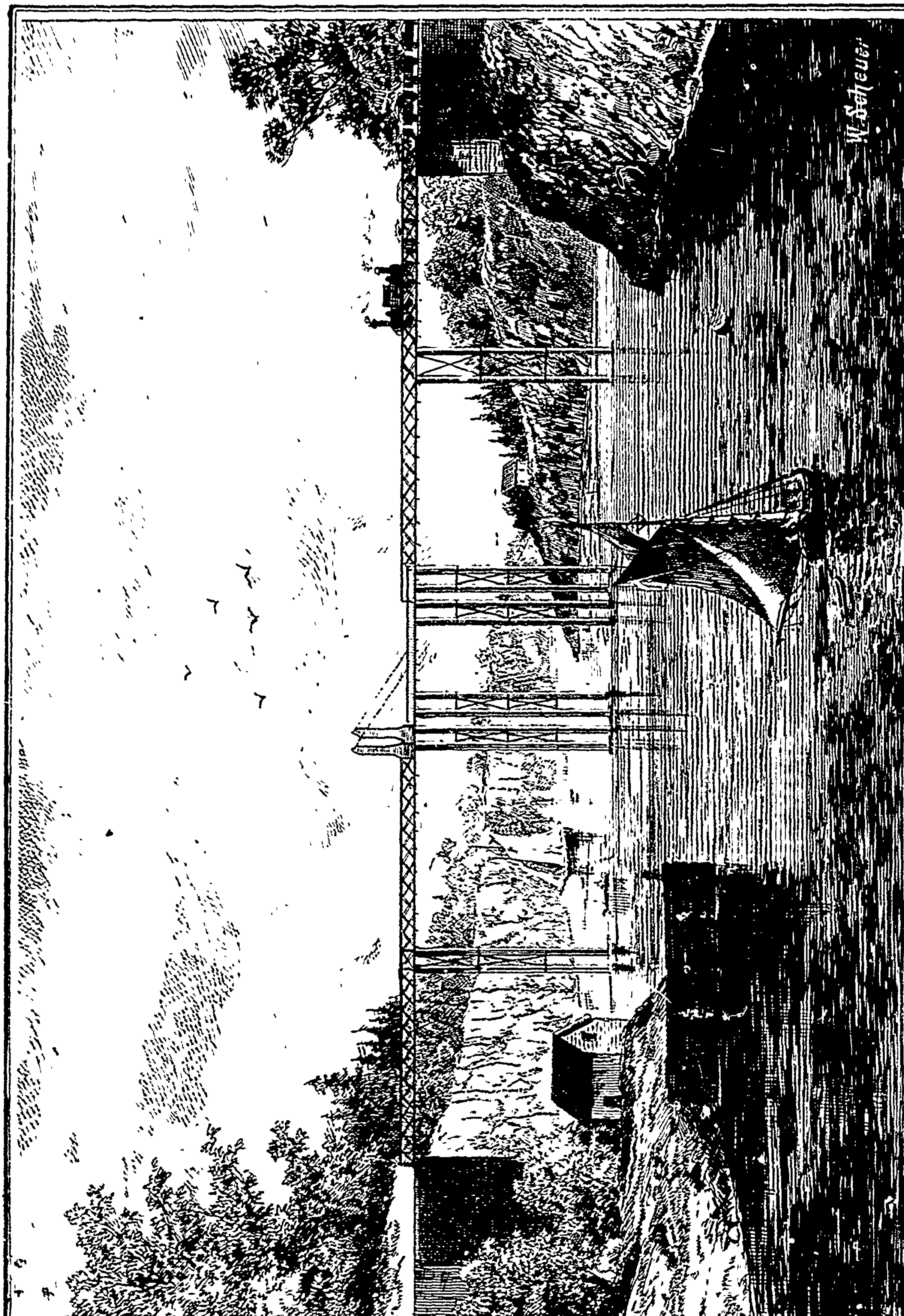
After forging follows the most delicate and important part in making a sword-blade—tempering. On this process depends the perfection of the weapon, and it is quite pleasant to listen to Mr Reeves while he descants on this part of the work. The object of tempering being, of course, to give the steel the required elasticity, it must not be too hard, or it will break, and it must not be too soft, or it will bend; but must be so equally tempered that, when its point is pressed on the ground, the blade will, when free at once take its natural shape without hurt or detriment in the slightest degree. The mode by which this great, this necessary quality is secured is as simple as it is effective. Before the blade can be tempered it must be made extremely hard. this is done by first passing it through the fire, and then, while hot, it is plunged into water. The first plunge hardens the blade to such an extreme hardness that it is as brittle as glass, and if thrown down would break into pieces. Again it is passed through the fire and then beaten straight, for the effect of the action of the water on the hot metal is to make it of all shapes. Just at the point at which the blade takes a particular color known at once to the practised eye, it is again plunged into the water, which, in technical language, "prevents it going down lower," and is tempered. It can now be bent backwards and forwards without any fear of its breaking, and is ready for the grinder.

The grinding is done on the best Leeds stone, the blade being placed in a frame of wood, and its surface pressed on the stone until the work is done. This also depends upon the skill and eye of the workman. In grinding the furrows a stone of a peculiar construction is used. The face is cut into raised flutings of the size and shape of the furrows of different swords, and on these the blade is pressed, and the furrow effectually ground. This is called the hollowing-stone. Each blade takes from an hour and a half to two or three hours' grinding, according to its quality. We saw one blade ground, and also some machetes, a kind of scimitar knife used for cutting down sugar-canes, etc., in India.

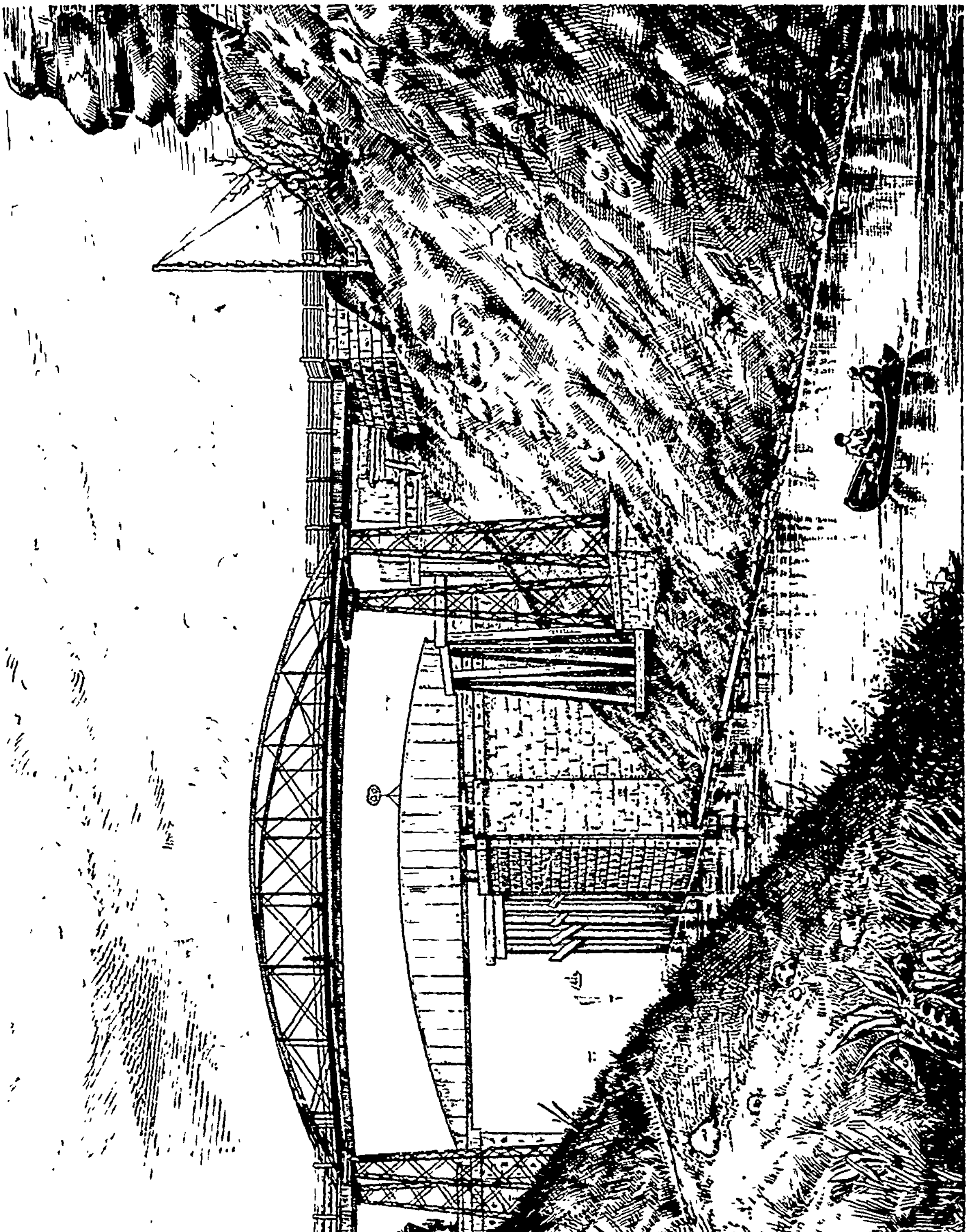
The blade is now ready for polishing. This is done on lathes worked by steam. Different-sized wheels are fitted on the spindle, and lard-oil and double-washed emery are used in the operation. The blade is often put into lime-dust during the process, and on the lathe-brush used a crocus dust, of deep purple tint and ground very fine, is thrown, and a most brilliant polish is the result. Scabbards and hilts, and other ornamental parts of the sword, are also polished in much the same manner. In the case of scabbards a larger wheel is used instead of the ordinary lathe-brushes. When polished, the blade is ready for the hilt and scabbard, so we will now see how these are made.

And first for the scabbard. In making a scabbard the workman takes a piece of flat steel cut to the required size. He first places it on the top of an open vise, and beats it with a wedge-shaped wooden mallet, bringing the two edges closer together each time it passes along the vise. It is then beaten on both sides until they almost meet; a mandrel is then put down it, and the steel beaten closer around the mandrel, both edges being hammered over. The edges are then soldered. It is next beaten on an anvil all round, the mandrel is withdrawn, and the scabbard is ready for the drag, which is a piece of iron fitted to, and fastened to, the bottom of the scabbard. The bands are then put on, and the scabbard, after being filed and smoothed is ready to be polished. The making of the grip is also a very interesting bit of work. These are the handles by which the sword is gripped, hence the name. A grip at first is a bit of walnut, oblong in shape, but narrower at the end than the top. The back, which is made of metal, is placed on it, and the wood is worked into the required shape by files. A large number of different shapes, sizes, and cutting powers are used in this work. When the top has been cut, the grip shaped, and the tenon for the ferrule made, it is then "balled." For this purpose it is fastened in a vise, a three-sided file cuts a deep indentation at regular intervals, each division is rounded or balled by a file, and the indentations connected by slanting interstices cut by a hand-saw. The grip is then drilled through in a lathe, for the purpose of receiving the tang. When this has been done, a piece of the skin of a dog-fish, which has been a long time soaked in water, is cut off. Every bit of flesh on the inside of the skin is then carefully removed, and a piece of pure skin is left. This is put round the grip, a piece of string or wire is fixed by a loop to a piece of steel fastened in the vise, and the workman binds the skin tightly round the grip by winding the string or wire round the space between each ball. It is then filed and the back fitted on again. In making a grip it passes through the workman's hands no fewer than thirteen times.

A hilt is at first a flat bit of metal of a peculiar shape, and may be cut to any pattern. A large number of these are used, which are all made to a regulation size. The pattern used is placed on the metal, which is then marked. They are then filed and cut by hand, beaten on blocks and knobs into the shape of the hand, and afterwards polished and made ready to be fixed to the sword. This is called mounting. In the cheaper swords the blade is bought from one person, the hilt from another, the scabbard from a third, and so on. But in this manufactory every part is made in the works, and each piece is prepared to suit and fit the other parts, so that when fitted together the sword is firm and sound; and the parts never give way or become loose, as they do when stuck on to the tang of a blade without any reference to their weight and suitability for each other and the blade to which they are attached. In such cases the parts with little wear become loose and rickety, and depend only upon the small rivet at the top for their security. In ordinary swords the blades and hilts, after having been ground, filed, and polished, are taken into the mounting shop. There the tang is placed in the grip. The hilt is fastened on by passing a rivet into the top of the grip, and fastening it to the tang. The hilt is drawn over this rivet, which passes through a hole at the top. It is then filed and broken off at a short distance from the hilt. The rivet is then welted by being filed and smoothed until it has the appearance of an ornamental knob, forming an integral part of the hilt. These swords are now complete. In the mounting of best work great care and skill are required. In the mounting shop a very ingenious tool is used, called a float. It is a long bit of steel, shaped almost like a tang, with a series of blades along its surface. The grip is worked to and from the float until it is cut to the exact size and shape of the tang on which it is to be fixed. Great skill is required in this delicate opera-



CAPE BRETON :—MIRA RIVER BRIDGE, LOOKING DOWN STREAM.—FROM AN ORIGINAL SKETCH.



HAMILTON:—NEW IRON BRIDGE OVER THE DESJARDINS CANAL.—From a Sketch by Jas. G. MacKay.

tion. In this mounting room the swords are proved. This is done by placing the point of the blade on the floor, and bending it backwards and forwards. After it has stood this test it is subjected to another. The workman strikes the blade strongly on a wooden block, both on the edge and back, and can tell by the ring whether it is of true and perfect quality. By these tests the slightest fault or flaw would be detected; for a very small fault, indeed, would cause the blade to break. The scabbards are lined. In the ordinary sword two thin strips of wood of the shape of the scabbard are placed on either side, and they must fit so accurately that neither in drawing nor in sheathing the sword must the slightest obstruction be perceptible. In the better swords leather is used in lining. In the mounting and ornamenting of swords any amount of artistic work can be employed either on the blade, the hilt, or the scabbard The rank of the officer is indicated in this manner, and naval swords are ornamented differently to military ones. The work put on presentation swords is often most elaborate and expensive.

ON ELECTRICAL AND ELECTRO-CHEMICAL EFFECTS IN BOILERS AND STEAM ENGINES.

(From *Le Technologiste.*)

It is not rare to meet with engineers who still deny the action of electricity and galvanism in engines; though such effects are frequently obvious, and fresh examples are met with every day, in the wearing out and deterioration of these apparatuses.

Among the cases which occur most often we might cite the corrosion of pins, rods, keys, door-plates, &c., according to their position and the neighbourhood of different metals. The steam seems to dissolve the more soluble parts, and so to lay bare the fibres of the metal. These corrosions may be remarked even in the tenders; the water seems to form a pile with the bronze valves and the iron of the rods. Hence there is removal of matter, reducing the rods sometimes to a section of a few millimetres.

This fact is much more evident where sea-water is used; the composition of which stimulates the electro-chemical action. In the engines of some wrecked vessels, the piston-rod, the large shafts, and the whole of the mechanism within the bronze plummer-blocks, have been found eaten away more than half a section, whereas at a certain distance from the copper, the polish of the pieces was hardly broken.

Of all kinds of iron, sheet iron is the most sensitive to galvanism. The sulphur of the coal-dust, electro-negative with regard to the electro-positive iron, corrodes it in the smoke-boxes and in the bottom of the furnace.

At all points where there is flexion within the boilers, that is, near the attachment of the supports and near rivets, grooves and holes are produced.

In locomotives, the angle-irons, by a sort of cutting, due to the difference of dilatation of the copper tubes and the iron boiler, undergo ruptures which are at first invisible; the tension produced in the fibres of the sheet iron by flexion at the contours and angles by the bolts, also causes imperceptible solutions of continuity; but all these lesions immediately become the seat of electric actions, the result of which is not long in showing itself in a more and more apparent manner: for these actions give rise, as has been said to removal of matter as shown by grooves and channels. These lesions are progressively intensified, for the effect becomes cause in its turn, and one may find some of these grooves attaining a length of 30 centimetres, and a depth which nearly absorbs the whole thickness of the plate.

It has often been sought by various means to guard against these inconveniences, which have been regarded as accidental, and the so e and true cause of which has escaped notice, viz., electricity. But all these means have been merely palliatives, that have always proved insufficient in the long run, and it could not be otherwise. The reason is the permanence of the cause referred to, and it is inherent to the matter itself. It is a case, then, in which one can only seek to attenuate as much as possible the hurtful consequences.

It may be observed that the circumstances influencing this cause increasing or moderating its energy, are so to speak, infinite in number. Still it would not be superfluous, but, on the contrary, of capital interest, if one could at least classify them with a view to circumscribing, and if possible limit and regulate the action in some way, if it cannot be entirely abolished.

The first that presents itself to our attention is the action of the machine. But this circumstance, which constitutes the normal state (since a machine is not made with any other end but to go), has not the deleterious and destructive influence which one might at first sight suppose. For we see a large number of machines working in an irreproachable manner and constantly for years, with very little appreciable wearing out. Against this may be placed the other observation, that the same machines in a state of rest commonly undergo very marked deteriorations, and that in very short periods of time.

There is in this contrariety of effects a very important question to be elucidated, and one to which hardly sufficient attention has been given It cannot be doubted but that a special study would reveal laws, probably very simple, ruling these two cases, and explaining the facts observed. It is not improbable that we might deduce from such an examination indications which would enable us to restrain the injurious causes to their minimum of influence.

There is, in the various phenomena of electricity, an important influence which probably plays a great *rôle* in them, and for this reason should not be omitted from our present study. We refer to the action of the earth on magnetic currents resulting from various causes, which affect all the parts of a steam engine This action certainly gives rise to induced currents of very varied nature, which introduce much complication into the question. It is important to find what is the extent of this action, of the variations in it, and in any case to dissipate the uncertainty and obscurity still enveloping the subject.

Next comes the nature of the waters used in working the engines. Their composition, which varies in an almost infinite manner, produces proportional variation in the effects. The foreign substances dissolved have a very energetic action in the development of the electricity, and so contribute largely to the wearing out of the boiler. The preventive remedy for this inconvenience is to introduce only the purest water (as far as possible.) Then, of course, we should still have the electric movements which are connected with formation of vapour, but so far as water is concerned only these, that is to say, the inconvenience could be reduced to a minimum.

In the third place may be mentioned defects of quality and of homogeneity of the sheet-iron and iron employed, and a vicious arrangement of the different metals entering into the construction of the engines. This vicious arrangement is what gives rise to the elements of the pile. This third category assuredly presents the most numerous cases of deterioration of engines, and especially of their boilers.

The attention of engineers should be specially directed to the homogeneity and purity of the metals employed. The least quantities of foreign substances, such as slags, oxides, &c., interposed in the texture of these metals, form with them permanent piles, and thenceforth become centres of generation of electricity and gradual denaturation of the metal. This is a point of much importance, and what we have said of the effects of juxtaposition of foreign substances with metals, applies every way to the employment of different metals. There is immediately created by their contact a focus of production of electricity, and consequently, continuous oxidation of the more attackable metal, together with all the perils arising from the deterioration.

To resume, electricity, the effect of which in engines, and particularly in their boilers, is to many persons very problematical, is the most powerful, if not the only cause, of deterioration and wearing out of these apparatuses, and especially of boilers. It is a question which may be regarded as absolutely new, if we consider the little that is known and the much that remains to be discovered in reference to it. It is to be desired that physicists and engineers would direct their investigations to it, so as to give new light and point the way of progress fo industry.

LONDON, within an area of twelve by eighteen miles, has no less than 245 railroad stations.

Of all metals known, silver is the best electrical conductor

WOOL-CARDING MACHINERY.

We publish on pages 168 and 169, drawings of wool-carding machinery, manufactured by the Sachsische Maschinen-fabrik, of Chemnitz. This firm has devoted itself with much success to the perfecting of this class of machinery, and the engravings we have prepared show a selection of three machines, and their various attachments, all of the most recent form. Fig. 1 — a scribbl·r — shows the first carder for opening the woc , and transforming it into a light mass, in which the fibres are laid parallel. This machine comprises a feeding apparatus, special rollers for preparing the wool, and an apparatus for laying the fibres. The feeding apparatus consists, as shown in the drawing, of a receiver A for containing the wool, of a mechanical device a B D for extracting it in small quantities, which fall into a cup C, mounted on a combination of levers c, h, i, and being moved by the gearing q r, the cam t, and the lever u So actuated, a inclined position is periodically given to C, when it is filled with wool and this movement throws the wool at first upon an inclined fixed table, and afterwards upon an endless platform. By means of the feeding rollers F the wool is led into the machine. This mode of feeding is very efficient, and its delivery is quite regular, because the cup C receives a given quantity of wool in a given time, and any excess is rejected, and does not enter the machine. This regulation is effected by means of the weight of the wool itself, and by the counting wheels. The wool passes by the carrying cylin ler to the drum, which revolves in connexion with five pairs of workers H, and cleaners I.

The large roller K raises the wool a little, so that the comb L may receive all the wool from the drum. The vibrating comb, worked by the lever and connecting rod O, separates the wool, and forms it into a light fleece, and it then passes off by the roller, shown in the engraving upon machine Fig. 2. This machine is fitted with a so-called "diagonal" feeding apparatus. It contains a guide moved by means of an endless band l running over the pulleys m n. Over the belt is a bar c, on which is mounted, free to slide, an arm d, the lower part of which is formed with a slot. To the band is attached a small finger which passes through the slot, and gives motion to the arm d, and at the bottom of this is placed a bracket carrying the gauge a and the double elliptical ring b. The band of fleece is fed through a and b b on the endless table. As will be seen from Fig. 3 this apparatus is placed diagonally with regard to the endless table, and the reciprocal movement insures the band of wool being placed also diagonally on the feed table, and it does not enter into the machine in the direction of the length of the fibre, but at an angle to it. By this means the amount of separation of the fibres can be increased, and their position with regard to each other equalised. The drum in this machine is also connected with five pairs of working rollers and cleaners w x, with a cylinder and doffer P. The oscillating comb r separates the fibres of the wool, and forms a fleece ready to be fed upon the third machine, Fig. 4.

This carding engine takes the wool from the previous machine upon the endless table E. The drum works also in connexion with five pairs of small rollers, and the large cylinder y lifts the wool from the dr m to the doffer, while the oscillating comb (driven by a pu y a and eccentric c on the shaft b) separates the wool from the doffer, and the dividing apparatus cuts the fleece into thirty cardings, which are compressed and rolled by means of three cylinders, which are driven by the eccentrics f, h, i, k, and r The fibres remaining on both sides of the doffer are taken off by means of the small combs. This continuous carding engine is supplied with the cleaning cylinders R R for clearing the drum. The whole of the machines are commendable for the simplicity of their arrangements, and the solidity of their work.

SCHMITZ'S REVOLVING FIREBARS.

We are indebted to our contemporary the *Revue Industrielle* for the accompanying illustration of Schmitz's firebars, recently introduced into France with good results. As will be seen it consists simply of a series of straight tubes, placed either singly or coupled together, and pierced with openings of a suitable form. Means are provided by which these tubular bars can be caused to revolve. It will be seen that the tubes rest upon transverse bearers also cylindrical and hollow, and longitudinally they are supported by a cast-iron plate fixed under the furnace-door, and formed with a projection upon which the tubes take their bearing, either by a groove as in the first and third types, Figs. 3 and 5, or against a ring as in the second type shown in Fig 4 The bars are turned by means of a key that is introduced into the end of the bar, which is fitted with a ferrule having a six-sided aperture as shown,

The first application of this system was made to a 12 horse power boiler, in which the steam was maintained by means of coke dust and slack, containing 25 per cent. of cinders. This boiler belongs to the Parisian Gas Company, which has a deserved reputation for investigating new and promising inventions. The success of their first experiments was so great that now some hundreds of these bars are employed by the gas company, so that the arrangement has passed from the phase of experiment into that of actual and large practice

It is claimed that by the use of the Schmitz bars, the work of firing is rendered much less difficult, while a thick fire (from 8 in. to 10 in) can be maintained economically The draught is regulated for a given consumption of fuel, and the front of the ash-pit may be closed, because sufficient air can be admitted through the open ends of the tubes. The inside of these tubes is always visible to the fireman, who can at once see when any of the openings are choked. When this takes place he is enabled, by partially turning the tube, to present a new surface to the fire, while he is easily able to clear those passages which have been closed In turning the tubes the ashes and other *débris* are precipitated into the ash-pit, and as shown in the second and third types, Figs. 4, 5, the bars are furnished with a spiral projection to assist in breaking up clinkers, &c.

The following are the results of this trial:

.	Ordinary Furnace.	Schmitz's Bars.
	lb.	lb.
Water evaporated per pound of coal .	4.678	5 563
Water evaporated per hour per square foot of heating surface	1.321	1.322
Coal burnt per hour per square foot of grate	6.79	5.70
Coal burnt per hour per square foot of heating surface	.283	.238

From trials made with a boiler in the Passy Gas Works, an economy of 26 per cent. was claimed for the apparatus, while the fuel employed was of such a nature that it could scarcely have been employed in an ordinary furnace.

NEEDED INVENTIONS.

The *Sewing Machine Journal* gives the following list of inventions in which great improvements can be made. There is great need it says of these specified, and also great room for advancement. Doubtless a fortune can be made on them if properly managed :

1 A R ffl r which can be set to gather a given fulness.

2. A simple Embroiderer.

3 An adjustable scroll Binder which will not stretch the binding.

4. A practical adjustable Hemmer, from the smallest size to an inch wide.

5. A Rotary Shuttle Sewing Machine, which will not twist or untwist the thread, and which will sew with great rapidity.

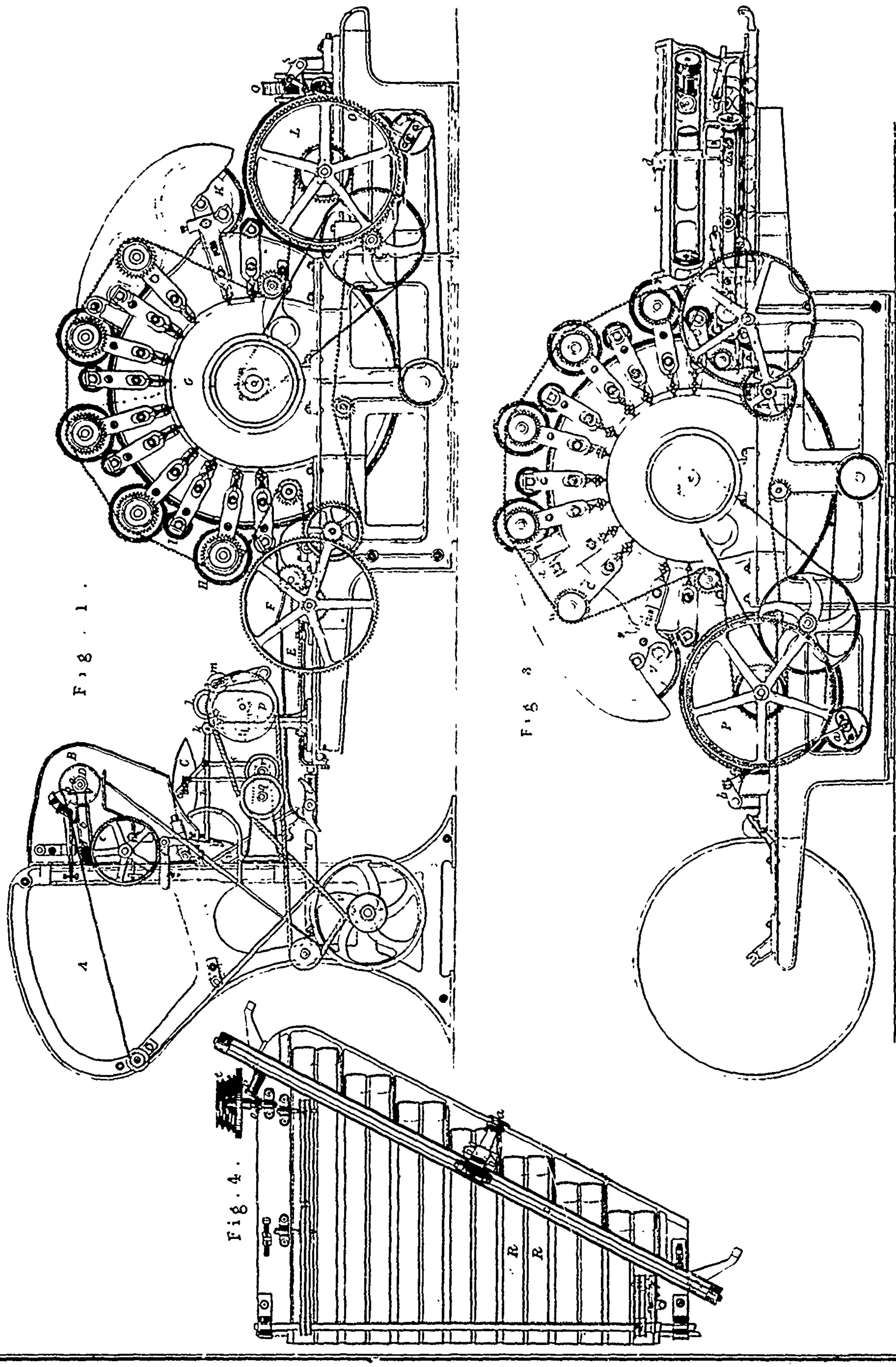
6. A practical Tuck Folder.

7. A Sewing Machine which will have in its working parts the different attachments which can be thrown in gear with some working part of the machine when the attachment is required.

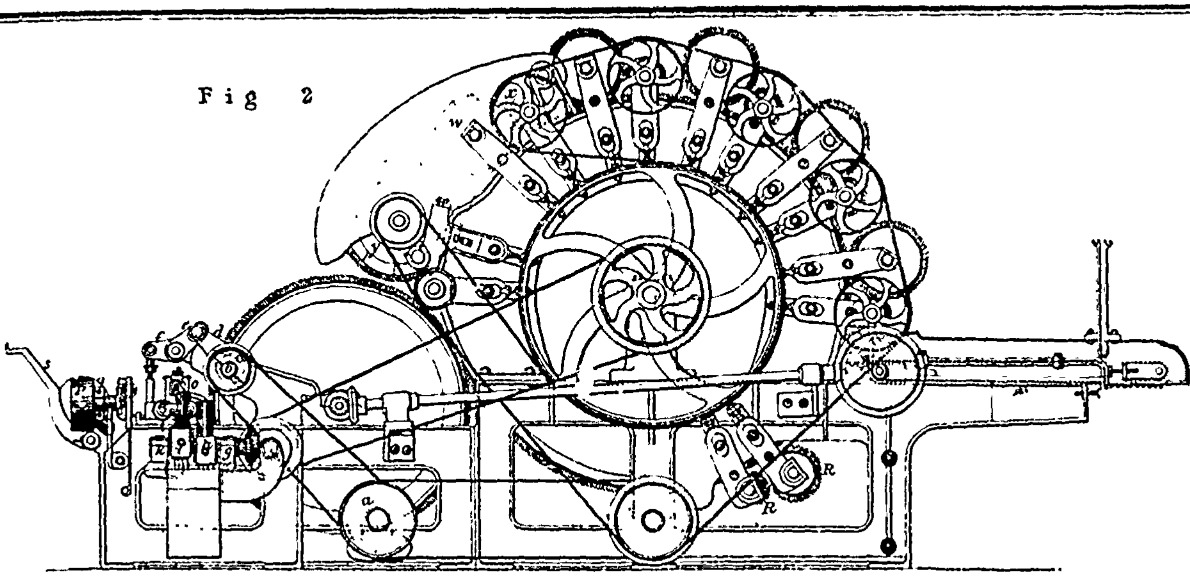
8. Motive power.

9. A good Needle Threader.

10. A glass Oil Bottle which can be sold cheap, and used to oil the machine instead of the oil can. It must be made so that the oil can be forced out.



WOOL-CARDING MACHINERY.



WOOL-CARDING MACHINERY.

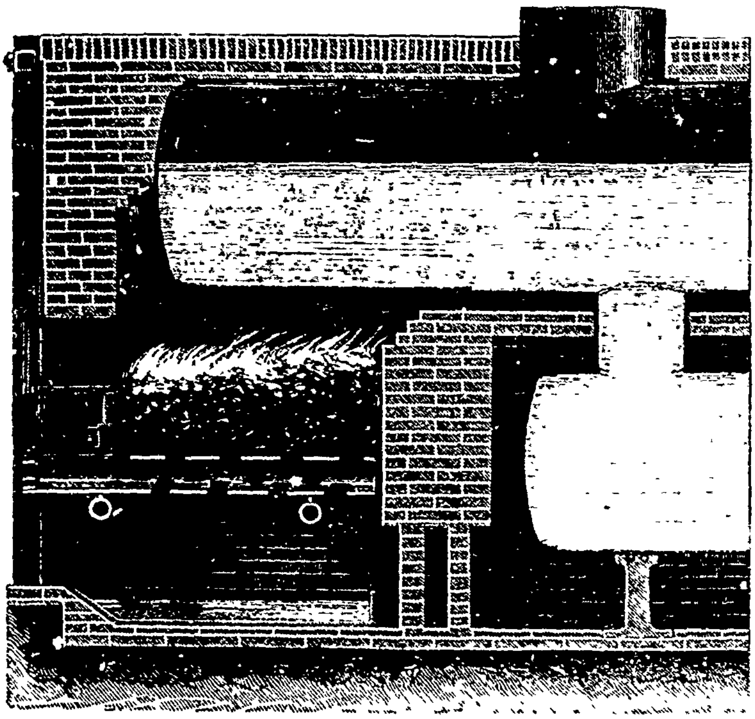


Fig. 1.

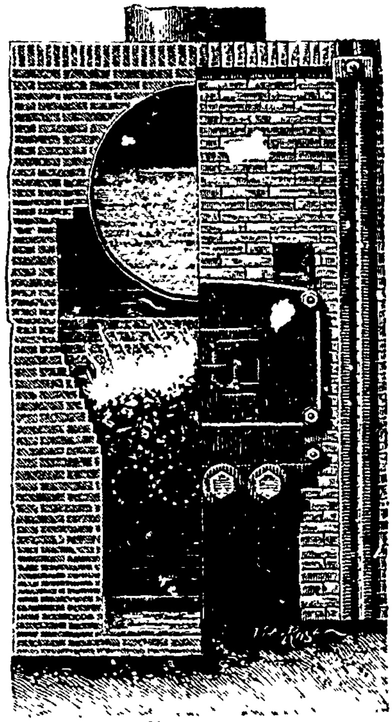


Fig. 2.

Fig. 3.

Fig. 4.

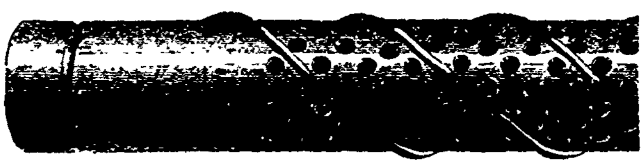


Fig. 5.

SCHMITZ'S REVOLVING FIRE-BARS.

PROFESSOR HUXLEY ON THE "CHALLENGER" EXPEDITION.

Professor Huxley recently delivered a lecture on "The Work of the *Challenger* Expedition, and its bearing on Geological Problems." He observed that it was now two years since that ship left these shores upon an expedition, novel if not unprecedented. She was not sent out to increase the bounds of geographical knowledge by the discovery of new lands, or to define the course of the navigator or the contour of lands already discovered, or upon that Sisyphean task of England, the discovery of a way to the North Pole—a task, however, which he trusted would, thanks to the First Lord of the Admiralty, soon be an accomplished labour of Hercules The *Challenger* was sent upon a purely scientific expedition, at the suggestion of the Royal Society, to clear up certain problems that were occupying the attention of scientific men. We had begun to understand what we wanted to know about the bottom of the sea and its temperature, and the *Challenger* went out to follow a line of inquiry every step of which was planned beforehand. She had performed fully half her task, and would return in the spring of 1876, whilst her commander, having discharged his duties, had been promoted to the higher duty of the command of the Arctic Expedition. What, then, had they for the trouble and cost of her equipment? He was not competent to deal with the whole of her work, part of which had already been discussed by Dr. Carpenter, but he wished to put before them a small portion of it, and show how important were its bearings upon some questions of theoretical science But first it was necessary to show what was their state of knowledge, and what they knew relative to the distribution of life in and at the bottom of the sea, and as to the action of living organisms in building up the solid crust of the globe. For this it was necessary to ascertain the condition of the sea at depths far beyond the few hundred fathoms of the ordinary navigator, and to have the means of bringing up actual specimens of the bottom The first apparatus of this kind was made by Sir John Ross, in 1818. He employed it in his Baffin's Bay expedition, and in lat. 72.30 he let it down 1,050 fathoms—about 1¼ mile—and brought up mud, exceedingly soft, very fine, and of a greenish colour. Captain, afterwards Sir Edward Sabine, who was with him, noted not only the greenish colour, but the fact that one living feather star was brought up, and that the sounding lead sank two or three feet into the mud. Similar deposits found in Assistance Bay, two degrees further north, were examined by Arenberg, the eminent microscopist of Berlin, who found these, and also the scum taken from the surface of the water and from the ice, to consist of the skeletons and cases of radularia and diatomatous plants. These were the outer cases, resembling pill-boxes, of minute plants, consisting of a mere particle of protoplastic matter contained in such cases, acting in every way like plants by absorbing and discharging carbonic acid gas and oxygen. Though excessively minute, they were elaborately and beautifully marked. The delicate cases were made of an almost indestructible materia —namely, fine flint extracted from the water, the Diatomaceæ being silicate plants. Together with these were other silicious cases, not like boxes, but like frames with projecting spikes; or like net-work. These were not plants, but animals, which manifested their vitality by throwing out filaments to catch their prey Those radularia existed in such quantities in Arctic regions as to form a scum on the surface of the ice and the water. Their skeletons sank to the bottom, and formed by degrees a mud, in thickness practically illimitable. In 1853, a United State ship, under Lieut. Brook, making soundings in the sea of Kamschatka, between 55 and 60 deg of latitude, brought up similar mud from a depth of 2,000 fathoms, and this, when examined microscopically by Professor Bailey, of West Point, was found to consist of the silicious shells and skeletons of diatoms and radularia.

There was no doubt that there was a Polar area or cap acumulating between 55 deg. of latitude and the Pole itself, at the bottom of the sea. They knew those organisms might hereafter become hardened to rottenstone, which was composed of them, or might turn by the action of water into opal or quartzite. In 1836-8 Arenberg made discoveries by which he showed chalk to be made up of shells or cases of animals, some living at the present date; and finding the construction of silicious rock going on, he wrote to Lord Minto when, in 1839, Sir James Ross started on the Antarctic Expedition, urging the investigation of this. Sir James Ross found a brownish scum consisting of innumerable multitudes of diatoms and radularia, with a bottom of greenish mud, into which the lead sank two or three feet, found to be an accumulation of cases of radularia. The *Challenger*, in her expedition, touched on several points untouched by Sir James, and verified the existence of a southern silicious cap like the northern one. What, then, was the condition of the intermediate zone, the 110 degrees between 55 north and 55 south, comprising the Atlantic and the Pacific? A great deal was known about the former Arenberg, who examined soundings obtained by Lieut. Berryman, of the United States Navy in 1853, in a line running from Newfoundland to the Azores at a depth of 2,000 fathoms, had been for 15 or 16 years advocating the theory that chalk was the same as modern deposits, and that the same animals which made it still existed The soundings furnished him contained a few diatoms and radularia, but mixed up with a vast mass of calcareous material found neither in Arctic nor Antarctic regions, and consisting of shells of Globularia and others found in chalk All subsequent investigations, including those of the *Challenger*, showed that the entire bottom of the Atlantic and the Pacific, with the exception of the Coral area, was covered with a deposit of uncertain thickness, containing a small proportion of silicious organisms, but an immense mass of calcareous. For some time it was doubted whether these calcareous organisms were found at the bottom or fell down, like the silicate particles, in a fine rain from the top, but the *Challenger* expedition has proved that whilst it was not certain whether or not they lived at the bottom it was quite positive they lived at the top. A geological formation found next to chalk was green sand. This Arenberg showed to be the shells of foraminiferæ filled with silicate of iron and alumina. Green sand, identical in composition, has been found in course of formation in shallow waters on the East Coast of America and Australia, and by the *Challenger* off the Cape of Good Hope. It is always at a depth of three or four hundred fathoms, though how the shells of the foraminiferæ became filled with this kind of glass and how they afterwards dissolved was not known. Lastly—the most important fact discovered by the *Challenger*. The barrenness of the deepest part of the Mediterranean was known. At great depths there were no calcareous shells of Globigerina, but merely yellow clay. In the deepest valleys of the Atlantic, between Teneriffe and St. Thomas, were tracts of a vast extent at a depth of 18,000 feet, covered with a uniform deposit of fine red mud—so fine as to take hours to settle when shaken up, and consisting of silicate of iron and alumina, without a trace of Globigerina shells or calcareous organisms. The surrounding space at a less depth bore these, but as the depth of water increased, they diminished and became broken. By dissolving the shells in acid, they gave a residuum of one or two per cent. of red clay. How a similar transformation goes on under sea was not ascertained, but there was no doubt that the red clay was the residuum of dissolved Globigerina. The formation of a bed chalk was stupendous enough, but the formation of one of such clay of vast depth was something hardly to be conceived. All those discoveries confirmed the geologist's theory of the natural as opposed to the catastrophical formation of the earth's surface, and Professor Huxley wound up with a high tribute to Sir Charles Lyell, who had been amongst the first to advocate this.

THE USE OF THE HAND AS AN OPTICAL INSTRUMENT

In an interesting paper on this subject in the *Illustrirt Industrie Zeitung* (No. 6, 1875), Dr. F. Thomas, of Utrecht, observes, that although artists are well aware of the advantages of monocular vision and the use of the hand as an impromptu stereoscope for the inspection of pictures, the public generally knows nothing of them. Any one who carefully watched the crowds that daily thronged the avenues of the late Vienna Exhibition might have seen how very, very few persons amongst them ever availed themselves of this ready resource.

And yet, how different is the appearance of a really good picture thus seen and the same viewed in the ordinary way by binocular vision! Regarding it with a single eye through the hollow of the hand as through a stereoscope, we get a relief, a substance, which otherwise is more or less wanting; in a word we get the third dimension, *depth*, which is indispensable to realistic effect. Nor is the method applicable to the contents of picture galleries alone: every photograph, every engraving and print of correct design, may be beneficially treated in the same way. As with the stereoscope, so with its impromptu substitute, we get increased focal length, and with it the several artistic advantages thence accruing. On the other hand, defects in drawing are ruthlessly exposed by the same means. Trifling errors in perspective, which might have passed unnoticed under ordinary circumstances, stand revealed in their full deformity.

Less familiarly known, perhaps, is the aid that may be derived from this use of the hand in correcting our notions of the *size of artistic objects*. Take, for example, a portrait,—say, that of Prince Bismarck in the *Illust. Zeitung* for 1863; regard it attentively with one eye through the hollow of the hand, the other eye being shut. The figure stands out boldly in relief. Open the other eye and remove the hand, and the illusion vanishes at once. The appearance of relief has gone, but the figure looks *larger than before*. Photographs are particularly well suited to an experiment of this kind, as with them there is no destruction of the stereoscopic effect, as sometimes happens with prints and engravings.

Here the causes of the illusion are evidently mental. Just as previous conceptions of the size and colour of a distant mountain may be changed by placing the observer's head in some unaccustomed position, so in the case in question we have to deal with psychological, not physiological causes. By regarding the object with one eye only through the hollow of the hand, we unconsciously place ourselves at the artist's standpoint; and as he saw it at the moment of execution, so must we see it to realise the effect aimed at. By removing the hand, this effect is destroyed, and the figure comes before us with that *apparent* increase of size which even the most familiar objects acquire by closer approach, irrespective of their real magnitude. A well known illustration in point is, that the moon's disc, when close to the horizon, may be reduced to its ordinary dimensions by thus viewing it steadily through the hollow hand.

With juster perceptions of the magnitude and relative dimensions of objects, monocular vision combined with the stereoscopic use of the hand gives us, also, a correcter appreciation of the effects of reflected light. And this applies not only to the confused appearance occasioned by the interposition of highly reflective media between the object and the observer, but also to artificial reproductions of the same effect. Look at the "Imperial Service of Bohemian Glass," in the *Illust. Zeitung*, No. 1,577, with one eye, through the hollow of the hand, and note how boldly the several objects stand out, and how well the glitter of the glass is reproduced. Observe the same in the ordinary way, by unassisted vision, with both eyes, and how crude and unreal appear the patches of white light on the several objects!

Another point ignored in every treatise to which Dr. Thomas has had access, is the effect of the hand when thus used, in modifying and correcting our perceptions of colour. The rays of the setting sun are flooding the landscape with golden light. Prominent in the distance stands forth a church-tower lighted up with a rich orange glow. By regarding it attentively through the hollow of the hand, and opening and closing the latter suitably, the tower can be made to assume any intermediate tint between the white it really is and the orange it has assumed in the rays of the western sun. The woods, too, dark, sombre, and nightlike to the unaided vision, in like manner can be made to resume the hues they wore in the broad light of noonday. A bright patch on the far distance shows a soft subdued white, and we notice then for the first time that to the unassisted eye it presents a bright golden colour.

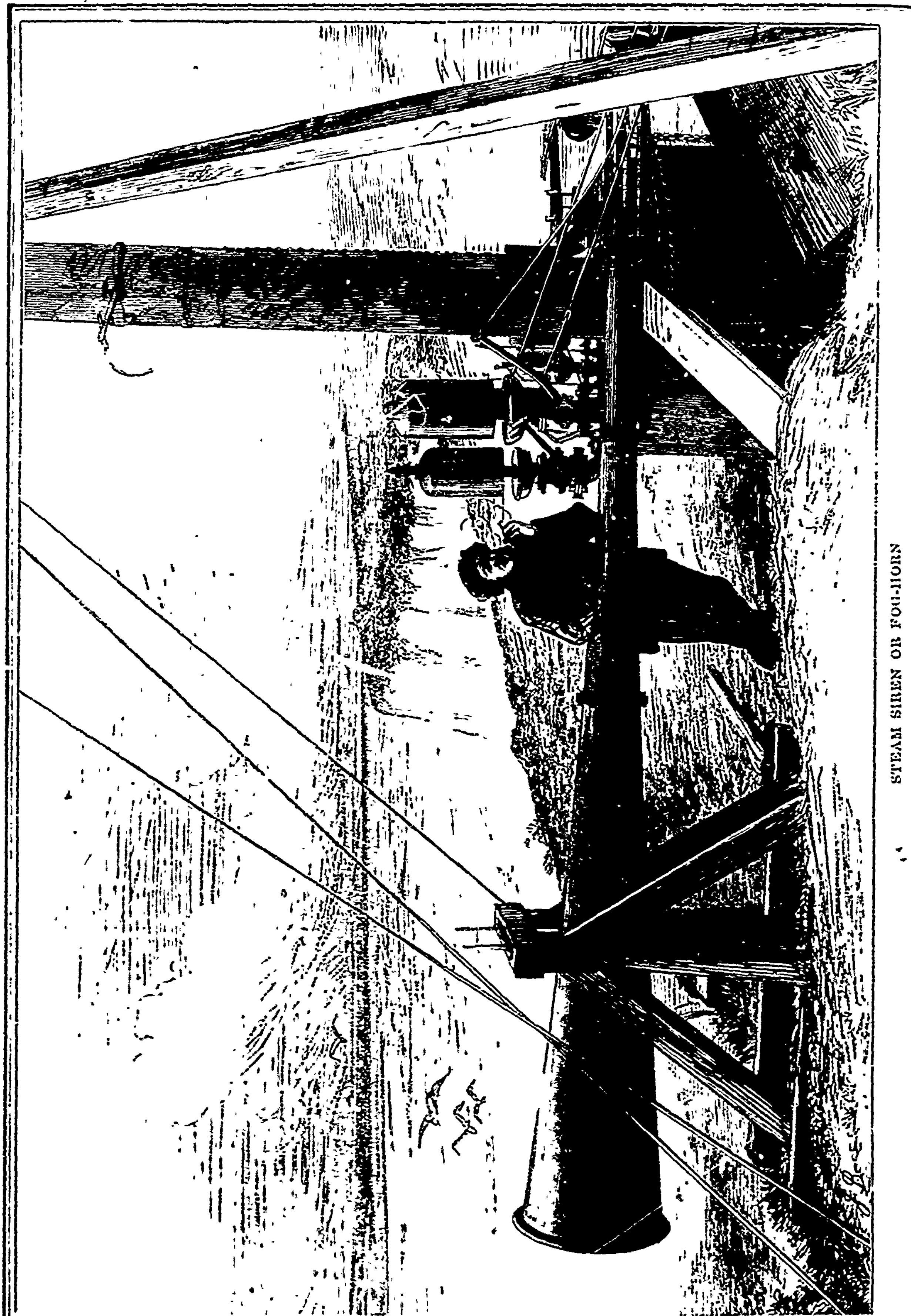
Indeed, our conceptions of colour are mainly dependent on comparison—contrast. But these are quite inadequate to enable us, under all circumstances, to detect and discriminate between minor differences of shade by ordinary unaided binocular vision. For that purpose, we must have recourse to the hollow of the hand, looking through it at the object with one eye, and comparing the effect observed with that produced on the other and unshaded eye. Both eyes may here be open.

In such cases, the chief point is not monocular vision, but the shading of the eye by the hand thus applied. As with a Nicol's prism, we thus restore the equilibrium of the blue light diffused through the atmospheric regions—which in the landscape above referred to was overpowered by its complementary colour, the orange emanating from the sinking sun—and are so enabled to see objects under the hues they would present when viewed by the white light of noontide sun.

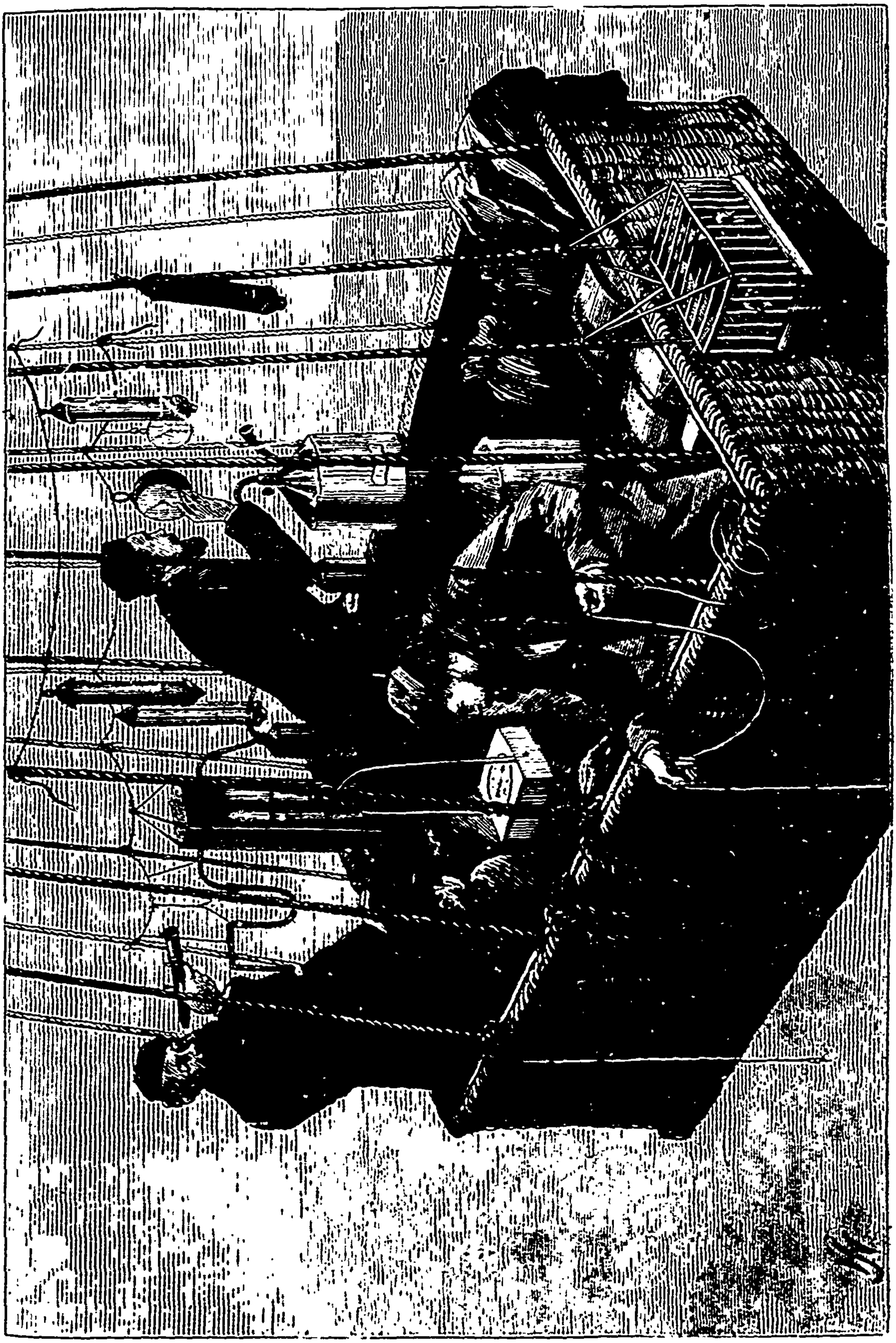
THE PLANE.

This instrument, when well made, and kept in order, surpasses, in accuracy of performance, all other hand-tools. Originally furnished with only one iron, the plane now has usually two, the undermost for cutting the shaving, the uppermost for breaking it in such a manner as to prevent it acting as a lever in lifting or tearing up fibres, in front of the cutting iron. In England, the *stock* or body of the plane, is generally made of beech but on the Continent apple and pear are frequently substituted with happy results. Through the stock is a vertical aperture of which the lower portion acts as a guide to the cutting edge, and forms together with this latter, the *mouth* of the plane. This effectually regulates the depth to which the cutting iron can penetrate, but it would not be sufficient to prevent it from following the inequalities of the surface to which it might be applied. This would utterly unfit the plane for the purpose for which it is intended; hence this tendency is overcome by giving considerable length to the stock, which causes a plane in operating on a rough piece of wood, to remove successive shavings from the more prominent parts until a surface level with the deepest original depression is attained. The flatness attainable with the plane is greatly dependent on the skill of the workman. He must always try to plane "hollow" rather than round, for if a plane be sufficiently long in the stock, it is impossible for him to give any appreciable concavity to a surface of moderate size. For this reason roughing out planes, or "Jack planes" are made as long in the stock as is possible, without making them too heavy and inconvenient, the usual size being from 14 to 17in long. Planes used for "trueing" or "trying planes" as they are incorrectly called, are used to correct the inequalities left by the former, and are usually from 22 to 24in. in length, or even 28 to 30in., in which case they go by the name of "jointers," and are principally used for making long joints. The smoothing plane which is employed to give the finishing strokes to a surface which has already been flattened, is generally about 8 in. long.

In grinding the edge of the cutting iron care should be taken to use a true faced grindstone, and a good flat oilstone. The wedge is released by giving the stock a smart blow or two on its hinderpart, if the plane be of the short kind, or by a stroke on the upper front surface if it belongs to the long class; the double iron is then drawn from the aperture, the screw loosened and the front iron removed. The front iron having once been sharpened will require no further attention, as it lies against the cutting iron in such a position as to protect its edge effectually from ever getting blunted. The cutting iron should be ground to a flat cutting edge at an angle of about 25o on the stone; and then finished on the oilstone in such a manner as to form a fresh "facet" or bevel making a more obtuse angle with the line of the iron, say about 10o more, so that the total inclination edge will be about 35o. In replacing the second iron on to the first, the kind of work for which it is to be used must be borne in mind. If the second iron is brought very close to the edge of the cutting iron, the shaving is broken up more effectually, the work is neater and less liable to tear up; but the labour expended will be greater. As a rule, for roughing out, the edges may be somewhat distant, say about 1-16in. apart; but for finishing, the top iron edge, and the cutting iron edge should be almost on the same level. The "bed" of the plane iron is made at different angles, to suit different kinds of work. the four angles most in use are known as *common pitch*, which denotes that the back of the iron reposes on its bed at an angle of 45o from the sole, and this inclination is usually employed for all surface or bench planes for soft wood. "*York pitch*" indicates an angle of 50o and is more adapted to use with mahogany, and other hard stringy woods. *Middle pitch* or 55o, and half pitch or 60o, are employed with moulding planes, the former being for soft wood and the latter the harder kinds. In the course of time, the mouth of the plane gets considerably enlarged, and out of truth. This may be to some extent avoided by keeping the sole slightly greased by rubbing over with a piece of bacon rind; but sooner or later the mouth must be rendered smaller, which can be done by letting in a piece of boxwood, in front of the cutting iron. Some planes, especially those used by cabinet-makers, have the sole made either entirely or in great part of brass or iron. With a mouth so fine as it is possible to make these, and by reversing the position of the cutting iron, so as to give it a pitch of about 50o, the use of the top iron is not needed at all.



STEAM SIREN OR FOG-HORN



THE FATAL BALLOON ASCENT.

MECHANICS' MAGAZINE.

MONTREAL, JUNE, 1875.

ILLUSTRATIONS:

CONTENTS:

LIFE PRESERVERS.

It is no wonder that we hear of so many new patents granted for designs for preserving life in case of accidents on the water. The amount of loss of life on the sea has always been almost appalling to a reflecting mind. And now, with all our improvements, with steam and with increased geographical and meteorological knowledge the disasters seem to increase rather than to diminish.

The last great disaster, the wreck of the "Schiller" points to the necessity of some improvement in the means of saving life, points, perhaps, not more clearly than others but as the facts are still present in the minds of all it will serve as a good illustration. Here, out of 355 souls on board more than 300 perished. The passengers were not in their berths at the time the ship struck but crowded the deck and by their importunities and struggles effectually prevented the successful launching of the boats. If now every passenger had known that he had about him something that would keep him afloat until he was picked up it is more than probable that he would have refrained from the senseless struggle for a place in the boats, being assured that he would certainly be picked up sooner or later; thus the boats would have been successfully launched and the ratio of the drowned to the survivors might have been inverted. Then again in the case of a fire on a river steamboat such as has already occured on the St. Lawrence with calamitous loss of life. In such a case, with life preservers such as we are about to describe it would be almost impossible that many could be lost. We are aware that all our river boats do carry life preservers of a certain kind but from a personal inspection of some of them we do not think they would be of much service except to experienced swimmers.

The invention we refer to above is patented by Mr. Arthur Wood, and is now attracting the attention of our English contemporaries. The patent consists of two pillows, which are used as ordinary pillows, in a general way, but which can be made available for life saving if required. They are fitted with tapes to sling them over the head and tie round the body — one pillow on the chest and the other on the back, and being made of a very buoyant material, they act as a life-buoy in case of danger. The special advantages claimed for these pillows over the ordinary life-preservers are thus enumerated: — The ease and rapidity of attaching them to the person, the perfect buoyancy of the person when in the water — a pair of these pillows being capable of supporting a man of 20 stone breast-high; the protection they afford from floating wreck or dashing against rocks, &c.; the fact that by reason of being tied to the person there is no occasion for holding on to them as to a common life-buoy; and being lashed the narrow way across the chest and back, they do not interfere with the action of the arms in any way, and a person could swim, haul a rope, or pull an oar, without the slightest inconvenience. For ordinary pleasure-boating they may be used for cushions, so that in the event of a person falling overboard or the boat upsetting, they can be used as life buoys.

We are glad to learn from a contemporary that these pillows have been adopted by the Allan line and are in use in all their ships. Every cabin passenger is supplied with them and they are issued to steerage passengers also on payment of a small fee. These pillows or air cushions are by no means an entirely new idea but they are so much superior in handiness and floating power to ordinary life preservers that we think that all who are liable to accident anywhere on the water should supply themselves with something of the kind. An air cushion uninflated occupies little or no space—it may be rolled up in the pocket even—but when inflated, which may be done in a minute, its floating power is enormous. There are other patents now before the public looking to this end viz Boyton's apparatus, which has been fully described by us already and Thomson's unsinkable life-raft which seems to be a very useful invention. It is a large raft which occupies the place of the bridge on a steamship and is so arranged that it may be launched with little or no trouble, or in case of the vessel suddenly foundering it floats clear and cannot be dragged down. All these new inventions seem to give good reason to believe that we may reasonably expect to see the proportion of saved from wrecks considerably increased in the future.

PUBLIC HEALTH.

In our last we called attention to the fact that Montreal enjoyed at present a very unenviable notoriety as to healthiness, and furthermore argued that nothing hardly but real and scrupulous cleanliness throughout the city, above and below, could remove the stain. There is however one prolific cause of disease which is not by any means apparent to any but a careful and even a professionally experienced observer. This cause is the improper arrangement for the disposal of sewage and house refuse. However magnificent the exterior of a house, however comfortable its interior arrangements, and however luxurious its fittings and decorations, a slight flaw in the construction and position of an unseen pipe is sufficient to render it uninhabitable.

In a recent report of the medical officer of the Privy Council in England special reference is made to the evils arising from defective drainage. The report goes at length into the subject of the various loathsome diseases generated in this manner, substantiating its statements by proof, and lays down the following rules which are based on careful and thorough scientific investigation.

No premises ought, either through water-closets or in any other way, to be brought into drainage connexion with common sewers unless they can be made reasonably secure against the dangers of sewage infection. Part of such security would consist in the fact of the sewers themselves being of such a kind, and in such a state, as they should be, especially with regard to scouring and ventilation; but a further very essential part would depend upon the proper situation, construction and keeping of the drains and drain inlets of individual premises. In this latter respect the following conditions ought to be insisted on :—

That every private drain be properly trapped and ventilated in relation to the common sewer, and be itself also properly constructed.

That every private drain having inlets within a house have ascending from its head or heads into some suitable high position in the open air, and where it cannot infect the interior, a ventilating pipe, or ventilating pipes, of sectional area amply proportionate to its own.

That all slop-water pipes from within houses be provided at their sinks or other inlets with fixed traps; but further, that, as far as practical, they be separated from privy pipes, and made to end open over trapped drain gratings outside the house, not direct into privy pipes or drains.

That no overflow-pipe from any cistern which furnishes domestic tap-water, nor from any cistern inside a house, be allowed to open directly into any drain or privy pipe, but be made (as above) to end open in the outer air.

That in cases where water-closets are supplied on a "constant" system, and where generally there will not be storage cisterns, the entrance of privy air into water pipes be prevented by the adaptation of special service-boxes (which also act as waste-preventers) to all such privies as have not cisterns.

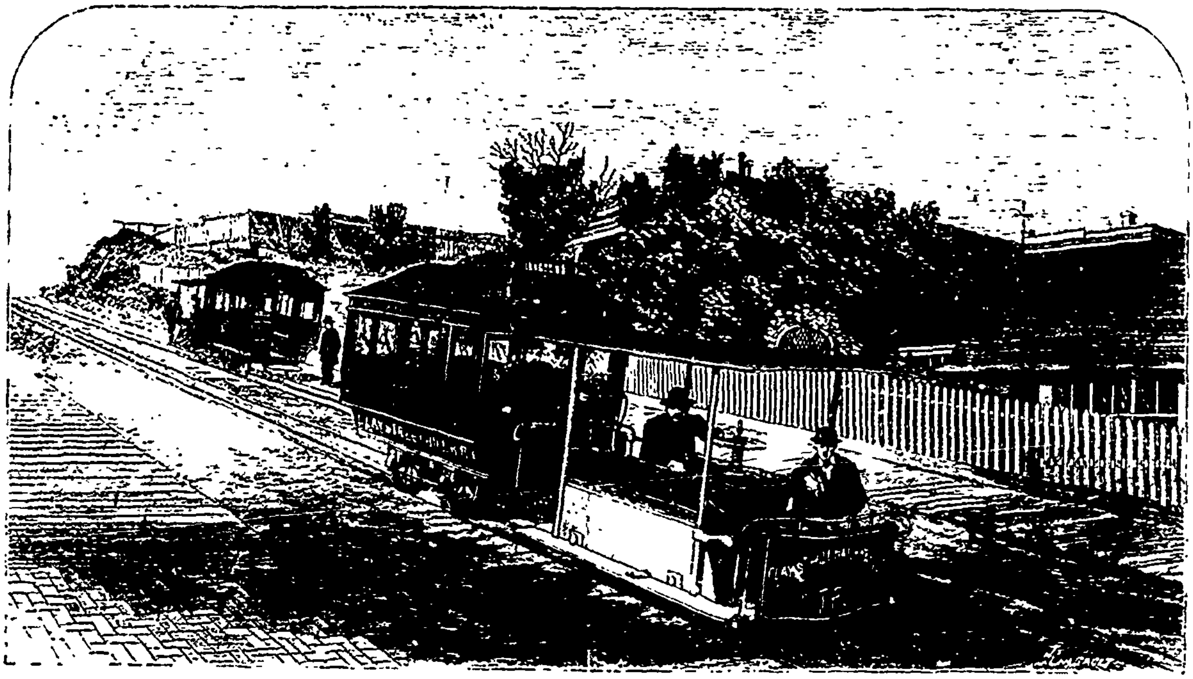
There are localities where the supply of water-closets is either impossible or undesirable, but wherever they exist they ought to be placed where they can have outside windows, and ought not, under any circumstances, to be placed in or near an ordinary room. The best position for them is near the top of the house; but, on whatever floor, they should, if possible, be built in a projection, and not in the body of the house, from which they should be divided by windowed lobbies.

In cities like this where house rent is steadily rising there is a great inducement to run up houses as fast as possible, on the smallest available space. Some, nay most, of these houses are marvels of economical arrangement as regards space, one of the latest developments of which is a combination of water closet and bath-room which seems to have been arranged instead of a small bed-room. This favourite arrangement is not shut off from the rest of the house at all but is most often [illegible] on the same flat with bed-rooms and opening off from a common landing by a single door, in fact just like any other room on the flat. Common sense, without any scientific knowledge ought to be enough to show any reasonable person the harmfulness of such arrangements.

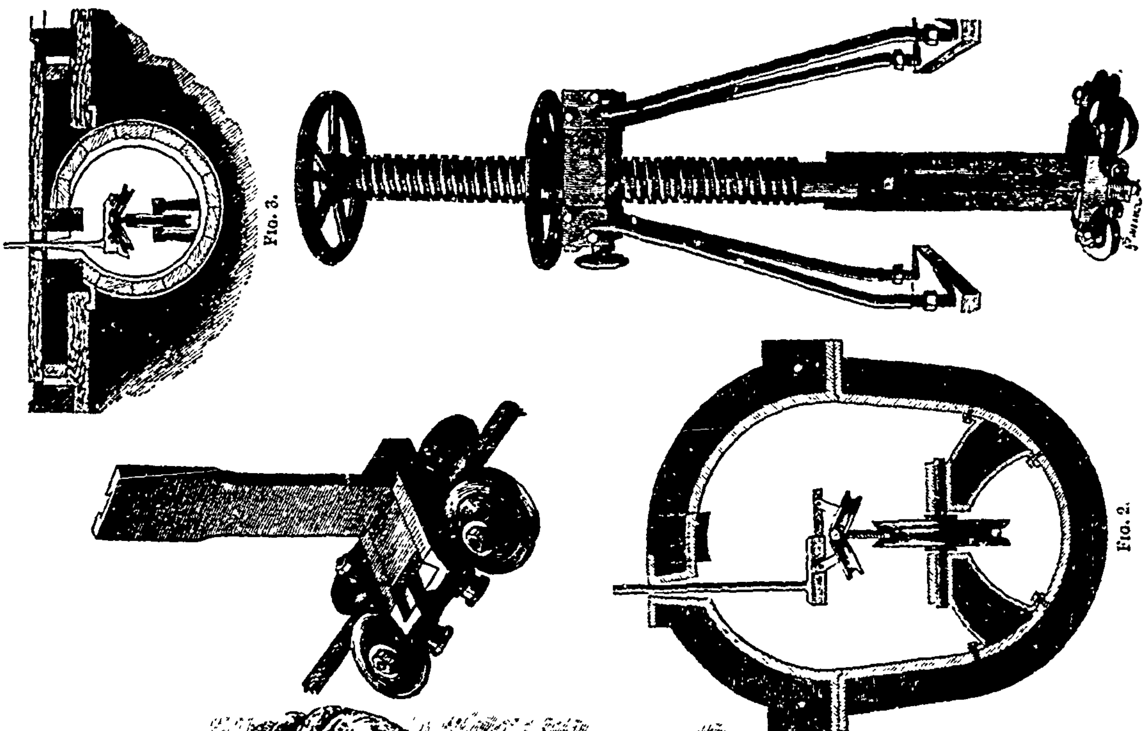
PUBLIC AQUARIA.

It is truly a pleasant thing to know when and how to take amusement, and the genius of a nation may with considerable truth be gathered from the manner in which it takes its pleasures. Taking this for granted it is reassuring to see how the English people are more and more devoting themselves to science as an amusement—not abstruse science but that natural science which is open to be read by whoever will take the trouble to read it. Of course, we know well that horse-racing and music-halls flourish there as they flourish in few other places, but then so do local scientific societies. These societies have gradually led the way and one of the results of their labours has been the establishment of public aquaria in several places, notably at Brighton, at Southport and the one we illustrate on page 189. These aquaria are immense affairs arranged so as to afford spectators a clear view of the habits and mode of life of all kinds of animals that live in the water. The English are naturally fond of animals of every description and no trouble is found in securing new and curious inhabitants for the tanks. Sea monsters and fresh water beauties are to be seen quite at home and unravelling before the eyes of scientific men problems in natural life that have puzzled naturalists for many years, problems that would never, probably, have been solved but for these new playthings of the nation. There is, it seems to us a great moral lesson to be learnt from these new amusement places, for such they profess to be and are to a great extent. People must have recreation and will provide it for themselves of one kind or another. If they cannot have the natural recreation afforded by the contemplation of the development of nature in its ever varying forms, they fly to artificial pleasures, some of which are harmless or even very useful and elevating, but many of which are just as debasing. It is then a subject of rejoicing to see a people constructing for themselves huge scientific playgrounds where they may at all seasons and in all weathers follow up a course of study and observation which is at once an elevating pursuit and a pleasant means of carrying away their thoughts from the dull routine of daily life and enabling them to take their amusement properly. No doubt the frequent rains in England have to some extent been the cause of driving the people to construct such covered places of amusement as those we have been describing and such too as the Alexandra Palace. It appears to us that we in Canada may well learn a lesson from them in this respect. In our long winters there are many periods of extreme cold or of disagreeable thawing weather when it is impossible for any but the most robust to spend any time in the open air and when a resort similar to these aquaria would be both a welcome lounging place and a most invaluable educational lever. Such a building once erected in Montreal would give an impetus to the study of natural science, in a popular manner, all over the Province and would gradually become a thing looked upon by people in all sections of the country as partly their own, as they became interested in the study of animal life and contributed their quota to the general stock. A resort of some kind is really needed in our cities for the winter afternoon and we are convinced that an attempt to follow the lead of the English in this matter would not only be successful in itself but could not fail to have a most beneficial effect on our society in general.

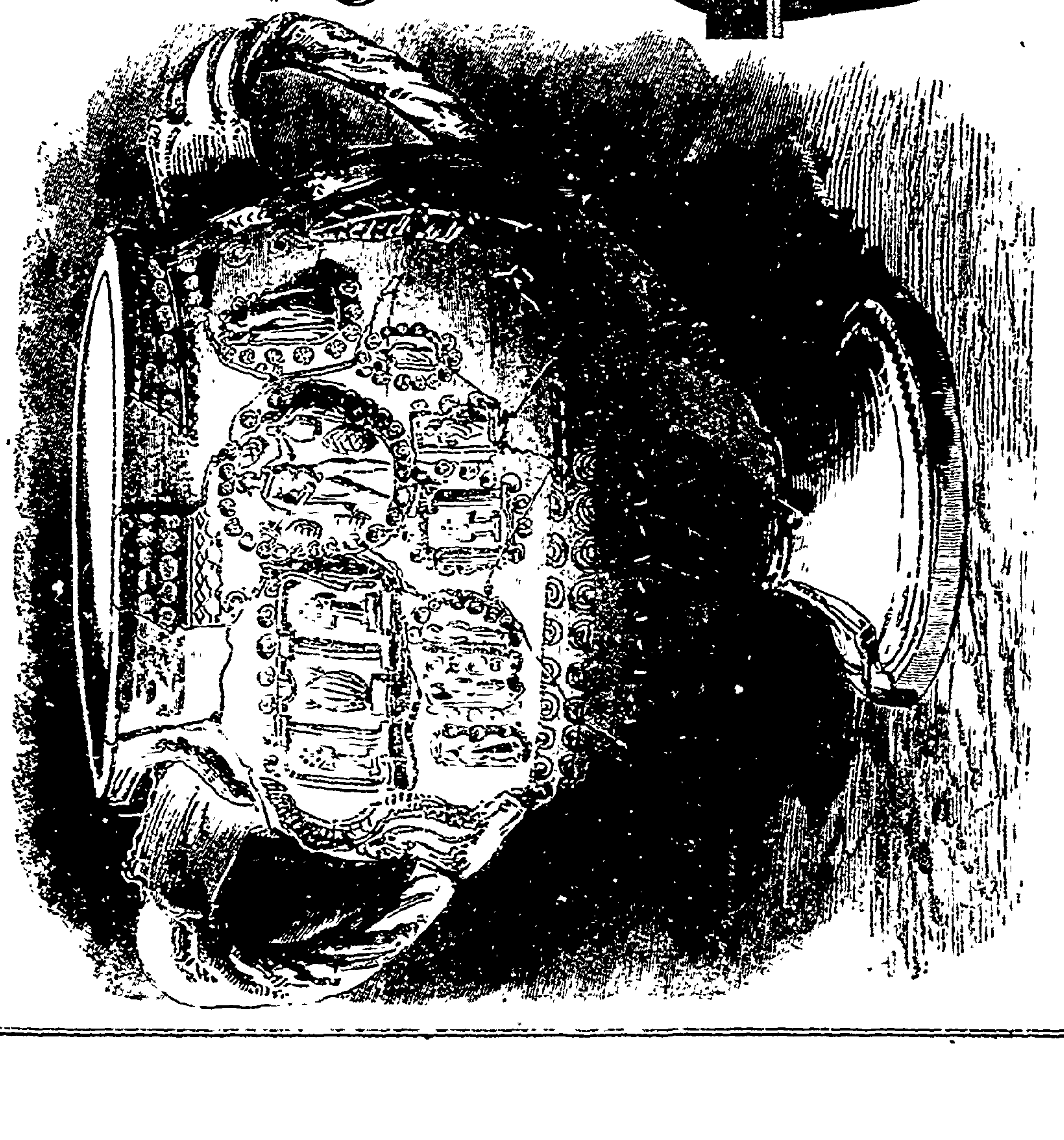
We give on page 184, an illustration of the method employed at the Observatory of Paris in experimenting on the velocity of light. These experiments are not yet concluded, but we gave some time ago (see page 183, Vol. I.,) the results of a previous series of experiments. As soon as those now in progress are concluded we will endeavour to give our readers a full account of the method employed and of the results attained.



WIRE-ROPE STREET TRAMWAYS.—(See page 179.)



WIRE-ROPE STREET TRAMWAYS.



THE BEZETHA VASE.

A curious fact bearing on the effect of age on iron and steel has been brought forward by Prof. Thurston. He says that about 1830 the first wrought iron T rails were laid on the Camden and Amboy railroad. They were of poor iron, and some years later were nearly all removed, but many still remained on the sidings, whence, however, they gradually disappeared and it was found that when re-rolled into bars the metal became unusually good, the long exposure having materially improved the quality of the iron.

THE STEAM SCREEN.

Our illustration on page 172, represents a very powerful fog-signal which was sent to England by the American Light house board to be tried with other instruments in the recent experiments at the South Foreland. It proved to be the most powerful of all the signals tried, making itself heard on one favourable occasion, a distance of 16¾ miles. The instrument is called a siren because the sound is produced by means of a disk with twelve radial slits, being made to rotate in front of a fixed disk exactly similar. The moving disk revolves 2800 times a minute, and in each revolution there are, of course, twelve coincidences between the two disks, through the opening thus made steam or air at high pressure is allowed to pass so that there are actually twelve time 2800 (or 33,600) puffs of steam every minute. This cause causes a sound of very great power, which is compressed to a certain extent by a cast iron trumpet, 20 ft. in length. The siren was designed and manufactured by Mr. Brown, of Progress Works, New York.

THE BEZETHA VASE.

This vase, which has been the subject of so much public attention in Europe is the last, and in the opinion of *savants*, the most important result of the labours instituted by the subscribers to the Palestine Exploration Fund. It was found at a depth of about twenty-five feet in an excavation beside the Via Dolorosa. An accidental caving in of the side of this excavation revealed the existence of a series of chambers one above the other. It was in one of these chambers that the vase was found. It was broken to pieces by the falling rocks but after a careful search all the pieces were picked up and the vase restored to its original condition as shown in our engraving. The material is a very hard, grey, terra cotta and it is covered with a profusion of ornaments and sculptures in relief. Judging by these ornaments the vase is said to belong to a period of pure paganism, probably to the time of Hadrian when Judæa became a Roman colony under the name of Aelia Capitolina. Vases of this kind were used in pagan worship to contain wine and water for libations and it is not impossible that this very vase may have been used by the conquerors in offering libations to Jupiter Capitolinus in a temple which was built to that deity close to the spot where the vase was found.

The Chatham *Planet* is assured that the works, already far advanced, at the Rond Eau Harbour will be made complete during the present season, by the erection of a light-house and light-house keeper's residence at the piers.

We (*Seattle Dispatch*) have been shown a despatch from Victoria, which states that the Los Angeles used Talbot coal on her trip from Seattle to that port, and that the engineer reports that the coal is excellent for steam purposes—that it is in every respect equal to the best Australia coal for that purpose.

DANGEROUS SCIENTIFIC RESEARCH.

Some time ago we commented on the fact that some branches of scientific research, in spite of the danger involved in them, had peculiar attractions for certain minds. Two of the latest items of news recal this fact very forcibly—we allude to the Arctic Expedition which has just started from Plymouth and to the horrible result which attended the recent balloon ascent in France. As to the former, while we are fully aware that there are many important scientific questions which an Arctic Expedition can help to solve, still it remains a question whether the amount of knowledge acquired by such explorations has at all corresponded to the loss of life and the amount of human suffering endured in its acquisition. It is, however useless to discuss the question, since there is no doubt but that while there is anything to learn men will be found who will risk their lives and their property in the noble cause. Just such a spirit animated the French savans whose daring attempts in the cause of science led to the tragedy, a description of which, from the *London Times*, we append.

"France is the country in which the balloon was first made practically efficient, and in the century since the first ascent of Joseph Montgolfier the annals of aerial voyages have presented, perhaps, no disaster more terrible than that of which Frenchmen have just been the victims. On Thursday week, M. Tissandier, the well-known aeronaut, accompanied by M. Crocé Spinelli, an engineer, aged about 30, and M. Sivel, a naval officer, somewhat older, ascended in the balloon "Zenith" from the gasworks at LaVillette, a little village in the basin of the Canal de l'Ourcq, a few miles north-east of Paris, and from which, it may be added, M. Tissandier set forth on a successful voyage in 1868. The balloon went up at 11.30 a.m., and after travelling about 150 miles S. W. by S. over the Departments of the Seine-et-Marne, Loiret, and Loire-et-Cher, descended about 4 p.m. at Ciron, a little place near LeBlanc, in the Department of the Indre. But during those four hours and a half it had soared through the atmosphere of this earth into regions where—at least, under these special conditions—human life could barely exist; and when the car reached the earth it bore but one living man; the other two were corpses.

"Such jottings as the survivor, M. Tissandier, was able to make during that dreadful time suggest the horrors through which he passed with a force in which fragments are sometimes superior to the completest records. At about 10 minutes to 12 they were close on two miles from the earth; the thermometer inside the balloon recorded 25° above zero; and within the car 15°; M. Tissandier's pulse was at 110, and M. Crocé-Spinelli's at 120. At 1 p.m., they were about 16,400ft.—i.e., upwards of three miles from the earth; at 1.10 p.m., 19,680ft., or about 3¾ miles. Here the distress began.— "We are well. Now the height is 6,500 metres (close on four miles). A little oppression.... . Hands slightly frozen...... We are better...... Hands frozen...... Crocé pants. We inhale the oxygen in the bag. Sivel and Crocé shut their eyes...... They are pale...... A little better, even gay. Crocé says to me, laughing, "You blow like a porpoise." 120.—We are at 7,000 metres (about 23,000ft., or 4½ miles.) Sivel seems drowsy.... Sivel and Crocé are pale.... 7,400. Sleepy, 7,500 Sivel still throws out ballast.... Sivel throws out ballast. M. Tissandier felt weak, but inhaled some oxygen, which reanimated him for the moment. "M. Sivel turned to me and said, "We have a great deal of ballast; shall I throw out some?" I answered, "Do as you like; and Crocé nodded affirmatively in a very energetic way." There were still five or six bags of ballast, each weighing about 55lb., in the car. M. Sivel took his knife, cut three ropes, three bags were emptied, and they rose rapidly. "All of a sudden I became so feeble that I could not even turn my head to look at my companions, who were, I believe, seated. I wished to take hold of the oxygen tube, but found it impossible to raise my arm. My brain was still quite clear. My eyes were fixed on the barometer, and I saw the needle point first to a pressure of 260. and then to 280 and over. I wished to call out, "We are at a height of 8,000 metres," but my tongue was, as it were, paralysed. Suddenly I shut my eyes and I fell senseless in a complete trance." At this moment it was about 1 30 p.m., and their distance from the earth was about 26,150ft., or something over five miles. When M Tissandier opened his eyes again, it was 2.8. p.m. They were descending rapidly; he was just able to cut off a bag of ballast to stay the rapidity, and to write a note on his register:—"We are descending; I throw out ballast; barometrical height, 315. We descend; Sivel and Crocé still fainting in the bottom of the car. We descend very quickly." He had hardly written this when a kind of trembling seized him, and he fainted again. A few minutes later he was roused by his arm being shaken, and recognised Crocé, who was throwing out ballast. "He said to me, 'We are descending;' but I could scarcely open my eyes, and did not see whether Sivel was awake I remember that Crocé unhooked the aspirateur, which he threw overboard, as well as ballast coverings. Of all this I have a very confused recollection, for I fell again into a state of coma even more completely than before, and seemed as though I was wrapped in eternal sleep." With his two companions that eternal sleep was more than a seeming, M. Crocé's act—done, of course, after his brain had become partially obscured—in fact doomed himself and M. Sivel. The aspirateur was an iron instrument for observations with carbonic acid, and weighed about 80lb—*i e.*, about as much as one whole ballast bag and a half, and thus lightened, the descending balloon started on a second ascent, in which two of the three voyagers died. When M. Tissandier finally regained consciousness it was 3.15 p.m. "I felt giddy and dejected, but my brain was clearer. The balloon was descending with frightful rapidity, the car swaying about violently and oscillating to and fro. I dragged myself up and took Sivel and Crocé by the arms. "Sivel! Crocé!" I cried, "Rouse yourselves." My two companions were huddled up in the car, their heads hidden in their cloaks. I collected my strength and tried to raise them up. Sivel's face was black, his eyes dull, his mouth open and full of blood. Crocé-Spinelli's eyes were shut, and his mouth was covered with blood.... Soon earth drew nearer. I wanted to find my knife to cut the rope of the anchor; it was impossible to find it. I was like a madman, and kept calling out, "Sivel! Sivel!" By good fortune I found the knife at last, and cut the anchor adrift at the right moment"

WIRE ROPE STREET TRAMWAYS.

We publish on pages 176 and 177, illustrations of a new and very successful mode of working street tramways especially adapted to localities where the gradients are such as to render it impossible to employ horses, and where interference with the existing traffic cannot be permitted.

This system, designed by Mr. A. S. Hallidie, of San Francisco, California, has been adopted by the Clay-street Hill Railroad Company in that city.

It consists of an endless wire-rope placed in a tube below the surface of the ground, between the tracks of the line and kept in position by means of sheaves, upon and beneath which the rope is kept in constant motion during the hours the traffic is running, by a stationary engine, the power being transmitted from the motor to the rope by means of grip pulleys, and from the rope to the cars on the street by means of a gripping attachment fastened to the car, and which passes through a narrow slot in the upper side of the tube.

A description of this system, as adopted in San Francisco, will best explain its mode of working.

Clay-street is a central street in the city of San Francisco, and for a number of blocks near the lower terminus of the road is very densely populated, the street is only 49 ft wide from house to house, and between the sidewalks are laid two lines of gas pipe, one line of water pipe, a street sewer, and at the cross street are water cisterns.

The lower terminus of the road is at the intersection of Kearny-street and Clay-street. The summit of the hill is 307 ft. above Kearny-street. The incline runs on Clay-street, has a double track, and is 2800 ft. long; the rope then runs down over the summit 500 ft. with an incline of 15 ft., to the engine house on Leavenworth-street This makes the entire length operated by steam 3300 ft. The grades are as follows: from Kearny to Dupont, 45 ft.; from Dupont to Stockton, 45 ft.; from Stockton to Powell, 62 ft.; from Powell to Mason, 42 ft.; from Mason to Taylor, 48 ft.; from Taylor to Jones, 67 ft. The average grade is 580 ft. per mile. Clay-street runs at right angles to the above streets which have widths varying from 15 ft to 68 ft. 9 in. The steepest grade is 1 in 6½.

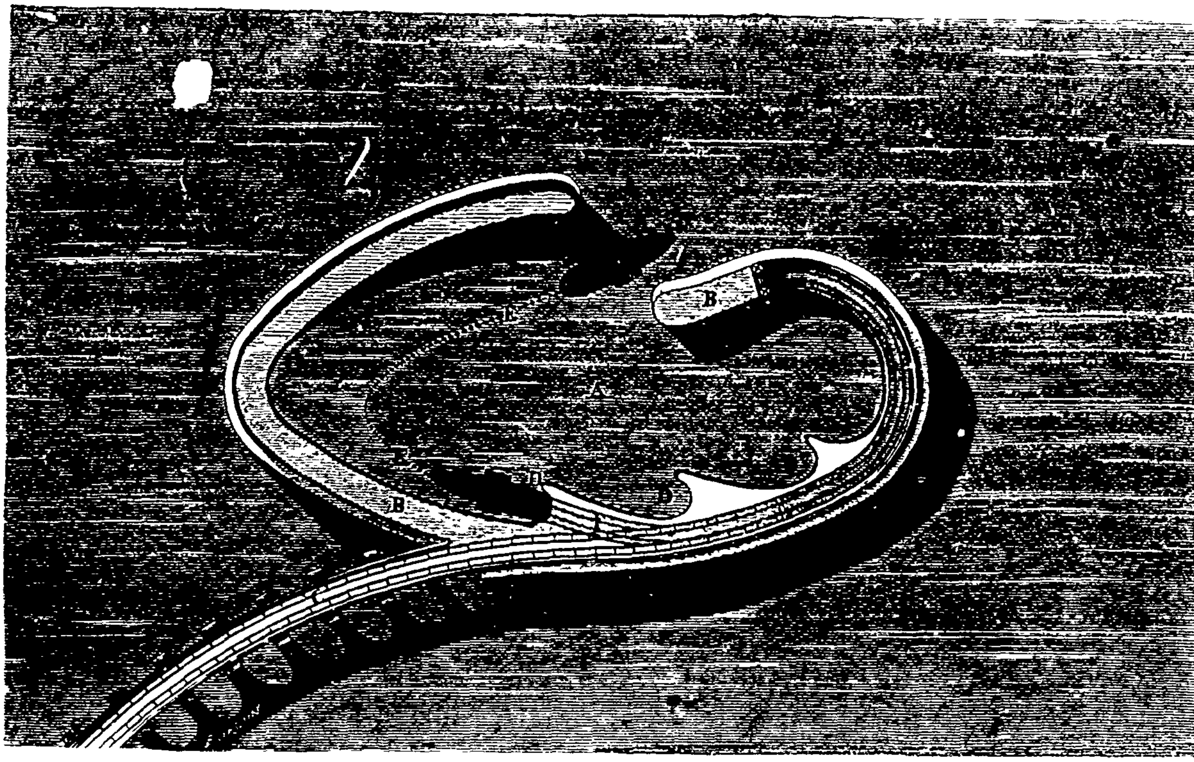
The system submitted by Mr. Hallidie, and determined on by the company, was that of a constantly travelling endless steel-wire rope, and the conditions to be met were, that the road should present no more serious impediment to ordinary travel than the usual street railroad: that the rope should be below the surface of the street; that the car could be instantly stopped on any part of the road: that it should be worked more economically than with horses, that its mechanical construction and management must be simple and easily controlled, and that no motor should be used in the more populous portion of the street that would frighten horses or endanger lives.

The general arrangement is as follows. an endless steel wire rope, 3 in in circumference, 6,800 ft. long, weighing 9,600 pounds, and made of 114 No, 16 gauge patent steel wire, hardened and tempered, is stretched the whole distance of Clay-street, lying in iron tubes, supported every 39 ft. on 11 in. sheaves This rope is supported at every change of angle at the lower crossings on sheaves 4 ft. in diameter, passing around a sheave 8 ft. in diameter at the lower end of the line, and at the engine house around two inclined sheaves, each 8 ft. in diameter, which lead the rope on the grip pulleys, also 8 ft. in diameter, which are driven by an engine with 12 in. cylinder and 24 in. stroke.

The grip pulleys being furnished at their circumference with jaws that grip and release the rope automatically by the pressure of the rope in the jaws, the rope is prevented from slipping; and the pulleys driven by the engine actuate the endless rope, one part of course travelling up one tube, and the other down the other tube.

In addition to the sheaves that support the rope in the tubes at each upper side of each crossing where the incline makes an angle upwards, there are sheaves in the tubes that keep the rope down and from striking the upper part of the tube From the cut showing the cross section of the tube (Figs 2, 3) it will be seen that there is an opening in the upper side of the tube. This opening runs the entire length of each tube, forming a long slot seven-eighths of an inch wide. This slot is not immediately over the centre of the tube but on one side, so as to clear the upper sheaves and to enable the foot of the gripping attachment to pass by and under the upper sheaves, and over the lower sheaves in the tube. The connexion between the cars on the street, and the travelling rope, is made by means of this gripping attachment, which plays an important part in this system, and is shown in Figs. 1, 4. The cars are made to seat about 14 passengers, but not seldom as many as 44 have ridden in them, and 9 on the dummy—53 in all. The traction car, or "dummy," with the gripping attachment, is shown in the perspective sketch on page 176 This car is attached to the passenger car, so that there can be no danger of accident The passenger car is amply provided with brakes. In addition to the usual car brake, there is another attachment operated in the same manner as ordinary brakes, which forces a broad band of wood down on each track immediately under the car. This arrangement is also shown in the drawings, page 177 Strong iron drags are provided, so that if an accident should occur in going up the hill, they will immediately catch in the street planking, and prevent the car from going backwards.

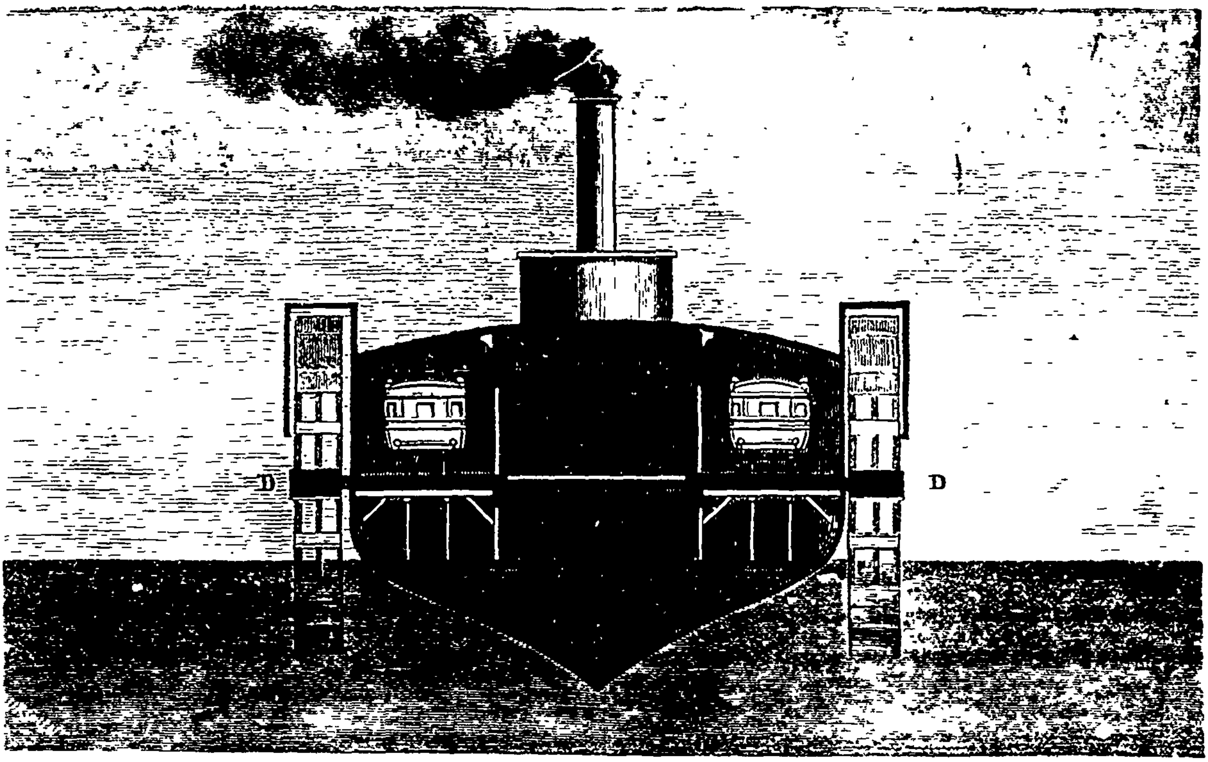
Since the road has been in operation, owing to some poor material furnished, the connexion between the "dummy" and the passenger car broke, on the steepest grade. Before the car went more than a few feet the brakes effectually stopped its further backward progress, showing conclusively that the precautions adopted were effectual. The car was crowded at that time. The "dummy" is also provided with a powerful brake. By this means the car can be stopped at any place on the route, stoppages not being confined to street crossings where it is level The "dummy" and car are connected with "bumpers," so that the weight of the car going down comes on the rope and is utilised to draw up the other cars on the other track The brakes are not generally used when coming down except when it is necessary to stop, the car running down with the same speed as the rope, since the gripping attachment is in connexion with it. Fig. 1 shows a perspective view of the screw gear gripping attachment, and Fig. 4 shows it to a



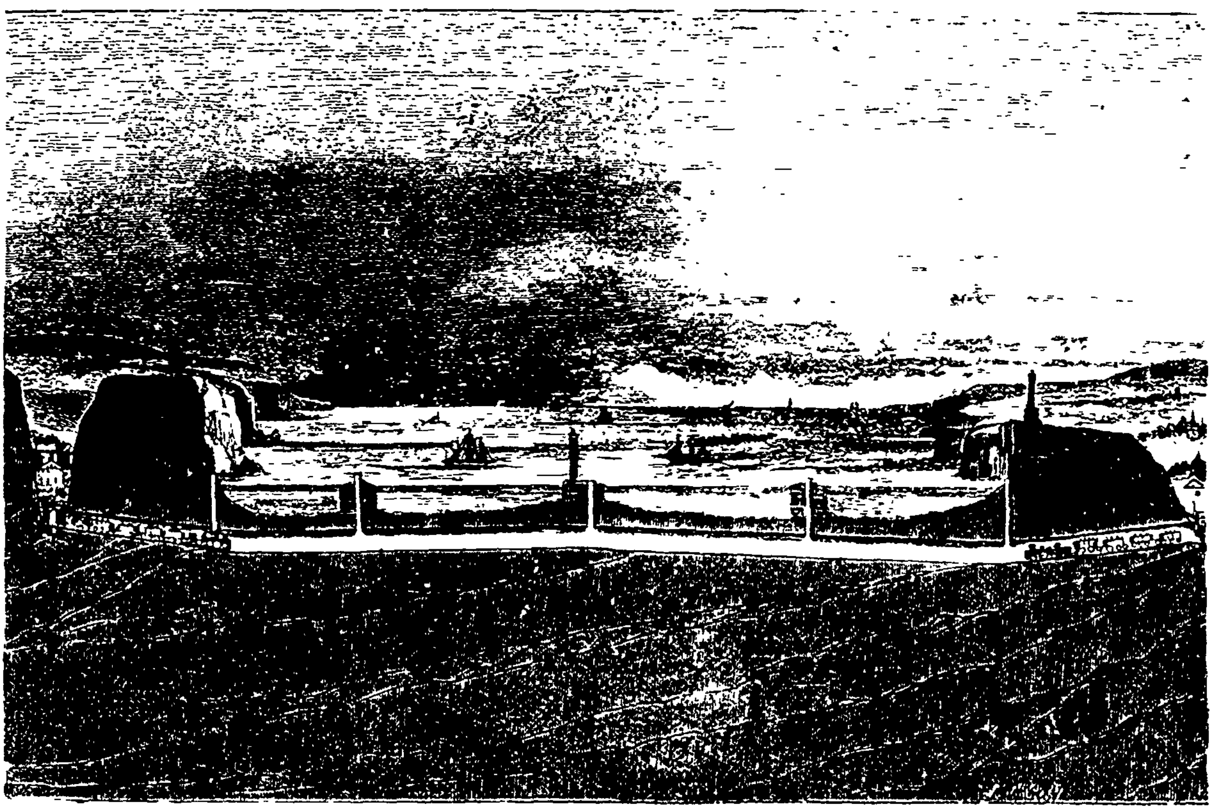
THE HARBOR AND DYKE PROJECTED BY M. DUPUY DE LOME.

A. Basin. B. Dyke. C. Railway and Bridge. D. D. D. Shipping wharves. E. E. Outward bound channel. F. Drawbridge regulated by the height of the tide.

THOMEE DE GAMOND'S SUBMARINE TUNNEL WITH SEA STATION ON THE CLIFF OF VARNE.



THE PROJECTED SHIP OF M. DUPUY DE LOME.—A. Waiting Room. B. B. Railway Carriages. D. D. Paddle wheel.



THE OUTLINE OF THE PROJECTED TUNNEL.

large scale. A vertical slide works in a standard, and is moved up and down by a screw and hand-wheel, Fig. 1. This screw is shown in the drawings on page 177. The small upper screw going down through the larger one operates it. At the lower end of this slide is a wedge-shaped block. The wedge actuates two jaws horizontally, which open and close according to the direction in which the slide is moved, closing when the slide is moved upwards. These jaws have pieces of soft cast iron placed in them, which are easily removed when worn out. These pieces of iron are of proper shape and size inside to grip the rope when they are closed over it.

On both sides of these jaws and attached to them, are two small sheaves. These sheaves are held by means of rubber cushions sufficiently in advance of the jaws to keep the rope off from them, and at the same time to lead the rope fairly between them, allowing it to travel freely between the jaws, when they are separated, without touching them. When it is required to grip the rope, this slide is drawn up by means of the small screw before described, and the wedge at the lower end closes the jaws over the rope, at the same time forcing back the small guide sheaves on to the rubber cushions. The standard containing the slide, &c., is enclosed and retained in a cast-iron bracket, and can be raised and lowered bodily through an opening in the end of the tube from above the surface of the street to the rope by means of a screw and nut, or rack and pinion. As carried out the former mode is employed. The cast-iron bracket is secured to the dummy, as shown in Fig 1, which is coupled to the passenger cars at the bottom of the incline, and uncoupled at the top, and *vice versâ*, horses then being attached to the car for the level road. At first the connexion between the dummy and car was made by means of spiral springs, to prevent any jar in starting, but this was found unnecessary. The arrangements made at the bottom of the incline for keeping the rope at the proper tension, and taking up the slack, prevent any noticeable jar in starting. As before stated, the rope is constantly in motion running between sheaves placed in the tube. The slot of the tube is on one side of a vertical line drawn through the centre of the tube, and referring to Fig. 4, it will be seen that the foot of the gripping attachment projects on one side, giving it an L shape, enabling the jaws to pass under and over the rope sheaves in the tube. In order to stop the car, the jaws of the gripping attachment are opened slightly; when they release the rope, the guide sheaves take it, and the car stops. The shank of the standard containing the slide which works in the slot of the tube, is one-half of an inch thick and 5½ in. wide, there being one-eighth play on each side; all the essential parts of the gripping attachment are made of steel.

The turntable at the foot of the incline is double. The available space at this point was very limited, and in view of this, some ingenuity had to be employed. When the traction car reaches the foot of the incline, it is uncoupled from the car and run on to the turntable, the slot in the latter allowing the shank of the grip to pass freely down. The table is then turned around one quarter of its circumference, and the track and slots are then brought in the same line. The traction car is then run on the other table, which is turned back and it is run on the up track. The car is then brought on the turntable, transferred in the same manner and coupled to the traction car, ready for the ascent. This course is necessary, as there are double tracks; and the travelling wire rope runs down beneath one pair and up under the other. As the gripping attachment passes down under the street through the slot, it is necessary to have a slot in both turntables to allow the traction car to be turned.

The method adopted at the upper end of the road is more simple. A turnout is made for the car and it runs down to a common single turntable. The dummy is turned as follows. A circular table connects both tracks with a slot described around a centre. A small iron triangle connects the dummy at two points with the centre of the slot and tube. By pushing on the dummy, the centre of this iron triangle being held in position by appropriate means, the dummy turns around in a very small circle, and is ready for the return trip when attached to the car, which has already been turned on the turntable.

The road has a gauge of 3 ft 6 in. An ordinary 20 lb. T rail is used, which is set flush with the street and presents a smooth appearance. The rope runs at the rate of about 4 miles per hour, and the ascent is made, including stoppages, in about 11 minutes, the distance being 3300 ft. The stretching arrangement at the lower end has a counterbalance of 3300 lb. weight on a double purchase, which keeps a constant strain on the rope under all circumstances. The motive power is supplied by a steam engine of 30 horse-power.

The rope runs around an inclined pulley, then down under one of the grip pulleys, over it to a plain pulley, and back again to another grip pulley fastened on the same shaft on the first grip pulley, being then guided back to a second horizontal pulley in the street again. This machinery is so arranged that the wire rope passes for some distance in open view of the engineer, so that it can readily be examined at any minute.

The cost of building and equipping the road has been about $100,000, the inclined portion costing $60,000.—*Engineering.*

PLAN FOR CONNECTING ENGLAND AND FRANCE.

We have already frequently drawn the attention of our readers to some of these plans which are now engaging the attention of the leading engineers of the old world. In this issue we give on pages 180 and 181 illustrations of the last two projects that have been devised. That on page 181, is that of the famous French engineer Dupuy de Lome. It consists of two parts. First, to build a harbor in which neither storms nor the undue ebb or flow of the tides shall have any influence on the entrance or exit of vessels. Secondly, to build a vessel in which railway carriages can be transported. The harbor A, has the shape of a mussel shell ... its opening so disposed that the waves break on the inte..r mason work, on the offside of which are three small cavities or wharves (D D D), having the form of a ship's stern and where the vessel can be fitted to the proper height for loading. Along the dyke B, is laid a railway C, to the farthest end, where a semaphore lights each of three cavities or shipping wharves. By means of the drawbridge D, the carriages back into the vessel, the locomotive remaining on the dyke. The vessel then takes the sea along EE. The ship is fitted to carry two trains of 14 cars each, one on each side. There is a waiting saloon on board, to which passengers can retire during the crossing, but they may retain their seats in the carriage if they choose and thus make the whole trip by rail. At Dover, a locomotive hooks on the train, and in a few moments, steams off to London.

The second project is that of a submarine tunnel imagined by Thomée de Gamond. This tunnel is cylinder-shaped, 9 metres wide, 7 metres high, with a slight grade at both ends. It has two parallel railway tracks, and two foothpaths, and extends from Cape Gris Nez to Eastware, between Dover and Folkestone. Halfway lies the cliff of Varne where there will be a sea station. The cliff will be transformed into an island with mole, harbor and a gigantic tower. At both ends, where the submarine tunnel becomes a subterranean tunnel, there will be towers fitted up with pumps and ventilating apparatus.

GOLD QUARTZ CRUSHING MACHINERY, NEW ZEALAND.

Our illustration on page 185, is of interest as indicating the progress of a sister colony.

The machinery, as shown in this illustration, is not actually working, but has been thrown out of gear for the moment, to allow of the photograph being taken. Its motive power is derived from the revolving of the horizontal shaft, which is driven by means of a band, worked either by steam or by water power. The water power, where used, is most frequently that of the stream in a leat or mill-race, but in some instances, as in Goodall's establishment, it is got by raising water to a certain height, by means of the Californian pump.

A glance at our engraving will show that the main or upper shaft, which is seen extending across the front view, communicates its revolving motion by the band working over two driving wheels, at the left hand side, to a second horizontal shaft, parallel with the first, placed across the row of perpendicular shaft of "stampers," in the rear of this view. The stampers, of which twenty are here shown, ranged at intervals one foot or fifteen inches apart, are lifted in rapid succession by the revolving action of the second horizontal shaft, which shaft is furnished with iron appendages, shaped in a double curve somewhat like the letter S, but more open, to catch the projecting cylindrical piece on the perpendicular shaft of each stamper. This serves, with every rotation of the horizontal shaft, to lift all the stampers, one after another, a height of three or four feet; and their fall at each release, by dint of their own weight, is the force ultimately applied to the work of crushing the fragments of auriferous rock. The bottom end of the stamper is shod with a square head of iron, which acts in its descent like a paviour's rammer; and its weight may be from 40 lb. to 60 lb.

At the back of our view are the stampers above described. Through the spaces between them are seen three or four men, standing beside heaps of roughly broken stone, the quartz-rock as brought up from the mine. Immediately below the stampers are the iron boxes, one box to five stampers, open at the top, into which the men put the lumps of quartz, to be hammered, as upon a smith's anvil by the falling action of the stampers. The front of the box, at its bottom, opens with two gratings, through which the stuff, when pulverised to a thick mud (for it is mixed with water in the box) can escape to flow over the pans beneath. There is a trap door, hinged on its upper edge, suspended horizontally over the front of the box, so as to cover the two gratings when shut; and, by adjusting this door to be more or less open, the men are enabled to regulate the outflow from the box. Of the two boxes shown in the right-hand part of our engraving one is open, affording a view of its two gratings; the other has its trap-door closed. Each box, while the battery works, has a copious flow of water poured into it from behind.

The muddy substance of the crushed quartz, passing out of these boxes through the gratings in their front, descends with the water over the mercury pans, of which there are two successive series. Each pan is about 3 ft. wide, and as long as the box beneath which it extends; and the bottom of each pan is covered with pure mercury, which chemically extracts the heavy gold. These pans occupy the middle ground of the view in our illustration. The mud, escaping from the second series of mercury pans through a row of holes at the bottom of their front side as shown in the foreground, spreads itself over green baize blankets laid there. With these two or three men are seen to be more or less busied.* There are several rows of blankets, and they are constantly changed for clean ones. The muddy blankets contain, in the mud with which they are saturated, a tolerable proportion of gold. They are washed and wrung out in large tubs of water. The sediment they deposit, after drawing off the clear water, is put, with a certain proportion of mercury, into a revolving drum, a barrel of some 4 ft. length and 1 ft. 6 in. in diameter. This is kept in motion during many hours. The effect of such a churning is that the mercury takes up all the remaining particles of gold. An amalgam of gold and mercury is formed, which is squeezed by hand in chamois leather, to expel the water; and the balls of this precious amalgam are then carefully deposited in the manager's iron safe, to await the remaining process, which is for separating the mercury from the gold.

It is in the retort-house, about once a week, and usually on Friday, that this process is accomplished, which they call "cleaning up." The retort-house has rather the aspect of a blacksmith's forge, with a blast furnace, but there is a large crucible place in the fire. The amalgam of gold and mercury is put into this crucible, above which ascends a funnel-shaped shaft for the evaporation of the mercury; but the metallic vapour, as it passes outside, being cooled in the pipe, is again condensed into the original liquid form of that metal, very little of which is lost. The gold is cast into ingots, the oblong mould of iron used for this purpose being chosen with a cavity of size adapted to the quantity of molten gold to be poured into it from the crucible. Mr. Mundy, from whom we have learnt these particulars, has seen as much as 30,000 oz., of gold produced by a single week's working, at one of the establishments in the Thames gold-fields. But there have been some occasions when still larger quantities were produced. The total yield, however, from all the gold-fields, both of New Zealand and Australia, in the year 1874, shows a considerable decrease, as compared with former years.

Mr. Howse, C. E., with a party, has gone out to explore the Cascade Range for silver and copper.

THE McGILL UNIVERSITY.

The McGill University has the honour of being the oldest in Canada proper, and the oldest but one in the Dominion—King's College, Nova Scotia, having precedence by a number of years in the date of its royal charter. McGill has also the credit of having developed its courses of study and public usefulness to a greater extent than any other of our Universities.

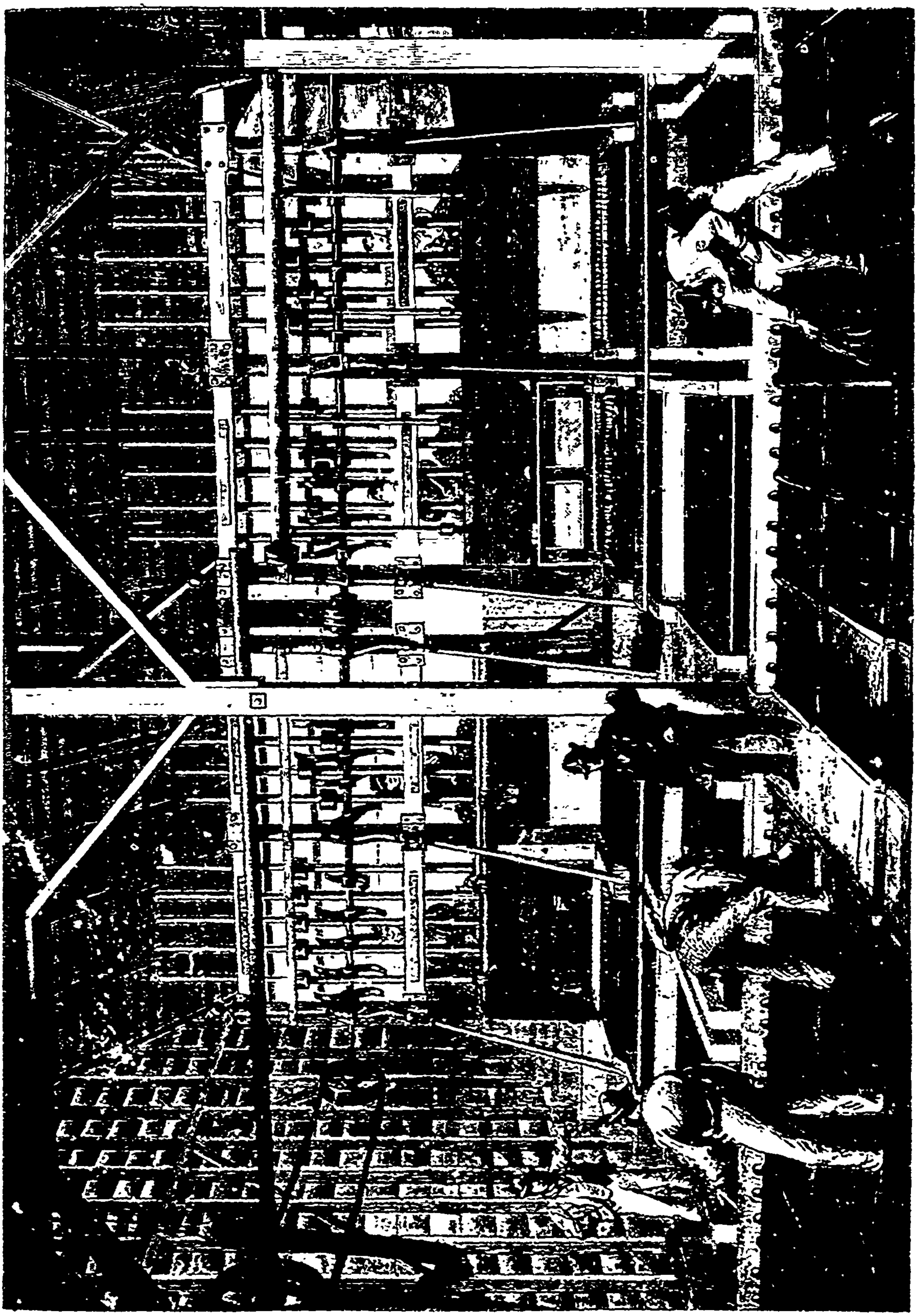
It numbers 38 Professors and other instructing officers, and these are distributed in three Professional Faculties or Departments as well as in the Faculty of Arts or College proper. The Faculty of Arts provides a wide and liberal course of study extending over four years. Connected with it, though constituting a separate branch, is the Department of Practical and Applied Science, including Schools of Civil Engineering, of Mining Engineering and Assaying and of Practical Chemistry. The Medical Faculty has long stood at the head of such Schools in Canada, and there is also a well equipped Faculty of Law. In addition to these branches of the University proper, the Morrin College, Quebec, as an affiliated College, sends students to the University examinations. There are in Montreal two large and flourishing affiliated Theological Colleges, the University not teaching theology directly, but affiliating with certain privileges such theological Colleges as may desire this benefit. The McGill Normal School which is the Provincial Institution for training Protestant teachers for Schools and Academies, is also affiliated to the University and under its immediate control.

The buildings of the University are plain and unpretending in exterior, but commodious and spacious, and their situation at the foot of Mount Royal with extensive grounds in front, is both beautiful and salubrious. The main building is occupied principally with the Class-rooms of the Faculty of Arts, while the Convocation Hall, Library, Museum, Laboratory and Residences occupy the wings and connecting buildings. The completion of these buildings by the erection of the West wing and the connecting buildings is due to the liberality of the late William Molson and in commemoration of which the west wing bears his name, and an inscription on a white marble slab in his honour. The Medical Faculty occupies the large detached building at one extremity, and at the other is the Observatory, which, is at present used wholly for meteorological observations, made in connection with the government system of telegraphy and storm signals. The Library now contains 12,000 volumes and is constantly being enlarged It is open under liberal conditions to citizens as well as to members of the University. The Museum is arranged with special reference to the use of students; and is especially remarkable as containing the collection of shells of Dr. P. P. Carpenter, one of the finest in its department on this continent. The apparatus is very good, and includes many of the best and most recent appliances for illustrating Physical Science. There are extensive and well-furnished chemical laboratories. The grounds in front afford space for cricket and lacrosse, and for the annual athletic sports of the students

According to the last report of the University, the number of students was 300 and there were besides 118 teachers in training in the Normal School. The University has now more than a thousand graduates in various parts of Canada, many of them occupying the highest positions in Political and Professional life.

The majority of aniline colours soluble in water furnish inks of excellent quality. Dingler's *Polytechnische Journal* of recent date gives the following practical recipes for their preparation, by which any one can make the fluids very easily:—Violet ink is obtained by dissolving one part of aniline violet blue in 300 parts of water. This ink is quite limpid, dries quickly, and gives a remarkably dark colour. It is necessary that new pens should be employed in using it, as the smallest quantity of ordinary ink mixed with it causes its alteration. Blue ink is made by dissolving one part of soluble Paris blue in 250 parts of boiling water, red ink, by dissolving one part of soluble fuchsine in 200 parts of boiling water. While ordinary inks are decomposed by numerous substances, and notably by hydrochloric acid, aniline inks are completely ineffaceable from the paper on which they are used. They resist the action of acids and even of chlorine.

EXPERIMENTS ON VELOCITY OF LIGHT, PARIS.



GOLD QUARTZ CRUSHING MACHINERY, NEW ZEALAND.

SILK CULTURE IN JAPAN.

The rearing of silkworms, Consul Robertson informs us, has always received great attention at the hands of the Japanese, and has now attained to a high degree of perfection. The commencement of the season varies in the different parts of the country, according as the temperature happens to be high or low. When the climate has a pretty equal temperature, the silkworm egg cards are taken out of store about the beginning of April, and hung up in some quiet nook of the house. After the lapse of twenty-two or twenty-three days the worms will appear; they are carefully watched and paper is wrapped round the cards, which are now placed in a basket-tray. They are looked at every morning, and brushed off lightly with a feather fan on to another piece of paper. Mulberry leaves are then taken, cut very fine, and well sifted, tossed so as to get rid of the leaf fibre, and then mixed with a certain proportion of millet bran. With this the worms are fed. Fresh paper is wrapped round the cards, and this course is pursued for three days, when all the worms will be out. The paper with the worms on it is then placed in clean basket-trays over a layer of matting. The worms are fed about five times a day. After three days the paper is removed, and the worms are transferred to matting. This stage is known as the "Kaminuke." One card will probably multiply itself sixty times so far as the number of worms go. As a rule, about ten days elapse before the first sleep is entered upon, but this depends upon the temperature. When the cocoons are observed to be preparing for the first sleep they are sprinkled with millet bran, and covered with a net, mulberry leaves being placed over the net. After a couple of hours the net is raised, and the worms brought away with the mulberry leaves, to which they will have attached themselves. They are then placed in a fresh basket tray, and the one from which they have been taken is well cleaned. When the worms have roused themselves from the first sleep they are sprinkled with rice-bran and covered with a net as before, after which they are shifted to a fresh basket. The same course is pursued when the worms go through the second and third sleep, but for the fourth sleep the net is not used. The period that elapses between the second, third and fourth sleeps is from six to seven days at each stage. Much attention is paid to cleanliness, as neglect in this respect exposes the worm to disease. Mulberry leaves are given with an unsparing hand, the leaves being chopped coarser and coarser as the worms grow in size. Sieves of different sizes are used so as to meet the feeding requirement with fine or coarse leaves. As a rule, the worms are fed five times a day, but in hot weather, when the leaves are apt to get dry, they are given as often as eight or more times a day; in cool weather the leaves are given perhaps only three times, but with no reduction in the actual quantity. The leaves are measured out with great nicety. An important feature in the rearing of silkworms is the giving the proper quantity of food, neither overfeeding, nor, on the contrary, starving the worms. After the fourth sleep the leaves are given whole. The worms have now attained full size, and soon cease feeding altogether. When they are observed to be seeking for a place to spin in, the best are picked out and placed on the "mabrushi;" this is a contrivance made either of straw or light twigs, and intended to facilitate the spinning of the c[illegible]s. The cocoons are spun in three days. Those selected for silk are dried in several ways, either in the sun, or by artificial heat, or by steam If the reproduction of eggs is desired, the cocoons are ranged in baskets. After thirteen or fourteen days the chrysalis will have changed into a moth, which will emerge from the cocoon. The male and female moths are then placed on a card, which is surrounded with a framework of oiled or varnished wood, so as to prevent the moths from escaping off the card. In a very short space of time, say about twelve hours, the card will be covered with eggs. Strings are then run through the cards, which are strung up in some quiet corner. In autumn, they are stored away in boxes, and so left till the following spring. The great thing to guard against is disease, so that careful watching of the worms day and night is most essential. If the weather is exceptionally hot, then the worms are kept cool, if, on the other hand, cold, then proper warmth is looked after.

There are several varieties of the mulberry. Exposed and open ground is generally selected for a plantation, with a stream near at hand. The ground is always well drained. With worms intended for reproduction, more than ordinary care is exercised in the selection of leaves for their food. The cocoons are used for two purposes, that is, either for the reproduction of seed or for the reeling into silk. In the case of the former, care is taken to preserve the chrysalis, and the cocoons are carefully stowed in a place of safety. When it is intended to use the cocoons for silk, they are dried as above. Two or three days' exposure will ensure the destruction of the chrysalis, and thus prevent the egress of the "uji," or moth. The mode of drying generally in use amongst the Japanese is by exposure to the sun's rays, though drying either by artificial heat or steam is not unknown. If dried in the sun, the cocoons should be left till after sunset, and until they are slightly moist with dew. If taken in when hot from the effect of the sun, it tends to make the silk brittle, and difficulties will be experienced in reeling. With a climate affording equal temperature, say 70° Fahrenheit, the worm takes seven or eight days to change into the pupa; if the cocoons are picked off the spinning beds too soon—in fact, before the change is perfectly effected—it results that when the cocoons are undergoing the drying process the feet of the silkworm are entangled in the cocoon fibre and the silk is consequently damaged It is a mistake to keep cocoons too long after they are dried; the fresher the cocoon the better the silk, the thread, too, is more easily reeled, and the silk will be heavier. About ten days after the worm has woven its cocoon, the chrysalis has changed into a moth, or "uji," and makes its egress by eating through the cocoon fibre. If the cocoon is intended for silk, great care is taken to preserve it from injury of any kind. When the cocoons are eight or nine days old, they are placed on baskets and laid out in the sun to dry. Two days' drying will effectually kill the chrysalis, and the cocoons are then placed where a draught can play freely on them. If it is intended to steam them they are placed in a basket-steamer, specially made for this purpose, over a cauldron of hot water. Two or three mulberry leaves are put in the basket with the cocoons, and the whole is then covered with stout wrapping paper. So soon as the mulberry leaves have completely changed colour the chrysalis may be reckoned on as killed. Another plan is to place a large box with a series of drawers or shelves over a fire. At the bottom of each drawer a layer of thick paper is placed, and on this the cocoons are laid Two or three mulberry leaves are then put into each drawer. The drawers should be constantly shifted, so that each may receive the same amount of heat; when the leaves pulverise to the touch the killing process is looked upon as effected. The water in which the cocoons are immersed prior to reeling is the best and purest that can be obtained, and, however good of its kind, is generally filtered before use. If ordinary well water, or water in the least degree tinged with mud is used, the thread is apt to lose in weight and natural gloss.

Silk is reeled either by hand or by machinery. The latter has been brought to bear recently upon the industry in question; but hand-reeling is most in vogue, and has been so from time immemorial. Hand-reeling is carried out in the following fashion:—About 8½ lbs. of cocoons are taken, and these are divided into thirty parts, one portion is put into boiling water and the thread reeled off first from five or six cocoons, increasing to seven or eight. This number will turn out the best silk, for medium and inferior silk eight, nine, to twelve or thirteen cocoons are used. A small ring, made either of horse hair or human hair, is attached to the edge of the basin containing the cocoons and the hot water. The thread is run through this ring, and then passed in and out of the first and second fingers of the left hand, the right hand meanwhile turning the handle of the reel. The Japanese seem to think that by the hand process greater evenness of thread and more absence of impurities is obtained than by machinery Cocoons are easily reeled at first, but the process gradually becomes a matter of difficulty, requiring a careful and expert hand The alleged superiority of hand-reeled silk to that turned out by machinery is combated by the fact that the latter commands a far higher price in the Yokohama market than the former, and the large outlay that has been made on the establishment at Tomioka, where silk is reeled by machinery under foreign supervision, not to mention other establishments in Yedo, and elsewhere, tends to confirm the success achieved over hand-reeling.

SCIENTIFIC NEWS.

It is a well-known fact that certain forms of epilepsy are characterised by a peculiar creeping sensation called by medical men *aura*, which precedes the fit. Dr. Solzer, of Berlin, has discovered that the inhalation of the vapour of nitrate of amyl prevents, if commenced at the instance of the sensation of *aura*, the culmination of the attack into a fit. He also observes that the vapour of the nitrate of amyl is also beneficial in cases of asthma.

Absorption of Oxygen by Plants, in the Dark.—According to Deherein, leaves kept in a confined atmosphere in darkness will absorb the whole of the oxygen, and still continue to give off carbonic acid, the resistance to asphyxia varying with the species. The rapidity of growth and energy of respiration of plants are both favoured by obscure heat; and it is shown that the internal combustion, by the absorption of oxygen and emission of carbonic acid, is the origin of part of the heat necessary to the elaboration of new proximate principles in the plant.

From a two year's study of the succession of barometric minima in North Western Russia, M. Koppen has laid down the following rule. If a barometric depression has passed away from a locality, there is considerable probability that the next day, or the day after, the locality will have come under the influence of a new cyclone; but if several days have elapsed since the disappearance of that depression, and, in the mean time, more uniform high pressures have been established, the danger of encountering a new depression on the following day is about a half less.

The fourth Darien Exploring Expedition has closed its work at the Isthmus, and all that remains is to make the various calculations from the data secured The line surveyed is called the Atrato-Napipi It has for its Atlantic harbour the Gulf of Darien, which affords anchorage for a thousand ships. From this point it is proposed to ascend the Atrato for 140 miles. There the excavations for the canal commence. About 21 1-10 miles from the Atrato the canal crosses the Napipi river by means of a basin formed by a retaining dam of 35 ft. in height. At this point is the summit of the canal, 141. 2 ft. above mean tide. From this basin the canal enters the mountainous region, the whole distance to the Pacific being there only 8 6-10 miles, of which 5 54-100 are to be by tunnel. The total length of the canal is 29 8-10 miles; and its estimated cost $56.000,000.

The *Gazetta d'Italia* states that Professor Schiff, the notorious vivisectionist, is supposed to have killed, since he settled in Florence in 1848, no fewer than 14,782 dogs in his laboratory. "What fine thing," the *Gazetta* asks, "what precious acquisition have you procured at such a price for science?" The plea for vivisection is that, by means of it, physiological discoveries of the highest value to the physician and surgeon are made. This plea involves the admission that when no such discoveries are made the practice is self-condemned. It is, therefore a pertinent question which the Italian journalist asks, when he demands to be informed of the equivalent in fresh knowledge which has been obtained in return for the elaborate tortures and agonies inflicted on the vast army of dogs whom Prof. Schiff has "utilised for science."

Some idea of the ramifications of the electric telegraph may be gathered from an experiment successfully accomplished in London not long since. Captain Sartorius, at present in Teheran, wished to test his pocket chronometer, and to check with absolute correctness its time in Persia with Greenwich time. To do this it was necessary to have a clear line from Teheran to London, a distance by "wire" of nearly 4,000 miles. After some little trouble in getting the German relays into satisfactory order (the lines come through Berlin), the important signal was made several times to insure accuracy, with the result the watch was found to be two seconds slow by Greenwich time. The experiment was of double interest, as it also tested the performance of a watch which has been constructed on a plan calculated to withstand a great deal of comparatively rough usage, and yet keep time with sufficient accuracy for many scientific observations. The watch was a half-chronometer, double-roller lever, made by Messrs. Barraud & Lund.

NOTES AND MEMORANDA.

The following is a cement for fastening wood to stone;—Melt together four parts by weight of pitch and one part wax, and add four parts of brick dust or chalk. It is to be warmed, for use, and applied thinly to the surfaces to be joined.

A simple means of testing the quality of leather consists, according to M. Bitner, in watching its behaviour when treated with acids—preferably acetic acid. Leather not completely saturated with the tannin will swell up, but if the tannin has penetrated, the leather will not swell.

To make a waterproof glue boil eight parts of common glue with about thirty parts of water, until a strong solution is obtained; add four and a half parts of boiled linseed oil, and let the mixture boil two or three minutes, stirring it constantly. Parts by weight are to be taken.

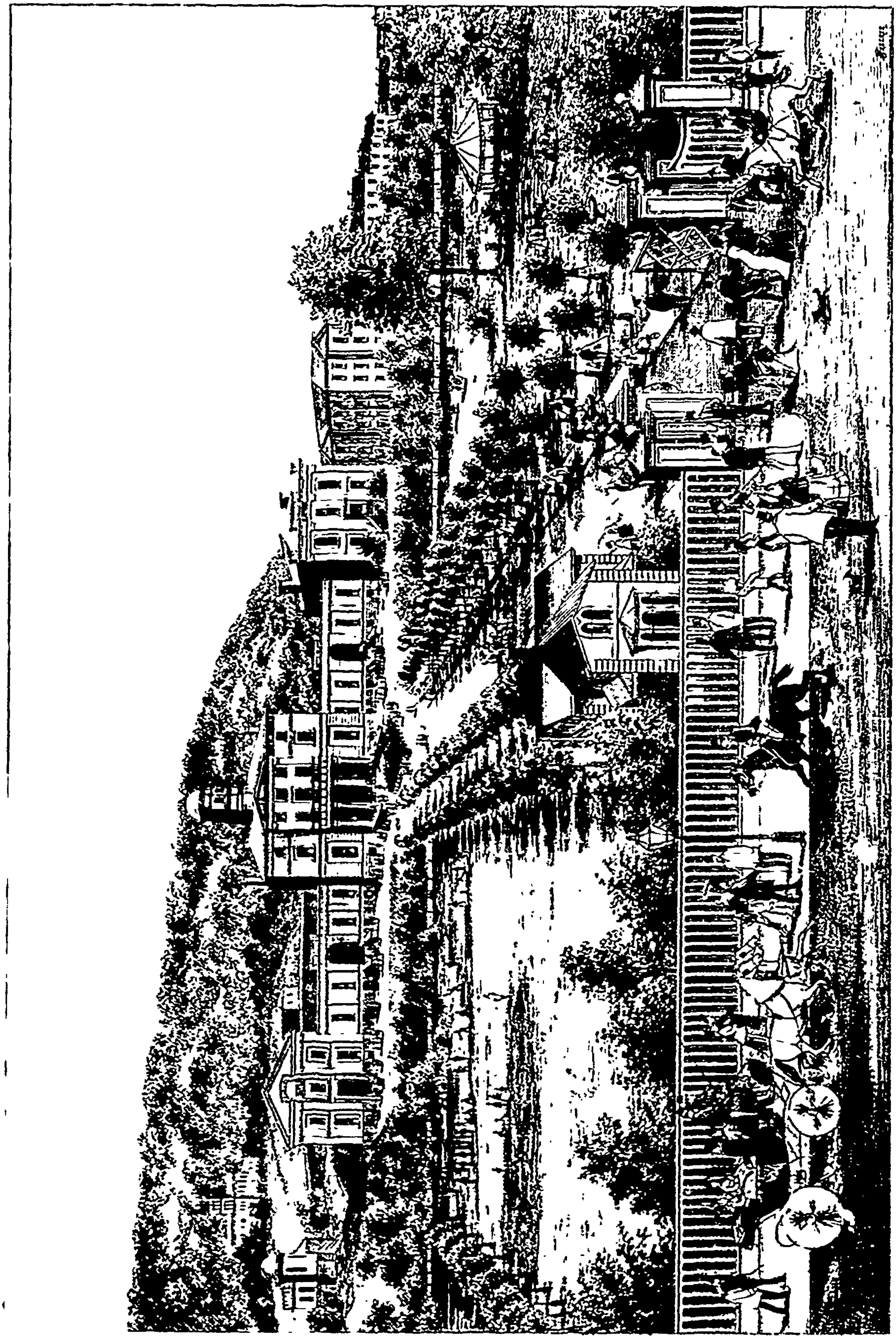
Substitute for Ink.—A substitute for ink has been devised by Dr. Jacobsen of Berlin, which consists of points, like the leads of ordinary pencils, that can be fitted into holders. The writing at first very much resembles lead pencil marks, but when moistened immediately assumes a violet tint, and then adheres to the paper like ink. As many as six good copies can be taken from it by means of an ordinary copying press.

Preservation of Meat, Vegetables, &c., by Acetate of Ammonia.—According to an English patent, fresh meat, fish, vegetables, &c., are preserved by immersing them in a more or less concentrated solution of acetate of ammonia, and allowing them to dry in the air. If the articles are to be preserved for months, or years, they are packed in cans or casks filled with solution of the salt. The boiling, roasting, &c , readily expels the acetate, and the articles are said to be free from the sweetish taste which acetate of soda imparts.

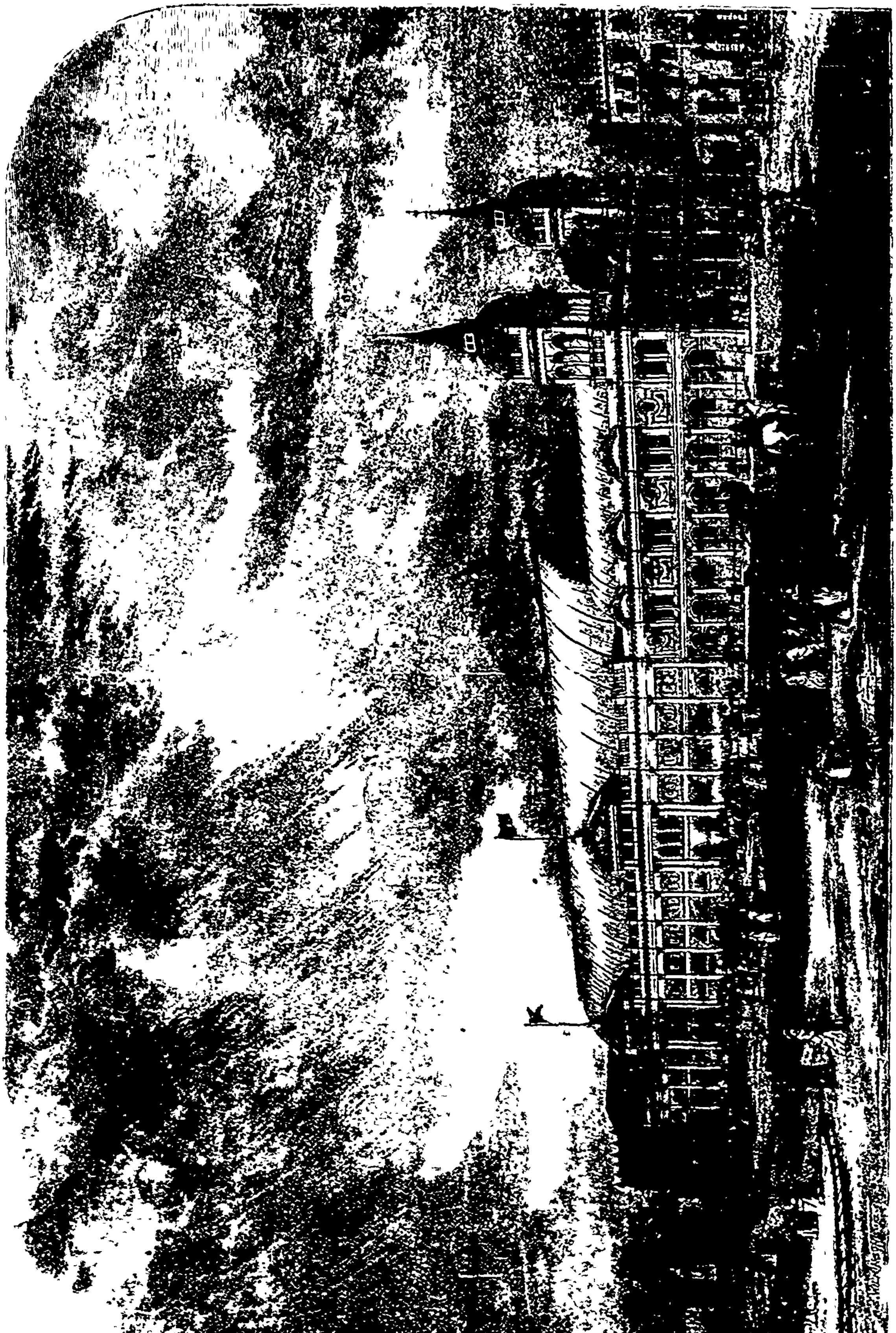
Imparting a fine Orange-yellow Tone to Oak Wood.—According to Niedling, a beautiful orange-yellow tone, much admired in a chest at the Vienna Exhibition, may be imparted to oak-wood by rubbing it in a warm room with a certain mixture until it acquires a dull polish, and then coating it after an hour with thin polish, and repeating the coating of polish to improve the depth and brillancy of the tone. The ingredients for the rubbing mixture are about 3oz. of tallow, ¾oz. of wax, and one pint of oil of turpentine, mixed by heating together and stirring

Bright Deep Blue Dye.—The following is said to yield a tolerably fast bright deep blue colour on wool:—The wool or cloth is prepared by boiling for an hour in a hot kettle, with 2¼lb. alum, ¾lb. chromate of potash, 1¼lb. sulphuric acid, and 2oz. tin salt in solution for 40lb. of material. It is then opened out and well cooled, and allowed to lie for twelve hours The day after, 8lb. of logwood is boiled in a fresh bath, and then 3oz. of aniline violet—the bluish, soluble in water—is added, and, as soon it is dissolved, another ½lb of sulphuric acid. The prepared articles, after being washed or rinsed, are placed in a bath at 122 deg., and, after half an hour, are worked at a boil for an hour. More aniline violet affords a stronger blue, more logwood a deeper blue. The colour can easily be cleaned in cold water.

Preservation of Wood.—M. Lostal, railway contractor, of Ferminy, has communicated to the Society of Mineral Industry, at St. Etienne the results of his observations on the effect of lime in preserving wood, and his method of applying it. He piles the planks in a tank, and puts over all a layer of quicklime which is gradually slacked with water Timber for mines requires about a week to become thoroughly impregnated, and other wood more or less time, according to its thickness. The wood acquires remarkable consistency and hardness, and, it is said, will never rot. Wood has been prepared in this manner for several mines, so that the plan will shortly be tested on a considerable scale. Beechwood has been prepared in this way for hammers and other tools for several ironworks, and it is said to become as hard as oak without losing its elasticity or toughness, and to last much longer than when unprepared. It has long been known that wood set in lime or mortar is preserved from decay, but no systematic plan for its preservation has until now been attempted.



McGILL COLLEGE.



PUBLIC AQUARIA, LONDON, ENGLAND.

APPARATUS FOR THE ARCTIC EXPEDITION.

The combined experience of successive explorers, aided by scientific improvements, has of late years effected quite a revolution in the method adopted by those who endeavour to penetrate the mysteries of the Polar regions. We will here name only two of the principal changes which have taken place. The introduction of steam has enabled vessels to pass in a few days through a sea covered with floe ice where weeks would formerly have been spent in effecting a passage; and, secondly, whereas in former days the ship was the sole instrument of exploration, the chief work is now by sledges, the ship acting as a storehouse and provision station when once the latitude has been attained from which it is deemed that a start can most successfully be made. And this substitution of sledges for ships involves another important change Formerly, all the work had to be accomplished during the brief Arctic summer, while during the prolonged winter the crews of the expedition were reduced to compulsory idleness, whereas now the most important part of the work is accomplished during the winter months, as it is evident that sledges can travel most safely when there is no risk of a thaw. Sledge travelling, it may be observed, was adopted by Parry as early as 1820, but the vehicles he used were cumbrous and heavy, and as he chose the summer season, his party made very little real progress northward, as the ice on which they were travelling was drifting in the opposite direction. Great improvements have since been effected, and "it is now," says Sir Leopold M. Clintock, "a comparatively easy matter to start with six or eight men. and a sledge laden with six or seven weeks' provisions, and to travel some 600 miles across desert wastes and frozen seas from which no sustenance can be obtained. There is now no position, however remote, that a well-equipped crew could not effect their escape from by their own unaided efforts." The sledges now being constructed for the Arctic expedition are from designs by Sir Leopold McClintock. They are made of American elm, and the runners are shod with steel. The eight-man sledge is intended to carry eight weeks' provisions. The sledges drawn by dogs are of a smaller size, and the different fittings and gear are therefore proportionately small. The sledge sail is an important auxiliary, as by its aid, with a fair wind, the men are greatly relieved in their laborious work of dragging. The mast is extemporised out of two tent poles. With regard to dress, the underclothing supplied is of the best and warmest material, the outside clothing is intended to fit loosely. The mittens when in use are slung round the neck. The sleeping bag is made of the Hudson's Bay three-point blanket, or of duffle.' It is about 7 feet long, and opens at the side. The tent is made of light, close, unbleached duck, and is partially lined with brown holland; but in severe weather, that is to say, when the temperature falls below—30 deg, snow huts, which can be built in half an hour by four experienced men, are preferable. Concerning the other implements a few words will suffice. The ice anchors are used for mooring a ship to a floe, when beset by drift ice. The blasting powder is for the purpose of clearing a passage for the vessel when frozen in, by drilling a hole through the ice and exploding a can of powder. This plan has been successfully adopted in former expeditions. The other ice tools are auxiliaries in effecting the same object. Pemmican, a food invented by the Canadian *voyageurs*, is made of the fat and lean of meat well worked together by a pestle and mortar, the rum supplied is concentrated, the fuel used for cooking is either camphorated or methylated spirits of wine, or crude cocoa-nut oil.

WOODEN FLOORS ON ASPHALTE.

A novel method of laying down wooden floors was introduced in France about twenty years ago, and has since then obtained a wide application. It consists in putting down flooring not, as hitherto, on sleepers, but in imbedding the boarding in asphalte. The new floors are used mostly for ground stories of barracks and hospitals, as well as for churches and courts of law. M. Schott, in the *Deutsche Bauzeitung*, draws the attention of architects to this new mode of construction, very little known out of France, and urges that its wider application is desirable on account or its evident usefulness.

For the floors in question, pieces of oak, usually 2½ in. to 4 in. broad, 12 in. to 30 in. long, and 1 in. thick, are pressed down into a layer of hot asphalte not quite ½ in. thick, in the well-known herring-bone pattern. To ensure a complete adhesion of the wood to the asphalte and obtain the smallest possible joints, the edges of the pieces of wood are planed down slanting towards the bottom, so that their cross section becomes wedgelike Nails, of course, are not necessary, and a perfectly level surface may be given to the flooring by planing after the laying down.

The advantages of this flooring, which only requires an even bed on which it rests, are said to be the following:—

1. Damp from below, and its consequence, rot, are prevented
2. Floors may be cleaned quickly and with the least amount of water, ensuring rapid drying.
3 Vermin cannot accumulate in the joints.
4. Unhealthy exhalations from the soil cannot penetrate into living-rooms. Asphalte being impermeable to damp, rooms become perfectly healthy even if they are not vaulted underneath. In buildings with several stories, as in hospitals, the vitiated air of the lower rooms cannot ascend, an object which it has hitherto not been possible to attain by any other means
5. The layer of asphalte will also prevent the spreading of fire from one floor to another in case of conflagration.

The flooring here described has been laid in the numerous casemates of the newly constructed forts round Metz, to the satisfaction of the authorities.

The cost is about 1s. per square foot. This estimate, somewhat high, would be much lower in districts where oak and labour are cheaper, and the distance from the places of construction less, and especially where there is more competition amongst contractors than at Metz; and the cost for larger undertakings may be reduced to 8 German mark (8s. English) and under per square metre.

COLLIERIES AND IRONWORKS IN CHINA.—Mr. Henderson, who has passed about 30 years in China, and who is now in England, has been commissioned by the Mandarins in charge of the Arsenals of Tien-tsin and Shanghai, in pursuance of instructions from his Excellency Li-hung-chang, Viceroy of the Province of Chihli and Superintendent of Trade for the Northern Treaty Ports, to procure the necessary plant for working the collieries and iron mines and for smelting and manufacturing iron in that province according to the most approved European methods. He has also been authorised to obtain the services of competent Europeans to direct the works. Attention has been repeatedly directed in the *Times* to the vast coalfields of China, and to the fact that steam coal, quite equal in quality to the best South Wales coal, abounds at Chaitang, in Chihli, about 40 miles west of Pekin. There is not at present a single coal-mine in China worked on scientific principles there is neither steam engine nor pump, and the smelting of iron is conducted only in the most primitive manner. Owing to the high prices which the Chinese are obliged to pay for foreign coal and pig iron—for the latter sometimes as much as £10 per ton—the authorities have determined to utilise some of their coalfields and deposits of ironstone which, as well as coal, occurs in great abundance in various provinces of China, and to work them in the most systematic and advantageous manner. The field which has been selected for commencing operations upon in the first instance is situated at Pung Chung, near Tre-chow, in the county of Tamingfu, in the southern part of the province of Chihli, and bordering on the province of Honan. It would have been impossible to select any locality richer in coal, ironstone, and lim stone, or better placed with regard to facility of access The field is situated on a plateau bordering on and about 300ft. above the level of the great plain of Chihli, and distant about 25 miles from some small rivers, down which the produce of the mines and ironworks will be conveyed to Tien-tsin. To complete the chain of communication it is intended to construct a railtramway from the mines to one of the rivers in question. It is proposed, in the first instance, to meet the requirements of the national arsenals; but, as soon as circumstances will permit, manufactured iron of all descriptions will be produced. In conclusion it may be mentioned, as a notable instance of neglect to utilise national resources, that the very locality in which the authorities are about to commence mining operations is referred to in an ancient Chinese history, some 2000 years old, as being the spot where the loadstone was first discovered in China.

COLOURING METALS.

It is frequently desirable to alter the natural colour of gold, brass, and other metals, either for the purpose of ornament, or to render frequent polishing less necessary. For this end, the following recipes will be found very serviceable :—

TO HEIGHTEN THE COLOUR OF GOLD.

Place 4oz. of salpetre, 2oz. of common salt, and 2oz. of alum, in a crucible. Add sufficient water to cover the mixed salts. Now place the crucible on the fire and allow the mixture to boil. When this takes place, place the article to be coloured in the mixture, taking care that it is suspended by a hair. It may be left in the crucible for about 15 minutes, when it should be withdrawn, well brushed with a fine scratch-brush, and redipped if the colour is not intense enough.

For small gold articles, such as a keeper or plain ring, &c., a very good plan is to place them on a lump of charcoal and make them red-hot under the blow-pipe flame, and then to throw them into a pickle composed of about 35 drops of strong sulphuric acid to the ounce of water, allowing the articles to remain therein until the colour is sufficiently enhanced. Washing the article in warm water, in which a little potash has been dissolved, using a brush, and finally rinsing and drying in boxwood sawdust, completes the operation.

Another colouring mixture, which has been greatly recommended, consists of a mixture of 20gr. sulphate of copper, 50gr. French verdigris, 40gr. sal-ammoniac, and 40gr. salpetre, dissolved in one ounce of glacial acetic acid. The articles, suspended by a horse-hair, as before, are to be immersed into this mixture, withdrawn and heated on a piece of copper until black. They are then to be placed in a pickle of equal parts oil of vitriol and water, which removes the black coating, and brings up the colour. Washing in weak potash-water, rinsing and drying as before, terminates the treatment.

SILVER.

Silver which has become much tarnished may be restored to its primitive beauty by immersion in a warm solution of 1 part cyanide of potassium to 8 of water. (This mixture is extremely poisonous.) Washing well with water, and drying will produce a somewhat dead-white appearance, which may be quickly changed to a brilliant lustre by polishing with a soft leather and rouge.

BRONZING IRON CASTINGS.

This may be done by giving them a superficial coating of copper by electrolysis, which can then easily be bronzed by means of an application of weak ammonia, which may be allowed to dry off, and the castings then brushed in the prominent portions. A layer of good, clear, spirit-varnish, greatly increases the durability of the bronzing.

Or, the finished coatings may be brushed over with a mixture of hard white varnish, and finely-ground bronze green, of an oily consistency. The castings must be slightly warmed, and be quite smooth and clean. When the first coat is dry, which soon takes place, another can be applied if required, taking care to lay on thinly each time, and to get body by repeated applications. This being satisfactorily coloured, a small quantity of gold bronze powder is taken up with a dry camel-hair pencil, and the prominent edges of the work lightly touched with another brush dipped in clear varnish; while still tacky the bronze powder is laid on with the dry brush. Again the work is allowed to dry thoroughly, when a final thin coating of the best hard varnish is given all over.

BRONZING FOR COPPER OR BRASS.

Copper or brass may be bronzed in various modes. The repeated applications of alternate washes of dilute acetic acid, and exposure to the fumes of ammonia, will give a very antique-looking green bronze, but a quick mode of producing a similar appearance is often desirable. To this end the articles may be immersed in a solution of 1 part perchloride of iron, in 2 parts of water. The tone assumed darkens with the length of immersion. Or the articles may be boiled in a strong solution of nitrate of copper. Or lastly, they may be immersed in a solution of 2oz. nitrate of iron, and 2oz. hyposulphite of soda in a pint of water. Washing, drying, and brushing, completes the process.

RAILWAY MATTERS.

Sir Hugh Allan has succeeded in contracting for the loan in aid of the Northern Colonization Railway Company in London, England.

EVERY passenger car on the Illinois railroads is by law compelled to be furnished with a woodman's axe, sledge-hammer, a hand saw and two leather buckets.

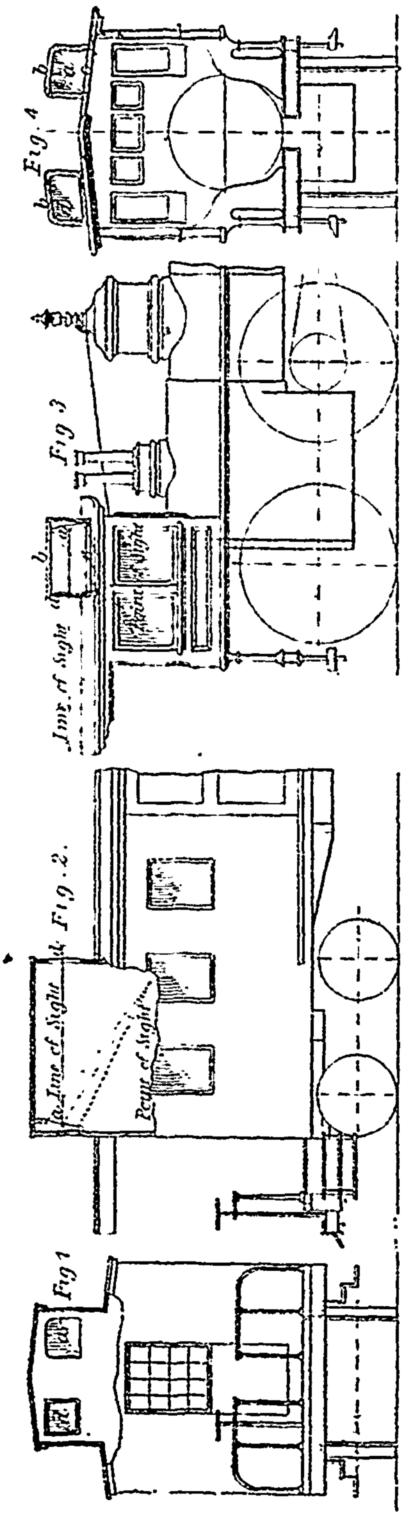
PORT DOVER, Ont., May 31.—The schooner "Erie Stewart," arrived to-day bringing 100 tons of railroad iron for the Port Dover and Lake Huron railway company. This is the first ship load of the 4,000 tons now lying in Buffalo. This section of the road will be opened on the first of July.

WE LEARN from Cairo that the Soudan Railway is being rapidly pushed forward, and that various schemes are under consideration for the better irrigation of Lower Egypt. One proposal is for the construction of a series of locks and weirs on the existing canals, which during high Nile are so many deep and rapid rivers. Another is for the construction of canals, taken from a high level on the river, in Upper Egypt, and distributing the water thus obtained over the surface of the Delta.

PERHAPS the heaviest piece of main line traffic in the world is that on the London and North-Western Railway between London (Euston station) and Rugby—a section 83 miles long. On this section the following trains run through: 30 express mail trains at 40 miles an hour; 5 at 36 miles an hour; 29 passenger trains at lower speeds and stopping at all stations; 32 express goods trains at 20 to 25 miles an hour; 27 ordinary goods trains, and 23 local goods and mineral trains—a total of 64 passenger and 82 freight trains in 24 hours.

The United States Treasury returns for the last fiscal year (ending June 30th, 1874) show exports of 79 locomotives, having an invoice value of 1,147,366 dols., the average value being 14,524 dols. Of these the largest number, 19, went to Chili; Russia took 14, Brazil 13, Cuba 12, Canada 9, Argentine Republic 4, Mexico and Central America each 3, and Peru 2. The number recorded as sent to Canada is undoubtedly less than the number really built for Canadian lines, as a large lot were built in the New England shops for the Grand Trunk, these, however, being probably delivered to that road at Portland, and not counted among the exports.

It will be interesting to know that fireless locomotives are in constant and successful operation on a city and suburban railway in New Orleans — namely, the New Orleans and Carrollton Railway, under the able management of Gen. G. T. Beauregard, who is a skilful engineer, and yet who is alive to, and keeps pace with, the improvements of the age. This success has been achieved, too, under the most adverse and unpromising circumstances. The road under other running arrangements had become nearly valueless, its stock having gone down to 7 cents; but it is now a paying and valuable road. The road is about six miles in length. From the centre to the outskirts of the city it is operated by mule power; there the mule is taken from the car and the little fireless locomotive is attached, which is accomplished in less time than would be occupied in attaching another mule. The train is then off like a rocket, the driver still on the platform of the car working the engine, managing the brakes, and making change, as usual; there is no other person on the train to attend these duties. The car is started and stopped quicker than when drawn by the mule. The railway (double track) is in the middle of a very wide street, and is a little raised, so that it cannot be crossed by carriages except at the street crossings; thus, being somewhat isolated, high speed is admissible. The locomotive is simply a cylinder of boiler iron, perhaps 3ft. in diameter and 10ft. long, mounted on four wheels, and partly filled with water. The engine—a double vertical—is attached to the end of the cylinder next the car, being within reach of the driver. The cylinder is then filled with steam at a proper pressure, from a stationary boiler at Carrollton, when the locomotive is ready, and it will run to the city and back without care or expense. There is no fire, no ashes, no pump, no danger, and less noise than from the hoofs of horses. The expense of this means of propulsion, General Beauregard assured me, is less than by mules. The cost of the locomotives is $1,250 each, which includes the builder's profit.



TRAIN SIGNAL MIRRORS.

TRAIN COMMUNICATION.

The subject of communication between trainmen and signal men—while trains are in motion—is one of such importance that any improvement of practical utility is always welcomed with deserved interest as a step in the right direction. Many improvements have of late years been introduced for such communication on passenger trains, but very little seems to have been done for goods or freight train service.

Above we give some illustrations of a very simple device introduced upon the Great Western Railway of Canada, and designed by Mr. W. A. Robinson (the locomotive and car superintendent of that railway), which promises to be of valuable assistance in the operating of goods trains, and would also be a useful adjunct for passenger-train service. The device consists of the introduction of a mirror placed on the engine weather plate immediately in front, and over the heads of the driver and fireman, at such an angle as to reflect a view of the whole of the wagons or carriages attached to the engine, and thus render the train behind as distinctly visible to the driver and fireman as the line itself in front.

Figs. 3 and 4 illustrate the arrangement of the mirrors as adapted to the American type of locomotive, and as in use on the Great Western Railway of Canada. The mirrors are shown at *a*, and are secured in a kind of bottomless boxes *b* which are placed over holes *c* cut through the roof of the engine cab or house. The back ends of the boxes next the tender are provided with plain lights of glass *d* for admitting the view of the train, and the frames of the glasses *d* are so fixed on hinges or swivels that they may be conveniently opened on the inside for cleaning.

The arrangement of the mirrors is such that the driver and fireman may, when in their usual position on the foot-plate, have an instantaneous view of the whole of their train as often as desirable. Instead of two mirrors being applied as shown, viz., one on each side of the weather plate or engine cab, one mirror only may be used and extended across the width of the plate (or, in American engines, the width of the cab), and thus afford the desired view of both sides of the train.

Figs. 1 and 2 show the same invention, also suggested by Mr. Robinson, for American conductors' cars or English guards' vans, by means of which the guards of a goods train could from within watch the condition of the train and see if all is right with it. In the case of guards' vans the mirrors are placed at opposite ends of the box, so that the mirror on one side will serve for the van going in one direction, while that on the other side will be used when moving in the opposite direction, unless the van be turned round to accommodate each trip.

Besides the value of these arrangements for the purposes of transmitting signals to the driver, and the oversight of train from the guard's van, there is the very important knowledge at once gained by the driver of any accident to the vehicles in his train, whether by their getting off the rails or any casualty arising from sparks or fire. We have known of many instances where valuable lives and property could, and would, have been saved from burning vehicles, &c., had such an appliance as the one we now illustrate been in use at the time.

With a desire of giving the public the benefit of the device, we understand that Mr. Robinson places this improvement free for the use of all railroads desirous of adopting it.

The *Independence Belge* gives some curious statistics relative to the consumption of wood in France. A large quantity of soft wood is used for making toys, and to give an idea of the magnitude of this trade it will be sufficient to take one article alone, children's drums, of which in Paris alone 200,000 are sold every month. The total number made annually in France is estimated at 30,000,000, while a considerable quantity of wood must be consumed to supply 60,000,000 drumsticks.

A Teaspoonful of powdered borax dissolved in a quart of tepid water is good for cleaning old black dresses of silk, cashmere, or alpaca.

The Chignecto *Post* says :—A block of coal weighing a quater of a ton was sent from the Spring Hill and Parisboro' Coal and Railway Company's mines, which had been taken from a new seam, between 40 and 50 feet below the surface.