Technical and Bibliographic Notes / Notes techniques et bibliographiques

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

☐ Coloured covers/
Couverture de couleur

☐ Covers damaged/
Couverture endommagée

☐ Covers restored and/or laminated/
Couverture restaurée et/ou pelliculée

☐ Cover title missing/
Le titre de couverture manque

☐ Coloured maps/
Cartes géographiques en couleur

☐ Coloured ink (i.e. other than blue or black)/
Encre de couleur (i.e. autre que bleue ou noire)

☐ Coloured plates and/or illustrations/
Planches et/ou illustrations en couleur

☑ Bound with other material/
Relié avec d'autres documents

☑ Tight binding may cause shadows or distortion along interior margin/
La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure

☐ Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/
Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

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

☐ Coloured pages/
Pages de couleur

☐ Pages damaged/
Pages endommagées

☐ Pages restored and/or laminated/
Pages restaurées et/ou pelliculées

☑ Pages discoloured, stained or foxed/
Pages décolorées, tachetées ou piquées

☐ Pages detached/
Pages détachées

☑ Showthrough/
Transparence

☑ Quality of print varies/
Qualité inégale de l'impression

☑ Continuous pagination/
Pagination continue

☐ Includes index(es)/
Comprend un (des) index

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

☐ Title page of issue/
Page de titre de la livraison

☐ Caption of issue/
Titre de départ de la livraison

☐ Masthead/
Générique (périodiques) de la livraison

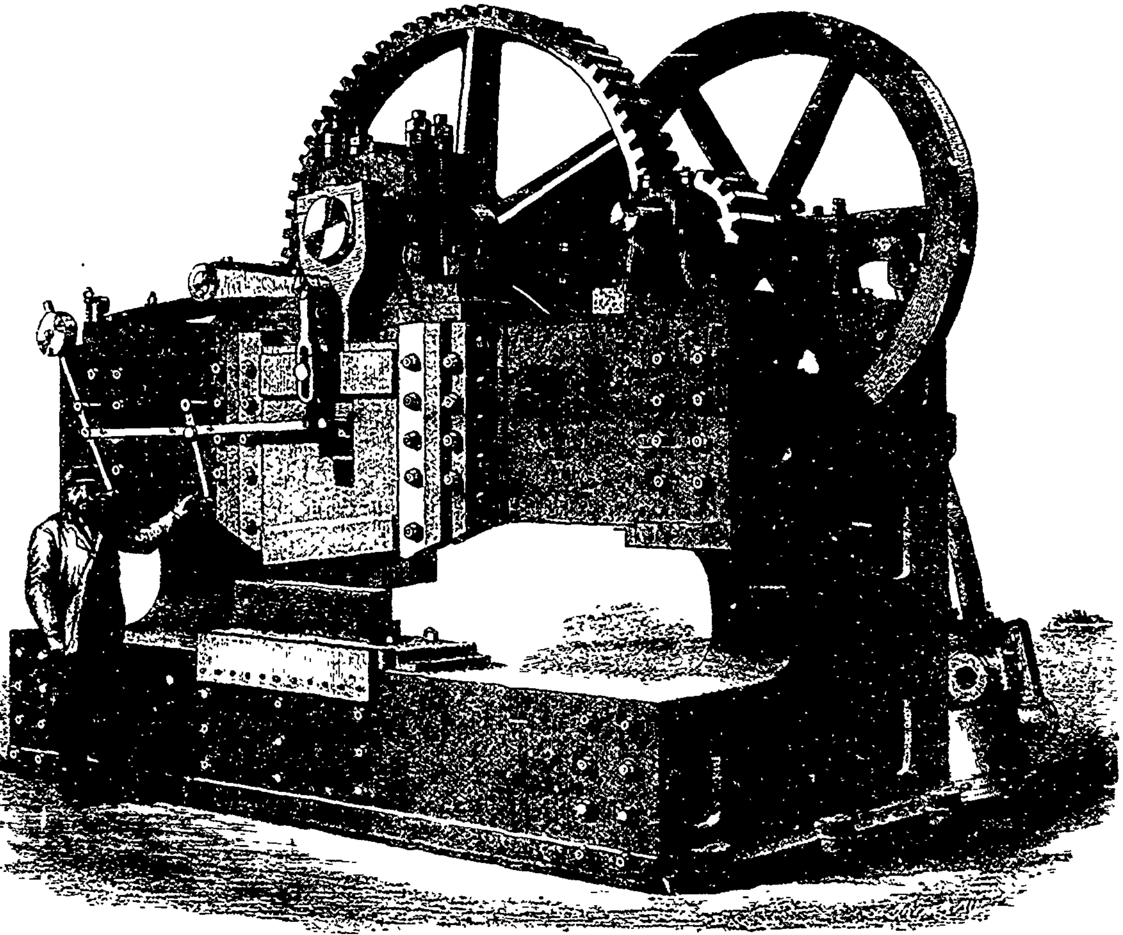
☐ Additional comments:/
Commentaires supplémentaires:

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

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

The Canadian Patent Office RECORD AND MECHANICS' MAGAZINE

Vol. I.—No. 10. JANUARY, 1874. Price in Canada $1 50 per An
United States - $2.00 “



SCRAP SHEARING MACHINE. (See next page.)

SCRAP SHEARING MACHINE AT THE VIENNA EXHIBITION.

We illustrate, on the first page of this number, a Shearing Machine of unusually large dimensions. Our illustration is from *Engineering*. The machine has been constructed in the shops belonging to the Iron and Mining Company, Friedrichs-Wilhelms-Hutte, at Muhlheim-on-the-Ruhr, in Rhenish Prussia, a firm which is best known on the Continent through its extensive foundry for water and gas pipes, some fine examples of which are exhibited at the Vienna Exhibition, in the pavilion for the iron and mining industry of Rhenish Prussia and Westphalia. This foundry of the Friedrichs-Wilhelms-Hutte turns out work to the amount of about 30 tons per day, and produces pipes up to 13 ft. long, and 3 ft. 6 in. diameter; the engineering works belonging to the same company supply chiefly machinery for iron works and mines.

The shearing machine we now illustrate consists, as will be seen from the engravings, of two strong hollow cast-iron uprights, connected by three box girders made of wrought-iron plates and angle iron, the two upper girders carrying the bearings of the engine shaft and of the main shearing shaft, as well as the guide for the shearing slide, whilst the block for the fixed shear is supported by the lower girder. The two uprights are curved as shown, and there is between them a clear space of 11 Rhenish feet (about 11½ ft. English), so that not only the edges of plates can be conveniently cut, but even the plates can be cut entirely through across their whole length. Plates as thick as 1¼ in. can be sheared in this machine.

QUALITATIVE ANALYSIS FOR AMATEURS.—VI.

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

(Continued from page 204.)

Group Third, (continued.)

The separation of iron, chromium, and manganese involves a new operation, known as fluxing. The precipitate containing the hydrated oxides of these metals is mixed with several times its weight of pure potassic nitrate and sodic carbonate, and the mass fused on a piece of platinum foil. If the fused mass when cold has a green colour, manganese is present; yellow indicates chromium. Dissolve one half of the mass in water, and filter; if a residue remains, it is probably oxide of iron, which may be dissolved in hydrochloric acid and tested with ferrocyanide of potassium. The filtrate soluble in water contains the chromium in the form of potassic chromate; to this solution add enough acetic acid to drive out all the carbonic acid, and after effervescence ceases, add some plumbic nitrate (nitrate of lead), when a yellow precipitate of plumbic chromate proves the presence of chromium. If, however, the carbonic acid be not all expelled before adding the lead, there will be a white precipitate formed of plumbic carbonate (white lead), which conceals the chromium. The manganese is present in the green mass as the manganate of potash (K^2MnO^4), and by placing some of the mass in a test-tube with nitric acid and red lead, the manganate of potash is converted into the permanganate ($KMnO^4$), which has the well-known and characteristic violet or purple colour. If no manganese is present, the red lead gives to the solution only a dirty red, or brownish colour, and soon settles, leaving the liquid above almost colourless.

The process employed in separating the metals of Group Third is represented by the following table:—

Example for Practice.

Nickel coins. A small piece clipped from the side of a nickel five-cent piece will dissolve readily in nitric acid. A drop of muriatic acid may be added to ascertain if traces of lead or silver are present. Hydrosulphuric acid is then passed through the solution until all the copper is precipitated; a portion of the liquid may be filtered out occasionally and tested for copper.

When the filtrate no longer gives a precipitate with H_2S, it may be filtered, the sulphide of copper carefully and thoroughly washed, and then dissolved in nitric acid. In separate portions of this solution the presence of copper must be proven by all the methods already given. The filtrate is nearly neutralized with ammonic sulphide.

For the sake of practice the following mixture may be prepared for analysis, the metals only being sought: dissolve a piece of tinned iron, a piece of limestone and a strip of zinc in acid, and add to the solution some blue vitriol and common salt. This will require considerable patience and skill to separate, but furnishes plenty of variety. A mixture of the nitrates of lead, bismuth, iron and potassium is another good compound to practise upon.

Precipitated with $(NH_4)_2S$.							
Cobalt. Black.	Nickel. Black.	Iron. Black.	Chromium. Green.	Manganese. Pink.	Uranium. Black.	Zinc. White.	Aluminum. White.
Residue.		Treated with dilute HCl. Solution.					
Cobalt.	Nickel.	Iron.	Chromium.	Manganese.	Uranium.	Zinc.	Aluminum
Fused with borax.	See methods of separating Ni and Co., p. 181.	Boil with NaHO. Precipitate.				Solution.	
Blue.		Iron.	Chromium.	Manganese.	Uranium.	Zinc with H^2S.	Aluminum. with NH^4Cl
		With $(NH^4)^2CO^3$. Residue.			Solution.	White.	White.
		Iron.	Chromium.	Manganese.	Uranium Acetic Acid + K^4FeCy_6		
		Fused with KNO^3 and Na_2CO_3 Dissolve in water. Prec.	Solution.		Brown.		
		Fe^2O^3 + HCl + K_4FeCy_6 Blue.	K^2CrO^4 Acetic acid + $Pb(NO^3)^2$ Yellow.	K_2MnO_4 with HNO^3 + red lead Purple sol.			

Group Fourth.

This group embraces the metals of the alkaline earths, whose carbonates are insoluble in water. They are three in number, barium, strontium, and calcium. The reagent of this group is ammonic carbonate $(NH_4)_2CO_3$, and its solution is prepared by dissolving 1 part, by weight, of the commercial salt in 4 parts of water, and adding to the mixture 1 part of strong ammonia water.

Chloride of barium, $BaCl_2$, gives with ammonic carbonate a white precipitate which is readily soluble in acids. With sulphuric acid it yields a dense white precipitate insoluble in any acid, hence we shall hereafter use baric chloride as a delicate test for sulphuric acid. Hydrofluosilicic acid, H^2SiF_6, which is formed on passing fluosilicic acid into water, forms a white precipitate, in baric salts, which is almost insoluble in water and perfectly so in alcohol. In using this test, therefore, it is well to add a little alcohol. Ammonic oxalate gives a white precipitate of baric oxalate, soluble in mineral acids. Aqueous solutions of the sulphates of strontium and calcium give white precipitates with baric chloride.

Chloride of strontium, $SrCl_2$, gives the same reactions as barium with ammonic carbonate and oxalate. Hydrofluosilicic acid produces no precipitate, and the precipitate with sulphuric acid is very slightly soluble in water, so that its solution may be used as a test for barium. Strontium salts yield a white precipitate with calcic sulphate, or gypsum, but it forms slowly, and the solution should be left half an hour to precipitate. Sulphate of strontium solutions are not precipitated by ammonic oxalate.

Chloride of calcium, $CaCl_2$, differs little from strontium in its reactions. The sulphate ($CaSO^4$) is more soluble, and its solution is precipitated by ammonic oxalate.

The materials of this group are also distinguished by their spectra, and by the colours they impart to a colourless flame. Barium gives a green flame, strontium a carmine red, and calcium a yellowish red. In making this test a clean platinum wire is dipped in a solution of the chloride, and held in the flame of an alcohol lamp or Bunsen burner.

Separating Metals of Group Fourth.

To a solution containing the chlorides of the three metals, Ba, Sr, and Ca, is added a little sal ammoniac, and some ammonic carbonate. The white precipitate is collected upon a filter and carefully washed. It is then dissolved in dilute muriatic acid, and some alcohol and hydrofluosilicic acid added. The barium is thus all precipitated The filtrate is divided into two portions ; to one add ammonia and sulphate of lime solution ; if a precipitate forms in half an hour, the presence of strontium is proven. To the other portion add sulphuric acid and filter. This removes nearly all the strontium and a large portion of the lime. In the filtrate, however, there will remain enough lime to yield a precipitate with ammonic oxalate.

If hydrofluosilicic acid is not to be had, barium may be tested for with sulphate of strontium, or, in acetic acid solution, with chromate of potash.

The following table gives the usual method of separating these metals as above described :—

<table>
<tr><td colspan="3">Precipitated by $(NH^4)^2CO^3$.</td></tr>
<tr><td>Barium.
White.</td><td>Strontium.
White.</td><td>Calcium.
White.</td></tr>
<tr><td colspan="3">Dissolve in HCl and add H_2SiF_6.</td></tr>
<tr><td>Precipitate.</td><td></td><td>Solution.</td></tr>
<tr><td rowspan="3">Barium.
$BaSiF^6$
White.</td><td>Strontium.</td><td>Calcium.</td></tr>
<tr><td colspan="2">Divided in two portions.</td></tr>
<tr><td>I.</td><td>II.</td></tr>
<tr><td></td><td>Ammonia and sulphate of lime. in 30 min.
Strontium.
White.</td><td>Add H^2SO_4
Filter and add ammonic oxalate.
Lime.
White.</td></tr>
</table>

When the metals of this group exist in combination with phosphoric, oxalic, or boracic acids, they are precipitated in group third, and require a special method of separation to be described in a future article.

Group Fifth.

This group embraces magnesium, sodium, and potassium, with the rare metal lithium. With the exception of the first they are characterised by their flame reactions.

Sulphate of magnesium $MgSO^4$, or Epsom salts, yields a white precipitate with ammonia, but if the solution contains ammonic chloride (sal ammoniac), a soluble double salt is formed. In general analysis it is necessary to add ammonic chloride before testing for group third, to prevent magnesium being precipitated in that group. With phosphate of soda NA^2HPO^4, a white precipitate is formed, characteristic of this metal.

Potassic chloride, KCl, in acid and neutral solutions, yields a yellow precipitate with perchloride of platinum. The most delicate way of testing for potassium is to evaporate the solution to be tested with the reagent nearly to dryness on a water-bath, and to treat the residue with a little alcohol, when the precipitate will remain undissolved. Tartaric acid produces a crystalline precipitate in strong neutral solutions. Compounds of potassium colour the flame violet, which appears red through a piece of blue glass. Hydrofluosilicic acid gives a white precipitate in strong solutions.

Sodium salts colour the flames intensely yellow.

Ammonium salts, heated with potash or lime, liberate free ammonia, which may be recognised by its smell, its action on test-paper, and its fumes when a rod moistened with muriatic acid is brought near it.

Analysis of Alloys.

Having become familiar with the reactions of all the principal metals when in solution, the student is prepared to begin the complete analysis of any alloy.

In dissolving a metal or alloy, nitric acid is usually employed. A small quantity of the finely divided alloy is covered with concentrated nitric acid, and gently heated under a hood, in a fire place, or out of doors, for half an hour. If it dissolves completely, gold, platinum, tin and antimony are probably absent. The acid solution may now be placed in a porcelain dish, and evaporated almost to dryness, then diluted and analysed in the manner already described. The separation into groups is conducted according to the table :—

<table>
<tr><td colspan="5">Add HCl to solution.
Solution.</td></tr>
<tr><td rowspan="4">Group I.—Hg, Pb, and Ag.</td><td colspan="4">Groups II., III., IV., and V.
Add H^2S to filtrate.
Prec. Solution.</td></tr>
<tr><td rowspan="3">Group II.—Hg, Pb, Bi, Cd, Cu, As, Sb, Sn, Au, Pt.</td><td colspan="3">Groups III., IV., and V.
Add NH^4HO and $(NH^4)^2S$.
Prec. Solution.</td></tr>
<tr><td rowspan="2">Group III.—Fe, Co, Ni, Mn, Zn, Al, Cr, U.</td><td colspan="2">Groups IV., and V.
Add $(NH_4)_2CO^3$.
Prec. Solution.</td></tr>
<tr><td>Group IV.—Ba, Sr, Ca.</td><td>Group V.
Mg, K, Na, Li.</td></tr>
</table>

THE MACHINE ROOM AT THE VIENNA EXHIBITION

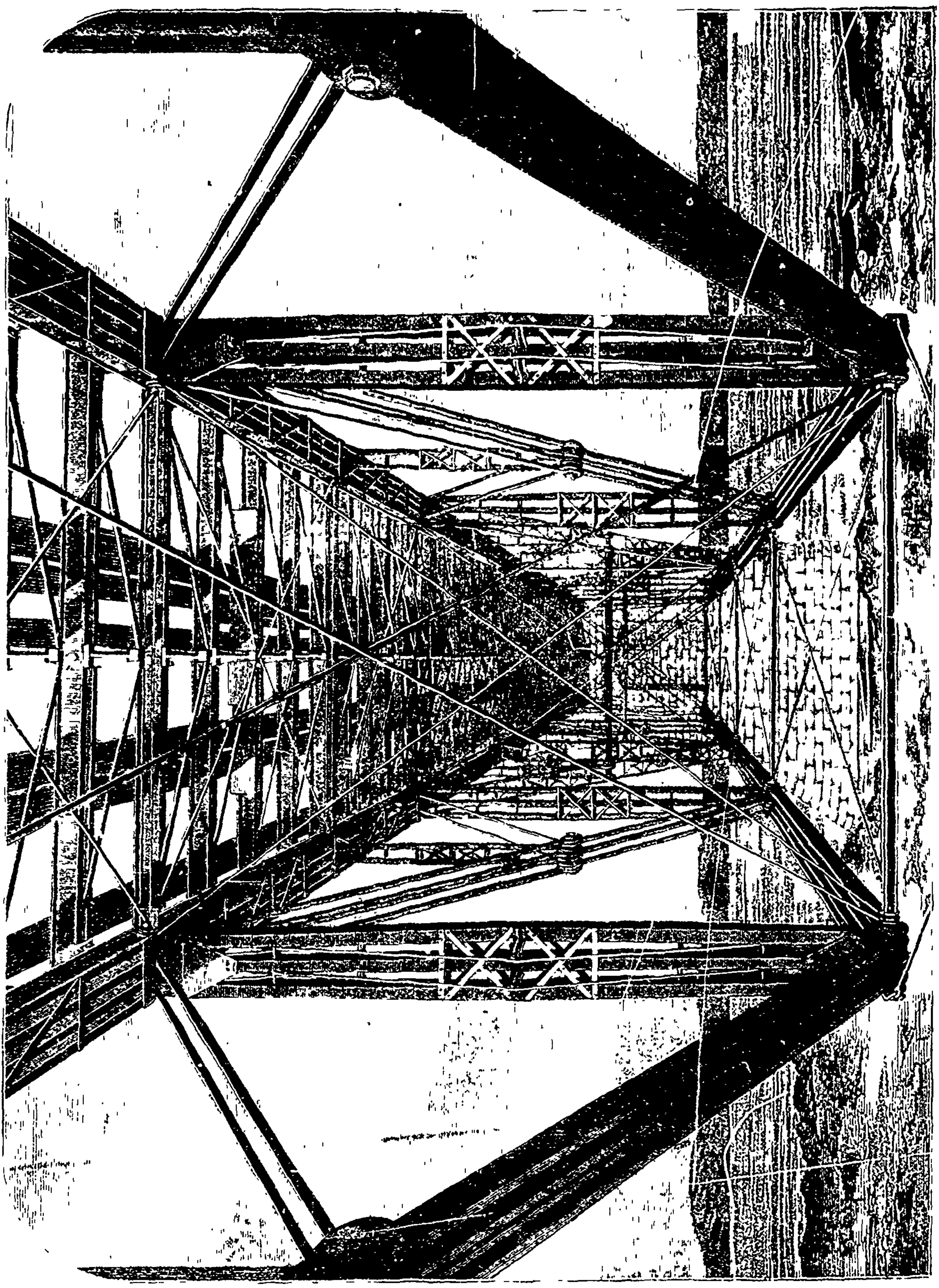
Our engraving on page 295 is from the *Illustrirte Zeitung* of Leipsic and represents a view in the machinery department at Vienna. The large machine on the right is a double steam engine of one hundred horse power, by Sigl, of Berlin. Near to this is the great sugar refining apparatus by Heckmann, of Berlin.

The sign *Oesterreich* at the left, signifies Austria ; that under the banners, *Deutsches Reich*, signifies German Empire.

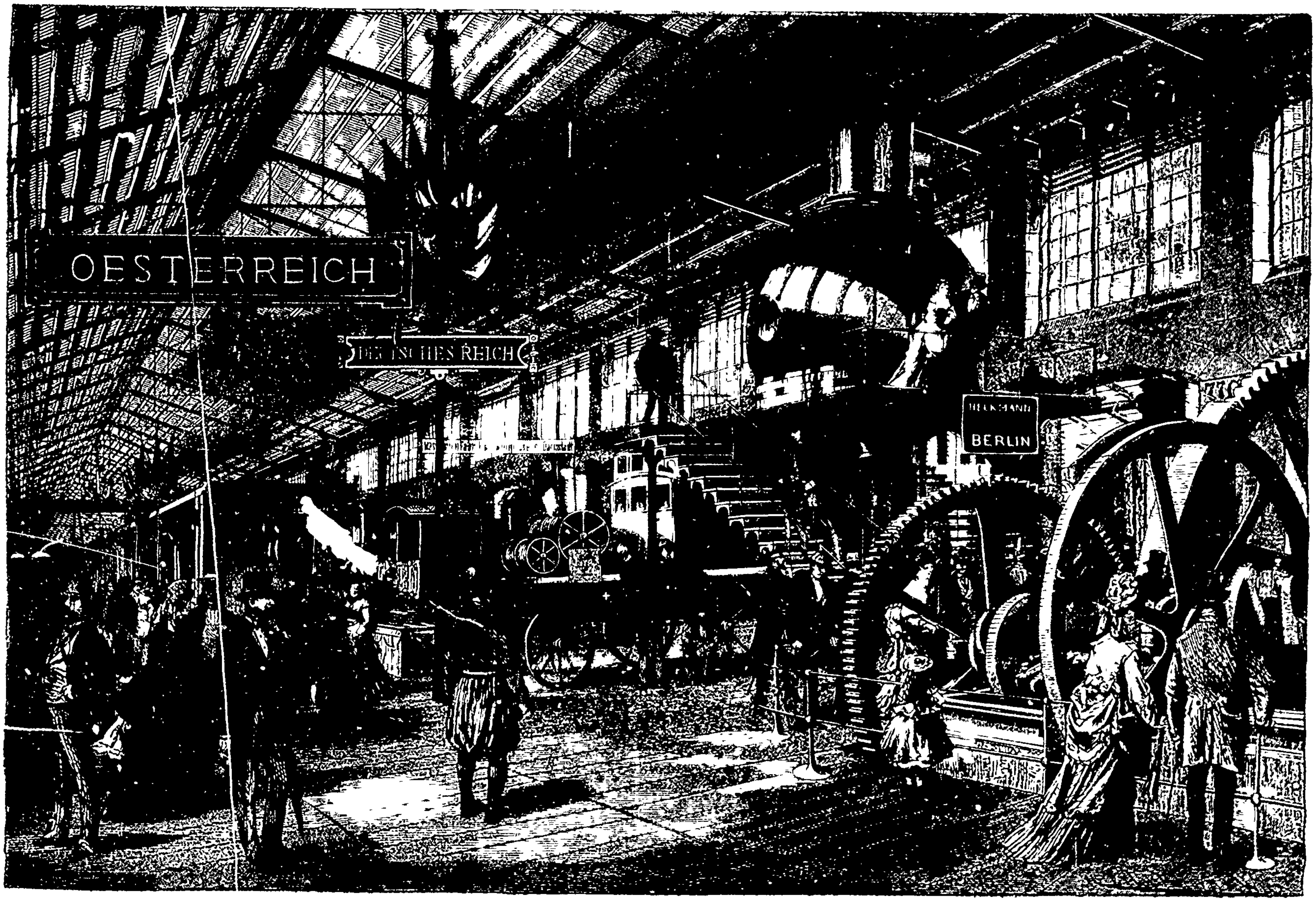
THE MONONGAHELA BRIDGE.

The Pennsylvania Railroad crosses the Monongahela river at Pittsburg by a bridge of eleven spans, amounting to a total length of 1622 feet. The superstructure was at first constructed of timber with the exception of the channel span, 260 ft. long which was built of iron. The East span has lately been replaced by an iron structure which we illustrate on page 294 The illustration is from the columns of *Engineering*. The following are the principal dimensions:

		ft.	in.
Length of span, centre to centre of end pins....		182	0
Number of trusses in span	2		
" main panels in each truss.......	6		
" sub " "	12		
Length of main " "		30	4
Distance centre to centre of trusses............		19	0
Height of truss, centre to centre of chord pins...		22	10
Height from top of masonry on bridge seat to base of rail..............................		4	11



LAST SPAN OF THE MONONGAHELA BRIDGE, PENNSYLVANIA RAILROAD.



VIENNA EXHIBITION.—VIEW IN THE GREAT MACHINE HALL

THE EMPLOYMENT OF DYNAMITE IN LAND CLEARING.

A number of important and interesting experiments with this object were recently performed in the fields and woods of the Calder estate of Sir W. Stirling Maxwell, near the Forth and Clyde Canal. The operator, Mr. Donnie, after explaining the *modus aperandi* of the powerful explodent he was about to use, turned his attention to the root stumps of a number of trees that had recently been cut down. By means of an auger, a hole about one and a quarter inches diameter was bored vertically to a depth of twelve or fifteen inches in one of the stumps, and when it was found to be quite through the wood of the stump, it was continued by means of a pinch to a depth of fully two feet. Two or three cartridges were put into the bore-hole and firmly driven home by means of a wooden rammer. Then a small cartridge, called a "primer," prepared with a cap-tipped fuse, was dropped in and rammed home and the hole was stamped or stemmed by filling it to the top with water, care having in this case been taken to put a luting of clay round the junction of the cap with the fuse. The latter was fired, the observers betook themselves to a respectful distance, and in a brief space of time a great upheaval occurred. The noise of the explosion, however, was in a great measure smothered When the members of the party returned to the spot, they found the stump to be rent in a most extraordinary manner; but the general opinion was that the bore-hole had been made so deep that the energy of the explosion had spent itself too much upon the subsoil and too little upon the wood. The stump next operated upon was bored to a less depth, and the result of the blasting process was more effective. In either case a few strokes with an axe, by way of severing the principal root members, would be quite sufficient to leave the woody masses in such a condition that they could easily be dragged out and lifted away. It was suggested that the operation of piercing with an auger should be dispensed with in blasting the next root stump, so as to do the work with as great economy of time as possible. In this instance, therefore, the pinch was brought into requisition instead of the auger, and by means of it a hole was driven horizontally inwards between two of the principal root-members to about the centre of the stump. The hole was charged and fired in the usual way, the result being a much greater amount of eruptive and disruptive action, with a smaller expenditure of time and labour. One or two other root-stumps of large size were blasted in the same way, and it was clearly demonstrated that, under certain circumstances, dynamite could be employed to more advantage immediately underneath rather than in the mass of material to be operated on.

The next experiments were with boulder stones, all of which were of very hard, tough, and compact whinstone. The first boulder that was tried was out in "the open." One small cartridge, properly prepared, was laid on an inclined face of the stone, then covered loosely with a sod, and fired. No rupture resulting from the shot, another was resorted to, a shallow groove on another part of the boulder being selected for laying on the charge. The latter was loosely covered, as before, and fired, and such persons as had not seen a similar experiment previously were greatly surprised at the destructive effect of the explosion, when the small amount of the charge was considered, together with the fact that no bore-hole was driven into the boulder. Other two large boulders were next attacked in an adjoining field that was being drained, the stones having being met with in digging the drains. The first of them was embedded in tolerably firm ground, and on being fired *in situ*, without any bore-hole, was almost crumbled in dust. Owing to the fact that the other boulder was embedded in a deposit of sand, the small charge of dynamite used at first seemed to have spent itself in burying it to a much greater depth in the sand; but on employing a somewhat larger charge, besides being buried still deeper in the sand, the boulder was so thoroughly broken that it might well have been used for road metal.

Mr. John Scott, of the Glasgow Canadian Land and Trust Company, after seeing the experiments, said he could use the new blasting agent with great effect and economy in land-clearing operations in Canada.—*Iron.*

A $15,000 two-set woollen mill has been erected in Winnipeg. A portion of the machinery was sent up from Galt.

THE TRANSIT OF VENUS.

No. II.

Having looked briefly at the question of a transit of Venus in its general aspect in our last article, we now pass on to review the operations that are being undertaken by England and other nations in the coming transit of December, 1874. In order to make the matter clear it is necessary to notice the features of this particular transit. We have already pointed out that occurring in December, the south pole of the earth is inclined towards the sun. Figs 1 and 2 show the hemisphere which is presented to the sun at the commencement and termination of the entire phenomenon, which will, of course, be the region of daylight. However simple it may seem, it is desirable to be quite clear about the matter. Any person looking down on these figures may note that their head occupies the position of the sun, so that an observer at any station near the centre of the map will see the phenomenon high over head, and any one near the edge will see the sun very low; for it is obvious that a figure standing on the globe at the part just turning away out of sight, would not see us over his head; on the contrary, we should appear to sink, and disappear below his horizon. Any astronomical observations suffer from the effects of refraction when made from a body near the horizon; consequently, other things equal, a station near the centre, or at all events, not near the edge of the daylight hemisphere, would be best.

Other things, however, are not equal by any means. We have to select stations so placed as to obtain the best record of the effect of parallax, in other words, that will give us the best base line, and this with respect to one of the methods we have mentioned, viz., Halley's or Delisle's. Nevertheless we may bear the principle we have enunciated in view throughout, that it is desirable not to have the sun close to the horizon; we put the matter moderately, because we shall see that the best base lines bring us towards this, in other respects, undesirable position. but the evil must be kept in view, and, if possible, avoided in its extremes in the selection of stations.

As to Halley's method, then, it has been explained that for this the entire double observation, that is, ingress and egress, must be made from the same station, the comparison of the duration of the phenomenon being the means employed to obtain the object in view. It follows, then, that stations must be taken which appear on *both* the maps we have given; next, they must, from comparison, form pairs, the members of which must differ greatly in latitude; if possible one station should be taken nearer the pole presented towards the sun, such that the commencement of the transit may be visible a little before sunset, and the night short enough to enable the termination of it to be seen after sunset. The 1874 transit may be said to last only about four hours twelve minutes of solar time, consequently the station we indicate, in spite of its lengthened duration, cannot be allowed a night of as much as four hours; which means that it must be near the edge of the region of perpetual daylight, we may say within 30 deg. of the south pole. Now the south polar continent being the only land that exists in this latitude, the observations would be made under great difficulties, and on this occasion it has been decided not to make the attempt.

In 1882, however, matters will not be better. unless more knowledge of the South Seas has been acquired so that the experiment of leaving observers to be frozen up, to live for many months on their own resources, may be made with a good prospect of the preservation of life.

We have explained how an observer, on what we may call the reverse side of the pole, gets a lengthened duration of transit by finding himself in succession in the positions of maximum acceleration and retardation. Professor Forbes in his paper gives the following as an illustration: "A person standing still sees a carriage pass between him and a distant house; the carriage will take a certain time to pass the house, but if he be also moving, and in the same direction with the carriage, the transit of the carriage will take longer, but if he move in the opposite direction to the carriage the transit will take a shorter time. If, then, two persons be seated on opposite sides of a merry-go-round, so that at the time the carriage is passing, one observer is moving with the carriage and the other in the opposite direction, then one observer will see the lines lengthened and the other shortened. Now the world is such a merry-go-round, consequently since Venus moves in a path apparently from east to west, an observer on the near side of the earth meets her, and to him her transit is shortened, while one on the reverse side of the pole goes with her, and to him her time of transit is proportionately lengthened.

There is, however, the other cause of variation in duration of transit to be taken into account, namely, the variation in the length of the chord described by the path of Venus across the disc of the sun. A southern position on the earth causes Venus to be seen further north—say along V_1 instead of the lower line, in Fig 3—and *vice versâ* with a northern position; consequently, the 1874 being a northern transit, a station on the reverse side of the pole, although it sees the transit retarded, sees Venus describe a chord so much shortened—V_1 being obviously shorter than its fellow—that the entire duration instead of being increased is *lessened*, and that by so much that the difference in time between transits seen at good stations chosen for Halley's system, is actually greater than is calculated for 1882, although, then, the transit being across the southern part of the sun's disc, the two causes act together instead of in contradiction to each other, this is because the path falls nearer the northern limb for 1874 than the southern for 1882, consequently the difference in length of the apparent path is much greater. We notice this feature merely as a very peculiar one in this pair of transits. A south polar station for Halley's method is desirable if it could be obtained in both, though it may turn out to be impossible for either—certainly, with our present knowledge of the south polar continent, it is impossible for 1874. In its fullest manner, then, Halley's method is not carried out. Nevertheless, there will be a considerable difference in the time of duration observed from certain stations. For example, New Zealand and Kerguelen's Land, or even Tasmania and the South of Australia, will give a fair comparison with stations in China. All these being seen in both maps, it is clear that the entire transit is visible from all, and the difference in latitude is in some cases as much as 80 deg.

If Delisle's method, however, is ever to be turned to account, 1874 is the time; and this method—which had to be employed after the failure in obtaining double observations in 1761—may now get a full trial. We have pointed out that for Delisle's system we require only the single observation of either ingress or egress observed at pairs of stations whose distance apart furnishes a base line to measure from, and that the order of time at which the observation was made, combined with the difference in longitude and the known rate of motion of Venus, furnishes the means of measuring from our base line. The object is then to obtain such stations that either phenomenon—ingress or egress—should be seen at the two places at times differing from one another as much as can be caused by their respective positions on the earth. As explained in our previous article, an observer at the station corresponding as nearly as possible to—or rather, brought opposite—the point on the circumference of the sun where Venus is first seen, observes the ingress accelerated to the maximum extent (*vide* Fig. 1), and an observer near his antipodes sees it with the maximum retardation. The line joining these two indicates, therefore, the best direction along which to fix Delisle's stations for ingress, and if possible they should be near the extremities. The path of Venus is shown across both Fig. 1 and Fig 2—that is, line on the earth opposite to her apparent path across the sun. In Fig. 2 is shown the point where she leaves the sun, from which, again, may be drawn a parallel line to a point near the antipodes, the extremities giving maximum retardation and acceleration respectively of the phenomenon of egress. The actual southern ends of this line are just past the visible horizon in the two figures. The factor giving the value of the parallax of any place depends on the cosine of the arc of the great circle intercepted between it and the point giving maximum parallax. This may not at once sound intelligible, but if an imaginary line be drawn connecting the two points giving the maximum parallax, it will be seen that the piece of the base line made available by any station is found by dropping a perpendicular from that station on to this base line, and that the available piece thus obtained is the cosine we have just given, which was Sir G. Airy's expression for it in his paper on the transits of 1874 and 1882, read before the Royal Astronomical Society.

In our selection of stations, then, for Delisle's method, we should seek to have them towards the extremities of this base line, both for ingress or egress, and if possible nearly on the line, because obviously the height of the sun depends on the distance of the station from the edge of our visible hemisphere, and we get the height of the sun at a maximum for any particular length of base if the station is actually on the line of best parallax.

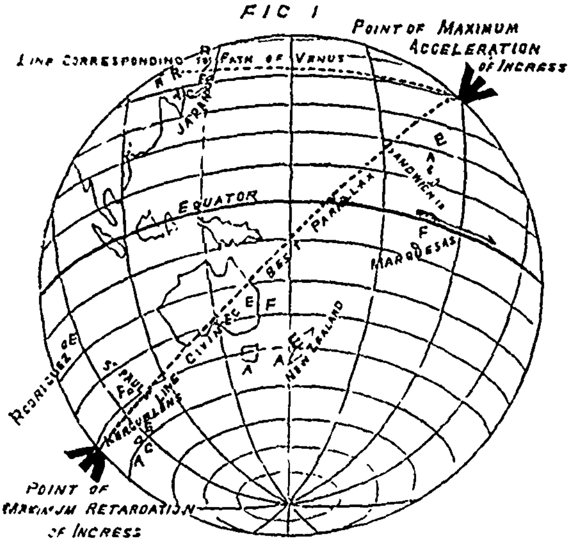
The actual stations chosen by Sir G. B. Airy are the following:— Alexandria, Rodriguez, the Sandwich Isles, New Zealand, and Kerguelen's Island. Of these, Kerguelen's Island, New Zealand, and Rodriguez will be found on both maps, and may witness the entire transit. The two former, if balanced by some northern station, are good for Halley's method, and Rodriguez is of some use for it. For Delisle's method, we have for ingress the Sandwich Isles, coupled with Kerguelen and Rodriguez; and for egress we have Alexandria coupled with New Zealand and Kerguelen's Island. It would be difficult to pick five stations fulfilling better functions for this transit, as we shall see by comparing those of foreign Governments with them. France may probably have Marquesas, St. Paul's, Sidney, Pekin and Yokanama. Of these, it may be seen that St. Paul's, Sidney, and Pekin may serve for Hailey's method. Marquesas and St. Paul's are pretty good for ingress but the egress does not seem well provided for. Sydney is available for its acceleration; but it seems strange that the French should not have proposed to go to Egypt or Syria for a retarded egress station. America has Tasmania, New Zealand, Kerguelen's Island, China, and the Sandwich Island—the last only a Delisle station proper. Germany as far as we gather, has Kerguelen, China, Japan, and probably others.

The Russians may be said to have confined themselves to the class of observations for which they have special opportunities, that is to say, stations in Northern Asia, near China, for Halley's method, and Western Asia for egress retarded by parallax. The number of their stations is very great, in fact they have between twenty and thirty small stations, perhaps. They will have the sun very low in most cases, and their work in winter must be very severe; they certainly deserve the thanks of other astronomical nations for filling up the place they occupy. A telegraph line is to give the longitude to them, and thus save some labour. The English stations we have mentioned are those equipped and sent out from Greenwich, but in addition to these the English observatories at Melbourne, Sydney, India, and the Cape will, it is hoped, do good work, being all well placed except at the Cape. There is to be a special station, under Colonel Tennant, equipped for India, but there has been great delay in its preparation, and absurd suggestions have made its completion now rather a matter of difficulty.

Lord Lindsay has made up a wonderfully complete equipment for a private expedition to the Mauritius. This he means to conduct himself with the assistance of Mr. Gill. He has made preparations for many methods of observing and recording the phenomena accompanying the transit, the details of which could not be here discussed even were they all known to us, which is not the case.

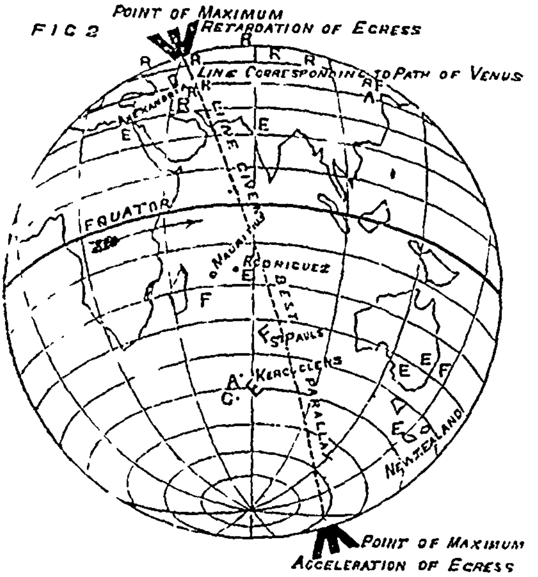
To come to the actual observation of the transit, we have said that the moment of ingress and egress are the points to notice; but in the case of similar phenomena—for example, the transits of Jupiter's satellites across the planet—it is by no means easy to record the moments of contact accurately; it is always a matter of dread that Venus transit observations might be rendered valueless from a similar difficulty. Great trouble has been caused by differences in the manner of recording or observing previous transits, though, thanks to the labours of Mr. Stone the maze of difficulties has been, in a great measure, unravelled. With regard to the coming transit, every means should be taken to secure uniformity in the method of work followed by each observer. The observation of the external contact will probably be attempted by Lord Lindsay and others, but the internal contact is, beyond all question, the principal matter. The five expeditions sent out from Greenwich may be said to be very completely equipped, and in some instances they may be called double stations, taking almost a double set of instruments, the regulator equipment of each station consisting of a 6 in. equatorial, and a 4 in. telescope-mounted for carrying to a distance so as to get a second chance of seeing the transit, obtaining time from the main station—a transit instrument, an altazimuth and a photoheliograph, with their huts and piers, besides clocks, chronometers, &c. The work may be seen to come under two heads: (1) the position of the station—i. e. its latitude

FIG 1



(Showing portion of the earth presented to the sun at the moment of ngress. E, English Stations; F, French Stations; G, German Stations; A, American Stations; R, Russian Stations.)

FIG 2



howing portion of the earth presented to the sun at the moment of egress)

FIG 3.

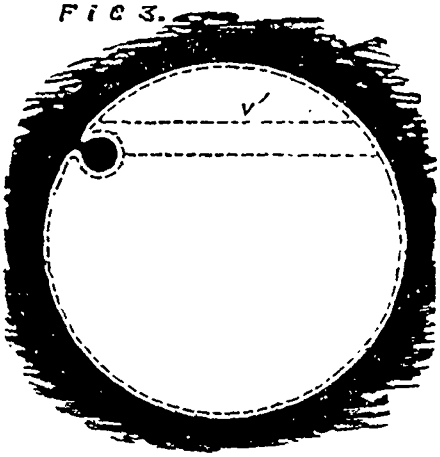


FIG. 4.

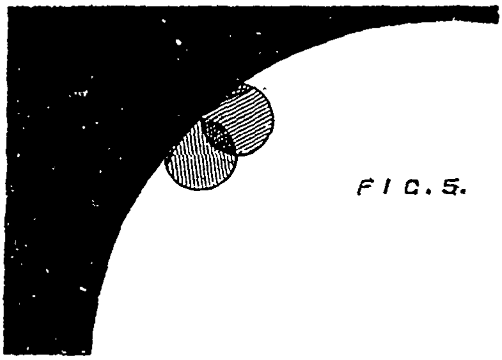


FIG. 5.

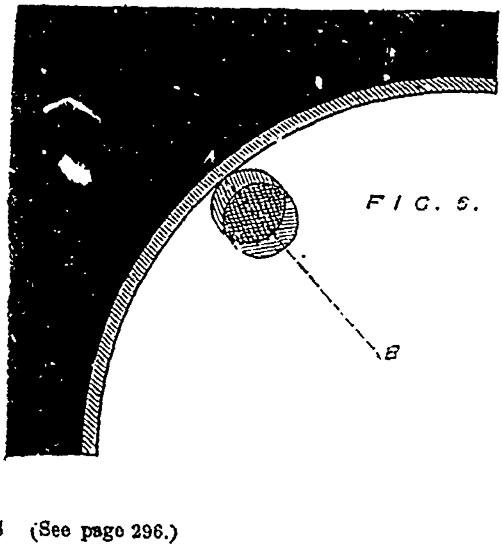
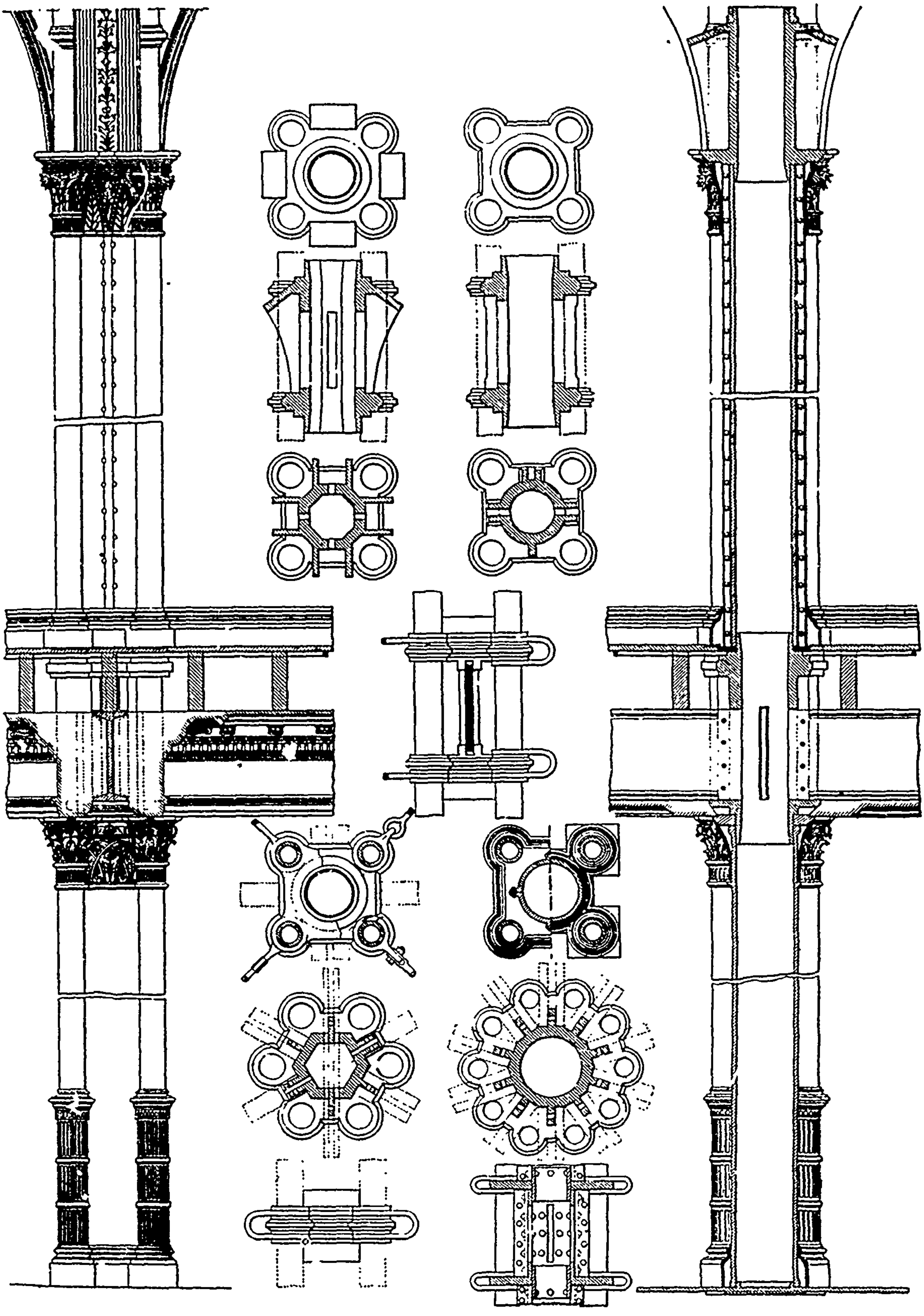


FIG. 6.

THE TRANSIT OF VENUS (See page 296.)



KAY'S COMPOUND IRON COLUMNS AND CONNEXIONS. (See next page.)

and longitude—must be obtained with accuracy; (2) the transit must be accurately recorded both by astronomical observations and by photography. It is not difficult to obtain the latitude, the local sidereal time being got with the transits, the altazimuths should easily dispose of the question. The longitude is obtained in different ways according to the position of the station. At Alexandria the Greenwich time may be telegraphed, and a comparison with the local sidereal time will at once give the longitude, the difference in time having merely to be converted into degrees, minutes and seconds of arc. At Rodriguez and the Sandwich Islands the longitude will be obtained by transits of the moon and moon-culminating stars, and by observations of the moon's altitude with the transit and altazimuth respectively. We have fallen into expressions that are not clear to those who have not studied astronomy. The explanation is not difficult, however. Suppose the moon to cross Greenwich in a certain relative position to a near star one night, and on the following night to pass nearly three-quarters of an hour further back, it is obvious that she had fallen back three-quarters of an hour in her apparent journey round the world. Suppose then she is observed to transit at a station West of Greenwich, one quarter of an hour behind her first recorded place at Greenwich, it follows that this station is one-third of the distance round the world, i. e. 120 deg. west longitude, and so in proportion for any other result. This is the principle on which the moon and moon-culminators are used With the altazimuth the moon is observed in other parts of the sky, so that results can be obtained on nights when she is not seen to cross the meredian, but the computation of the longitude becomes rather a complicated process. New Zealand and Kerguelen's Island being far from the equator, it is better to record the moon's place by her motion in azimuth than in altitude, the moon skirting low, near the horizon. Consequently, the altazimuths furnished for these two stations have special attention given to the graduation and means of reading of the azimuth circle, which in the three other instruments is only used incidentally, for setting, &c.

Of the equatorials, three are old, well-known instruments, the others are new ones designed and made by Simms. Alexandria has the Lee equatorial with which Admiral Smyth did such good work and which is described in his celestial cycle. Kerguelen's Island has the Corbett and the Sandwich Isles the Naylor equatorial: The whole of the transits and Altazimuths are turned out by Simms; the workmanship of these it is hardly necessary to say is excellent. The 4 in. telescopes are also Simms' work. The photoheliographs are, of course Dalmeyer's—they are mounted equatorially, being an improved of [illegible] Kew instrument. The duty of the photoheliograph on the transit expedition will be to take a rapid series of photographs of Venus during the transit, thus recording her actual apparent path across the sun's disc at stations where a large proportion of the transit is visible. At all stations as many photographs as possible, while the phenomenon of ingress or of egress lasts, should be obtained. These photographs will have to be taken by the help of some special arrangement for giving the required speed, which has yet to be arrived at. Jansen's method is proposed, by which only a spot on the plate is exposed large enough to take in Venus and a little of the sun's limb; the plate being turned through an angle in its own plane after each exposure, so as to get a circle of photographs round the edge of the sun's disc, showing Venus' movement by her position at each short interval of time, say every two seconds.

The Government arrangements still wait completion on certain details. The whole of the solar eye-pieces and double image micrometers are not yet finished, but regular practice with the double-image micrometer has been commenced by the officers and other observers of the expedition at Greenwich on the automaton transit described in a previous number.

The process of observing an entire transit with the double image micrometer may be described as follows:— When the planet is about half on the sun the two images are brought as in Fig. 4, the moveable image being brought into contact with the fixed one along the line A, B, both above and below it repeatedly. This gives the zero reading of the micrometer, as well as the apparent diameter of Venus. This operation may last eight or nine minutes. Then commences the measurement of the cusps (*vide* Fig. 6), the times of measurement being carefully noted. The apex of the cusp, or overlapping parts of the two images is brought to internal contact with the limb of the sun. A little reflection will show that this amounts to a measurement of the chord across Venus at the points where its limb intersects that of the sun. The length of this chord diminishes in a rapidly increasing rate, and thus its measurement becomes more valuable, and the position it indicates becomes affected in a less degree by errors in estimation each moment up to the time of contact. Probably five or six minutes will be all the time available for this work. As Venus comes close to internal contact the double-image is brought to a single one by setting the instrument at zero, and the moment of contact is observed, that is, the separation of the black drop or ligament.

The measurement of the distance between the limbs of Venus and the sun comes next (vide Fig. 6); the sliding motion of the double image being made to act along the line A, B, and the moving image being brought on each side of the fixed one, until the planet moves far on to the disc. As the phenomenon of egress approaches, the above operations are repeated in reverse order, that is to say, the observations of limbs, contact, and cusps follow in succession.

KAY'S COMPOUND COLUMNS.

We illustrate on page 299, a system of compound iron columns, introduced by Mr John A Kay, of Saint Louis, formerly of the Baltimore Bridge Company, Baltimore, United States, the object of which is to reduce cost by adopting simple standard patterns and connexions. How this is attempted will be seen clearly from the illustrations, which show the mode of coupling the lengths together, and of making the cross girder attachments. In three of the detached figures, wrought-iron coupling plates are shown above and below the joint, to preserve the structure in case of sudden fracture. As will be seen in the illustration, these columns may be formed of wrought and cast iron combined, or they may be of cast iron entirely.

The Mississippi and Dominion Steamship Company (limited), more popularly known as the "Dominion Line," running from Liverpool to Canada *viâ* Belfast, have just added the seventh steamer to its fleet, bearing the title of the Dominion, which will be commanded by Captain Bouchette. She made her trial trip on the 3rd inst. She has been built by Messrs. Archibald M'Millan and Son, Dumbarton. Her dimensions are:—length. 345ft; breadth, 38ft.; depth, 32ft.; her tonnage being 3176 gross, and 2031 net register. She has four decks, one of which is iron covered with wood. The Dominion is classed 100 A1, the highest at Lloyd's; but she is actually in strength greatly in excess of the requirements of this class. She will carry 3600 tons weight. She has accommodation for 50 saloon and 1000 steerage and intermediate passengers; and possesses very lofty 'tween decks, which are exceedingly well lighted and ventilated. She has flush upper deck, unencumbered with houses, affording ample promenading space for passengers. On this deck is a smoking room, handsomely fitted up, adjoining the bar; and the room forming the entrance to the saloon is designed as a lounge for ladies. The saloon is magnificently decorated, the panels being in maple, and the substantial comforts of passengers are carefully studied. Commodious accommodation is wisely provided for officers, engineers, and others, under the deck amidships, including bathrooms, and there are also permanent hospitals for emigrants—a prudent precaution happily rarely needed. The Dominion is fitted with compound engines of 400-horse power nominal, or about 1800-horse power effective, constructed by Messrs. J. Jack, Rollo, and Co., Victoria Works. The Dominion, which was lying in Huskisson Dock, cleared out shortly after eleven o'clock on the 3rd, the work being very quickly and efficiently done under the superintendence of the dock officials; and, after receiving a pilot on board, she proceeded about ten miles beyond the North-west Lightship, near to point Lynas. The engines worked with great steadiness. During the run back to Liverpool the steamer's speed was tested by the measured mile, which she made in six minutes forty seconds against a four-knot tide, the revolutions of the engines being at the rate of 58 a minute. This gave a speed of about thirteen knots an hour. The whole trip was eminently satisfactory.—*Engineer.*

SCIENTIFIC NEWS.

A PUZZLE for horticulturists has been forwarded by the French Bishop of Canton to the *Jardins d'Acclimatation* in Paris, in the shape of a plant which changes color three times a day. There is nothing remarkable in the hues of this vegetable chameleon, but the regularity with which the changes take place is extremely curious.

THE *Société d'Encouragement* has offered the following prizes for chemical discoveries:—Best commercial process for the preparation of oxygen gas, 2000 fr., 1874. Artificial preparation of the fatty acids or of matters allied to wax, 4000 fr, 1874. Disinfection of gas residues, 3000 fr, 1874. Disinfection and prompt clarification of sewage, 1000 fr, 1875. Ink not attacking metallic pens, 1000 fr, 1875 Economical production and application of ozone, 3000 fr., .875. Fixation of atmospheric nitrogen, either as nitric acid, ammonia, or cyanogen, 2000 fr., 1876. Artificial production of graphite, suitable for lead pencils, 3000 fr., 1877. Artificial preparation of a compact black diamond, 3000 fr., 1877. Industrial application of oxygenated water, 2000 fr., 1878.

A REMARKABLE paper has recently been contributed to a German magazine, by Prof. Mohr, showing not only that the sap does not freeze in trees and plants which live through hard winters, but also the reason why it does not freeze. He says that though it is true water, as we generally see and understand it, freezes at thirty-two degrees, it does not do so when its particles are finely divided. Tropical plants have large cells, and these are the ones in which the sap freezes; but in plants with very small cells in which the liquid particles are finely divided, there is no freezing of the liquids until after the structure has received injury of some sort. This is true, he says, of insects and insect pupæ. They never freeze; but cut one apart, soon after the humors solidify, and on thawing life revives.

THE French are determined to do their best in the now rapidly approaching Transit of Venus. They will have stations at Yokohama, Amsterdam Island, St. Paul in the Indian Ocean, Chee-foo, Pekin, Noomea, Shanghai, Tahiti, the Macdonald Islands, and the Marquesas. Photographing will form a principal feature of the expeditions, and in order to insure as far as possible the success of this branch, a small observatory has been erected at the Luxembourg for the purpose of experimenting and agreeing upon the best process of manipulation in order to obtain photographs of the requisite delicacy.

IN the *Bulletin* of the Chemical Society of Paris, there is a description of a curious process for obtaining colouring matter from organic bodies. Any vegetable matter—such as sawdust, bran, humus, tannin, aloes, &c.—is acted on by sulphur and caustic soda in a furnace. Sulphuretted hydrogen is liberated in large quantities, and the vegetable substance, whatever it may be, is rendered soluble in water, to which it imparts a strong colour, varying with the substance employed. These solutions are employed as dyes, which are fixed by passing the fabric through boiling bichromate of potash.

THE following information will be of interest and importance to the possessors of fir trees, of which there are many in Scotland. In the juice of fir trees, between the wood and the bark, there is a crystalline substance called coniferin. This is what chemists call a glucoside—that is, a substance which readily breaks up into grape sugar, and some other variable substance. When this coniferin is acted upon by oxidizing agencies, it is easily converted to vanillin, or the chemical principle of vanilla. A few grains of this chemical principle is sufficient to flavour at least a dozen ice puddings. The juice of an ordinary sized fir tree contains enough coniferin to make five guineas worth of vanillin. This last triumph of chemistry is the result of researches made in Dr. Hoffman's laboratory at Berlin, and communicated in a letter which has been placed at our disposal by a gentleman who was formerly professor of chemistry in Edinburgh.

IN answer to numerous inquiries, Mr. S. P. Sharples, Massachusetts State assayer, has given in the *Boston Journal of Chemistry* a brief description of the process of nickel plating The patent is still before the courts, and no decision has been reached in regard to it The double sulphate of nickel and ammonium, which is the salt that is generally used, may now be had in commerce almost pure. It is manufactured on a large scale by Mr. Joseph Wharton, of Camden, N J., who controls the American nickel market. Cast nickel plates for anodes may be obtained from the same source, the anodes should considerably exceed in size the articles to be covered with nickel. Any common form of battery may be used. Three Daniell's or Smee's cells, or two Bunsen's, connected for intensity, will be found to be sufficient. The battery power must not be too strong, or the deposited nickel will be black. A strong solution of the sulphate is made and placed in any suitable vessel; a glazed stoneware pot answers very well if the articles to be covered are small. Across the top of this are placed two heavy copper wires, to one of which the articles to be covered are suspended, to the other the anode. The wire leading from the zinc of the battery must then be connected with the wire from which the articles are suspended, the other battery wire being connected with the anode. In order to prepare the articles for coating, they must be well cleaned by first scrubbing them with caustic soda or potash, to remove any grease, and then dipping them for an instant in *aqua regia* and afterwards washing thoroughly with water, taking care that the hand does not come in contact with any part of them. This is accomplished by fastening a flexible copper wire around them, and handling them by means of it. The wire serves afterwards to suspend them in the bath. If the articles are made of iron or steel. they must be first covered with a thin coat of copper. This is best done by the cyanide bath, which is prepared by dissolving precipitated oxide of copper in cyanide of potassium. A copper plate is used as an anode. After they are removed from the copper bath, they must be washed quickly with water and placed in the nickel bath; if allowed to dry or become tarnished, the nickel will not adhere. Great care must be used through the whole process to keep all grease, dust, or other dirt from the articles to be covered, or else the result will be unsatisfactory. The whole process is one of the most difficult that is used in the arts, it being far easier to gild, silver, or copper an article than to nickel it; but if due care be taken the results will amply pay for the trouble.

ANOTHER BALLOON EXPEDITION.—The failure of all North Pole expeditions to discover the secret of the Arctic regions has stimulated the Aeronautic Society of Paris to attempt an Arctic balloon voyage. Extravagant as the notion may appear, it is not more extravagant than Prof. Wise's project of crossing the Atlantic Ocean in a balloon. One advantage of an aerial North Pole voyage is the temperature of the Arctic regions, which prevents the escape of gas from the balloon to such a degree that it is supposed to be quite feasible to construct a balloon which will last a three month's voyage. Another advantage is the absence of darkness in the Northern regions. If the balloon leaves in the summer time, the sun will illumine the heavens during the whole trip. Then, again, the permanency in the direction of the winds around the regions of the North Pole would be another point in favour of the trip to the North Pole over that across the Atlantic. The size of the proposed balloon is fixed at about 18,000 cubic metres. It is calculated to carry ten men, three months' provisions, apart from the ballast, a number of instruments, an anchor, and a dragging rope, which will touch the ground should the balloon sink too near to the earth. An ingenious arrangement has also been made to prevent the balloon from rising higher than 800 metres, or about 2,500 feet. The boat of the balloon is to be lined with sheepskins and heated with lamps, so that even if the temperature should fall to 32 deg. below zero outside, it will be 5 deg. above zero inside. A vessel is to carry the men, the balloon, and the ingredients for the manufacture of the necessary amount of gas to about seventeenth degree of latitude. This will leave a trip of about 300 miles to the North Pole for the balloon to accomplish, and the voyage there and back could be made within twenty days. Everything, however, is to be prepared for a full three months' trip. The enterprise is exciting unusual interest amongst the scientific men of Europe, and is, indeed, one of the most wonderful schemes ever conceived by the human mind.

A LARGE number of sewing machines are sent from Canada to South America. One house proposes to send an Agent to Lima.

LUMBERING ON THE SUSQUEHANNA RIVER, PENNSYLVANIA.—MAKING UP RAFTS.

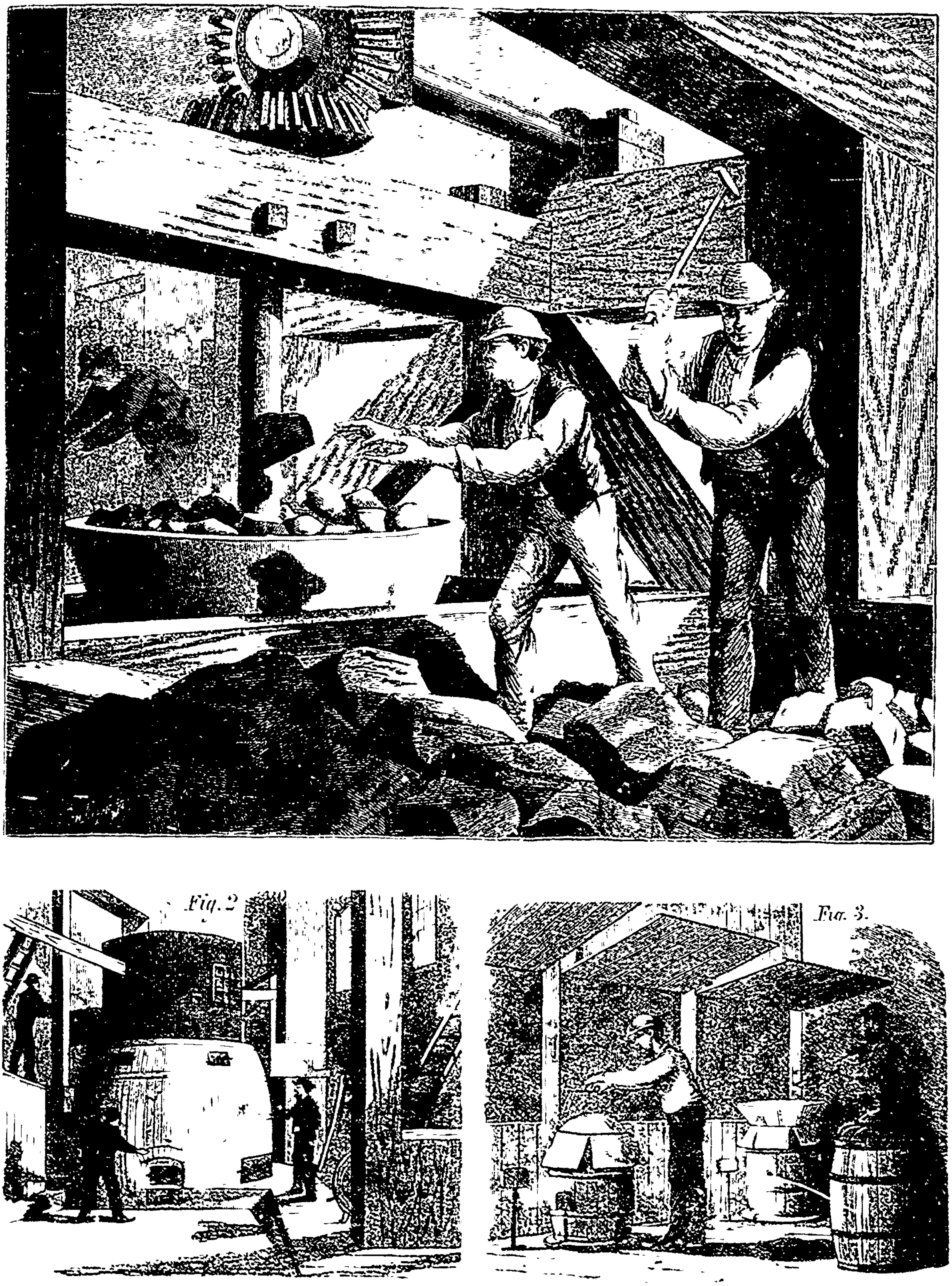


Fig. 2

Fig. 3.

THE MANUFACTURE OF PLASTER OF PARIS

MECHANICS' MAGAZINE.

MONTREAL, JANUARY, 1874.

ILLUSTRATIONS :

CONTENTS :

CANADIAN WOODS.

Canada has often been called, and is undoubtedly looked upon very much as, a *wooden* country. This is to a great extent true, witness our vast exports of lumber, our wooden-rail railroad, our wooden houses and sidewalks, the saw-mills on almost every stream—almost the only piece of iron in which is the saw. It is by no means a bad thing, this wood; but do we make enough, or the best of it? We are led into making these remarks by certain items which have recently appeared in the scientific and daily press. Some of these passages force upon the mind the fact that there are yet undeveloped in Canada, resources for several flourishing branches of industry. There is a considerable trade done now in the New England states in the exportation of curry-comb and other handles to Birmingham. Now this trade would be eminently suitable to Canada. We have more and better wood, we have cheaper labour, we can send the freight more cheaply. Such an industry as this could not help flourishing if it were once established in such favourable localities as the Eastern Townships or on the north shore of the St. Lawrence along the edge of the Laurentian hills. Wood of finest kind for the purpose is, especially in the latter locality inexhaustible, manual labour is very cheap, so much so that it goes off two and three hundred miles in search of work, and lastly water sufficient to do the lathe work hundreds of times over is running to waste in every river that tumbles down from the Laurentides into the valley of the St. Lawrence. It seems a pity that for want of energy or from lack of knowing how to use what we have such opportunities should be lost. The trade in handles might be developed to a great extent. Handles for hoes, axes, carpenters' tools, curry-combs and other small things of the kind could be turned out in quantities to supply the world and at a price that would defy competition. At present a traveller might go from Montreal to Quebec in winter along the valley of the St. Lawrence and among the hills bordering it and see no sign of productive industry. Far back in the woods the lumberers are at work it is true, but their labours must come to an end at last when the pine suitable for exportation has been exhausted. Such industry as we have mentioned would, however, change the face of the country and present to the traveler's view scores of small and large mills turning out, not crude material, but a manufactured article of universal demand. It would be necessary to pay particular attention to turning out a good article, and a neat one. The Americans are proverbial for the neatness and lightness of their manufactured articles, and if we would compete with them, even with great advantages on our side, we must be careful to supply patterns not inferior to theirs.

Another article of special demand now is wood suitable for wood engraving. There is a great scarcity of this now in Europe. Boxwood cannot be procured in sufficient quantities. What is required is a wood sufficiently hard to stand printing from and not too brittle. Experiments are being made now with many differend kinds of woods but not with much success. It may be that we have no wood that could suit this purpose, but when one remembers the large collection of different Canadian woods prepared for the great exhibition in London it seems highly probable that among them all there should be some that might be adapted to this purpose. There is no doubt but that no small reward will repay the labours of whoever may succeed in producing wood suitable for engraving in pieces large enough to suit the trade.

Still another industry, the manufacture of paper from wood pulp. The arguments used in the previous case, the enormous quantity of raw material of every description, the unlimited water power, the cheapness of labour, the proximity to a grand outlet by the St. Lawrence,—all point to the valley of the St. Lawrence as a locality where such an industry should pay if it pays anywhere in the world.

GIGANTIC CUTTLE-FISH.

Our last number contained a short account of an encounter, on the shores of Newfoundland, between some fishermen and an enormous cuttle-fish. Since that occurrence another of these monsters, little inferior to the former one in size, has been taken in a herring net, by some fishermen, in Logie Bay, near St John's. The immense arms of the creature were rendered almost powerless by the folds of the net, but such was its power that the men had a severe struggle to capture it, and indeed could not do so until they had succeeded in severing its head from its body. The entire body of this monster was brought to St. John's and photographed. An excellent reproduction of the best photograph appeared recently in the *Field*, showing the anterior portion with the beak and all the arms. We produce this illustration on page 307. The body of this specimen measures 8ft. in length, with a girth of 5ft.; the two longest tentacles 24ft. and the 8 shorter arms each 6ft. in length. The formidable, horny, parrot-like beak is the size of a man's fist, and the sockets of the prominent eyes give a diameter of 8 inches. Steps have been taken to preserve this the first entire body of one of these ocean monsters ever captured. Many previous attempts, however, have been made to capture specimens of these creatures. A gigantic calamary was encountered by the French corvette *Alecton*, between the islands of Madeira and Teneriffe. The monster was found floating at the surface of the water about mid-day, Nov. 30th, 1861. It was attacked with harpoons and with fire-arms, neither of which made much impression on the yielding flesh. One ball, however, had a marked effect, the creature immediately on being struck discharging a quantity of foam mixed with blood and giving out a strong musky odor, which was plainly perceptible all over the ship. A noose was at length made fast round the body of the fish, but when a large portion of the weight of the body began to tell on the rope the softness of the flesh was such that the cord cut through it, and thus only the posterior part was brought on board. The remainder with the head and arms disappeared immediatetly. The attempt to capture this enormous creature lasted during three hours, this length of time giving opportunity to M. Rudolphe, one of the officers, to make a sketch of the scene. The length of this calamary was estimated by those on board the *Alecton* at about 30ft., of which 18 or 20 belonged to the body. It is supposed that these monsters are by no means rare in the deep waters of the ocean. Unlike whales they are not compelled to rise to the surface for air, and their powerful organs of sight enable them to see and avoid approaching ships. The nature of their food has not yet been determined, but on the other hand there is evidence that they are themselves an easy prey to the physeteridal, or toothed whales, these latter having been frequently seen with arms of cuttle-fish, thirty and forty feet in length, depending from their mouths.

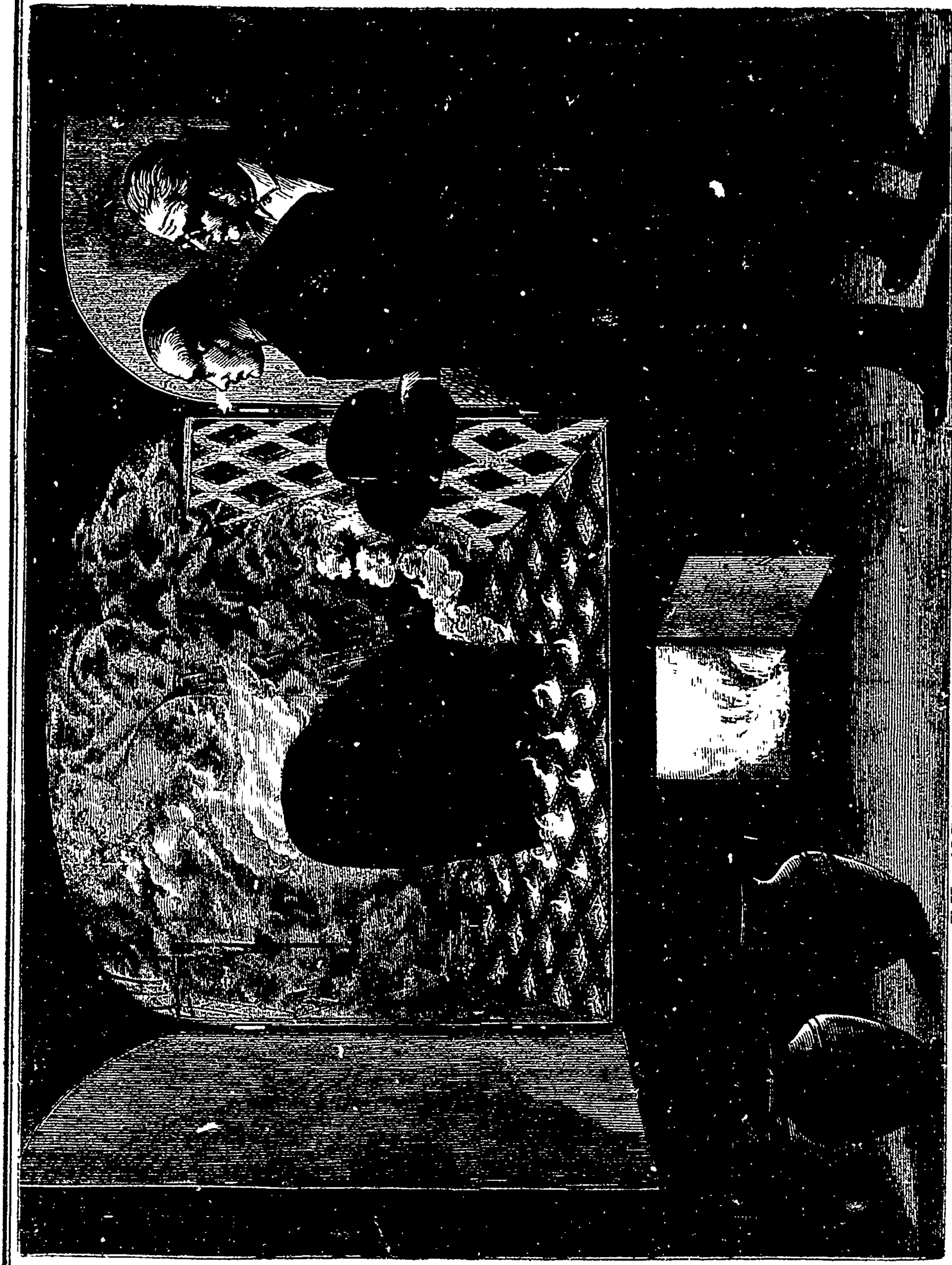
CREMATION.

Perhaps no single subject has lately been so fully discussed in public journals as that of the disposal of the human body when it has served its purpose and become something which nature insists shall be put away, but to which the minds of the survivors cling as to the only remaining part of an object of the dearest affection. The present system of burial is one to which our minds have become accustomed and from our reading and from association we have become accustomed to look upon the place of interment with certain feelings of grateful sentiment. It is now proposed in the interests of surviving humanity to discontinue this method, especially in the case of urban population. It is found that cemeteries are yearly becoming less remote from the towns and the effect of this is marked upon the public health. Many proposals have been made to obviate [illegible] state of affairs but the one most generally accepted as feasible is that of cremation, or burning. Many scientific men in England and elsewhere have advocated this system, and we illustrate on page 306 the method devised by Sir Henry Thompson, a leading English scientist, to effect the proposed result. The matter has been thoroughly discussed, found practicable, and even adopted to a certain extent. At Zurich, lately, 2,000 persons formed themselves into an Association for the promotion of this system and a society is stated to have been formed in New York for the same purpose. The chief obstacle to any change in this matter lies in the sentiment which has been formed in the human mind by habit continued through countless generations, and it is questionable whether it will ever be possible so to overcome this feeling that cremation may occupy the place now held by interment. It is argued that cremation is but hastening the slow combustion which we call decay, that the expense attendant on funerals will be much lessened, above all that some change is necessary in a sanitary point of view. The last argument is the only one of very great force, and there is no denying that cases of slow poisoning, and of the inducing of fevers by water and air contaminated by the proximity of graveyards are of every-day occurrence. It is a question which remains to be solved, whether more stringent regulations concerning interments, or cremation, or some other system shall put a stop to this evil. As we stated above, however, it is more than probable that, except in isolated cases, the force of habit and of sentiment will prove stronger than the most cogent and undeniable arguments of science.

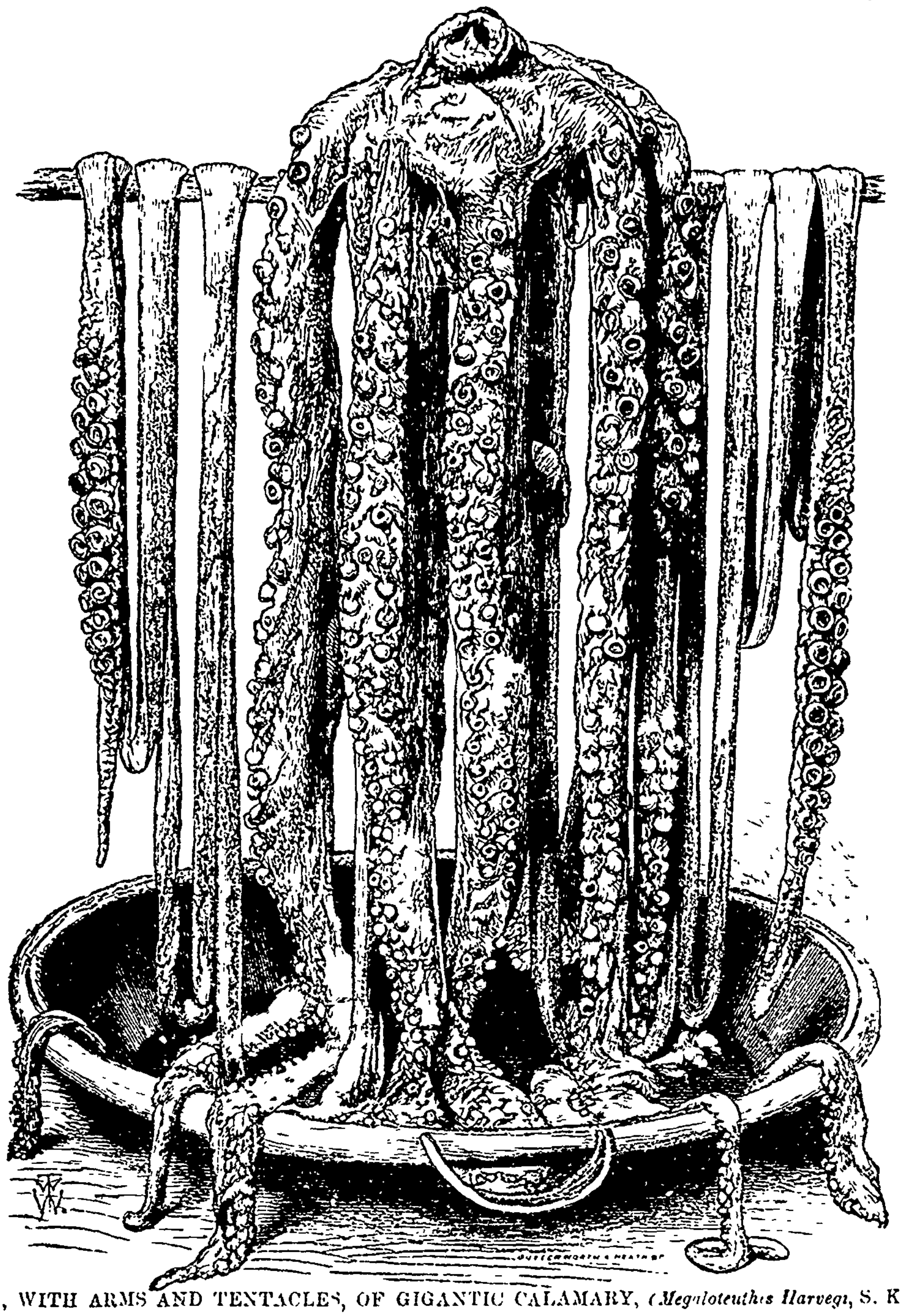
PLASTER OF PARIS.

Plaster of Paris, so-called from its having been first extensively prepared near Paris, is the term applied to ground and calcined gypsum. Gypsum is well known in the form of alabaster, and the uses of plaster as a fertilizer and for numerous other purposes are too well known to need description. Ordinary gypsum is a sulphate of lime and contains, in round numbers, in 100 parts, 46½ of water, 32½ of lime and 21 of water. The commercial value of plaster, as regards the manufacture of cements, &c , is derived from the fact that when gypsum is heated to 212° Fah. it begins to lose the water it contains, and at 272° Fah. it parts with it entirely. If it be now withdrawn from the heat and powdered and mixed with water it combines again with the quantity of water it previously held and again becomes solid. The largest and best deposits of gypsum on this continent are found in Nova Scotia and New Brunswick. These are extensively worked, the export to the United States amounting to over one hundred thousand tons annually. Two of these quarries, one at Wentworth, near Windsor, N.S., and the other at Hillsboro', N.B., supply with gypsum the large plaster mills of Messrs. Wotherspoon Brothers, New York. We give on page 303 illustrations of these mills and of the processes employed. The illustrations are from the *Scientific American*. The crude gypsum which, when brought to the mill, is in masses weighing from 20 to 100 lbs. or over, is broken up by the hammer into pieces rather smaller than an ordinary paving stone, and thrown by the workman into the crusher. This consists of an upright shaft expanding below into heavy iron cogs, which turn in an exterior iron shell, as seen in Fig 1. The stone is here rapidly reduced to powder, but not yet sufficiently fine for the calcining process. A pulley below conducts the powdered material, by means of cleats revolving in an inclined wooden pipe, termed a conveyer, to the floor above. This style of conveyer is used in flour mills, and is located on the left of the crusher in the engraving. Here the crushed plaster is fed by a hopper, like wheat, to a burr stone mill, which reduces it to a fine powder, ready for the calcining process. Another conveyer, similar to the one described, carries the fine raw plaster to a bin at the top of the building, where it is delivered in successive charges to the kettles. These, as shown in the illustration (Fig. 2), consist of large cast iron receptacles, capable of holding 45 barrels as a charge. They are set in brick furnaces and their bottoms are constructed in a peculiar manner and of stout iron, to withstand the heat of an anthracite fire. Revolving stirrers, almost in contact with the bottoms and sides, are kept in motion to prevent caking.

Care and skill are requisite in the calcination process, to avoid either over or under burning. If all the water be driven off, the plaster will not harden so rapidly as that which has been heated so long as the tumultuous expulsion of vapour lasts; and if only half the contained water be expelled, the plaster will have entirely lost its power of hardening with water Properly calcined gypsum seems to retain one-fourth of its combined water. When the calciner judges the process



THOMPSON'S METHOD OF CREMATION.



HEAD, WITH ARMS AND TENTACLES, OF GIGANTIC CALAMARY, (*Megaloteuthis Harveyi*, S. Kent.)

(From Loggie Bay, Newfoundland)

to be complete, the calcined plaster is drawn out into a bin, where it is conducted to the bolt, which is a revolving cylindrical drum made up of three different finenesses of wire cloth set on an incline. The finest sieve is first encountered, and then the material falls upon the others in turn. Directly below, corresponding to the width of each particular fineness of the sieve, are bins which receive the calcined plaster of three degrees of fineness, known as superfine, casting and common From these bins the article is rapidly shoveled into barrels and packed for the trade.

THE EMERALD MINES OF MUZO

Within four days' journey from Bogata, a French company has been enjoying a monopoly for the last ten years of all the emeralds found in the neighbouring mines, and indeed of all the emeralds found in Columbia. The lease expires shortly, and the Government think they can get better terms in the open market for a fresh contract, than by granting a renewal to the present leaseholders. The annual payment now is 14,700 dols (£3000), for which the Government bound themselves to prohibit the working of any other mines existing in the territory of the Union.

Little, hitherto, has been known respecting these mines, although by far the greater quantity, and certainly the finest emeralds which are sold in Europe come from Muzo. The French company has taken precaution in concealing its history and prospects, lest more enterprising capitalists should cast a hungry eye in its direction and successfully compete against it when the dying lease expires. But Her Majesty's Chargé d'affaires, Mr. Bunch, has said that, "notwithstanding the expense of working, its financial condition is prosperous," and we may fairly assume that its dread of foreign competition is no insignificant sign of the profitable character of its operations.

The mines were known and worked long before the discovery of America and the conquest of New Granada by the Spaniards. When an expedition arrived in that part of the country, about 1553, to reduce the tribe Los Muzos to the Spanish rule, these Indians were found to possess a large quantity of emeralds. It is, however, not easy to see how they worked the mines as they had no tools of iron. It is supposed that they had found the stones in the bed of the mountain torrents; for it sometimes occurs that the winter rains produce great land slides which lay bare large veins of emeralds, the stones in which are washed out by the waters. But report speaks unfavourably of the quality of these gems; they resemble those which are still found in the Indian burial-places, or in the lakes into which the Indians used to throw their relics during their struggle with the Spaniards Let, however, this be as it may, the mines of Muzo were worked soon after the arrival of the Spaniards on a large scale, both in the open air, and by means of subterranean galleries; but about the middle of the eighteenth century, the mines were abandoned, no one knows why. And it was not until the war of independence and the expulsion of the Spaniards that working operations were again resumed. The mines were naturally taken possession of by the Republic, and let out to individuals and companies.

In 1844 a Columbian named Paris carried a large quantity of emeralds to Europe and the United States, many of which he sold for considerable prices. He died a rich man. In 1864 the French company already named obtained a grant of the mines for ten years. The company is now in possession of Muzo, where the works are directed by a French engineer. In the opinion of this gentleman, the mountains of Muzo are very rich in emeralds, the quantity hitherto extracted being almost inappreciable. The principal mine now in work is pierced in every direction by galleries made by the Spaniards Since 1825 it has been worked in the open air. An immense number of gems have been found, many of them of great value. After this mine shall have been exhausted, which will not be for many years, not a thousandth part of the ground containing emeralds will have been touched

This consists of a chain of mountains, which extend beyond human sight About two days' journey from Muzo there is another mine called Lasquez, which was just touched by the Spaniards, and is evidently very rich. All this ground including Lasquez, bears traces of the presence of the Spaniards, and as the geological formation is the same in the whole neighbourhood, it is clear that the day is far distant before these mountains will be exhausted.

The mountains of Muzo belong to the lower formation of chalk. The emeralds are found in two distant layers; the first or upper one composed of a calcareous bitumen, but hard and compact These two layers are generally separated from each other by a distance of from seventeen to twenty-two yards. In the upper layer are found the veins which yield the "nests" of emeralds—that is to say, a number of these gems massed together. But after one of these nests the vein disappears, being crossed by others of a different kind, which run in a different direction to those containing the emeralds. These latter veins are called "ceniceros," from their ashy colour; they are generally horizontal, while the emerald veins are perpendicular. They all run from N. E to S W. The veins of the lower layer are more regular, and are followed for fifty to sixty yards, and even more. "Nests" of emeralds are seldom found in them, but they are more easy of extraction. When veins of fluor spar, well crystallised, are met with, the emerald is not far off; the presence of rock crystal is also a good sign, as likewise that of a pretty pyramidal-shaped stone of the color of honey.

The mine of Muzo is worked both by galleries and in the open air; the latter method, although more expensive, is more profitable, in consequence of the great irregularity of the veins, which are thus more easily got at. The emeralds now extracted are sent principally to Paris, where they are cut; an operation which causes them to lose more or less of their weight and size, according to the degree of crystallisation and purity. It is impossible to determine the number of carats annually taken from the mines of Muzo. The production is very variable, depending upon the number of veins which may be found, and their richness. Whole months may pass without a single emerald being found while 100,000 carats may be produced in a few days. It is also impossible to fix the mean value of a carat of emerald, as when the stone is large and of a very dark colour and perfectly pure (which latter condition is extremely rare) it may be worked up to £20 a carat, while stones of a light colour and full of flaws, and divided into small fragments, are not worth 5s. a carat. These are there called " morallos, and have scarcely any value. There are no means of ascertaining the mean annual quantity of emeralds which has been previously or is now procured. That is the company's secret, which it takes care to preserve.

CHINESE PROGRESS.

According to official despatches, great improvement is being effected in many Chinese ports and cities. Thus with regard to the port of Chinkiang, we learn that its general condition is satisfactory. The marks of progress as regards material comfort throughout the place are very conspicuous. The houses are of a better appearance, and approach more nearly to the civilised idea of what such domiciles ought to be The suburbs of Chinkiang are also increasing rapidly, especially in the direction of the British Concession. Land, in favourable situations, it is stated, realises as much as 600*l*. an acre, and even 800*l*. have been known to be refused. It is further remarked that without the town farmhouses of substantial brick continue to be built, and replace the mud-plastered reed-hovels at first erected by the cultivators on their return to their ancestral soil. From Shanghai we also get news as to recent indications of advancing enterprise there. Telegraphic wires now intersect the settlements in various directions, and a scheme is also under consideration for facilitating passenger-traffic by means of a tramway, to be laid between the extreme limits of the American settlement of Honkew and the native city. A concession has, moreover, been obtained for the construction of a public roadway, between Shanghai and Wusung, by a private company of shareholders, who have taken no particular pains to conceal their intention of eventually converting the line into a tram or railway for passenger and goods traffic. The Land Regulations, a code which has grown out of a series of modifications made from time to time as circumstances have rendered it necessary during the past thirty years, have latterly been found defective, and a recommendation has issued from a public meeting of the ratepayers that the whole code should be reformed. The consul at Shanghai also alludes to the Chinese arsenal at Kao-Chang-Thiao, an important establishment, employing a number of foreign artificers and about 1,300 natives. Considering that it has only been in working order for about five years, a remarkable efficiency has been attained in the construction of vessels and the manufacture of arms and machinery. The Chinese Government has also made great improvements in lighting and buoying the approaches to the port of Shanghai. Amongst other improvements, new bar-marks have been substituted for old ones on the Yangtzse; a new lighthouse, with dioptric lights of the fourth order, has been opened at Wusung; and a buoy has been substituted for a blockhouse beacon, washed away at the entrance of the Yangtzse. There are many coal-mines in the district of Kelung, but the way they are worked is most primitive. In fact, it is stated that the so-called mining is little more than a scratching of the surface in a few places, the real coal-beds being left practically untouched. The ventilation of the mines is left to itself, and it is said that no system of pumping out the water is employed. Firedamp is unknown, but accidents frequently occur, in consequence of the side or roof falling in. The quality of the coal has been favourably reported upon by competent engineers; indeed, it is stated that Kelung coal, for household purposes, has no superior. In China there is a great disinclination to utilising machinery in the working of these mines, enterprise being greatly wanting in this respect.

LUMBERING ON THE SUSQUEHANNA.

Our illustration on page 302 represents a busy scene of raft building on the Susquehanna river. Gangs of men are busy at the different operations of hauling logs and putting together the rafts. Across the stream an Erie express train rushes along. The illustration is from *Frank Leslie*, and is a pretty faithful delineation of some interesting points in the progress of American mechanical industry.

REVIEWS.

THE TECHNOLOGIST, OR INDUSTRIAL MONTHLY, FOR 1874.

The January number of this standard journal, issued by the Industrial Publication Company, 176 Broadway, New York, has reached us, and, as usual, it is filled with valuable and interesting information. The table of contents gives a list of nearly fifty important articles, not including mere current items of information, of which there are seven or eight columns. Of these articles nineteen are illustrated, the illustrations including two full-page engravings, printed in colors. In looking over its pages, one is struck with the clearness and simplicity which characterize the descriptions of new machines and processes; the earnestness and vigor of the editorials, and the spiciness of the news items. Those of our readers who are interested in industrial progress, ought by all means to examine this periodical, which may be obtained of any news agent, or direct from the publishers. It is the cheapest industrial journal published in the United States, the subscription rate being only $1 50 per year, or fifteen cents per single number, for a large, thirty-eight-page magazine.

POPULATION AND INDUSTRIES OF KANSAS.—EXTRACTS FROM THE ANNUAL REPORT OF THE KANSAS STATE BOARD OF AGRICULTURE, FOR 1873. By Alfred Gray, Secretary

Judging from these extracts, which in themselves form a large pamphlet of 111 pages, the original report must be an exhaustive blue-book of great importance. The first extract has reference to the census of the State, which was estimated by counting from four to six persons to each vote for Governor at the election in 1872. The result is believed to be reliable and gives a population of 610,863, showing a yearly percentage of gain for three successive years of 22 54. Statistical tables relating to the agricultural products follow, showing the number of acres under cultivation in each township and the average of each principal crop. Then follows a report on silk culture as conducted in Franklin County of that State. The number and value of the live stock in each county is also estimated and suggestive remarks on the subject are added. The report contains, also, directions to intending settlers as to obtaining Government lands and concludes with statements of business, of public interest, transacted during the year by the various railroad companies.

WATER LOCOMOTIVE.

This is a startling and apparently absurd idea, but a French civil engineer, M. A. Huet, advocates its possibility most strenuously, and, what is more, backs up his theory with most recondite and laborious mathematical demonstration. One may, however, prove almost anything by figures, so that any amount of theoretical demonstration does not advance it materially to practical accomplishment.

The idea is, briefly, that it is a mistake for ships to have to force their bulk *through* the water, meeting thereby the large opposing surface of water and a sliding friction over the whole of their immersed surface. This, M. Huet holds, is as great a mistake as if we were to dismount our railway carriages from their wheels and drag them, like sledges, along the rails.

He boldly puts forth the theory that vessels should be mounted on rolling drums, that these drums should give principally the power of flotation, and that they should be driven round as paddles to move the ship forward. We should in this way have a floating locomotive mounted on its supporting wheels or rollers. The vessel would offer no resistance but a rolling one, to motion, and the whole of the supported weight of the ship would be used as useful pressure to give adhesive frictional effect to the rollers. In this way M. Huet affirms that a velocity equal to our trains might be attained at sea. This is certainly a prodigious leap in advance. We have by no means reached our limit of invention yet, at any rate

---

IT is rumoured that rich gold findings are being made on Lake Winnipeg. Several parties are out prospecting.

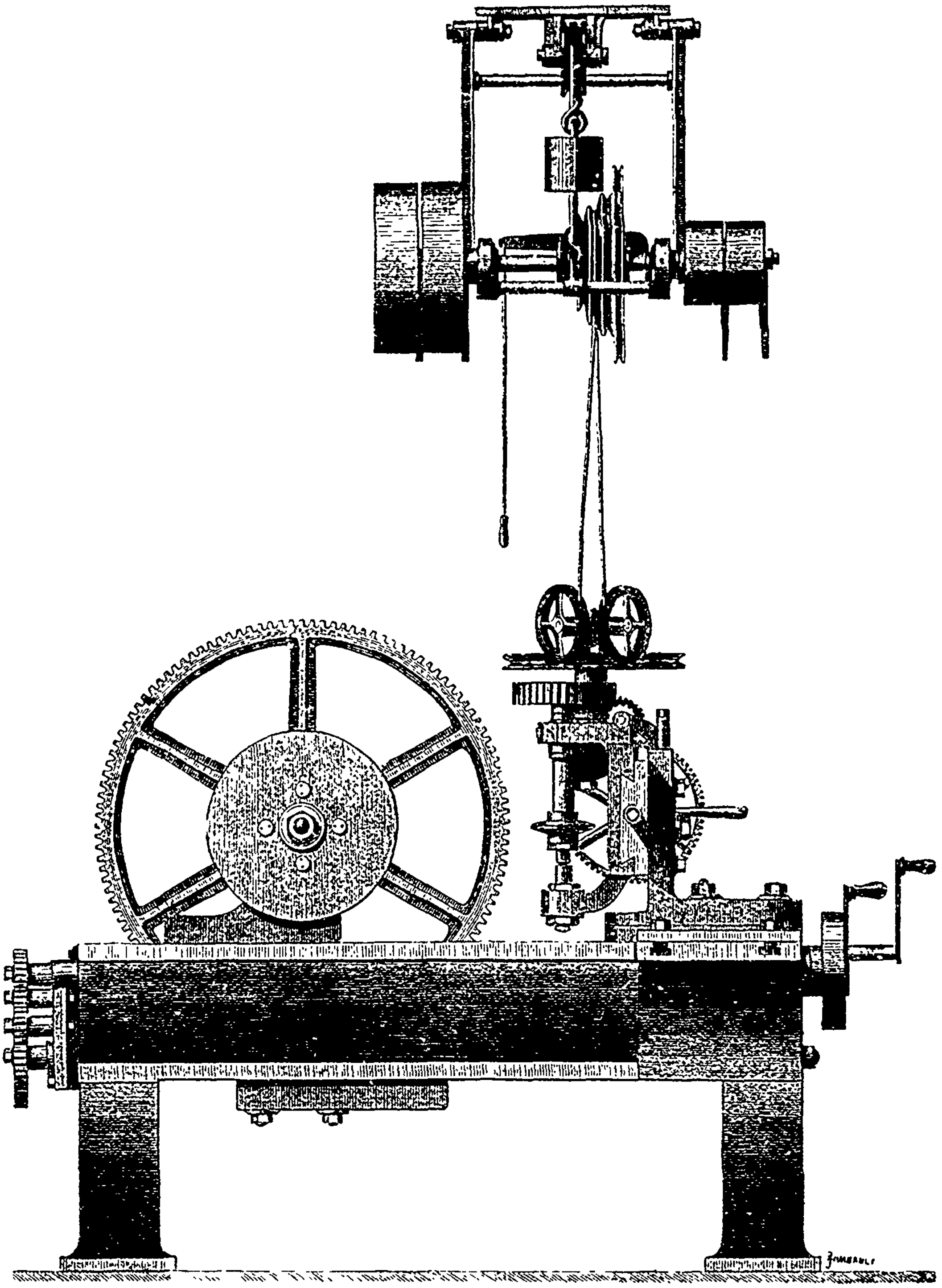
PROGRESS OF TECHNICAL CHEMISTRY.

Amongst proofs of progress in the above department of applied science is the production of the Salts of Potassa. It was long ago foretold by Chemists that the Salts of Potassa would be obtained directly from the mineral kingdom. instead of indirectly through the ashes of terrestrial vegetation, but the prophecy was not fulfilled until 1861, when the commercial production of Potash fertilizers and Chloride of Potassium began at Stassfurt mine. The following year the mine of Leopoldshall, in the Duchy of Anhalt, was opened. The deposit at these places consists of beds of common salt, interstratified with small beds of Carnalite, the hydrated double Chloride of Potassium and of Magnesium, and Kieserite, the hydrated sulphate of Magnesia.

Beside these are found Kainite, the hydrated double-sulphate of Potassa and Magnesia, Chloride of magnesium, and Sylvine, the Chloride of Potassium, the latter merely in pocket. Existing distributed throughout the deposit are boracite, acid borate of magnesia, chloride of magnesium, tachhydrite, the hydrated double chloride of calcium and magnesium; anhydrite, the anhydrous sulphate of lime, and antracanite, the hydrated double sulphate of soda and magnesia; carnalite kainite and tachhydrite contain small quantities of bromides. In 1867 the yield of potassa salts in the mines was 3,350,000 centners, number of laboratories 16; in 1872, the yield had risen to 10,284,000 centners, and the numbers of laboratories had increased to 33. Eleven hundred miners and three thousand laborers were employed, and the population, only two thousand seven hundred in 1861, had become twelve thousand.

Regeneration of manganese is another of the results of the inventive talent of chemists As is also the production of kerosene from lignite. The first attempt made in Germany to distil off the oleaginous products of bituminous coal resulted in failure, but more recently a sufficient measure of success has been realized to drive the products of American petroleum out of the markets of the little State of Saxe. and also out of those of the Kingdom of Saxony and of a portion of Austria. This success is ascribed to the employment of one variety of coal only, the lignite, and the adaptation of the process to that variety, instead of, as formerly, endeavouring to distil kerosene from all varieties including bituminous schist, boghead, &c., in similar apparatus. Indeed it would seem that but few of the lignites prove profitable, and these from quite restricted localities. The product may be estimated at 100,000 centners of paraffine, 300 000 centners of kerosene, and 90,000 centners of second quality paraffine. The latter is used in the manufacture of lubricating oils and illuminating gas, and is mixed with wax and stearine in candle making. For the same purpose the first quality of paraffine is used without admixture. It is also employed instead of butter in the beet sugar process, and instead of wax in the making of children's dolls, and the impregnation of the wood of matches.

Artificial madder dye also evidences the important advances making in technical chemistry. Madder, the colouring matter extracted from the plant of that name, the *Rubia tinctoria* of botanists, is largely produced in Germany and France, and an idea of the total value of the product may perhaps be found in the fact that in the French canton of Vaucluse alone, madder yields annually from 7 to 8 millions of thalers. The colour of the extract is due to alizarine, which can be obtained from it in red silky crystals, and this substance two German chemists, Graebe and Liebermann, were able to convert into anthracene, a hydrocarbon derived from gas tar. Before the year 1868, in which they made this discovery had expired, they were able to reverse the experiment and convert anthracene into alizarine. They thus became the founders of a new industry, the manufacture of artifical alizarine, which, since, 1870, has so extended itself, that there are from ten to twelve manufactories in Germany, and parties in England and France have begun the business. In 1872, the yield was 22,000 centners of artifical alizarine paste, valued at four millions of thalers. Gas tar contains about 5 per cent. of anthracene, and is sufficiently abundant to furnish all the alizarine demanded by the dye works Although the natural madder red still competes with the artificial, yet the competition cannot last long, and it is probable that in two or three years the cultivation of madder will cease.—From the *Polytechnic (American) Bulletin.*



WHEEL-CUTTING MACHINE AT VIENNA.

The illustration given above represents a wheel dividing and cutting machine, which formed a part of the large collection of tools exhibited at Vienna by the Chemnitzer Werkzeugmaschinen Fabrik, formerly Joh. Zimmermann, of Chemnitz. This machine is adapted for cutting wood patterns, as well as for the softer metals, such as brass, zinc, tin, &c., in which case a cutting tooth is used, whilst the cutting and shaping of cast and wrought-iron wheels is effected by means of a rose cutter. Both these tools are provided with the machine, which is capable of cutting all classes of spur, bevel, and worm wheels, up to 3 ft. 9 in. in diameter for iron, and 5 ft. 6 in. for wood, and of widths varying from ⅜ in. to 10 in.

The motion is transferred from the overhead gear by means of the two small vertical pulleys to the horizontal rope pulley on the machine, which drives, by means of spur wheels, the spindle carrying the cutter. This spindle is fixed to a slide, which is moved horizontally, but only in one direction, by means of the gearing in connexion with a screw spindle, whilst the slide has to be moved back by hand after the wheels have been put out of gear.

The wheel to be cut or divided, is fastened to the disc shown in the engraving; on the shaft of this disc is mounted at the

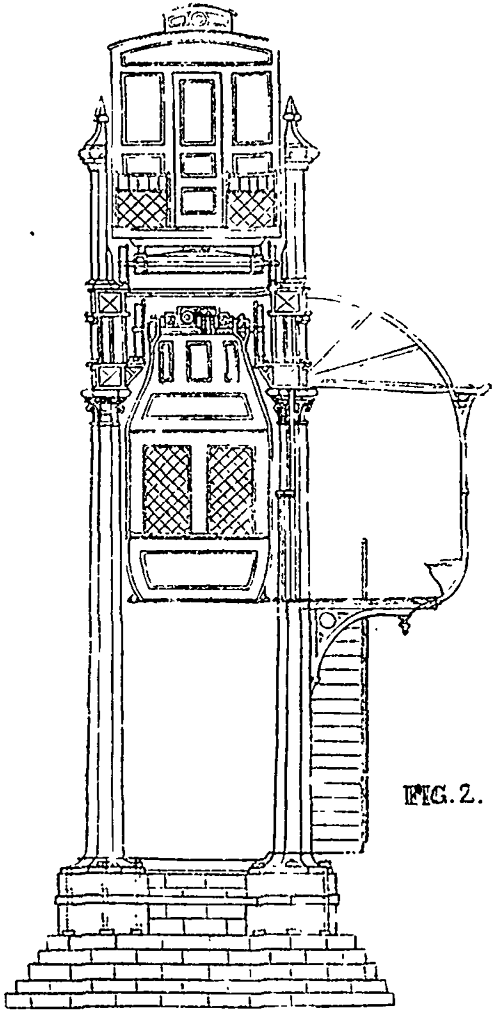
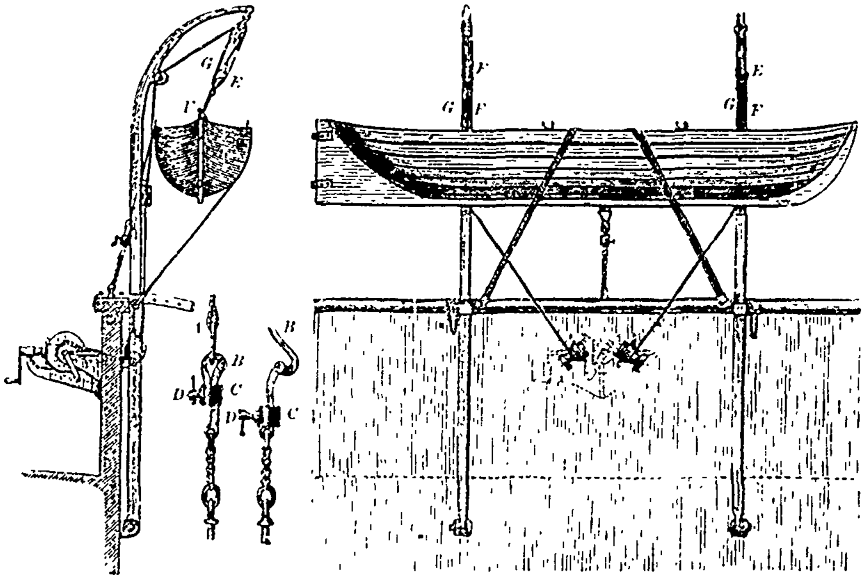
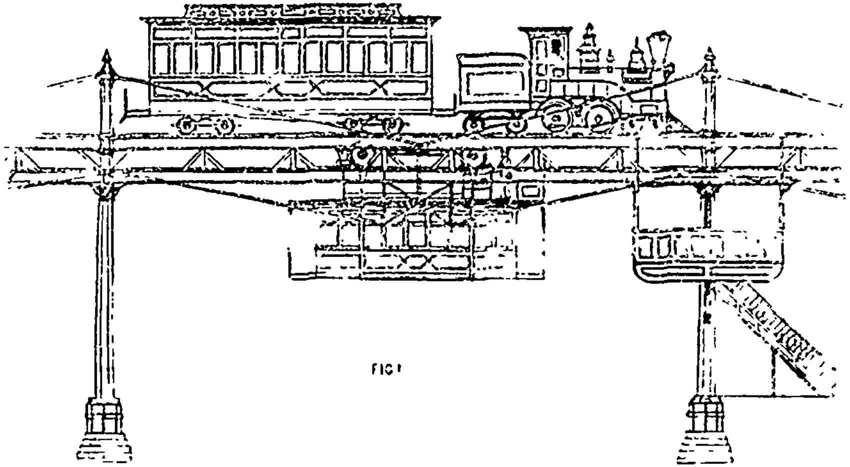


FIG. 2.

E. A. COGGESHALL'S PLAN FOR RAPID TRANSIT.



CAPTAIN EDWARD BARRETT'S IMPROVEMENTS IN APPARATUS FOR HOISTING, LOWERING AND DETACHING BOATS.



E. A. COGGESHALL'S PLAN FOR RAPID TRANSIT. (See next page) other end the large spur wheel, which gears into an endless screw sliding upon a shaft running alongside the bed of the machine. One of the handles shown on the right-hand side of the machine is used for turning this shaft, and by differently arranging the change wheels on the left-hand side of the machine, any desired pitch may be obtained. The second handle on the right-hand side of the machine is used for working a screw by means of which the whole tool-holder can be moved forward and backward during the operation of cutting screw wheels.

ANOTHER RAPID TRANSIT SCHEME.

A mechanic of Bridgeport, Conn., Mr. E. A. Coggeshall, proposes an elevated rapid transit railway for the city. His plan, which we illustrate on page 311, is to occupy about eight feet of one side of a street with two elevated tracks, supported on two rows of ornamental wrought-iron columns, the outside row to stand eight feet from the curb. The upper track is to be for steam-cars, and three feet below he proposes a track for horse-cars carrying way passengers. All the cars are to run up one street and down another, a block apart. Should it be necessary to have an up and down track on each avenue he would occupy eight feet more of the street, with another row of columns, as before described, and construct double tracks, running all cars on one track the same way, thus avoiding the possibility of collisions.

He would have a station at one corner of every block for the way passengers, and one for the through line at every six blocks—the depots on the through being one story higher than those of the way line, which will be suspended from the structure, and no obstruction of the sidewalk except at the foot of the staircase. Passengers could alight at the stations of the through line, descend to the way station below, and take the way-car to any point they may wish to stop at. By having continuous rails with hard rubber between them and their bearings, all noise would be obviated, and the trains would run comparatively quiet. The way-cars would be about twelve feet above the street, and suspended from the lower track, the motive-power being placed directly on the top of the car and working on the same principle as an ordinary locomotive, thus enabling the cars to be propelled either way.—*Frank Leslie.*

CAPTAIN BARRETT'S APPARATUS FOR HANDLING SMALL BOATS AT SEA.

The difficulty attending the lowering and detaching of boats in a sea-way, and the danger of the sea striking them on the roll-to of the ship, calls for an apparatus which, at a moment's notice, can free the boat from its tackles, and permit it to be shoved off. The contrivance here described was invented by Captain Edward Barrett, who commanded the U. S. steamer *Ticonderoga* during the recent naval manœuvres at Key West. A man attends the lever, and at the proper time throws it back, loosening and detaching the bolts.

A greater difficulty is that of attaching or hooking on boats in a sea way. Thus far only one system has been in operation, that of a hook attached to the straps of the block. The new mode offered is the application of a check stopper to the lower block—a stopper which permits the men detailed to hook the falls to do so at leisure, and to clasp the chain at the right moment; that is, when the sea throws up the boat and permits the chain to be shortened in. The detaching process requires one man, and the attaching two. The following describes our illustration:—A, Attaching bolts; B, Clasps, kept in place by the bars C, attached to lever D. By throwing back the lever (D) the bolts (A) are detached. The lower block (E) of the fall has a clasp (F) attached to it; the chain (G) runs through an opening of the clasps (F).—*Frank Leslie.*

An extensive deposit of hematite iron ore has been discovered on the banks of Bolton's Creek, Bathurst, by Mr George Mitchell, of Perth, who in prospecting for minerals came across this treasure, hidden up to this from the praying eyes of mankind. The deposit is apparently inexhaustible, and the ore contains a very large percentage of pure iron. Mr. Mitchell, having at once opened up successful negotiations for the lease of the property, has now several men employed in getting out ore, which will be shipped to the American market.

PUBLIC BATHS.

The low death rate of the enormous city of London is one of the most interesting facts in modern scientific and medical experience. One of the secrets of this satisfactory condition of things will be explained to a certain extent by our illustrations on pages 314 and 315. They represent the public baths and wash-houses recently erected for the parish of Paddington, and are described as follows by the *Builder*, to which interesting journal we are indebted for our illustrations.

The keynote of the design is the position of the men's first-class swimming-bath. As it is the largest and most important of the various departments into which the establishment is divided, it occupies, so to speak, the place of honour,—the centre of the site,—the other buildings being grouped in respect to the same in such positions as their relative importance and uses would suggest.

This bath is 90 ft. long by 40 ft. wide, and will hold, when filled, 100,000 gallons of water. It will be provided with fifty boxes for bathers, and will have a spring-board at its eastern end, and an ornamental fountain at its other extremity.

The men's second and third class swimming-baths are placed in the rear of the first-class swimming-bath, end to end, and are each 70 ft. long by 30 ft. wide, provided with forty boxes for bathers.

The ladies' swimming-bath is 45 ft. long by 36 ft. wide, and is fitted up with a dozen dressing-boxes. Each class of bathers is provided with a separate waiting-room, with the necessary water-closet and other accommodation. The whole of the swimming-baths are lighted from the roof.

The private baths are in square compartments; made of slate, the first class being 7 ft long by 6 ft. wide; the second class being 6 ft. square. It is proposed to enamel the slate partitions dividing the first-class baths, but simply to oil these of the second class. The first-class baths will be made of porcelain the second of copper japanned.

The washhouse is 75 ft. long by 40 ft. wide, subdivided into groups of compartments, and immediately adjoining are the ironing-room and house laundry. A residence for the engineer in charge and a smith's shop are also provided. It should be noted that provision has been made to enable the engineer and other officials to proceed from the front to the rear of the establishment without going into the open air.

The first floor is devoted to a board-room, clerk's office, and superintendent's apartments and the rooms on the second floor will be used as bed-rooms only.

The style of architecture adopted is Italian, the materials employed in the front elevation being white Suffolk bricks and Portland stone.

The total expense of the erection is in the neighbourhood of $100,000.

There is much need for something of this kind in our Canadian cities, whose death rate would undoubtedly be sensibly affected by the opening of public baths. During our long winter, when the body is covered up by multitudinous wrappers the far greater part of the population live in houses unprovided with baths, and so the exudations of the body remain a prolific cause of fevers and by no means a hindrance to the spread of smallpox and other infectious diseases.

All the paper used to print the United States national currency on is said to be made in the Glen Mills, near Westchester, Philadelphia, by a sixty-two-inch Fourdrinier machine. The principal peculiarity is that short pieces of red silk thread are mixed with the pulp, and it is poured on the wire cloth without going through a sieve, as this would retain the threads. Next from a separate contrivance worked in a very peculiar manner, a shower of short blue-silk threads falls in strips on the paper while it is in the process of formation. One side of the paper is thus covered with blue lines, formed by the blue silk thread and this is used for the front of the greenback, on which these threads are distinctly visible, conform to the manner in which they were superficially distributed, notwithstanding they are deeply enough embedded in the texture of the paper. The peculiarity of this machine is to make a paper so peculiar as to be practically impossible to imitate; and this is one of the principal guarantees against forgery in the possession of the Government.

RAILWAY MATTERS

M. Victor de Lesseps has arrived in Bombay on a tour of inquiry respecting the overland railway to India, which has been undertaken by his father.

The Illinois Legislature has passed a law making drunkenness on the part of railroad officials during the hours of employment a criminal offence.

The extent of new railroad opened last year in the United States was 3,993 miles, as compared with 7,340 miles in 1872. The total length of line in operation in the United States at the close of 1873 was 71.969 miles. The following States have now each upwards of 5,000 miles of railroad in operation:—Illinois, 6 530 miles; New York, 5,417 miles, and Pennsylvania, 5,724 miles.

Baron Reuter writes to contradict the statement recently made through the public press, that the Persian Railway concession had been annulled. He states that under Article 8 of the concession he was bound to commence the railway works within fifteen months from the date of its signature, that is before the 25th October last; and in point of fact by that time nearly two miles of earthworks had been completed, and seventy-five miles of the route were surveyed.

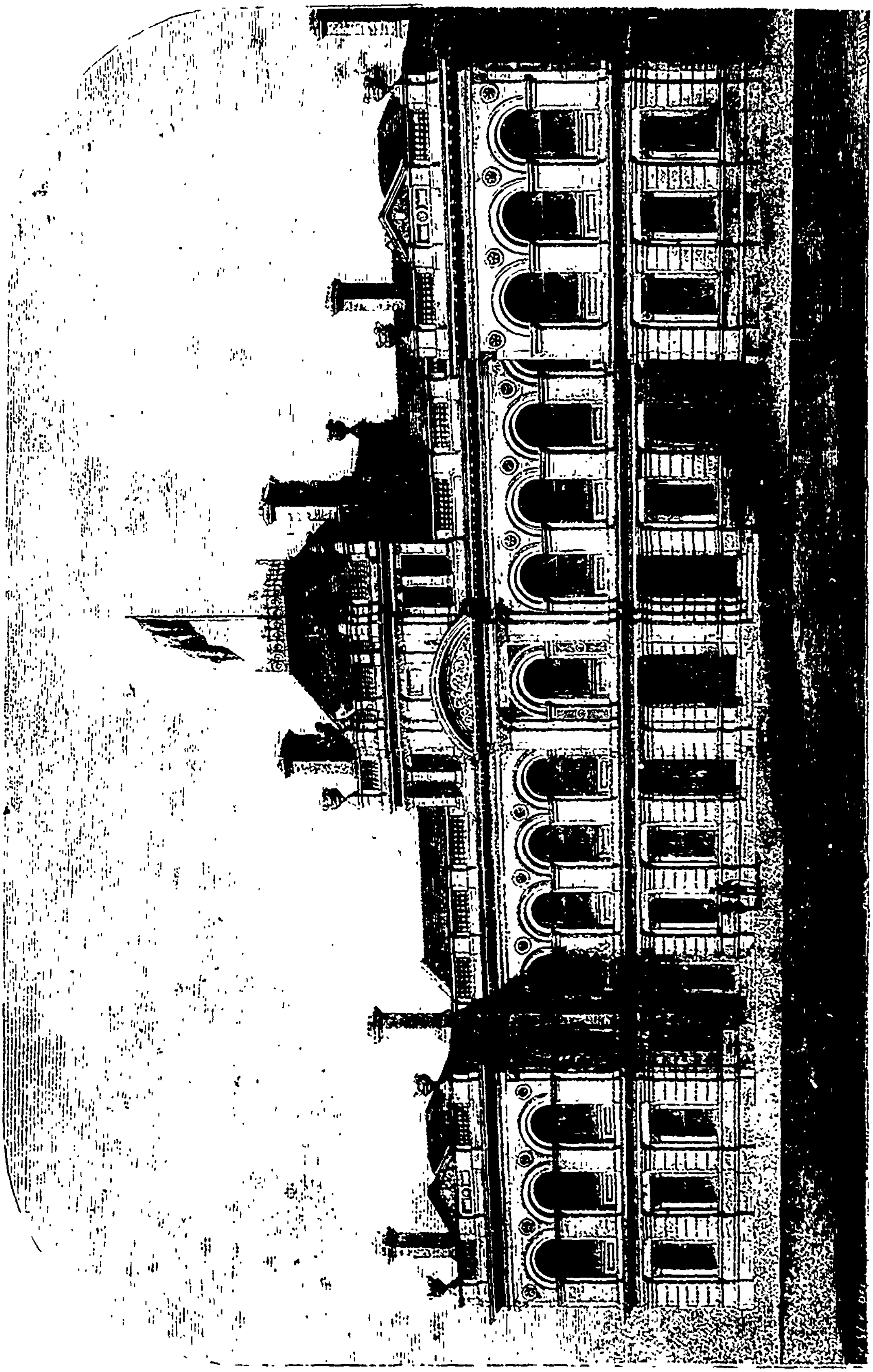
How a railroad opening up a new country creates business for itself is demonstrated very remarkably in official statistics accompanying the message of the Governor of the Territory of Colorado. A comparison of the United States census of 1870 with the territorial census of 1873 shows that between those years all the counties on the line of the Denver and Rio Grande have either trebled or quadrupled in assessed wealth and population

Altitude of Railways.—A Mexican paper says that the highest point in the world where railroads are new in operation is at Apizaco, on the Vera Cruz and Mexico Railway, 7,478 feet above the level of the sea. The next highest is on the Central Pacific, in the Nevada range, 7,111 feet above the level of the sea. The third is at Arequipa, an important city in Peru, 7,000 feet above the level of the sea; and, under the Peruvian railway system, the work is to be continued and is expected to reach double that altitude at the ancient capital of Cuzco, 14,000 feet above the level of the sea.

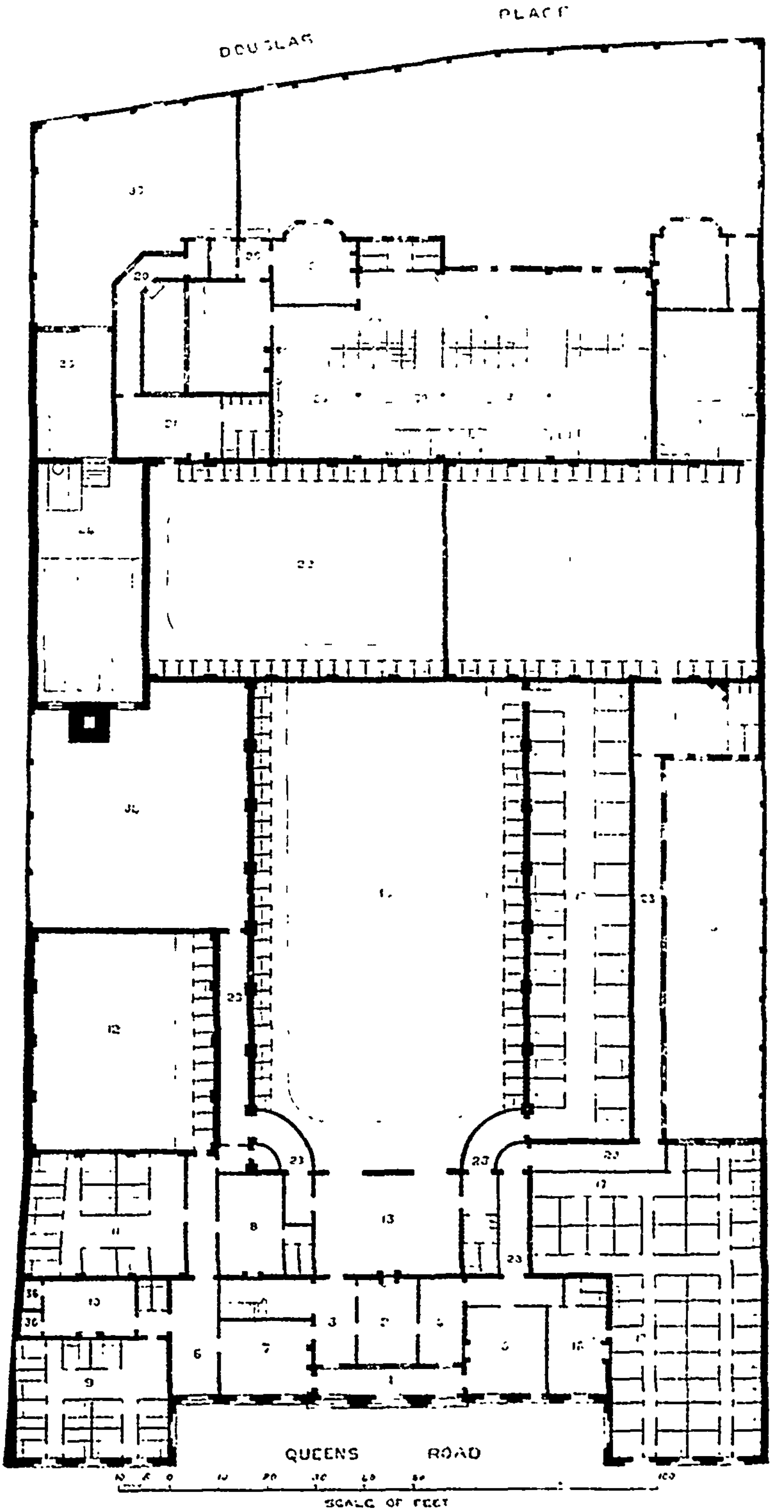
A company seeks for incorporation, with power to construct a line from the Georgian Bay, at or near the mouth of French River to a point near the south-east shore of Lake Nipissing, with powers of extension to the southward, to connect with the railway system of Ontario, and to the eastward to connect with the railways of the Ottawa valley. The capital stock is fixed at one million dollars, with power to increase the amount. It is provided that the railway shall be commenced within five years, and completed within ten years from the passing of the Act.

The *Stockholder* gives the following account of the first trip made by an express train over the newly-opened Canada Southern road:—"Two or three weeks ago, when the train known as the Chicago express on the New York Central road had made some thirty-five miles from Detroit towards this city on the Great Western Railway of Canada, word came by telegraph that a sudden flood had carried away certain bridges and culverts, and made the road ahead impassable for the time The conductor, probably acting under orders, took the back track to Detroit, where his train was switched over to the Canada Southern road. On the track of that company, entirely strange both to conductor and engine-driver, the train was run through, 256 miles, to the International Bridge to make the connection with the New York Central. None of those in charge knew even where the watering stations were. The engine, nevertheless, kept its speed. When convenient creeks or rivers were reached, holes were cut in the ice, and the brakemen filled the tender with buckets. To recover the time lost in this mode of watering, the train was urged at accelerated speed. The road is new, not as yet ballasted, and slightly undulating, accordingly, as is the case with American new roads generally, full of hills and hollows; but the rails were fresh and sound and made of steel. No accident ensued, but the passengers found out how much 'ground and lofty tumbling' could be had without charge on a new road in an express train at unslackened speed An Englishman (the inevitable Englishman always brought in to give the point to an American story) getting out of the train at one of the stops for water, going forward, asked the engine-driver, 'Where are we?' 'Don't know; never was here before!' 'Where are we going?' 'New York.'"

New York Railroad Signal Office.—The signal office is a little room at the northern entrance of the depot, about 30ft. above the pavement. It is reached by a narrow passage way from the west side, and when you get into it you see a sight which made Jones go into an unmistakeable surprise Looking down the depot there was a space of more than 600ft. extent by 200ft. breadth, covered with an iron roof and lighted from the top. Trains of cars were coming and going incessantly, but no confusion was perceptible, and everything, as my friend said, "went on like clock-work." There are two operators in service here, relieving each other during a tour of duty which extends from 5 a.m. to 11 at night, their motions being regulated by a large and costly clock. The gentleman in charge received us very politely, but before we had hardly thanked him we heard the sharp and rapid ring of a bell overhead. It was marked "Ninety-sixth to Seventy-fifth street" "You see," said the operator, "there is a train coming in, and it wants to know if we are ready for it." "But how does it ring that bell?" said Jones "By electricity," was the reply. "This is Hall's patent which works like a charm." In a few minutes another bell rang. It was marked "Sixty-first to Fifty-sixth street." "The train now reports itself again," said the operator, "and this renews notice either to prepare for it or to signal it to stop." He touched a telegraphic machine, and then said, "This throws up the signal to come in," and sure enough in a few minutes the train arrived. One hundred and forty trains arrive and depart in a day, including the Central Hudson, the Harlem, and New Haven Roads, and hence the signal service is one of incessant activity. The operator then informed us that each road has four starting bells of different keys, all of which were rung by him by means of electricity. Three started passenger trains and one ordered out the cars as soon as emptied. "You see," said he, "this train which has just come in. The passengers are gone, and I want to know if the baggage is taken out." He touched a stop and rang a bell, as he said, 600ft. distant. In a moment a bell overhead struck twice. "Baggage is out," he said, "otherwise he would have struck once, and would have waited. I must order the train out. Do you see that locomotive just ahead? Well, now, see it move. He touched a stop, and I saw the letter Z displayed at a window in a side building. "He hears a bell ring also," said the operator. The engine backed down and hitched to the empty train and the Z disappeared. "I shall now send him out," said the operator, as he touched another stop, and the empty train at once moved forward and left the station. The letters X Y Z, I may add parenthetically, designate the locomotives of the Harlem, Hudson River, and New Haven Roads, and are the signals to back down and connect with trains. "I am now about to send out a passenger train," continued the operator, "a half hour ago I struck twice to open the doors and let the passengers pass from the sitting-room to the cars. Now I shall soon close that very door, but first I must stop checking baggage." A small knob was touched by his finger. "Now," said he, "the next trunk that comes must wait for another train. There (another touch with the finger), the baggage car is hauled out and switched on to the right track. Five minutes more and she is off. Here goes to 'close the door bell;' (at a touch) no one passes in after this. Now I say 'all aboard'" (a touch) and we heard the distant voice of the conductor echoing through the vaulted roof. "Now it moves" (another touch), and the rumbling movement was immediately perceptible, and in a few moments the train left the station. As the cars go up the road they signal their progress by ringing bells in the same office until they have got through the city streets, and thus give assurance of a clear track for all that may follow. The station will contain twelve trains of thirteen cars each, and by means of this wonderful system they are all managed with despatch and safety.—*Troy Times.*



PUBLIC BATHS AND WASH-HOUSES, LONDON, ENG.



GROUND PLAN

1. Vestibule.
2. Ticket-office.
3. First-class entrance.
4. Second-class entrance.
5. Superintendent's office.
6. Women's entrance
7 Shampooing-room.
8 Women's second-class waiting-room.
9. Women's second-class private baths
10 Women's first-class waiting-room.
11. Women's first-class private baths
12 Ladies' swimming-bath.
13 Men's first-class waiting-room.
14 Men's first-class swimming-bath.
15. Men's first-class private baths.
16. Men's second-class waiting-room.
17 Men's second-class private baths.
18 Men's second-class waiting-room.
19 Men's second-class swimming bath.
20. Third class entrance
21. Men's third class waiting room
22 Men's third class swimming bath
23 Corridor
24 Boiler house
25 Engineer's shop.
26. Lobby
27. Waiting room.
28 Washhouse
29. Washing-trays
30. Drying closets.
31. House laundry
32. Engineer's living room.
33. Yard.
34 Space available for Turkish baths
35. Space available for gymnasium
36. Closets.

PUBLIC BATHS AND WASH-HOUSES, LONDON, ENG.

DOMINION.

The Surveyors of Winnipeg talk about organizing an association.

It has been decided to sink an artesian well on Main-st. Winnipeg, and the work is progressing rapidly.

Canadian Magnetic Iron Ore.—During the last few weeks deposits of Magnetic iron ore have been discovered on the Canadian side of Lake Ontario. The ore is stated to be of remarkable richness, the yield being as much as 70 per cent.

The International Salt Company "struck" salt in their works at Goderich at the depth of 1054 feet A company, with $50,000 capital, is to develope the phosphate of lime mine at Buckingham.

The G. W. R. are now negotiating for the purchase of the Suspension Bridge at Clifton. The price to be paid is reported to be $600,000, $100 000 more than the original cost, but much less than it could be constructed for.

Midland Railway of Canada—The first locomotive for the Midland Railway of Canada upon the narrow gauge system has arrived at Port Hope from Portland. Ten other engines are to follow shortly. The Midland Railway Company of Canada is proceeding vigorously with its extension to Georgian Bay.

The Cape Breton *Times* says it is reported that Sir Hugh Allan, Cyrus Field, and others, have purchased lands at Liscomb Harbor, in Guysboro County, Nova Scotia, with a view to construct a railway (50 or 60 miles in length, in order to connect their Pictou coal properties with an Atlantic port.

H. Lee Smith, Esq , an eminent English engineer, has completed an examination of the Lewis and Kennebec Railway and makes a very satisfactory report of the prospects of the road to the syndicate formed to float the bonds in the London market, who sent him out.

We understand that an addition is to be made to the list of our manufactures by the formation of a Company called the Tolley Manufacturing Company, for the production of elastics used for gusseting in boots and shoes. The promoters of the concern, the capital of which is $200,000, are now makers of these goods on a large scale in Nottingham, England, for the Canadian trade.

The St. Catharines *Times* understands that some wide-awake ship builders are negociating for property near Lock No. 2, with the view of preparing the place for a building dock, where a large class of vessels and propellers will be constructed as soon as the new canal is completed. We have no doubt but many of the present generation of Saints will live to see the canal banks between here and Port Dalhousie lined with dockyards and factories.

The St. John *Telegraph* says:—The building of the Baie Verte Canal would have the effect of stimulating the shipping, fishing, lumbering, and agricultural interests of the North Shore, and of the Gulf ports of Nova Scotia and New Brunswick, that the increase of population and trade would indirectly repay any outlay necessary for the construction of the canal. It would open up new branches of business which cannot now exist, and stimulate a region now torpid, owing to its isolation from the great markets of America, into renewed vigour and life. The whole Dominion is as much interested in this work as we are, for the trade which builds up the maritime interests of the East supplies a market for the products of the West.

The *Proceedings of the Nova Scotia Institute of Natural Science* contains a paper "On the Geology of the Cobequid Mountains, Nova Scotia,' by Mr. D. Honeyman. The survey described in this paper promises to be of considerable scientific and practical importance. On the Cumberland side of the range a great metalliferous, as well as marble-containing series, has been, for the first time, recognised. A series of jaspideous and amygdaloidal conglomerates which correspond to those of Quebec, Canada, has been carefully examined. Above the conglomerates is a considerable thickness of diorites, shales, and slates. The shales contain abundance of fossils of older forms than any yet found in Nova Scotia. These are in the finest state of preservation. Graptolites of the most delicate and beautiful forms are in a state of preservation unexampled in such rocks.

WATER SUPPLY—PREVENTION OF WASTE.

Continued from page 289.

I believe a suggestion to place meters upon water mains has been made in former times; but it remained for Mr. J. H. Wilson, the chairman of the Liverpool Water Committee, to propose the systematic adoption of the plan, and to see it carried out with the most complete success, and with results far surpassing anything that could be anticipated.

The best form of the waste water meter may be described as follows:—It will be seen from the illustration (page 290) that it consists essentially of a vertical tube lined with brass and equal in diameter at the upper end—where it is connected with the inlet from the main—to the diameter of that main, but larger at its lower end In the tube is a horizontal disc of the same diameter as the main, with a vertical spindle on the centre of its upper face, from the end of which the disc is hung by a fine wire passing out at the top of the tube through a brass gland. This wire is connected above with a counter-balance weight which, when the water is at rest. retains the disc at the top of the tube, which it completely fills.

It is obvious, that if water is caused to flow through the instrument, the disc will find somewhere in the tube a position which it will retain until the velocity of the water changes. The lower end of the conical tube being about double the area of the main, no obstruction to the flow can take place, such as must necessarily be the case in all piston meters, while the motion for any given increment of velocity near the top or place of minimum flow can be made equal to, or even greater than, that due to an equal increment at the bottom or point of maximum flow, so that its sensitiveness is not diminished at low velocities—a feature which is unattainable in any meters constructed on the turbine or analogous principles.

In order to insure the absence of any friction sufficiently great to prevent the disc and wire from reaching the exact point at which they would stand if perfectly free during the continuance of each particular velocity, I found it desirable to abandon the use of a stuffing-box, properly so-called, and to substitute a single brass gland, the hole in which fits the wire accurately, but not tightly. This wire being an alloy of iridium and platinum, maintains its condition for any length of time, and the small quantity of water which oozes past it is allowed to drain away. The absolute accuracy and freedom with which the meter acts has been proved by the strictest tests. The vertical motions of the wire are registered by a pencil, connected with it, on a drum revolving once in twenty-four hours, the paper on which can easily be removed at any time and replaced by a sheet with horizontal lines, each of which corresponds with the height at which the pencil stands when the number of gallons per hour marked upon the line is equal to the quantity passing through the meter, see page 290. The essential peculiarity then of the waste water meter is that it registers on paper the exact quantity of water moving at every instant, and the exact time and rate at which that quantity changes. The meter is fixed close to the kerb just beneath the footpath. A single length of the main is removed, and a loop formed to it by two double elbow pipes. Access to the drum and clock is easily obtained by simply lifting the parapet cover and opening the inner lid.

I will now as shortly as possible describe the process of detecting the various kinds of waste and the system to be ultimately adopted in order to prevent its recurrence:—A district of about 13,000 persons supplied by a 3in. or 4in. main having been chosen, a waste water meter is placed upon that main, and diagrams are taken for a few days before the condition of supply is disturbed. If stopcocks outside all premises do not exist they are at once fixed under the footway on every service pipe; and, at the same time, a day inspector calls at each tenement and fills up a suitable form. Besides giving much information with respect to the fittings, the forms afford, in connection with the diagrams already taken the means of tabulating the normal condition of the supply, as in the three first lines of the following form :—

Example of form used to record information contained on waste water meter diagram.

———Street, district No.—

Population—	Day occupants.	263
	Day and night occupants	1110
	Total	1373

Date	Total consumption for 24 hours in gallons.	Rate of consumption in gallons per head per day			
		Average for the 24 hours.	Lowest point reached	Time of reaching lowest point.	Average from 1 to 5 a. m.
1873					
* Oct. 4-5	80,183·2	58 4	27	8 a.m.	50 4
† 5-6	81,693 5	59 5	39	7 a.m.	52 44
† 7-8	81,418 9	59 7	41 5	7 a m.	50 0
‡ 10 11	69,479 3	54 1	33 2	9 a m.	41 0
§ 29-30	35,698 0	26 0	15 0	6 30 a.m.	21 0
‖ Dec 10-11	28,252 0	20 5	12 7 12 2	9 45p.m. 5 a m.	15·0

In this form the 3rd, 4th, 5th, and 6th columns contain information peculiar to the waste water meter of the greatest value. The results of deducting any one of the figures in the 4th column from the corresponding one in the 3rd is generally found to be about equal to the actual quantity of water used. Thus from the 4th to the 5th October, nine gallons per head per day was about the actual quantity used, while fifty gallons per head per day was about the waste from all sources. The figures in the 4th column, being the lowest rates of consumption, are [illegible]ched at times when the intermittent waste due to care[illegible]s is accidentally at its minimum, and the constant waste due to leakages in the pipes is nearly equal to these figures ; when it appears that they are quite or nearly reached more than once on the same diagram, as happened on the 11th Dec., where the constant waste is shown to be about twelve gallons per head per day.

The use of column 4 in the detection of waste is further shown by the following table, the figures in which are those which actually occurred in the district :—

Night readings of meters between 1 and 4 a. m., at various dates, in No. 1 District.

January 22, 1873, 30 0 gallons per head per day.
April 19, " 9·4 " " " " "
June 27, " ·74 " " " " "

The moral influence of the waste water inspector's presence in bringing down the figures in column 4 to those in column 5 is sometimes very curious. By referring to the actual diagrams, it will be seen that the figures in column 4 are only maintained for very short periods, often only a few seconds.

After stopcocks have been fixed it is desirable to issue official notices to all tenants and owners of property in the district under test, embodying the full powers of the corporation or company with respect to fittings, and explaining the steps which will be taken upon the discovery of the waste of water within any premises.

At this stage the work of discovery is commenced in earnest At twelve on the first night, a waste water inspector sounds each stopcock, partly closing it, if necessary, in order to contract the passage and increase the noise. If the inmates have retired, and a flow of water is heard, the stopcock is closed, its number and time being accurately noted. At the same instant the meter registers the reduction in the flow of water, and the time at which it takes place It is sometimes found desirable to arouse the inmates and enter the house, in order to obtain the necessary evidence of waste, especially when the running of water from taps is heard. In other cases the house is visited by the inspector early on the following morning, and if while he is within another inspector outside turns on the stopcock there is generally no difficulty in detecting the source of waste at once. If, however, the waste is not superficial, sounding with the teeth at the taps and other fitting will generally discover a leak in the buried pipes. Each source of internal waste having been discovered by these means, the greatest care must be exercised by the inspectors to insure its remedy in the best possible manner.

In most districts the whole of the stopcocks may be sounded by one inspector in a single night; but a large number of such night inspections, followed by day inspections and repairs, are always necessary before the internal waste is nearly removed. A test for the condition of pipes is conducted as follows, and generally with most valuable results :—Any convenient section, say, one-fourth of the district, is isolated from the remainder by a valve, and commanded by the meter. In this sub-district all the fittings are closed and tied with a string, a number of men being employed for the purpose, and each having several houses to watch. The stopcocks are then closed one by one, and, the time being noted, waste in the pipes of any premises is thus discovered and measured. The following statement shows the various classes of defects in fourteen waste water districts in Liverpool, containing an aggregate of 3000 persons :—

	Notices issued for defects.					Simple repairs by inspectors.					
	Cocks.	Ball cocks.	Water closets	Pipes.	Total.	Cocks.	Ball cocks.	Water closets	Pipes.	Total.	Total noticed and repaired
Total for 14 Districts	713	5	555	1232	2665	253	58	55	28	304	3076

Tests for leaks in public pipes are conducted as follows :—The condition of the main and branches to the stopcocks may be ascertained by closing those stopcocks entirely when any flow must be due to leakage. By sounding closed stopcocks, and all other exposed meter work connected with the pipes, that leakage may often be localised. An internal examination of the neighbouring sewer on a dry night may lead to many important discoveries, especially if large isolated leakages exist.

If, however, the pipes are old, and the metal indicates a considerable flow, it is well worth while to strip them entirely, having at hand new pipes with which to replace the old ones, if thought desirable.

It only remains for me to point out the means by which I propose to maintain the condition of comparative freedom from waste in those districts in which a normal consumption has been attained. Taking for example a town of the size of the borough of Liverpool, containing 500,000 persons, there will be about 300 waste water districts and 300 waste water meters. Unless the consumption of a district has suddenly become abnormal, it is not objectionable to leave each diagram on for a week, and to allow the seven diagrams to be superimposed upon each other. Each day fifty diagrams will be removed and replaced by blank sheets and brought to the office.

The work can easily be performed by two meter inspectors and two boys, with the reserve of one inspector and one boy, who in addition, will wind up the clock and do any other necessary work in connection with the meters.

Any district the consumption in which the diagrams brought in shows to have increased unduly will be excluded from the general inspection, and omitted by the ordinary meter inspector. Two or three special inspectors will at once be sent to it, and there is no doubt that a few days' work, or even less, will generally bring it back to its normal condition.

The advantage of such a system is manifest Without it waste water inspectors discover only superficial defects, and spend their time equally on good and bad ground, but the best evidence of its value is the unprecedented success which is attending its adoption in Liverpool."

---

* Saturday and Sunday morning. † Normal condition of district. ‡ Taking census, inspecting and making sundry small repairs. Fixing stopcocks. ‖ Stopcocks fixed.

NOTE —The figures are those of an office district in Liverpool in connection with which the operations for the prevention of waste are incomplete, the next step being to serve general notices and proceed with the detail examination.

Fig. 1.

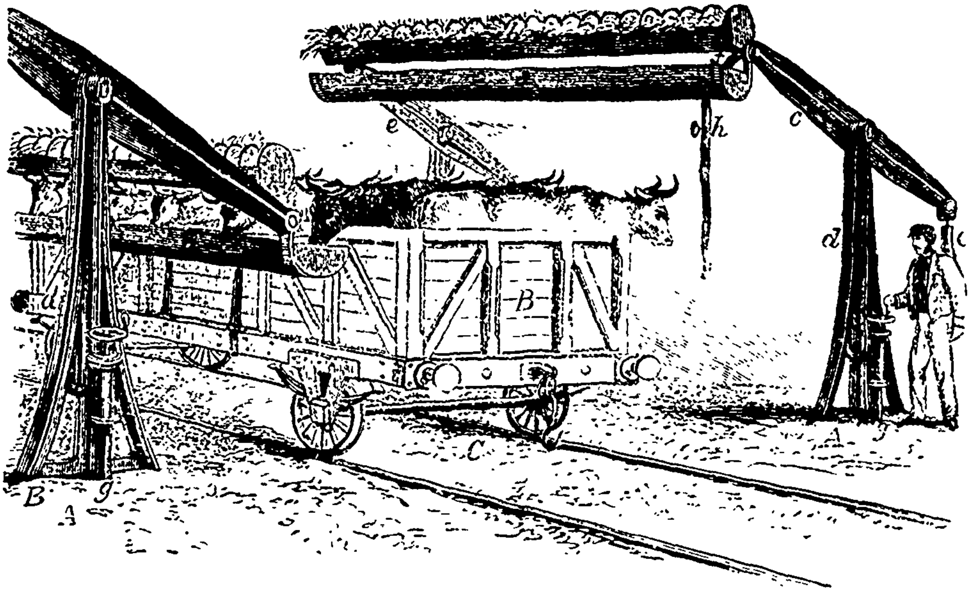
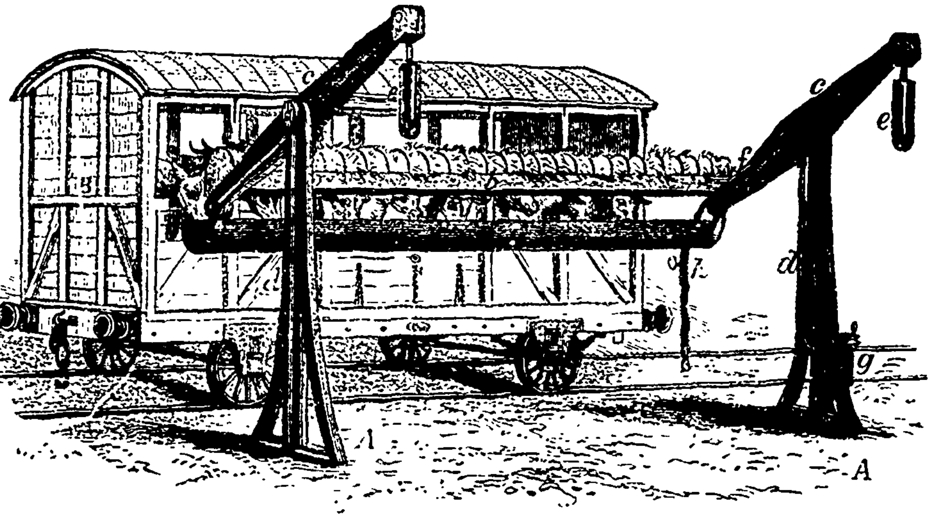


Fig. 2.



DEVICE FOR FEEDING AND WATERING CATTLE.

FEEDING AND WATERING CATTLE ON RAILROAD CARS.

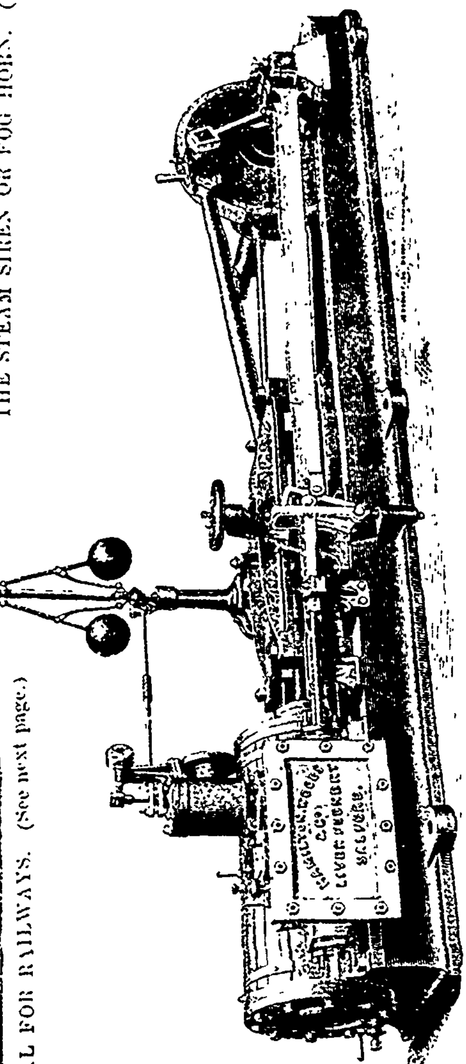
Every now and again we see in the daily press statements concerning the suffering of cattle in transit over our railroads. There can be no doubt but that the cattle do suffer much and the meat must lose much in quantity and not less in quality. An English butcher has recently patented a device by means of which much of this misery and loss may be obviated. It is hardly necessary to state that if such an apparatus be deemed essential in England it must be much more so in this country where the journeys are many times longer and where our single lines cause much more detention on the road. We commend the idea to the consideration of the Society for the Prevention of Cruelty to Animals.

The hay rack, *b*, and the water trough, *a*, are suspended at the end of a balanced lever, *c* (seen in both our illustrations, which we reprint from the *Practical Magazine*). Water is turned on at *g*, till the weight of the trough overbalances the counterpoise, *e*, and descends to the required level. When the animals are well refreshed, the cock, *h*, is opened, the remainder of the water flows away, and the troughs rise out of the way. Our engravings show the complete apparatus in use with an open car (Fig. 1) and a closed car (Fig. 2).

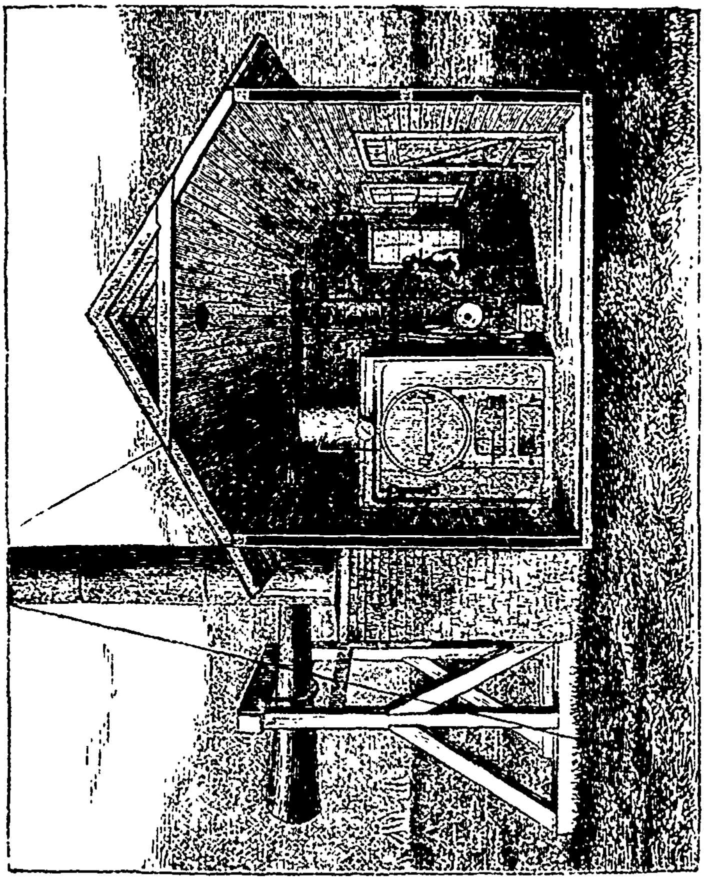
The cost for apparatus to feed 30 cars of cattle at once is estimated, by a firm of engineers, to be $4,260, a moderate outlay, considering the permanent value of the appliances, and the greatly improved condition of the stock.

The St. Louis Bridge.—The iron work is now complete, two weeks in advance of the contract time. A grand banquet has been given by the Keystone Bridge Co., contractors, to their employees, some 200 in number, at the Grand Central Hotel. The approaches will now be hastened to completion, railroad tracks laid, and carriage ways finished as speedily as possible; and the indications are that the bridge will be thrown open to public traffic at a much earlier day than was anticipated.

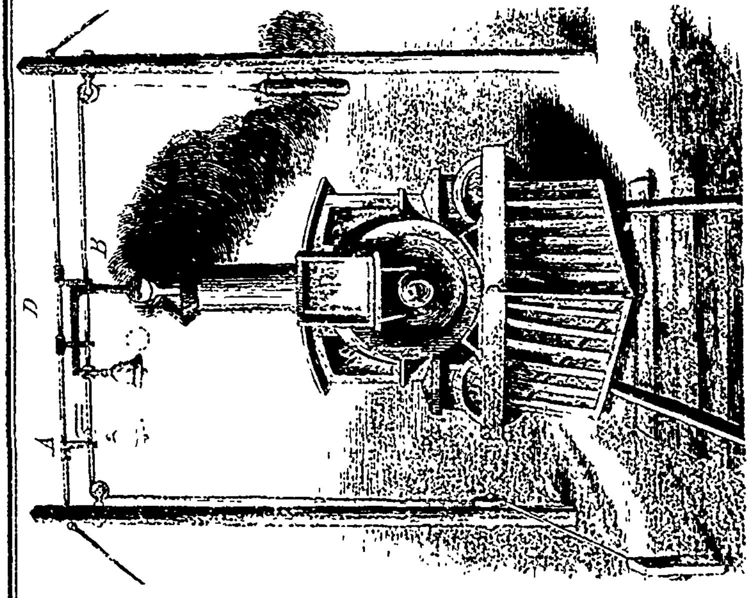
The original patent for metallic tips for shoes was sold for 100 dols., and the company which bought it became wealthy. Now, upon its expiration, the inventor has obtained its renewal, and compels the company to pay him 60,000 dols.



HORIZONTAL ENGINE WITH VARIABLE EXPANSION GEAR. (See next page.)



THE STEAM SIREN OR FOG HORN. (See next page.)



SAFETY BELL SIGNAL FOR RAILWAYS. (See next page.)

THE STEAM SIREN OR FOG HORN.

Fog signals, many of which are required at different points on the Atlantic and Pacific coasts, are of several kinds. Some are steam whistles, the sound of which is made deeper or louder by being sent through a trumpet, but the most effective is probably the siren. This ingenious machine consists of a long trumpet and a steam boiler. The sound is produced by the rapid revolution past each other of two flat disks pierced with a great number of small holes, a jet of steam under high pressure is projected against the disks, which revolve past each other more than a thousand times a minute; as the rows of small holes in the two disks come opposite each other, the steam vehemently rushes through, and makes the singular and piercing noise which a siren gives out. One of these machines, of which we give an illustration, cost about $3,500 complete, with its trumpet, boiler, &c.

Daboll's trumpet is worked by an Ericsson engine, and requires no water for steam.—*Harper's Magazine.*

SAFETY BELL SIGNAL FOR RAILWAYS.

It is generally agreed that travelling on railroads is somewhat safer at night than during the day time. Fewer trains run at night, the attention of the driver is not so much distracted from his work and light signals, that is lamps are more clearly seen than semaphores in the day. But in the case of danger signals such as torpedoes and danger lights, there is always possibility that the former may fail to explode or the latter to be seen. In order to render the attraction of the engineer a matter of certainty, M. Scheppers, in the *Chronique de l'Industrie*, suggests the simple arrangement represented in the engraving on page 319. Two posts are erected on each side of the track, at a suitable distance from the draw, switch, or other point, the connection of which the engine driver must be informed of before proceeding. Between the tops of these is a stout wire, on which are three travelers, A, the lower and vertical portions of which serve for supports for a line B, which passes over pulleys on the posts, is connected with the switch lever, and carries at its free end a counterpoise C. Secured to the line B, which passes through and is secured to its vertical arms, is a double lever D. One arm carries a bell, the other extends down and has a disk-shaped end directly over the middle of the track. When the switch lever is properly adjusted, the counterpoise is raised, and the lever carried by the rope B, over to the left of the track, as indicated by the dotted lines; should, however, the rails be wrongly placed or left open, the arrangement of the connecting lever is such that the counter weight draws the bell lever into the position shown. As soon as a train comes along, a projection on the smoke stack of the engine strikes the disk arm of the lever and rings the bell, thus warning the engineer. The usual signals for the eye may, of course, be connected to apparatus in the ordinary matter.

HORIZONTAL ENGINE.

We give, on page 319, a perspective view of a type of horizontal engine now being made as a speciality by Messrs. Hamilton Woods, and Co, of the Liver Foundry, Salford, Manchester, the particular engine illustrated having a cylinder 18 in. diameter with 36 in. stroke The first engine of this type was made five years since for working the machine in the locomotive shop of the Tasmanian Railways, and has done exceedingly good work. Others have since been made for breweries and manufactories, among them one for Messrs. Wright, Turner, and Son's mill at Pendleton, where with a pressure of 80 lb. in the boiler, the engine making 72 revolutions, it has been indicating 100 horse power, the engine nominally being 20 horse power.

The engine, as shown, has the expansion link raised by a hand-wheel and screw, the expansion slide on the back of the main slide being thus regulated, for general purposes, where the work is pretty constant, this is sufficient and preferred, as if some of the machines are idle, the engineer can easily regulate the screw accordingly; where a more sensitive action is required an arrangement is provided for raising or depressing the link by the governor. The design of the engine is very neat and substantial.

ACTION OF WATER ON LEAD PIPES.

(By Chas. W. Vincent, in *Iron.*)

In most great towns the water, after it passes from the mains of the water companies, is distributed to, and through, the houses of the inhabitants in lead pipes. Every now and then some wiseacre who has learnt enough chemistry to know that plumbic oxide is sometimes formed by the action of water on lead, creates a panic in the mind of the public by pointing out this important fact. A great fuss is then made, and a great deal is said about the danger of this poison being overlooked until too late, from its being introduced into the human system in almost imperceptible quantities, there to accumulate until fatal consequences to health and strength are produced.

Experiments are thereupon immediately directed to be made by the professional chemists of the locality, who accordingly proceed to plunge pieces of pure lead and lead-piping into the waters accused, into distilled water, fresh rain water, well water, &c.

The results to be expected are well known, and have been well known for the last fifty years. The distilled water attacks and dissolves the lead with very great rapidity; rain water not quite so rapidly, the well water but seldom attacks it at all, and the river water, if it has travelled through any considerable distance, never. Few people have had long experience of a country district without meeting with more or less of such a panic; but that Paris, one of the most scientific of cities, and better supplied with chemists than perhaps any in the world, should have been frightened by such a silly outcry, is certainly matter for astonishment. It is, however, true. Paris has lately had her equanimity very greatly disturbed by having this terrible grievance added to her other troubles. According to a petition presented to the Municipal Council of Paris (and acted on by it), "the unwholesomeness of water which has remained for any length of time without circulating, in tubes of lead, is a fact recognised by the chemists and physicians of all ages and of all countries. The water so situated dissolves the lead, and, when thus contaminated, its employment for culinary use will give rise to veritable poisoning—slow, chronic, without producing sudden fatalities, and for that reason all the more dangerous, for the lead accumulates in the organisms, and only reveals itself when the mischief is consummated."

The consternation was extreme, though no one could be found who was suffering the dire effects of lead poisoning, however, Professor Dumas, Dr. Belgrand, and Dr. Felix Le Blanc, came to the rescue, and as their experiments, though not at all novel, are, being recent, nevertheless very comforting to sanitary engineers and medical officers of health, who are at all times liable to have to answer for the water under their charge upon similar grounds, they may be shortly summarised.

Professor Dumas in five flasks put samples of distilled water, rain water, Seine water, Ourcq water, and surface well water, into each flask he then put granulated lead. The first water-flask, when submitted to the action of sulphuretted hydrogen, gave indications of lead in solution when the contact had been only momentary between the water and the metal. In the case of those other waters which were more or less charged with calcareous salts, no lead was found, even after standing for a considerable time. The rapidity, Dumas says, with which pure water charges itself with lead is very surprising, but the effect produced by the merest traces of calcareous salts present in solution in preventing this reaction is not less so.

Belgrand and Le Blanc directed their enquiries to the actual effect produced by leaden pipes at present in use. They found that the total amount of leaden tubing was not very great in comparison with other kinds of pipes In the city of Paris there are, for water conveyance:—Cast-iron mains, 1,466 500 miles; iron plates asphalted, 75,700 miles; lead pipes (about), 3,600 miles—total, 1,545,800 miles.

The public mains are manifestly above suspicion. It is only the short private branches which are of lead. The total number of these leaden connections is 39,495. The result of most careful experiments made upon the water from different sources, after passing through the lead branch into the house was that in inhabited houses, that is to say, where the water never remains stationary in the lead branch for more than ten to twelve hours, not a trace of lead could be discovered.

With regard to water which is allowed to remain for a considerable time in contact with lead, the amount of the action depends entirely on the purity of the water. In distilled water the pretty tiny white scales of crystalline hydrated plumbic oxide form with very great rapidity, if there is free access of air, and the bottom of the vessel containing the lead and water will speedily become covered with a white deposit Freshly fallen rain water acts nearly as well. Hence rain water for alimentary purposes should never be collected from leaden gutters

On the other hand, however infinitesimal the amount of lime salts in solution may be, if they can be detected at all the water in which they are found is positively free from all action as regards lead. Soft water dissolves lead; hard water preserves it untarnished.

No other salts appear to preserve the lead so entirely from oxidation as do the salts of lime. Inasmuch, however, as it is impossible for the water to percolate or pass over any considerable amount of soil without taking lime into solution, and this lime it is impossible wholly to remove by any means short of a complete distillation, it follows that all river water may be conveyed with the most perfect security through lead pipes without in any way interfering with its wholesomeness as a potable water.

In Paris the matter is still being enquired into, and reports on the subject are expected from MM. Bouilland, Fordos, and Boudet; so that, perhaps, after the ghost of lead-solution in drinking-water has been duly laid by so many priests of science, it will not reappear for some few years to come, at least not in such a bold way as to affect the repose of the scientific world.

THE MINERAL WEALTH OF THE NORTH.

There can no longer be any doubt that the country to the north of this village abounds with iron ore of a superior quality. Specimens of ore are frequently brought to our office by persons from the back country, and in each case the specimens have been of a good quality, and were represented to have been procured at places where the supply was in prodigious abundance. Reports reach us, moreover, from many quarters of fresh discoveries of iron ore. A careful search will probably disclose the presence of other valuable minerals, and at no very distant day we may expect to find the mineral treasures of our back country become the source of greater wealth and prosperity than that which has been flowing for so long a period from the timber and other produce of its forests. It would really seem Nature had destined the back country for a gigantic metallurgical laboratory. Not only is the ore found in the richest profusion in the heart of the forests which supply the fuel necessary for the extraction of the metal, but in close proximity are found the lime stone, without which smelting cannot be carried on, and the most wonderful system of lake and river navigation for its transport that can be found in any part of the world. The chain of waters of which Bobcaygeon is the centre gives a navigation from Port Perry to Bridgenorth, some seventy miles in length, and throughout the whole of the back country are chains of lakes of varying length on which steamboats can ply with advantage. A reference to the letter of our Minden correspondent will show that a proposed dam at the outlet of Mountain Lake will give an uninterrupted navigation nearly thirty miles into the townships of the English Company, and the commencement of this navigation is scarcely a mile distant from the termination of the navigation of the Gull River, which latter, at a comparatively trifling expense, could be brought into connection with the navigation that connects Port Perry, Lindsay, and Bobcaygeon. Burnt River could also be made available for a barge navigation, and thus every point of the mineral region would be brought within a distance of a few miles of water transport Seeing that the consumption of iron is largely increasing, who can doubt that our back country iron ore will ere long furnish the material for a great, important, and profitable industry?

In the meantime, a proposition is on foot to open a good winter road from Nogey's Creek, on Pigeon Lake, to the Snowdon Iron Mine. As this would pass directly through the thriving Swamp Lake Settlement, it would be a most desirable local improvement. From navigable water in Pigeon Lake to the Campbell mine would be about seventeen miles, and this winter road would probably ultimately form the track of a tramway or railroad.—*Bobcaygeon Independent.*

THE PROPOSED CHAMPLAIN SHIP CANAL.

By reference to the annexed map, the reader will be enabled to trace the extended route which it is proposed to open to commerce, by the construction of a ship canal and the improvement of the Hudson River between Troy, N.Y., and Whitehall on Lake Champlain. A perfectly feasible engineering work is contemplated, which, while inconsiderably small beside others of a similar nature which have been completed throughout the world during recent years, nevertheless offers beneficial results of the highest importance to the North and Northwest of the United States, in that it provides undeniably the natural and best route from the Great Lakes to tide water.

From New York to Troy, a distance of 150 miles, the Hudson is navigable, as is well known, by vessels of large tonnage. From Troy to Fort Edward, a distance of forty miles, there is an elevation of 116 feet to be overcome; from Fort Edward to the summit, a distance of two miles, an elevation of thirty-one feet; from the summit to Lake Champlain, at Whitehall, a distance of twenty-one and three-tenths miles (seven miles of which is in Wood Creek), there is a descent of fifty feet to Lake Champlain Thus it will be seen that the highest point between tide water and the St. Lawrence is 147 feet, and that the entire length of the river and canal improvement is but sixty-three and three-tenths miles. Eleven locks and dams are required, the former to be 300 by 45 feet in size, to overcome the elevation and to give ten feet of water in the river. Wood's Creek, which runs into Lake Champlain, is already nearly ten feet in depth, and would require little straightening, so that the canal portion to be constructed is reduced to but seventeen miles, requiring but two locks. The width at the bottom is to be 110 feet and at surface 150 feet.

The route from Whitehall extends up through Lake Champlain to the Richelieu river, and thence to St John's, where the latter stream is entered by the projected Caughnawaga canal. For this enterprize a charter has already been granted by the Canadian Government, and work is to be speedily begun. The canal extends to Caughnawaga upon the St. Lawrence river, and is 29 miles in length. The country through which it passes is almost a dead level, there being a rise of but 25 feet, so that the entire work can be built in half cutting—that is, a cut of six feet and a bank of six feet would be all that would be required to construct a canal of 12 feet in depth. From Caughnawaga the route continues, *via* the Beauharnais canal of eleven miles and the Cornwall canal of twelve mile (which canals are constructed around rapids in the St. Lawrence river, and which rapids are now being improved so that vessels on the downward course do not need to use the canals), through the St. Lawrence to Lake Ontario, and thence through that lake and the Welland canal (twenty-seven miles) to Lake Erie From Lake Erie, vessels of any tonnage can pass into Lake Huron, Lake Michigan, and Georgian Bay; and *via* the Sault Ste. Marie canal, of a little over one mile in length, vessels of 2,000 tons can pass from the waters of Lake Huron to Lake Superior. From Green Bay, an arm of Lake Michigan, there is now an improvement in process of construction which will when completed, so improve the Fox and Wisconsin rivers that water communication will be opened between the Mississippi and Green Bay, a distance of 278 miles, and another already concluded by the Illinois and Michigan canal and the Illinois river to the Mississippi river, a little above the mouth of the Missouri. Through this entire distance, from the lakes to tide water, with the exception of eighty-four miles of ship canal, there is, so far as speed is concerned, a free and uninterrupted water way upon which steamers or sailing ships can be propelled at an average rate of eight miles per hour for steam vessels. From all the ports on the upper lakes to the foot of Lake Erie, all vessels whose cargoes are destined for tide water by any route will be upon equal terms. At that point Nature has presented a barrier, and here the products of the west take different routes to different markets. By the Champlain route a boat could come from Port Colborn, near the foot of Lake Erie, to tide water (without breaking bulk) in four days' time, allowing only the same rate of speed in the eighty-four miles of canal as are now made on the Erie canal, as against an average of at least ten days from Buffalo to Albany by the latter. This saving, of time and interest, of the expense of breaking bulk, of transhipment and division of cargo, requires no argument to prove its importance. It is believed, moreover, that a canal adapted for a vessel of 1,000 tons—as it is proposed to construct that

MAP
SHOWING THE ROUTE OF THE
CHAMPLAIN SHIP CANAL
AND
HUDSON RIVER IMPROVEMENT
AND CONNECTING WATER WAYS.
to the West and North West.

under consideration—will lessen the cost of transportation between the foot of Lake Erie and the Hudson river fifty per cent, a gain of two dollars per ton on the commerce of the west, or at least $2,000,000 annually.

The Canadian Government is now contemplating the con-struction of a water way, known as the Ottawa and Lake Huron canal. *This leads by a natural chain* of rivers as a glance at the map will show, from Georgian Bay to French river, thence through Lake Nipissing to Trout river, thence to the Ottawa, and *via* the Ottawa to the St. Lawrence at Caughnawaga. It would make a route of 980 miles from Chicago to Montreal, against 1,348 miles by the St. Lawrence route, showing a saving of 368 miles. This, therefore, when built, must tend to cut off comparatively the Erie canal and the Oswego canal from competition with the commerce over the Ottawa route, while the Champlain and Caughnawaga canal would be in the direct line and would give New York all the advantages of the saving in distance. There are also local considerations which point to the advantages gained in the construction of the Champlain route. It would afford a highway and materially lessen the cost of the transportation of lumber manufactured in the Ottawa district, nearly 500,000,000 per annum; of the iron ore also from Lake Champlain, 400,000 tons of which are yearly raised and shipped; of the products of the great fishing trade of Labrador and Newfoundland, and also of the coal from Picton.

The bill before the New York legislature provides for the survey and location of the work at once, and calls or the raising of the necessary sum for its accomplishment, $10,000,000, by suitable taxation.

The Brantford gas works are to be reconstructed, and the relations between the company and the town re-organized.