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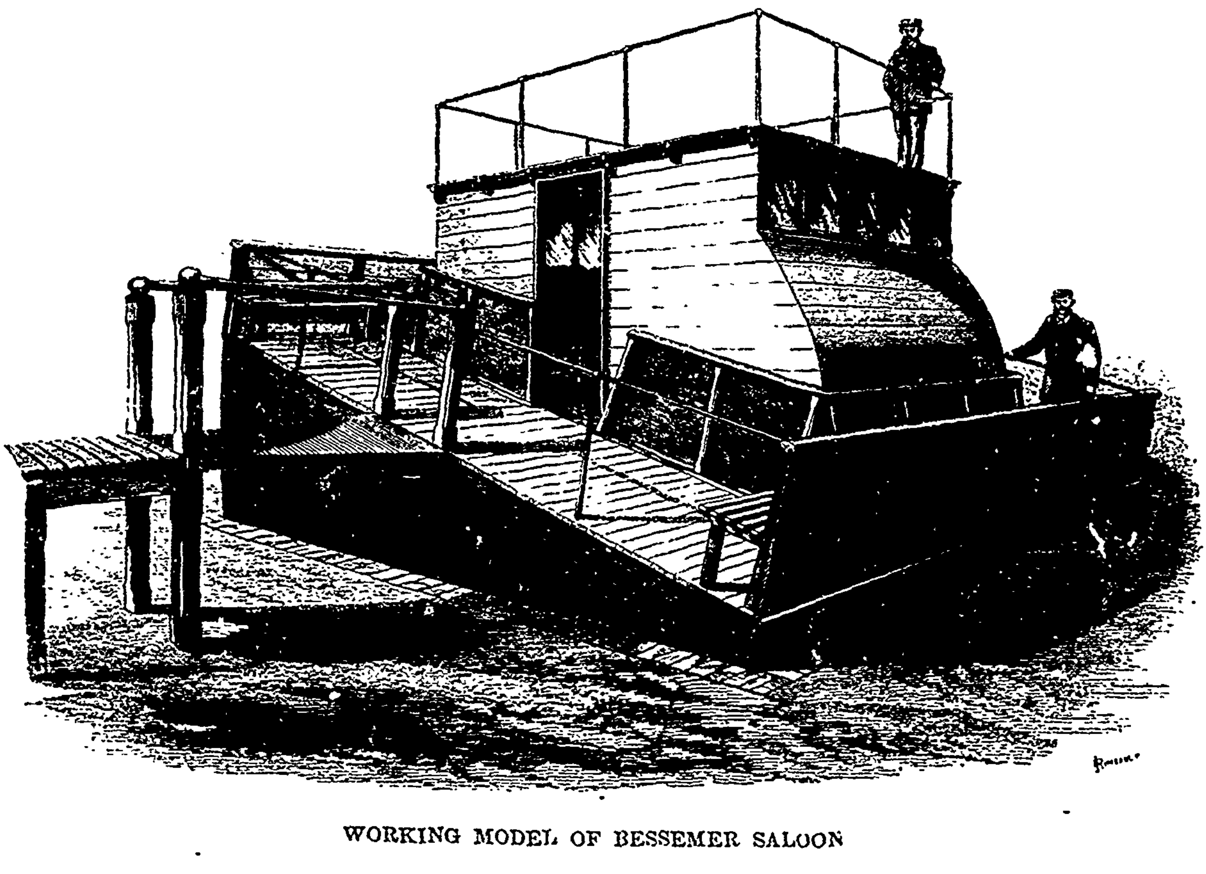
The Canadian Patent Office Record and Mechanics' Magazine

Vol. I.—No. 1. MARCH, 1873. Price $1.50 per An.

THE BESSEMER SHIP SALOON.

Our engraving of the above invention which is now being so fully discussed by the general press, is taken from *Engineering*. The "vessel" is shown at its maximum inclination, the cabin around which it moves being in the horizontal position in which it can be constantly and steadily maintained by the operator within, who, standing on a platform below the level, and in the centre of the cabin, controls its movement in the one direction which is imparted to the "vessel" with the utmost ease. The flexible platform, by which approach to the model is obtained, is clearly shewn in the drawing. It consists of strips of wood with rubber distance-pieces between each, threaded upon bars, which, in the model, secured to the fixed gangway, are free to move in every direction with the motion of the vessel. The movement of this platform, in actual practice, would thus be at a maximum at its junction with the moving deck, decreasing gradually to nothing at the entrance to the cabin.—*Scientific American.*



WORKING MODEL OF BESSEMER SALOON

PROSPECTUS.

The undersigned has the honor to announce that he has been entrusted by the Honorable Commissioner of Patents for the Dominion of Canada, with the publication of the OFFICIAL RECORD OF THE PATENT OFFICE, to be illustrated by diagrams of all the patents susceptible of illustration. This Official Record will be published Monthly, and will be combined with letter-press and illustrations selected from the best English and foreign scientific papers, thus not only placing before the public of the Dominion the products of native genius and industry, but also keeping them posted on the progress of Science and Mechanics in other countries. Inventors will thus know in what direction to apply their ideas. Mechanics will note the advance in labor-saving appliances, and the improvement in tools. Manufacturers will be prevented from employing obsolete methods, while new machinery and modes of operation are in use elsewhere. Builders and contractors will know where to apply for all the latest productions in their line combining economy, beauty, and utility. Chemists and Druggists will be saved useless search for compounds already invented by others, and be told where to get the most recently discovered curative remedies and toilet perquisites. Farmers will see every new agricultural implement illustrated and described. In a word there is not a scientific, industrial, mechanical, or commercial pursuit that will not be benefited by this publication. It is therefore expected that a very large circulation will take place among all classes, and the price is fixed correspondingly low.

THE CANADIAN PATENT OFFICE RECORD AND MECHANICS' MAGAZINE will be published once a month. The official portion will cover from 16 to 32 pages, comprising from 100 to 240 patent claims, specifications and diagrams. As the publication will commence with the patents issued under the new Act, which came into operation September 1st, 1872, the first four issues will contain 240 patents each, and each successive number will contain the patents issued during the preceding month.

The unofficial portion, or ***MECHANICS' MAGAZINE,*** will give in each number 32* pages of carefully selected articles and items, gleaned from the very best foreign technical papers. Every branch of Engineering, Mechanics, and Manufactures will be treated, especially such as have a practical application in Canada. For instance, Railways, Shipbuilding, Lumbering, Mining, Architecture, Machinery, Cabinet-making, and the manufacture of Cloth, Linen, Cotton, Paper, Tobacco, and other articles of Home Industry. Practical Chemistry, Mineralogy, and Natural Philosophy, will also receive attention. Original articles will be contributed by distinguished Canadian scientists, engineers and manufacturers, and the whole will be profusely illustrated.

The subscription price of the ***CANADIAN PATENT OFFICE RECORD AND MECHANICS' MAGAZINE*** is fixed at ONE DOLLAR and FIFTY CENTS per annum, invariably in advance. Single numbers will be sold at 15 cents. Appropriate advertisements will be inserted at 10 cents per line for each insertion.

The first issue will be dated 1st March 1873, and will be distributed about the 25th instant.

Your subscription is respectfully solicited.

ADDRESS: GEORGE E. DESBARATS,
PUBLISHER, MONTREAL.

MECHANICS' MAGAZINE.

MONTREAL, MARCH, 1873.

The publication of the *Patent Office Record and Mechanics' Magazine*, while it marks a new phase of Canadian journalism, will not fail to be recognized as another manifestation of the rapid progress the Dominion is making in those mechanical and engineering developments which are the invariable accompaniments of progress towards a high condition of civilization and prosperity. The westward march of progress is becoming more and more rapid as the means of its advance are developed and improved, and, as certainly as Canada is possessing herself of the means, so certainly will she rapidly attain the end,—a continually increasing extent of inhabited territory, with plentiful means of communication and abundant facilities for transportation of products. There never has been, in the history of the country, such a promise of the extension of our public and private works as is just now manifesting itself. New roads of the most extensive character and of the first importance are being pushed forward in a spirit of great earnestness. Our water communication is to be rendered more capable of performing the work required of it in transporting the rapidly increasing products of the West, and each season sees new lines of steamships added to those already visiting our shores. The immediate result of the inception of these undertakings must be a great stimulus to all branches of industry, especially to those connected with engineering and mechanics. It is under these somewhat favorable circumstances that the *Mechanics' Magazine* appears before the public. We shall present, each month, to our readers, in the first place, a record of all inventions patented at Ottawa during the preceding month; each invention, when susceptible of illustration, accompanied by a diagram. This part will be official. The unofficial part will consist of original and selected articles. The former will be contributed by the ablest authorities in Canada on the different subjects treated of. The selected matter will be carefully chosen and will consist of such articles from the best foreign scientific papers as may be of special interest either in themselves, or from their relation and adaptibility to circumstances in Canada. We purpose also to keep track of the advancement of all enterprises and undertakings of general interest, such as the Canada Pacific and Intercolonial Railroads and other great works, the erection of new manufactories, &c.

The progress of all such undertakings, will be carefully followed. The descriptions of these works will be illustrated from time to time by drawings made by artists on the spot. Other interests (see prospectus) to which we have not room to allude here, will also receive attention.

The *Magazine* will thus become a guide, and a store of information to all connected with mechanical and scientific pursuits and will at the same time be greatly interesting to the general public as a record of whatever of interest, in these subjects, is taking place in other countries and in the Dominion.

CORRESPONDENCE.

PATENT LAW.

To the Editor of the MECHANICS' MAGAZINE,

SIR,—On the first of September, last year, it will be remembered by many of your readers that the present Patent Law came into force, repealing the former enactments, and providing a means, whereby foreigners could obtain in Canada for their inventions, the protection which had hitherto been denied them. The beneficial effects of such an enactment are already becoming visible, and arrangements, which would never have been thought of, had the old law remained in force, are being entered into, to start large manufacturing establishments in Canada.

To place our country on a footing with others it is absolutely necessary that we should encourage home manufactures by every legitimate means in our power. Judicious legislation is better adapted to do this than any bribe of free passage and other expenses, for what use is it to a man to have his passage free to a country where he has great difficulty in obtaining employment? How many persons having the means are there in Great Britain to-day, who would leave it to come here had they the certainty of being employed when they arrive? This is the class of people that we require: it is not the sweepings of the poor-house, the jails or the streets, or the ruffian who has made the country he lives in too hot for him, that we have any interest in inducing to come here, but it is the honest, industrious, temperate, prudent individual, who will form a useful and valuable acquisition to any nation or social community, that we wish to invite to our shores. There can be no doubt that the only way to get such a class of persons is to ensure employment for them on their arrival here, and this can be done in two ways:—

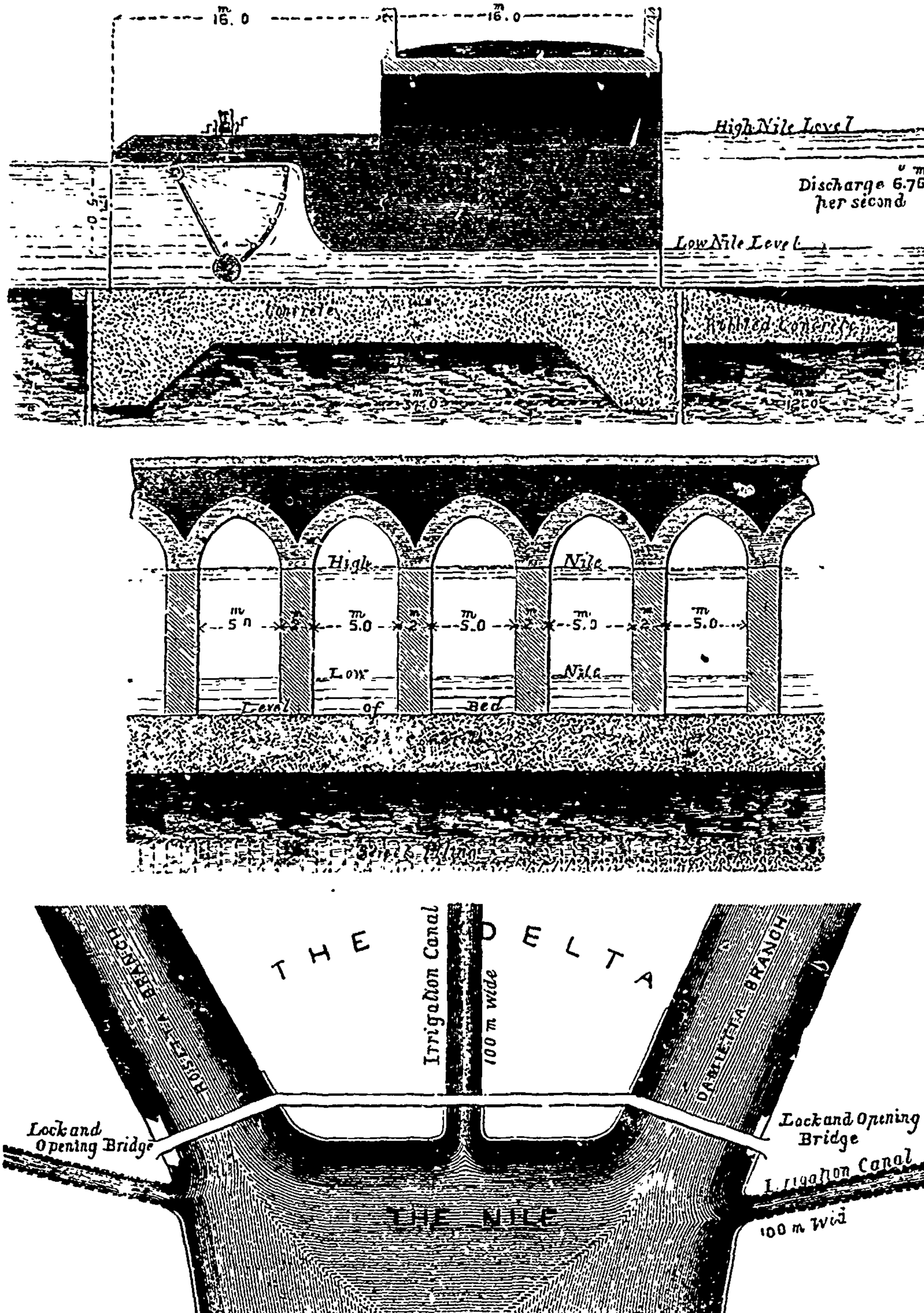
1st. By giving every encouragement to the increase of manufactures, and 2nd. By the development of the natural resources of the country.

Our government should, therefore, be watchful and zealous in rendering every encouragement in its power to those whose enterprise is calculated to advance these two points, which, in most cases, will re-act on each other.

It may be considered that I have diverged from the subject before me, but it is somewhat necessary to do so in order to bring before the minds of your readers the importance of proper legislation on the *subject* of Letters Patent.

Although, as I said before, the present law is a very great improvement on the preceding one, and reflects much credit upon its introducer and supporter, and on the administration that sanctioned it, yet I am sorry to say that it is in many points deficient. Had I space to explain these deficiencies I could show to the minds of all reasonable men that they amount to absolute injustice.

These are due mostly, not to the introducers of the bill, but to those who opposed it, they, like the man in the fable who



BARRAGE ACROSS THE NILE.

THE GREAT LAXEY WATER WHEEL.

"killed the goose that laid the golden egg," considered it best to hamper the law with restrictions, which, in many cases, could not be complied with.

Let me view the case in its broad light, and not in that of one self-interested individual.

I must first take it for granted that reward is absolutely necessary as a stimulus to invention, and invention may be considered the mother of manufactures. Without reward all energy ceases. God Himself has ordained this, and appointed that the reward of the good shall be everlasting happiness.

Can anybody, for a moment, pretend that exertions will be made for any earthly things without an inducement? If then we diminish the rewards, we diminish efforts to attain the object, and with these diminished efforts come also diminished results.

Having thus shown that a proper reward must be held out to inventors, let us examine the law as framed for that purpose.

It must be remembered that the Patent Office is not, in any way, to be blamed for any defects in the existing law, as of course, they can only put into operation the provisions of the statute with regard to the applications laid before them.

I will now review the objectionable clauses in the present Patent Act in their proper sequence, and begin with the 6th section, of which the following words form part:—

"Not known or used by others before his invention thereof, "and not being in public use or on sale for more than one year "previous to his application in Canada, with the consent, or "allowance of the inventor thereof, may on a petition * * * "obtain a patent."

It may seem at first sight to those not well acquainted with the law that this is all reasonable enough; but those who are better versed will readily understand that the one year is too little, in so much as many of the best inventions take many years to bring them to the proper perfection to introduce to the public. This clause in the law might, however, do well enough, were it not that it must be taken in conjunction with the 48th section which reads as follows:—

"Every person who, before the issuing of a Patent, has pur- "chased, constructed, or acquired any invention for which a "Patent has been obtained under this Act, shall have the right "of using and vending to others, the specific article, machine, "manufacture, or composition of matter patented, so purchased, "constructed or acquired before the issue of the patent there- "for, without being liable to the patentee or his representatives "for so doing; but the patent shall not be held invalid as re- "gards other persons by reason of such purchase, construction, "or acquisition, or use of the invention by the person first afore- "said, or by those to whom he may have sold the same, unless "the same was purchased, constructed or acquired or used for "a longer period than one year before the application for a "patent therefor, which circumstance would then have the ef- "fect of making the invention one having become public and "in public use."

Thus we see that, if the inventor requires time to work out his invention, another man to whom he has imparted his knowledge may construct it, and should one year elapse before the application is made, the patent when granted is null and void for all that part of it which has been so constructed. It may be thought by some that the fault lies in the 48th section and not in the 6th, but it is not so: the 48th section (which we will consider in its proper order,) although no doubt not without its faults is nevertheless substantially a very useful and necessary clause. The fault lies in the shortness of the time: this should be two years instead of one, and in fact the clause should be made to agree with the 24th section of the United States Patent Act which is as follows:—

"Section 24. And be it further enacted, that any person who "has invented or discovered any new and useful art, machine, "manufacture, or composition of matter, or any new and useful "improvement thereof, not known or used by others in this "country and not patented, or described in any printed pub- "lication in this or any foreign country before his invention "or discovery thereof, and not in public use or on sale for more "than two years prior to his application, unless the same is "proved to have been abandoned, may, upon payment of the "duty required by law, and other due proceedings had, obtain "a patent therefor."

We may take it for granted that no nation is more fully alive to its own interests than the American, and the opinion just expressed may therefore be considered as supported by that of the United States.

We will now review the 7th section of our present Patent Act which reads as follows:—

"7th. But an inventor shall not be entitled to a patent for "his invention, if a patent therefor in any other country shall "have been in existence in such country more than twelve "months prior to the application for such patent in Canada; "and if during such twelve months any person shall have com- "menced to manufacture in Canada the article for which such "patent is afterwards obtained, such person shall continue to "have the right to manufacture and sell such article, notwith- "standing such patent; and under any circumstances, where a "foreign patent exists, the Canadian patent shall expire at the "earliest date at which any foreign patent for the same inven- "tion expires."

The intention of this section of the Act is this: That whereas it has been legal heretofore in Canada to steal the inventions of foreigners, and no doubt some persons in the Dominion have committed such legal theft, we wish to protect them from the consequences.

The wording of the section is of the clumsiest character for, in the second place, where 12 months are mentioned, it is evident that it refers to a space of time the duration of which may be anything less than twelve months, in fact not even a week.

The latter part of this clause is utterly unjust to our own inventors, as by it they are precluded from obtaining patents in those countries, such as Russia, which only grant them for a period of ten years, unless they are willing to sacrifice the last five years of their Canadian Patent.

In France a patent is only granted for one year, but is renewable on the payment of a yearly tax for a total period of 15 years. Should, however, the tax not be paid by a certain time the patent at once lapses.

In the generality of cases the inventor has a better opportunity of working his invention in the country in which he resides, and it therefore happens that in many instances no use is made of a foreign patent when obtained.

An inventor who has secured a patent in France is thus often obliged to pay his yearly tax to the French Government in order to save his Canadian patent from becoming null and void.

I am of opinion that the first part of this clause should be obliterated altogether and in its stead the first part of the 25th section of the U. S. Law be substituted as follows:—

"Sec. 25. And be it further enacted that no person shall be "debarred from receiving a patent for his invention or discov- "ery, nor shall any patent be declared invalid, by reason of its "having been first patented or caused to be patented in a "foreign country. * * *"

and then the clause should conclude thus:—

And whenever a patent has been obtained in a foreign country prior to the application for Letters Patent of Canada for the same invention, the Letters Patent of Canada obtained therefor shall expire on the same date as the first of those previously obtained in any other country.

The Dominion at large has an interest in every dollar possessed by every single individual living in it, and therefore, by thus preventing her inventors from obtaining rewards from foreign countries, she is only acting against her elf.

The 48th section above referred to will be quite enough to prevent foreigners from coming in and claiming damages for infringement of their patent rights, on account of articles constructed or used before the issue of such patents.

In the next letter I will consider the 11th section of the Act and other objectionable clauses.

I am, Sir,
Yours, &c.,
C. G. C. Simpson.

BARRAGE ACROSS THE NILE.—(See page 4.)

This work, of which M. Mongel was the engineer, was sanctioned in 1843; it is situated at the head of the Delta, about 120 miles from Alexandria, 100 from Rosetta, and 12 from Cairo; it was designed with the object of raising the low Nile about 16 5 ft., the discharge at that time being about 23,000 cubic feet per second.

The original design consisted of two dams or series of arches with arrangements for blocking the channels below them. The dams were to be connected by a roadway, and each was to be provided with an opening bridge and a lock capable of raising vessels from the lower to the upper waters. The end of the Delta was to be defended by a quay way, and three irrigation canals constructed, so that when dead low Nile was raised 16 ft. there should be 10 ft. of water in them.

The arches as shown in the sketch, were to be 16.5 ft. span, the thickness of the piers 6 ft. 6 in. each, the springing being at high Nile level. A lock was to be built at the end of each dam, and immediately above it an opening bridge 49 ft. 2 in. span. The size of the lock on the Rosetta Branch was 49 ft. 2 in. by 416 ft. 1 in., that on the Damietta Branch 39 ft. 4 in. by 416 ft. 1 in. The number of arches on the Rosetta Branch is 62, on the Damietta Branch 72.

The machinery for damming the arches consists of a wrought iron radiating slide door, the two lower stiffening beams, being hollow and connected by tubes, so that by forcing in air the entire door should raise itself.

The arches are bedded on a layer of concrete 111 ft. 6 in. long, 11 ft. 3 in. deep at centre, and 24 ft. 6 in. at ends, with rows of sheet piling 29 ft. 6 in. long, and an apron of rubble and concrete 39 ft. 4 in. long on the lower side. The quay walls and locks to be similarly based on concrete.

The whole of these works have been executed, as shown on page 4, with the exception of the Eastern and Western Irrigation Canals, and the machinery for raising the water on the Damietta Branch. That on the Rosetta Branch was erected, but the pneumatic arrangement for lifting it by its own buoyancy was found not to answer, and lifting chains were attached

When completed the doors were lowered and the water consequently rose, but on attaining a difference of level between the upper and lower water of 6 ft. 6 in. the whole dam began to give way, forming an arc in plan, the central part descending the river about 11 in., a settlement of the foundations of about 7⅞ in. also taking place, and one of the arches cracked.

The doors were at once raised, the water lowered, and the experiment has not been repeated, the effect of the obstruction offered by the piers, being considered all that the barrage can stand Repairs to the foundations are being constantly made during low Nile, but the engineers have no intention of again attempting to raise the water more than at present. The locks are completed but not used, and the gates are now much out of repair, while in order to utilise the central canal its bed has been lowered.—*Engineering*.

Wood Carpeting.—Wood Carpeting is made of slats of ornamental shapes, glued or cemented upon a cloth backing. The slats or stripes of wood, are of different colors, and arranged to produce all the effects of tesselated floors, mosaic work, etc.; being about a quarter of an inch in thickness, they will wear many years. They are finished in oil, and fit together so tightly, that the joints are as perfect as those in inlaid work. The surface thus produced can therefore be scrubbed, washed and oiled, when needed, precisely like other floors, made of ornamental woods, which floors they resemble in all respects when laid.

RAILWAY MATTERS.

Petitions favoring a new motive power for street railways in Brooklyn are being signed at all the ferries by thousands of citizens.

If the total length of railroads in all countries is 146,243 English miles, as has been computed, it is not surprising that their maintenance, together with the new construction, takes more than half the iron production of the world. Europe has 48 per cent and America 47 per cent of the whole.

A Transandine survey, made jointly by the Argentine and the Chilian Governments, leaves little doubt of the possibility of railway communication between the Atlantic and Pacific. The length of such a communication would be about 1200 miles, of which nearly 400 miles are actually made.

A Railroad is to be built from Pittsburg Landing, on the Tennessee river, through the great coal and iron region of Alabama to Birmingham, the centre of the iron region of that State. The road will be 162 miles long, and will have a maximum grade of 65 ft. to the mile, and will cost as per estimate 27,300 dols per mile. Birmingham is a railroad centre, and hence the importance of the road in connecting the southern railroads with northern rivers.

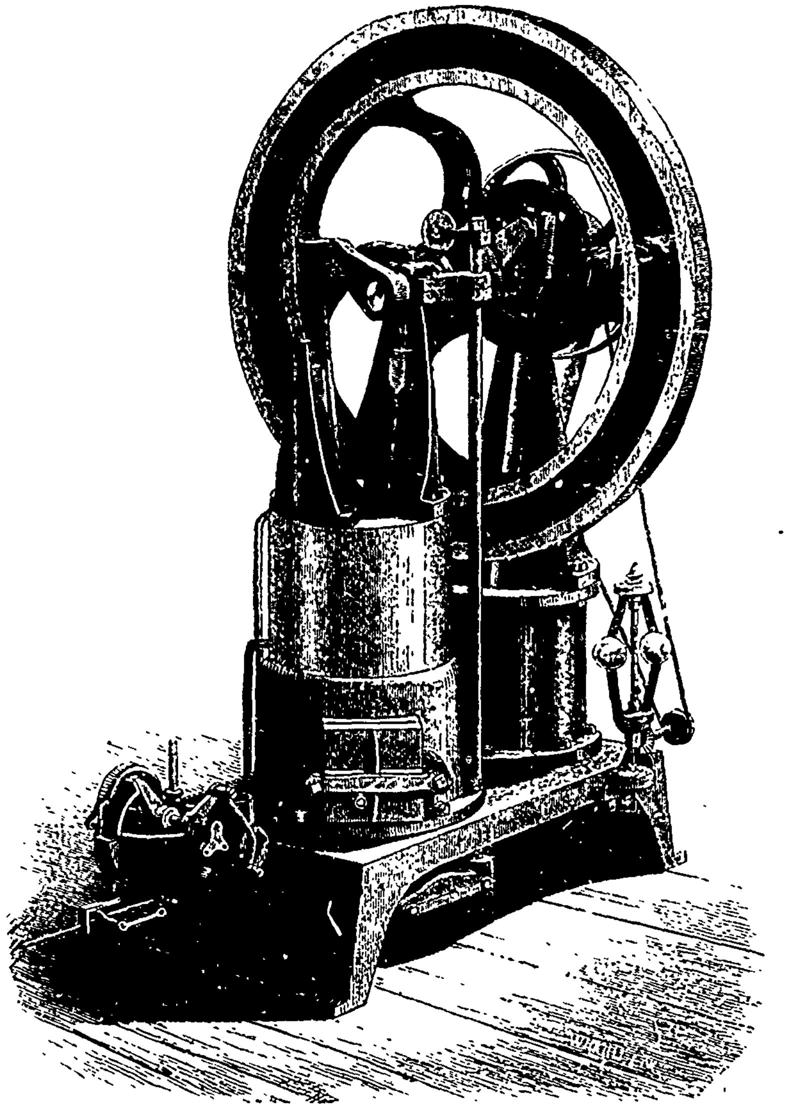
American Rail Imports.—The rail imports into the United States during the eleven months ending with November 30, 1872, were 186,084 tons, against 200,123 tons in 1871. The imports in November were very light—only 11,411 tons—but of these imports more than one-half were steel rails The production of American iron was doubtless much greater in 1872 than in 1871; but, on the other hand, there was a larger consumption last year.

To the New York and New Haven and Hartford railroad Company is accredited the following brilliant plan for keeping switchmen awake: It is proposed to have the lever of the switch in a sentry-box, so arranged that when the switch is open the door is shut and locked, and can only be opened by closing the switch. If a train comes along while the switch is open it is sure to smash the sentry-box first, and the switchman can only save his life by attending to his business. He is not likely to sleep much when trains are due on his track.

Wire Ropemaking.—Messrs. John and Edwin Wright, of the Universe Works, Garrison-street, Birmingham, have lately completed two very large endless ropes, each between three and four miles long. One is for the Wapping Tunnel of the London and North-Western Railway at Liverpool. It is 6,000 yards in length, 5½ in. in circumference, and is composed of six strands having ten wires in each. The weight of the rope is 34 tons. The other rope is for the Cowlairs Tunnel at Glasgow, and is 5,000 yards long, and weighs 25 tons.

An Iron Boomerang.—A locomotive lately exploded at Lafayette, Ind., and the *Journal* of that city says that a large piece of iron, weighing about a hundred pounds, in the shape of the segment of a circle, was projected from the wreck, and struck the wall of Levering and Abernathy's saw-mill about 3 ft. from the ground, going through that and a partition within, lodging against the inside north wall, and playing sad havoc with the contents of the office through which it passed. The distance from where the locomotive stood was three hundred feet. The course taken by the mass of iron was most peculiar—first upward in a curve, going in a south-westerly direction until it had passed over the saw-mill, then suddenly changing when near the ground to directly north, and going in a direct line through the walls. The erratic movements of the mass of iron can only be accounted for by its peculiar shape, being not unlike the boomerang of the Australian aborigines.

Norwegian Narrow Gauge Railways.—Another link in the narrow gauge railway system of Norway has been completed, in the Christiania Drammen line, which was opened on 7th of October last. This railway is 32 miles in length, and is connected at Drammen with the 3 feet 6 inch line, running to Handsfjorden, 56 miles in length, and with it making a continuous line 88 miles long, besides the branch to the silver mines at Rougsberg, 17½ miles, opened in 1872, and another to the Lake of Krodem, 16 miles. Owing to the exceptional difficulties in construction, the Christiania-Drammen Railway has been the most expensive of all the narrow gauge lines yet built in Norway. The total cost for the 32 miles was $35,000. For the whole of its length, the line runs through a most beautiful and picturesque country, and will command a large and yearly increasing tourist passenger traffic.



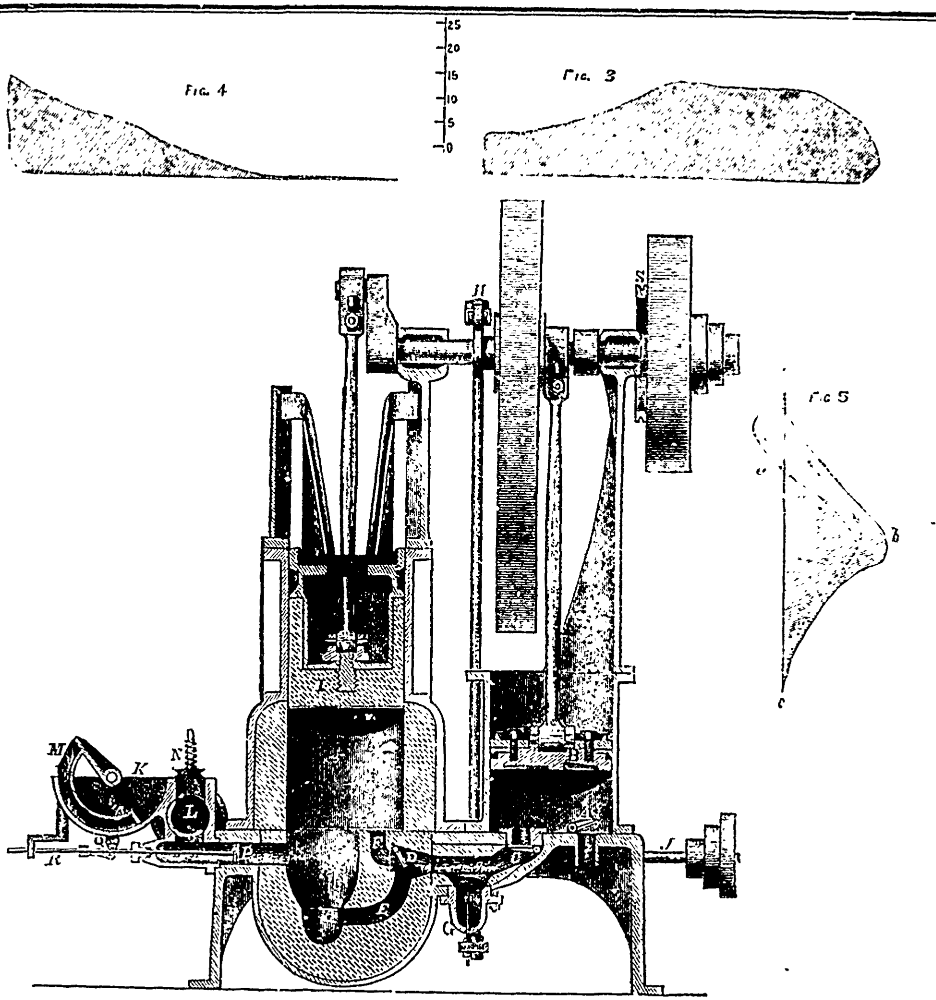
HOWARD AIR ENGINE.

We publish on this page and the next, views of a new air engine lately brought out in the United States, and which received a medal at the recent fair of the American Institute in New York. This engine is the invention of Mr C. C. Leavitt, and the inventor claims to have removed the great objections that have been urged against engines of this class by securing a comparatively high working pressure, without heating the metal to a greater degree than is done in the steam engine, by heating the air at constant volume without irregular movement in the working parts, and by feeding the fire automatically, so as to obtain an uniform power. The engine has the fire-box directly within the cylinder and uses the products of combustion to drive the piston.

The following description has reference particularly to a small engine only 6 in. bore, and 6 in. stroke running 150 revolutions. The indicator cards here published were also taken from this engine. The coal account while running was 1¼ lb. per hour. The cards when worked out give a power of 9 lb. per square inch mean pressure, equal to 126 foot-pounds per stroke on the 6 in. piston, while the friction brake showed 60 foot-pounds per working stroke as the power transmitted to the wheel. Hence the friction diagram gives a mean of 4 72 lb per square inch. Under the above circumstances, therefore, the engine developed 0.27 effective horse power, and the consumption of fuel was at the rate of 4.63 lb per effective horse power per hour. The inventor, however, claims to be able to reduce the friction to 1 lb. or less in larger engines, and to carry heats high enough to realise a mean available power of 12 lb. to the square inch, while expanding the air from one volume to three.

Referring to Fig. 2, which is a vertical section—Fig. 1. being a perspective view—A represents the induction valve of the air-pump, and B the air-pump plunger. C and D are stop-valves in the air passage from the pump to the fire-box. The air passage, as two branches. The branch, E, leads to the fire-box, and the branch, F, is the exhaust passage from the cylinder of the engine leading back to the general passage of which G is the exhaust port. The valve which opens or closes the port, G, is actuated by a cam, H, and a suitable connecting rod. I is the piston of a hot-air cylinder. This piston is lined with soapstone, and so made that a little annular space is left between it and the upper half of the cylinder, except at the top, where it meets the cylinder to form an air-tight packing. The lower part of the cylinder is thickly lined with soapstone, as is also the fire-pot immediately below it. The exterior of the hot-air cylinder is protected from the heat by a cold-water jacket. The heat, however, is no so intense but that this jacket may be dispensed with.

The shaft, J, driven from the cone pulley on the fly-wheel shaft, operates the coal-feeding apparatus by an automatic ar-



HOWARD AIR ENGINE.

rangement. The coal is placed in the hemispherical receptacle, K A semi-circular feed-bar, M, oscillates on a pivot, and at each oscillation raises on its inner end a small supply of coal. A wire brush, N, which has a horizontal movement, brushes off the coal thus raised into the open mouth of the cock or gate, L, the latter being so constructed that it completely closes the passage to the fire-box, both when receiving the coal and when delivering it into the cylindrical passage in front of the plunger, P. The plunger P, is actuated by an arm, Q, linked to the rod, R. When the fire-box is full, the plunger, P, meets so much resistance as to prevent its reciprocation. It then causes the belt to slip on the cone pulleys, and thus retards the feeding.

O is a dampei placed in the port of the induction valve of the air-pump. This damper is controlled by a governor, shown in Fig. 1, and which is driven from the grooved pulley on the flywheel shaft. When the damper closes, it causes a partial vacuum in the cylinder of the pump, resisting the ascent of the piston, and thus reducing the power of the engine.

As the pump piston rises, air enters at A to fill the pump cylinders. The cranks of the pump piston and the hot-air cylinder piston are set at right angles. It follows that on the descent of the pump crank to the lower centre, the hot-air piston will have passed the bottom centre, and will be at mid-stroke. When the pump piston is at mid-upward stroke, the hot-air piston crank will be at the upper centre, and the hot-air piston will be at the end of its upward stroke. When the pump piston arrives at the end of its upward stroke, the hot-air piston will be at mid-downward stroke, and when the pump piston is at mid-downward stroke, the hot-air piston is at the end of the downward stroke, being brought to that position by the motion of the fly-wheel. When the hot-air piston is at the end of the upward stroke, the exhaust takes place. The hot-air piston then descends to mid-stroke, when the pump piston beginning to descend, the cold air from the pump cylinder exhausts, together with the hot-air from the hot-air cylinder, the mingling of the cold and hot-air so far reducing the temperature that the exhaust valve is not injured.

The cold clean air passes last through the exhaust, freeing th surface of the valve and seat from dust, so as to permit a complete closure of the valve The exhaust closes a little in advance of the full descent of the hot-air piston, and also a little before the pump-piston reaches the mid-downward, stroke, giving a little compression, as shown in the diagram, Fig. 3. Then, as the pump-piston is travelling rapidly downward, while the hot-air piston is rising slowly, having just passed the centre, the air is condensed somewhat by the force of the fly-wheel, the combined negative force of these two compressions being represented by that portion of the diagram, Fig, 5, lying to the left of the central vertical line, this line representing a little more than half the revolution of the crank. As the hot-air piston rises rapidly after passing the lower centre, the pump forces the air remaining in it into the fire-pot. The rapid expansion of the air in heating now forces the hot-air piston upward, imparting momentum to the fly-wheel.

The valve, A, is of brass, faced with leather. To prevent the noisy fluttering of this valve, it is operated or steadied by a light steel finger, manipulated by a delicate cam and rod not shown in either view. The valve, C, opening within the passage, is simply of brass, and is accessible from the inside of the pump by removing the seat. The pump piston is packed with the very best oak-tanned cup leathers, carefully turned and fitted, and is stated to require no attention—beyond being lubricated—for long periods of time. The valve, D, is simply a damper valve, made of light Russia iron, and never has to be air-tight. It might seem, at first sight, that this valve would become overheated by the exhaust air, but it must be considered that the cold air strikes this valve on its way to the fire, and this added to the radiation from the valve itself, keeps it at such a moderate temperature that it is found never to overheat.

The packing found most convenient is the common soapstone packing. The cylinder being open at the top, it is very convenient to apply a small portion of tallow, or tallow and beeswax, occasionally. The packing is kept screwed down by means of a follower ring turned with a spanner. The engine is provided with self-oilers wherever practicable, and being transparent they need never be allowed to get empty.

Fig. 3 shows the card of the hot cylinder, the exhaust end being on the left hand. The scale shows pounds per square inch. It will be observed that the engine goes very lightly over the dead centres, and that the pressure continues to rise until the centre of the stroke is reached, where it attains nearly 20 lb. to the square inch, a result unprecedented in air engines. The gradual increase is caused by the fact that the confined air is at that time passing from the cold pump through the fire and into the hot cylinder without change of volume, and consequently the full pressure is not attained until the whole of the air is transferred to the hot cylinder, when the pressure attained is in proportion to the heat received. The pump diagram, Fig. 4, shows plainly the increase of pressure to the end of the pump stroke. The atmospheric line on the right hand end of this diagram shows the time the pump is throwing air through the port G. It must be understood that the pump stroke is completed at the middle of the cylinder stroke, and consequently the resistance of the pump is almost always overbalanced by the power of the cylinder.

Fig. 5 is a stress diagram, and is constructed as follows :— The force exerted by the pressure on the main cylinder to turn the crank is set off on the right of the central line, *c* being the top centre of the crank and a point midway between *a* and *d*, the bottom centre. Call this line *bc*. The resistance of the pump during the same periods of time are set off on the left of the line *b c*. Thus so much of this resistance as exceeds the power given out at that instant projects on the left of the straight line and is negative force. The pump centres at *b*. The upper half of the diagram above, *a*, is the portion of the revolution between the closing of the port, G, and the lower centre of the crank. The remaining part of the revolution, *i.e.*, from the top centre to the lifting of the valve, G, is passive. The dotted lines show the effect caused by closing the port, G, when the cylinder is at the bottom stroke. It will be observed here that the power of the engine is positive for over three-quarters of the stroke, and that the negative power is very small. The result is that the engine runs very steadily with a light fly-wheel, and is easy to start.

A New Steam-Steering Screw.—There was a large attendance of the members of the United Service Institution at Whitehall-yard recently (Admiral Elliot in the chair), when Captain G. W. Bremner delivered a lecture upon a new steam-steering screw which he has recently invented. The object of his screw is to effect the turning and manœuvring of a ship, and it claims to do this without the necessity of headway. The invention was described in detail by Captain Bremner.

U. Gayon comes to the conclusion that the main cause of the decomposition of eggs is the presence of small organisms which must have formed in the eggs while in the oviducts of the fowl.

PROFESSOR TYNDALL ON LIGHT.

The eminent English scientist and investigator, Professor John Tyndall, has for the first time, appeared before a New York audience, and in two masterly discourses has opened a series of lectures on the subject of "Light." Familiar as we are with the admirable works of this learned author, we naturally expected an able and entertaining disquisition on the prolific subject he had selected, but we confess we were unprepared for so excellent, clear and scholarly an elucidation of the most elementary principles of physics. He fairly placed light in a new light, and, by his simple explanation of theory and splendid execution of experiments, illuminated, with the brilliancy of his genius even the dazzling rays from which he drew such treasures of learning and thought.

It is a matter of regret to us that the pressure upon our columns and the rapid sequence of Professor Tyndall's lectures prevent our giving them *verbatim*, but the most interesting and striking portions will be carefully selected and presented as fully as our space will admit. An allusion to the favor with which his books were received in this country, and the circumstances which brought about his visit to the United States, constituted the introductory remarks of the opening discourse.

After briefly glancing at the birth of science and in a few words tracing its progress to the time of Newton, the lecturer entered upon his subject proper at its very beginning. The ancients, he said, satisfied themselves that light moved in straight lines, they also knew that these lines, or rays of light, were reflected from polished surfaces and that the angle of incidence was equal to the angle of reflection. This knowledge constitutes our starting point. To the source of light to be employed during the experiments attention was asked, and after alluding to the generation of heat and light by combustion, Professor Tyndall brought together coke points, which being attached to the poles of a small voltaic battery, glowed with a white heat. Whence comes this heat? Suppose, in the first instance, when the thick wire was employed, that we had permitted the action to continue till one hundred grains of zinc were consumed, the amount of heat generated in the battery would be capable of accurate numerical expression Let the action now continue with this thin wire glowing until one hundred grains of zinc are consumed. Would the amount of heat generated in the battery be the same as before? No, it would be less by the precise amount generated in the thin wire outside the battery. In fact, by adding the internal heat to the external, we obtain for the combustion of one hundred grains of zinc a total which never varies. Here, continued the speaker, we have an illustration of the constant law that in physical nature we have incessant substitution, but never creation.

Professor Tyndall then added some further remarks regarding the electric light, saying that it would constitute the mode of illumination for experimental purposes, and noting the fact that, during the intense glow of the carbon, the eye failed to see the coke points whence the light issued. This, he stated, is due to the spherical aberration of the organ, or in other words, that the circumferential and central rays have not the same focus. To illustrate by means of a lens, the carbon points in the lantern were projected on the screen. The image was faint and nearly obliterated by a halo of light by which it was surrounded. A similar effect is produced in the eye, the blur of light upon the retina being sufficient to destroy the definition of the retinal image of the carbon.

The theoretical defect of the eye were alluded to—its opacity, want of symmetry, lack of achromatism and absolute blindness in part—which, said the speaker, caused an eminent German philosopher to say that, if any optician sent him an instrument so full of faults, he would return it with the severest censure. Referring to the

PROPAGATION OF LIGHT,

its rectilineal nature may be shown by the simple experiment of allowing the rays to pass through a minute orifice into a darkened chamber, where external objects will be projected reversed upon a screen. Every straight ray proceeding from the object stamps its color upon the screen, and the sum of all the rays forms an image of the object, which is seen inverted because the rays cross each other in the aperture. To explain this fact, the lecturer made a small perforation in a sheet of tinfoil stretched before the light in his lantern. A single reversed, though blurred, image of the carbon points appeared on the screen. A second aperture produced another image, several orifices a number of images, until if the foil be removed altogether all these bright figures run together and combine to form the circle of clear light.

ILLUSTRATION OF A LAW OF LIGHT.

The law that the angle of incidence is equal to the angle of reflection was experimentally illustrated by the simple apparatus shown in Fig. 1.

A straight lath is placed as an index perpendicular to a small mirror, A, capable of rotation. The beam of light from the lantern is received upon the glass and reflected back along its line of incidence. The index being turned the mirror turns with it, and at each side of the former the incident and the reflected beams are seen tracking themselves through the dust of the room. This device enables us also to illustrate the law that, when a mirror rotates, the angular velocity of the beam reflecting from it is twice that of a reflecting mirror. That is, referring to our engraving, that while the mirror B passes from the perpendicular to its represented position of an angle of 45o, the beams diverge to a right angle or 90o. This is shown by mere inspection from the position of the index.

Passing to the subject of

REFRACTION,

Professor Tyndall gave a short historical sketch, of the course of inquiry into the phenomenon from the year 1,100, by Alhazen, an Arabian philosopher, to the first discovery of the principle by Willebord Snell in 1621. The bending of the ray in passing from a thin to a dense medium was admirably illustrated by the apparatus shown in Fig. 2,

the lecturer observing that he preferred to produce direct optical proof rather than ask the audience to believe facts from chalk lines on the black-board. A circular vessel with its two sides of clear glass is partially filled with colored or turbid water, A is a movable inclined mirror which may be placed at any point on the periphery of the circle, so as to reflect a beam of light from the lantern either perpendicularly to the surface of the water or obliquely, as represented. Striking the liquid perpendicularly to its surface, the course of the ray is shown in a bright vertical line in the water, so that it is unrefracted. Meanwhile the beam passes unseen through the air above the water. Laughingly observing that he was not addicted to the small vice of smoking, Professor Tyndall lit a cigar and puffed the smoke into the space B, when the track of the ray became clearly apparent. Moving the mirror A to the position shown in the cut, the beam was caused to strike the liquid obliquely, when refraction was clearly produced as represented. Snell's discovery that the quotient (the index of refraction), obtained by dividing the sine of the angle of incidence by the sine of the angle of refraction, was always a constant quantity for the same medium, whatever the obliquity of the rays may be, was then graphically described and referred to as one of the corner stones of optical science. This was applied by Descartes to the

EXPLANATION OF THE RAINBOW.

The bow is seen when the back is turned toward the sun. Draw a straight line through the spectator's eye and the sun; the bow is always seen at the same angular distance from this line. This was the great difficulty. Why should the bow be always, and at all parts, forty-one degrees distant from this line? Taking a pen and calculating the track of every ray through a rain drop, Descartes found that at one particular angle the rays emerged from the drop almost parallel to each other, being thus enabled to preserve their intensity through long atmospheric distance, at all other angles the rays quitted the drop divergent, and through this divergence became practically lost to the eye. The particular angle here referred to was the foregoing angle of forty-one degrees, which observation had proved to be invariably that of the rainbow.

Newton's experiment with the prism was then described, and served to introduce the subject of the

PHENOMENA OF COLOR.

Various well known experiments were made in the analysis and synthesis of light, proving that the colors of a spectrum may be squeezed or blended together by the aid of a lens; that an image of the carbon points, whence the light issues, may be built up from the colors of the spectrum, and that, in virtue of the persistence of luminous impressions upon the retina, the prismatic colors may be mixed together in the eye itself, the impression of whiteness being the result.

DISPERSION

is the drawing out of a white line into a spectrum. Newton supposed that refraction and dispersion were inseparable, but Dollond showed that, by combining two different kinds of glass, colors could be extinguished still leaving a residue of refraction, and he employed this residue in the construction of achromatic lenses. This point was illustrated by throwing a beam through a prism of water and marking with a pointer the position of the spectrum on the screen; then, by adding a prism of glass, a white image was produced, which, compared with the point noted, was still considerably refracted. The refraction and dispersion of bisulphide of carbon, as compared with water, was alluded to in order to show the great extent and richness of color of the spectra of the former substance.

WHAT IS COLOR?

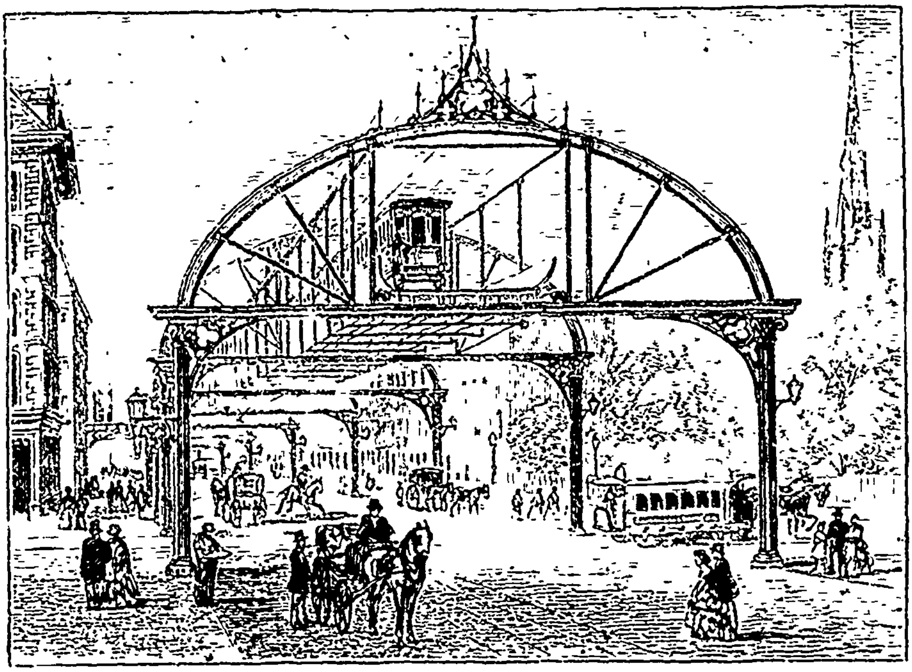
Natural bodies have showered upon them, in the white light of the sun, the sum total of all possible colors, and their action is limited to the sifting and appropriating from this total the colors which really belong to them and rejecting those which do not. The portion rejected gives them their hue. But what is black? Throwing a brilliant spectrum upon the screen, the lecturer placed a piece of black ribbon in succession in the different colors. It quenched all, and consequently blackness is the result of the absorption of the constituents of solar light. Taking a second piece of ribbon he held it in the red portion of the spectrum, it appeared as black as the first piece. He then moved it along until it reached the green, when it appeared of a vivid shade of that color. Therefore the ribbon absorbs all the red and yellow light and offers mere darkness to the eye; while it rejects the green and blue shades, appearing of its proper hue. The same was similarly shown with a red ribbon, which absorbed the green color and rejected the red. Why is it that on looking at objects through a red glass, all are tinged with that hue? This was answered by passing the dispersed rays through such a colored glass, when the spectrum showed nothing but the red, all other tints being quenched. A blue glass allowed blue, indigo, violet and green rays to pass, and a yellow glass permitted only the transmission of green, yellow, orange and red. A very beautiful experiment was made with a solution of permanganate of potash, which is a very exquisite purple and unlike the pure tone of that tint in the spectrum. Passing the light through the prism of that liquid, it was found that not only the purple but the red rays were allowed to pass, so that by the mixture of these colors the unusually beautiful shade was obtained.

BLUE AND YELLOW DO NOT MAKE GREEN

but white, as they are complementary colors. Why is it then that by mixing chrome yellow and Prussian blue we obtain a green pigment? It was shown in the course of the above experiments that a blue glass permits not only the blue of the spectrum to pass through it but a portion of the adjacent green. A yellow glass, though cutting off the blue, also allows the passage of the green. This may be expressed as follows, representing the colors by their initials, those absorbed being in italics, thus: Blue glass, *R*, *O*, *Y*, G, B, I, V, yellow glass, R, O, Y, G, *B*, *I*, *V*. Now combine both glasses, together they destroy every color but the green which as experiment proved, appeared singly on the screen. Consequently the blue and yel-

THE NIAGARA SHIP ELEVATOR.

low powders when mixed together absorb all other colors and appear to the eye as of the only color to which both are transparent. The blending of blue and yellow light to make white will be explained in a subsequent lecture. In conclusion, said Professor Tyndall, we may profitably glance back on the web of relations which these experiments reveal to us. We have, in the first place, in solar light an agent of exceeding complexity, composed of innumerable constituents, refrangible in different degrees. We find, secondly, the atoms and molecules of bodies gifted with the power of sifting solar light in the most various ways, and producing by this sifting the colors observed in nature and art. To do this they must possess a molecular structure commensurate in complexity with that of light itself. Thirdly, we have the human eye and brain so organized as to be able to take in and distinguish the multitude of impressions thus generated.
—*Scientific American.*



VIEW OF THE PROPOSED OVER-GROUND RAILWAY FOR NEW YORK CITY.

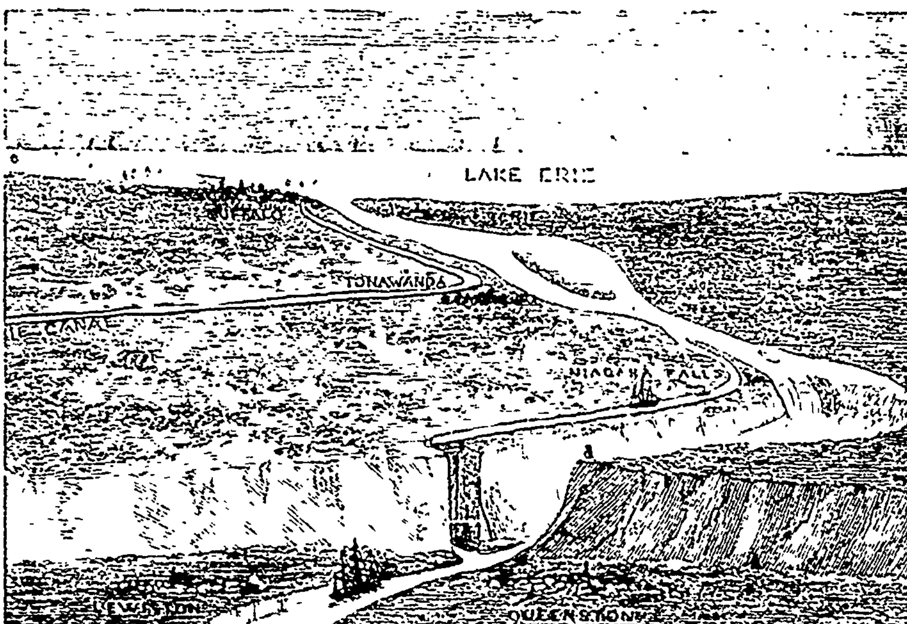
THE NIAGARA SHIP-ELEVATOR.

Our illustration of the above recent invention is from *Frank Leslie's*. It is a contrivance to raise and lower, in suspended and perpendicular line, a large ship from one water-level to another, and wholly dispense with the old fashioned locks.

By this device, vessels of 1,200 tons carrying capacity are to be raised and lowered 300 feet, at Lewiston, to overcome in one lift the falls and rapids between Lakes Erie and Ontario, in the space of fifteen minutes, thus saving nearly two days in the time of a ship's voyage from the East to the West.

The wasting or passing of water from the upper to the lower level is prevented, for two of these suspension locks or elevators will operate like two buckets in a well—one ship will be raised as the other is lowered, and as much water carried up as is brought down.

The engraving is not designed to embrace all the forms of the invention, or the particulars of the working machinery, which, however, are more or less matters of detail, and too voluminous for our columns. The simplest form for illustration is the single elevator. This is made wholly of iron, and raised and lowered in the open shaft, being suspended by means of numerous wire cables passing over pulleys, at one end of which are weights that in the aggregate equal the weight of



THE NIAGARA SHIP ELEVATOR.

the lock, full of water, with the vessel floating therein. The power to start this equipoised mechanism from its state of rest, and to overcome friction, is so inconsiderable as not to require comment.

The inventors are Horace H. Day, of New York—whose numerous devices of elevators, inclined planes, etc., to cheapen the cost of the Niagara Ship Canal, are known to the country—and the eminent scientist, Professor Samuel D. Tillman, of New Jersey, now, and for many years, connected with the American Institute of this city.

By this process it is claimed by the inventors that $8,000,000 can be saved in constructing the James River and Canawha Canal, Va., where it crosses the Alleghany Mountains. They also believe that they can reduce the expense of constructing the Interoceanic Canal across the Isthmus of Darien by from $30,000,000 to $50,000,000.

HYDRASTIS CANADENSIS, OR GOLDEN SEAL, AND ITS ALKALOIDS.*

Dr. Van der Espt has recently presented to the Royal Society of Medical and Natural Sciences at Brussels an interesting memoir upon the *Hydrastis Canadensis*. This plant, known also under the name of Golden Seal, is as its name indicates, a native of Canada, and belongs to the order Ranunculaceæ. It is the rhizome, which is yellow, lactescent when freshly fractured, tortuous, and composed of nodose, fleshy tubercles, furnished with numerous long fibres, that is employed in medicine. Two alkaloids have been found in it: one yellow, berberine; the other white, hydrastine.

Berberine, which is also found in the barberry, calumba root and elsewhere, appears in the form of small concentrically grouped prisms, or clear yellow silky needles. It is inodorous, but possesses a persistent bitter taste; it is slightly soluble in cold alcohol or distilled water, and perfectly insoluble in ether. With hydrochloric acid it forms a salt which crystallizes in slender yellow needles.

Hydrastine crystallizes in white shining four-sided prisms, which lose their transparence upon desiccation. It is very bitter and pungent, and provokes in the mouth a feeling of numbness which causes it to be employed in America as a local anæsthetic. Nearly insoluble in water, it is freely soluble in alcohol, ether, chloroform and benzine. As the last three do not dissolve berberine, the hydrastine may be easily extracted by treating the powdered root in a displacement apparatus with either of those solvents. The proportion so obtained is about 1½ per cent.

In America neither berberine nor hydrastine is prescribed, but a crystalline substance known under the name of hydrastin, which is said to be a mixture of hydrochlorate of berberine and hydrastine. The purity of this product depends upon its mode of extraction. Among the processes indicated, that of Professor Wayne is the most simple. It consists in the maceration of the powdered root of the golden seal and displacement by cold water. The product is treated with hydrochloric acid, the precipitate separated by filtration, and washed, treated with alcohol and left to crystallize.

The hydrastin appears under the form of yellow acicular crystals, without acid or alkaline reaction, and yielding upon trituration a clear yellow powder. It is soluble in boiling alcohol, insoluble in cold alcohol, ether, chloroform, spirit of turpentine and distilled water; but these various liquids acquire a yellow tint and contain hydrastine.

The rhizome of the golden seal is a bitter tonic analogous to calumba. It is administered in the form of powder, in doses from half a gram to a gram and a half. The hydrastin is prescribed in doses of from five to fifty centigrams. In larger doses these substances act as laxatives, similarly to rhubarb. This latter effect, in the absence of any cathartic or irritant principle, M. Van der Corput thinks would be due to a kind of indigestion, or the stimulation of the mechanical action of the digestive organs under the influence of large doses of the drug. The affections for which it is stated hydrastin may be beneficially employed are those connected closely with atony and increased secretion of the mucous surfaces. A decoction for external use is prepared by boiling thirty parts of the bruised root in five hundred parts of water.

* "L'Union Pharmaceutique," vol. xiii., p. 321, from "L'Union Médicale."

THE PROPOSED GILBERT ELEVATED RAILWAY IN NEW YORK.

Not content with street tramways, which, however convenient they may be to the passengers who use them, certainly cause a good deal of annoyance to the drivers of other vehicles; and not content with locomotive engines puffing and snorting in the midst of their public thoroughfares, our enterprising American cousins are now about to utilise the air above their heads for transit purposes. Not by means of balloons, or other aerial machines — the practical adaptability of such contrivances remains yet to be discovered—but by means of a railway elevated upon pillars above the roadway, as shown in our engraving on page 13. The idea is not altogether unknown in this country. It was once seriously proposed to make a railway on top of the arches which formed the arcade formerly so well known to Londoners as the Quadrant, continuing the covered avenue from Piccadilly to the top of Portland Place; but we presume that the scheme was abandoned because the first-floor storeys of the houses would have been rendered almost uninhabitable. An aerial railway for the conveyance of light goods in baskets along an endless wire rope was projected some years ago in the north of England, but, as far as we are aware, has never been practically adopted.

The railway represented in our picture is invented by Mr. Rufus A. Gilbert, who is also the inventor of the Elevated Pneumatic Railway, and a company for carrying out its design has recently been incorporated under an Act of the State Legislature of New York. The plan, says an American authority, combines great strength with lightness and beauty of architectural design, and is so arranged as to use steam as a motor for passengers and the pneumatic dispatch for parcel traffic. The railway is elevated about 24 ft. above the middle of the street, and rests on arches, which are supported by ornamental columns placed along the line of the kerbstones, leaving the foot pavement and the roadway clear for ordinary traffic. The telegraph wires are to be carried on the arches, and the columns support the gaslights. It is claimed that the latticed girders which support the railway will not interfere with the light, and, that owing to a peculiar construction, the noise of the trains will hardly be noticeable. By means of screens, the horses in the street below will be prevented from seeing the trains. The railway will be located on both the east and west sides of the city, and will run from the Battery to Harlem, that is, the whole length of Manhattan Island, and is expected to cost 700,000 dollars per mile.—*Graphic.*

NOLAN'S RANGE FINDER.

Our illustrations of this new form of telemeter will be interesting to Canadian marksmen and to others. They are from *Engineering*. The following description of it is taken from a pamphlet recently published by the inventor. The sketches will supply the deficiencies in the description.

"The infantry range-finders are worked separately or in pairs; the only difference between the fellows of the pair are that the positions of the mirrors and of the figuring are inverted in a right or left range-finder.

"The infantry range-finder may be made to work independently of a musket, but the description given is that of a range-finder adapted to the stock of a Snider rifle; it consists of a sextant and of a mechanical calculator; the sextant fits on one side of the stock of the rifle, the calculator on the other. The sextant does not resemble the ordinary pocket sextant; it consists of a stout steel plate, about 7 in. long and 2 in. wide, to which is screwed a mirror; a tangent screw moves on this plate a steel limb with a second mirror attached.

"The sextant plate is fastened to a stock, recessed for the purpose, by hinges, and shuts snuff-box fashion, making no change in the shape of the stock when not in use. The calculator receives the base in paces, but gives the answer in yards. A tape graduated in paces and a pair of rifles will get the range in less than half the time occupied by a single rifle.

"The infantry range-finder has been tried before two committees. The first was held in November, 1870, and consisted of Major Kirk, 91st Highlanders; Captain Chapman, Deputy-Instructor of Musketry; Lieutenant Creagh, 42nd Highlanders.

"The chief trial in this case was a match between the instruments (worked by private soldiers), against six picked judges of distance, at ranges varying from 500 to 1000 yards, the distances being taken on infantry soldiers.

Correct distance, infantry	980	790	600	505	935	830	745	590
Error of Range-finder	40	5	12	13	5	10	30	20
Error of Private Spillman	20	50	20	65	5	50	115	20
Error of Private Read	40	10	100	145	5	130	95	80
Error of Private Campbell	80	90	100	125	35	80	95	10
Error of Private Hurgin	90	40	80	15	65	60	25	50
Error of Private Hammill	80	40	100	115	45	70	35	10
Error of Private McDonald	0	50	80	145	35	10	5	40

"At Woolwich, in July, 1871, the infantry range-finder was tried before a committee, consisting of Colonel Wray, Royal Artillery, C. B.; Captain Glynn, Royal Brigade; Captain Fryer, Rifle Brigade; Captain Noble, Royal Artillery, Captain Rawling, 48th Regiment.

"The judging party in this case did badly, because they had to guess on fixed points instead of on men, to whose uniforms they were accustomed, their errors at 9 ranges were, 0, 20, 40, 45, 52, 70, 116, 150, 275. The average error of the range-finder was under 15 yards.

	4 Marksmen.	4 Captain Nolan's Party.	REMARKS.
1st trial. About 900 yards	1 hit		Remainder over target.
		5 hits	Some short, some over.
2nd trial. About 800 yards	1 hit		Remainder all over.
		4 hits	Some over and two short.
3rd trial. About 600 yards	0		All over.
		14 hits	Remainder close to target, left target fell down, prop knocked away.
4th trial. About 550 yards	2 hits		Remainder over.
		16 hits	Remainder round target.
5th trial. About 750 yards	6 hits		Remainder over.
		15 hits	Remainder short and close in front of target.
6th trial. About 850 yards	3 hits		Remainder over. Too high.
		7 hits	Remainder close in front of target and to right.
7th trial. About 700 yards	1 hit		Remainder over to the right, very much.
		2 hits	Remainder about 20 yards short.
Total Hits	14	63	

Rough Table for Practice with Roller.

Tape.	First Angle.	Second Angle.	Range (nearly).
50	40	30	3820
50	30		1910
50	97		1146
50	90	81½	4000
50	61	6½	3500
50	9	53	3000
50	90	69	2800
60	28	28	2600
50	41	11	2400
50	47	1	2200
50	50	92½	2000
50	35	4½	1900
50	40	99½	1900
50	30	6½	1800
50	30	2½	1700
100	80	10	22920
100	61	9	7640
100	37	3	3820
100	80	20	2292
25	90	0	5730
25	97	73	1910
25	32	13	955
25	0	0	573
On the low figures to the left of the cypher.			
50	80	12	1050
50	70	9½	1440
100	37	3	1430
25	3	37	358

"A new class of trial was here introduced by firing at a wooden target, 18 x 6 ft, at various distances. Four marksmen of the Rifle Brigade, judging their own distances, were pitted against four men of the same regiment (not all marksmen), who used the range-finder.

"In the first four series the men advanced on the targets, in the last three series they retired; the result being that the men naturally judged much better retiring than advancing. (See table.

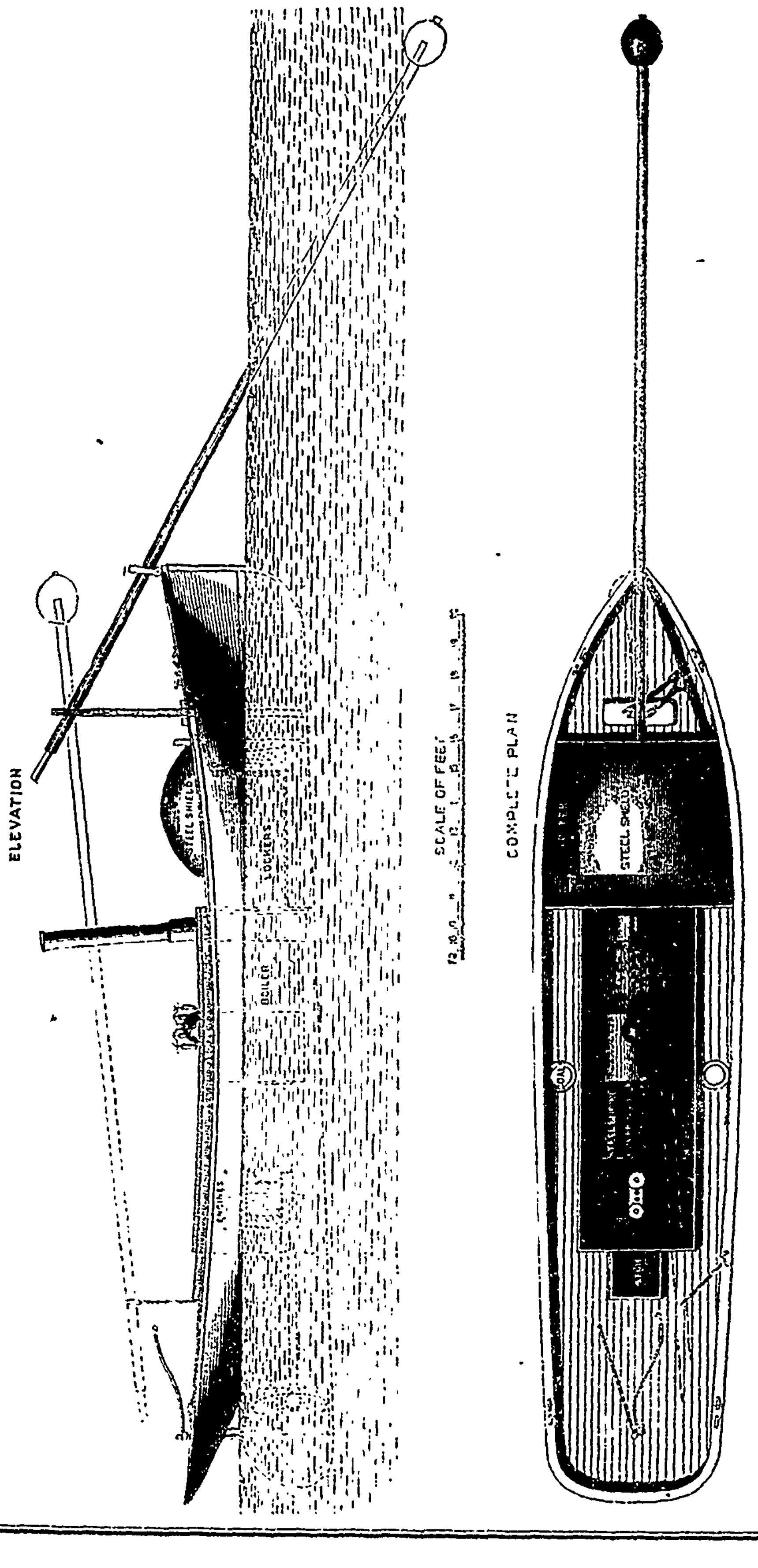
"The infantry range-finder has only about one-tenth the accuracy of that used for artillery. Still a single rifle altered to take it would permit a company to know its ranges in any defensive position — as infantry men pace pretty accurately no fresh article of equipment need necessarily be carried — its use can be learned by any man who knows how to read figures; its insertion weakens the to. of the butt of the rifle, but still leaves that portion stronger than the small of the stock, the present weakest point; an extra 1½ lb. has to be carried, but there is no other inconvenience.

"A pair of rifles so altered, and the addition of a measuring tape, will permit of the distance being taken with a sufficient rapidity for offensive operations. The instrument is peculiarly adapted to work on broken ground. It must be, however, allowed that in comparison with the range-finder for artillery, the infantry range-finder is untried.

(To be continued.)

STEAM TORPEDO LAUNCH.

We illustrate on the next page a steam torpedo launch built in England for a foreign Government, under the superintendence of Mr. Hunter Davidson, of the United States navy. The launch, as well as the machinery, was constructed by Messrs. Yarrow and Hedley, of Poplar; both are of the ordinary type, for which the firm have acquired a reputation. The dimensions of the hull are:—Length 30ft.; beam, 6ft. 6in., with draught of water of 2ft. 6in., when equipped ready for work, and a speed of eight and a half statute miles an hou. with 70 lb. of steam. The boiler is of the ordinary tubular type, and the engine direct-acting inverted; the boiler being fired at its after-end enables the engineer to attend to it and regulate the engines without moving from one position. The exhaust steam is passed into a large chamber before issuing into the funnel, and is arranged so as to be perfectly noiseless in its escape—a most essential requirement. Fixed to the stem is a brass sheave, and a few feet aft are two angle iron upright guides, arranged so as to admit a long pole passing through them, and over the bows of the launch into the water, suitable tackle being fitted for hauling the pole in or out at pleasure. Forward of the machinery is a space sufficient for the accommodation of two or three men, one man having charge of the steering wheel, which is placed in the position shown; this space is completely protected by a permanent steel shield, sufficient opening only being provided in front for the steersman to look out. The engineer aft, in like manner is protected by a sliding steel covering, which he can pass over himself when required.

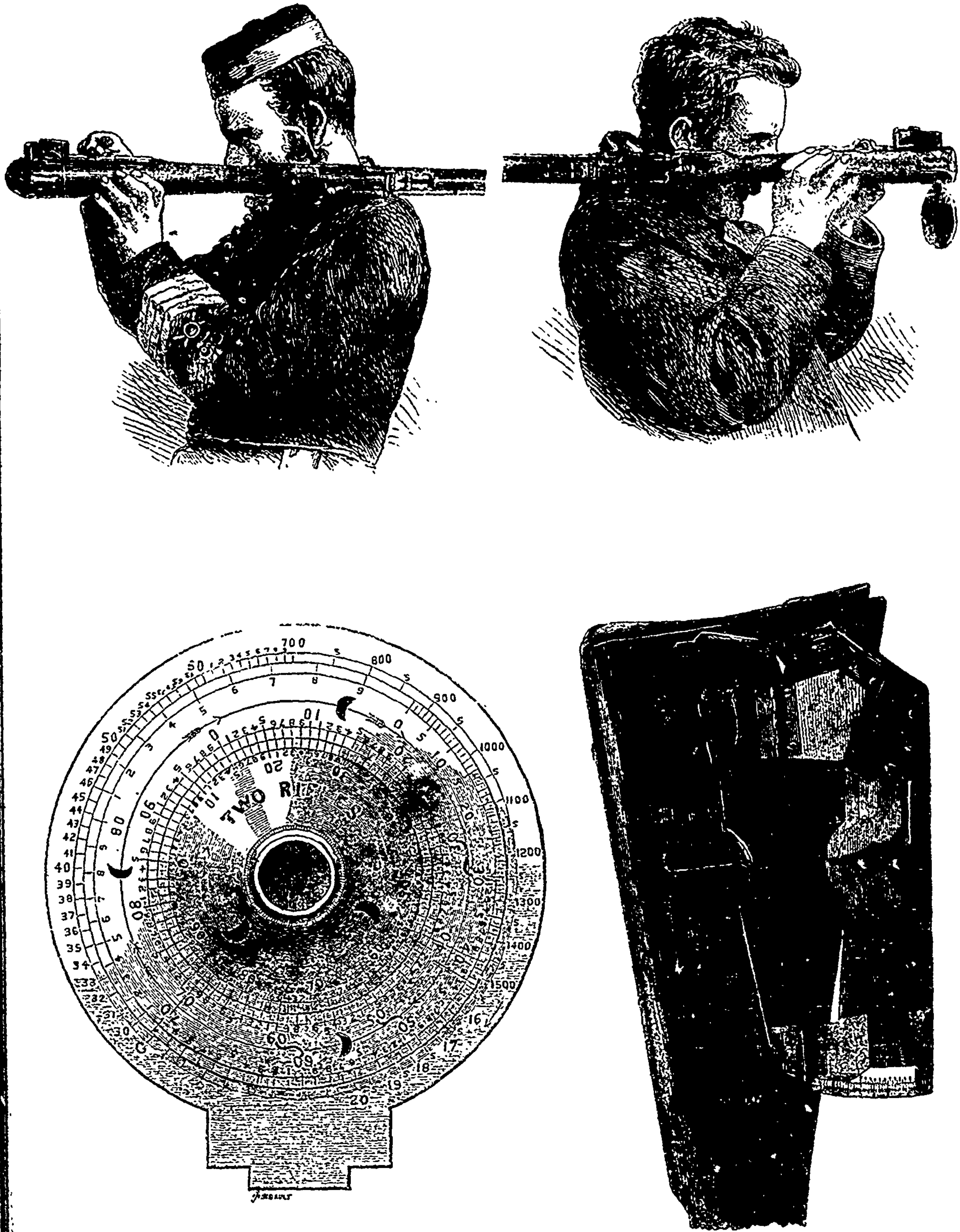


STEAM TORPEDO LAUNCH.

The object of this little craft is to attack any description of vessel below the water at its most vulnerable part; sufficient dynamite, which is the explosive used for the purpose, is carried at the end of the pole in a suitable torpedo, to penetrate the thickest plates hitherto used in the construction of the largest vessels afloat, and from the results of repeated experiments it has been found that if the torpedo pole project not less than 22ft., and provided the explosion takes place at least 7 ft. below the surface of the water, no fear whatever need be entertained as regards the safety of the launch itself, the water forming a sufficient barrier to give ample protection from the shock.

The explosion of the torpedo which, to be effective, must take place at the moment of contact with the plate to be penetrated—is not effected by means of a percussion fuse, but by a galvanic battery placed inside the launch, and under control of a man who is alongside the steersman. This battery is only in action when the explosion is about to take place. The torpedo pole is made of teak, hollow, through the interior of which two copper wires are led from the battery to the torpedo, arranged in such a manner that the blow, on striking the ship's side, makes contact and completes the circuit, causing the explosion to instantly ensue. We have explained thus much to make the general arrangement clear to our readers; further details we are, however, not at liberty to publish.

A few experiments were tried at Messrs. Yarrow and Hedley's works to determine upon the thickness of shields to be used, which were required to be proof against rifle shots fired from the deck of the attacked vessel direct down upon the launch. A breech-loading short Snider was used, at a range of eight yards, fired point blank. The ball in most cases penetrated 3-16 of an inch iron plates; ¼in. Bessemer steel plates were pierced in like manner; 3-16in Bessemer steel plates, which were adopted, the balls in no case passed through, but they were indented, on an average of several trials, to an extent of ⅛ of an inch. The diameter of the bore of the rifle is ·577 of an inch; weight of ball, 1¼oz; weight of powder, 2½ drs. The little vessel would prove a dangerous foe on a dark night or in a fog.—*Engineering.*



NOLAN'S RANGE FINDER.

SUNDRIES.

KINDLING WOOD SPLITTER.—(See page 21.)

*This ingenious little device will doubtless save many from self-*inflicted cuts and bruises due to the awkward blows of hatchets in inexperienced hands. It is a kindling wood splitter, and consists simply of a strong blade, at one end of which is a handle, and at the other a projection which fits into one of the holes of a perforated standard. It is only necessary to place the stick of wood under the knife, as shown in the engraving, and press *down on the handle. Mr. Franz Wagner, of New York city,* is the patentee.—*Scientific American.*

CHAFF CUTTER.—(See page 21.)

Our illustration of the above is from Engineering. The machine was exhibited at the recently held Smithfield Club Show by Messrs. Richmond and Chandler of Salford, Manchester. Its most peculiar feature is a new form of adjustable mouthpiece which is worthy of attention. The surface of the mouthpiece (where the knives cut against) is made of steel, and this has the advantage of presenting the same smooth edge as long as *the machine* lasts; the knives are also *kept sharper on* the steel face than when cutting against cast iron. There is also an expanding jaw to the mouthpiece, which jaw is hinged to the axle of the upper tooth roller, and is pressed down by a hand screw, so as to securely hold the material being cut, while admitting of considerable alteration, according to the nature of the substance acted upon. A travelling web is introduced in place of the ordinary bed of the feeding box, which is a material help to the attendant particularly in the larger machines, relieving him of the labor of pulling the hay or straw forward and allowing him to concentrate his entire attention on the feed. A handle is placed at the side of the machine by which two lengths of cut are obtained, and the small handle acts upon a stop motion to arrest the rollers at any moment.

GAUGE LATHES.—(See page 21.)

Messrs. Goodspeed & Wyman, Winchendon, Mass., favorably known as the manufacturers of tub, pail and chair machinery, and also of sawing and boring machines, have lately brought out an improved gauge lathe, which in regard to strength, durability, good workmanship and comparative low price, is foremost among this class of tools. It is made in three different sizes, turning three feet, 4½ feet, and the largest, 6½ feet long. This lathe is especially made for the turning of beaded and plain chair work, bedsteads, posts, table legs, hoe and fork handles, broom handles, etc., and they enable the workman to turn this kind of work out so rapidly, that the lathe pays for itself in a very short time, by the great saving in the amount of wages, which is the result of using it in place of ordinary lathes, made for all kinds of work.

In order to give an idea of the amount of the saving of time, accomplished by this lathe, we will state that one man can, after a little practice, turn easily 3,000 spindles, 11 inches long, headed in proper style, or 1,300 19-inch front chair posts, or 1,000 long posts, for ladies' dining-chairs, in a day of 10 hours, which we call an extra day's work. The lathe is, of course, able to turn beaded or plain work, and it is no wonder, therefore, that it is used extensively in the leading furniture shops, chair shops, bedstead manufactories, agricultural work, etc., of the country.

The lathe is provided with a screw feed, while the nut being covered, the shavings are prevented from getting into it. It will stand a speed of from 3,000 to 4,200 revolutions per minute, according to the size of stuff to be turned on it, smaller diameters requiring greater velocity, and vice versa. The spindles are cast steel, white it is claimed that the whole tool, with all its accessory parts, is most thoroughly made, a claim corroborated by the fact, that it has been so extensively adopted, and that many firms having one such lathe in use soon afterward ordered several more.

For the benefit of those of our readers not familiar with all the different contrivances, which in modern times have been produced to facilitate labor in manufactories, we will state that gauge lathes are thus called, because they may be set to a previously determined gauge, and may then turn out very rapidly large numbers of equal pieces, perfectly similar in all their dimensions, without delaying the workman, by the necessity of *taking continually the measure of his work.* The enormous saving of time thus effected is evident, while its result is, that the workman may earn higher wages, which the manufacturer is fully able to afford, by the increase in the productive capacity in his shop.

CLAY'S CUTTING TOOLS.—(See page 21.)

At the last meeting of the Institution of Mechanical Engineers, a paper was read on a mode of increasimg the cutting power of tools employed for shaping metal by taking means to keep the Cutting edges cool by a powerful jet of water. Of this paper, which enumerated some very interesting results, an abstract appeared in our pages at the time, and we now publish engravings showing the form of tools referred to, these tools having being designed and patented by Mr. William Clay, of Birkenhead.

In turning metals (wrought iron for instance) a slow drip of water is usually allowed to drop upon the metal shaving that is being turned off. A portion of this water afterwards finds its way on to the tool in a tardy manner, but the shaving being in the way the water hardly ever reaches the precise cutting edge or point of the tool, and therefore considerable difficulty is experienced in keeping this cutting edge or point cool, the consequence being that the machine can only be driven at a very limited velocity, whereas if the cutting edge or point were kept cool the speed of the turning or cutting operation may be very considerably increased.

The object of Mr. Clay's plans is to effect this either by making the cutting tool hollow and then forcing a jet of water, or other cooling medium through it, so as to impinge upon or near to the cutting point or edge, or if the nature of the work precludes the use of a hollow tool, then to arrange a cooling jet so as to impinge on the outside of the cutting point or edge of the tool, care being taken as far as possible to cause the water to strike between the cutting tool and the shaving that is being cut off the mass. By this means the frictional or other heat that is produced by the operation of the cutting tool on the metal will be carried off by the water or other cooling medium, so that the machine may be driven at increased speed.

In the accompanying engraving, Fig. 2 represents in plan one mode of adapting the invention to a lathe. In this figure, *a* is the piece of metal to be operated upon; *b* is a hollow cutting tool shown detached in elevation at Fig. 1, in which the point is shown in section. It will be seen from these views that the tool is bored out, and to one end of it is adapted a flexible tube, *c*, made of india rubber connected with a water tank, so that a jet of water may be made to pass along the inside of the cutting tool and run over the cutting edge between this latter and the shaving that is being removed.

In order that the water should issue from the exit opening with sufficient force and velocity, and in order, moreover, to avoid weakening the tool, the exit opening or openings (as there may be more than one) at the cutting end of the tool is or are contracted as shown in the figure. The main water channel is bored or otherwise made longitudinally right through the tool, and is plugged at the working end. The exit opening or openings are then drilled in a diagonal direction into the main channel so as to cause the water to issue as near the cutting edge as possible, and after striking the under part of the shaving to impinge on or flow over the cutting edge.

Fig. 3 is a sectional elevation of one of Mr. Clay's hollow cutting tools fixed in a holder. The tool is here made with a shoulder, the tail end of the tool being less in diameter than the forward end, and this shoulder, rests on a corresponding shoulder made in the socket of the tool holder, so that any possibility of the tool being forced back in the holder will be effectually prevented. *d* is a pin or cotter to hold the tool securely. When the cutting end of the tool has been worn down to such an extent as will render it necessary to raise up the tool in the holder, this can be effected by placing one or more washers under the shoulder, as indicated in the figure. The water is supplied to the channel in the tool through a flexible tube as in the former instance.

Instead of boring out the tool in the manner described, it may be made of a piece of steel tube, the working end of which may be plugged, as seen at Fig. 4, with a plug of wood, metal, or other suitable material, through which the exit opening for the issue of the water is made, as shown. When the tool cannot conveniently be made hollow, the water may be supplied in a jet, which is made to impinge as nearly as possible on the cutting edge, care being always taken that the water is made to impinge between the shaving or metal to be operated upon and the cutting edge of the tool. In some cases it may be found convenient to combine the two plans, that is, to cause a stream of water to pass through the cutting tool, and another stream or jet of water to impinge upon the outside of the cutter.

Altogether, Mr. Clay's plans possess considerable interest and we shall be glad to learn further particulars of the performance of tools made and worked on his system.—*Engineering.*

THE GREAT LAXEY WATER WHEEL.

Probably the largest water wheel in the world is that represented in our illustration. It is located at Laxey, Isle of Man, in which village are extensive mines which have now been worked for several centuries, and which are noted for their richness in copper, lead, and silver ores. The deepest workings extend 1,380 feet below the surface, and are drained chiefly by the powerful pumps operated by this immense motor.

The wheel was erected by Mr. Casement, a Manx engineer. It is known as the "Lady Isabella," after the wife of a former governor of the Island, and was started September 27, 1854. It is of about 200 horse power, and can pump 250 gallons of water per minute from a depth of 400 yards. Its diameter is 72 feet 6 inches; circumference 217 feet 6 inches. Its breath is 6 feet, and it has a crank stroke of 10 feet. The water for driving it is brought from a reservoir on a neighboring hill. The wheel and its fittings are, as represented in our engraving, supported on an elegant structure of iron and masonry formed in open galleries.—*Scientific American.*

OSCILLATING PUMP.

The engravings on page 29 represent a new form of oscillating pump, the novelty of which consists in the use of a section of a hollow cylinder, oscillating on its longitudinal axis, in connection with a stationary packing and suitably arranged valves. By this construction it is claimed that increased efficiency of working parts is obtained, and that the usual boring out and much of the necessary fitting incident to pumps of this class, are dispensed with.

Fig. 1 affords a perspective view of the device, and Fig. 2, a representation of the interior portions. A and B are the two sections of the shell or outer casing, each provided with a flange and bolted together to form an oblong cylinder with closed ends. C is the induction chamber, in which are valves opening upwards. The leather forming these valves is in one piece passing over the abutment, E, thereby packing the joint between it and the shaft, F. G is a plate supported on springs in a groove in the abutment and serves to hold the leather in close contact with the shaft. H is a sectional hollow cylinder connected to the shaft, F, by plates through which are ports, closed by the valves, I, I, opening upwards.

The joint between the sections, A and B, is packed with leather, the inner edges of which are turned up as shown at J J, and, resting against the periphery of the cylinder, H, serve also as packing between said cylinder and the casing. K is the discharge opening leading from the air chamber formed by the upper portion of the section, A. The outer ends of the shaft, F, are squared to receive a handle, as shown, by which the cylinder, H, is caused to oscillate in its bearings. By this means, through the action of the valves, I I, the water is drawn into the interior of the cylinder, whence it passes through the opening, L, and finally escapes from the discharge, K.

The invention, as is evident from the illustration, is very simple in construction. The cylinder, H, is turned off with great facility, and as the two sections of the case are cast separately, each in a single piece, little is required beyond attaching the lower valves and bolting the flanges together. By removing the top section, the entire working parts are exposed for examination and repair.—*Scientific American.*

MISCELLANEA.

There was an Exhibition of Science and Art in Bombay, last month.

Only one nickel mine is now worked in the United States. It is in Pennsylvania, and yields 600 tons per month.

An exceeding rich vein of copper, penetrating to a depth of 40 ft below the surface, has been discovered at Hope, Pennsylvania.

Palmetto leaves have recently been shipped from Savannah to England for the purpose of testing their value in the manufacture of paper.

The latest style in mourning is to have a black frame printed in the paper at the head of the obituary notice of your friend, in which a photo portrait of the deceased is pasted after the papers come from press.

It is stated that the authorities of the Royal Gun Factories, Woolwich, England, have designed and are prepared to construct a 70 ton gun, which shall throw a projectile of 1,400 pounds.

Dr Louvel has been awarded a prize of four hundred dollars by the French Academy of Sciences for designing an apparatus for keeping grain in a vacuum, or rather within a vessel in which the air is so rarefied as to kill any granivorous insect.

A Philadelphia manufacturer is preparing a plan for a column 1,000 feet high, to be constructed entirely of iron, in open work, from the summit of which the grounds of the Centennial Exposition are to be illuminated by means of a Drummond light. If adopted, it will be the loftiest monument in the world.

When ink spots are of long standing it is difficult to get them out, since the iron has become thoroughly peroxidised and must be reduced. The following is recommended:—Water, ½ litre; hydrochloric acid, 100 grms; tin salt, 100 grms. Moisten the spot with this solution, keeping it moist until the colour disappears, and rinse with water.

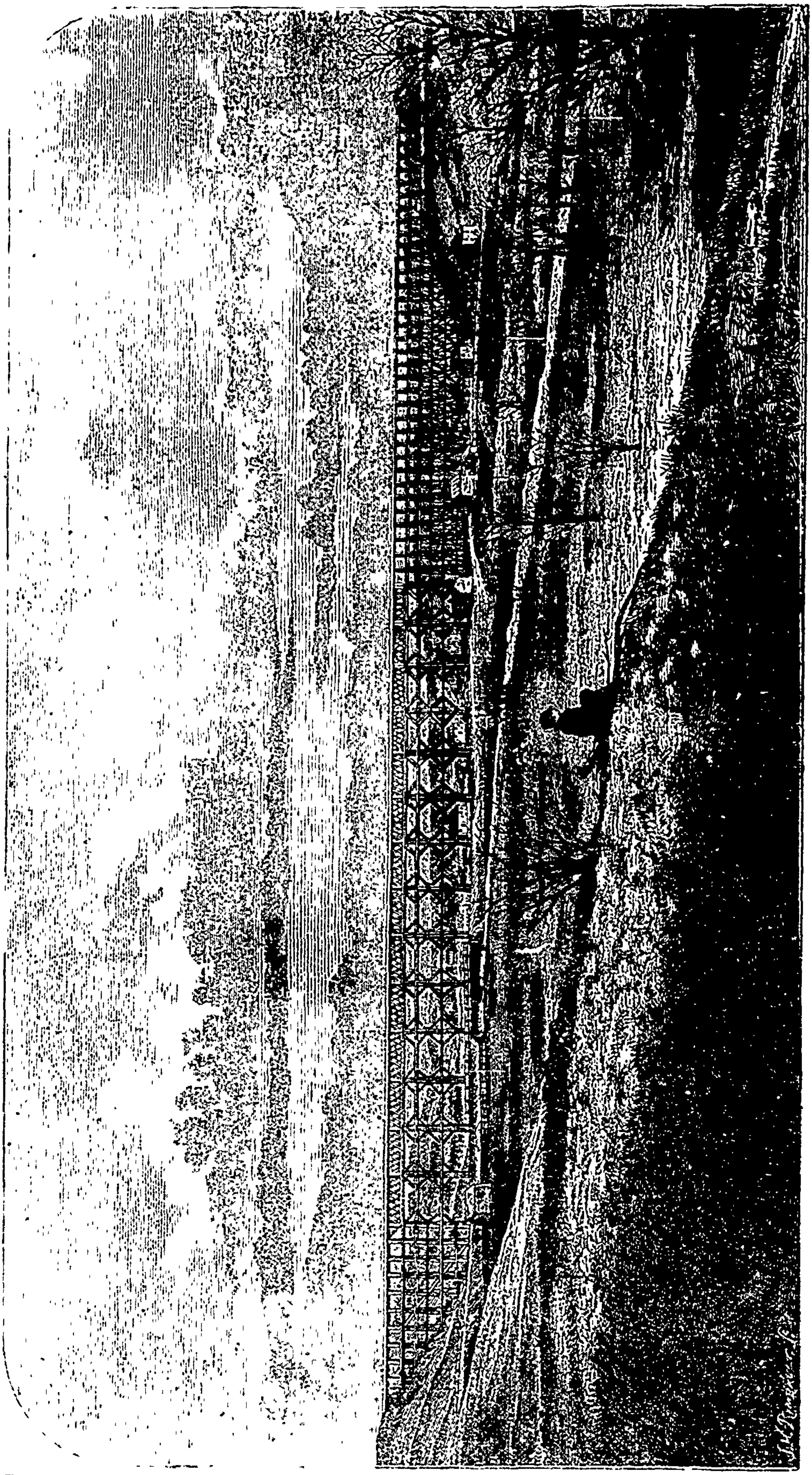
Yarmouth, N. S., is ahead of any town of its population in the world in the matter of ship-owning. Of the 248 ships owned by Yarmouth, 33 are ships and 84 barques, forming about 90 per cent of the entire tonnage of the port. 21,500 tons of shipping are now being built or have been contracted for by Yarmouth ship-owners.

Dust Respirators.—Good service is being done in England by calling attention to the great prevalence of lung diseases among the operatives in dust-abounding factories, such as those where cotton, iron china, flax, lime, etc., are worked. A simple and effective respirator, consisting of a light, flexible frame work lined with a filter of cotton wool, is used. The protection afforded by this apparatus is effectual, and it is simple and cheap.

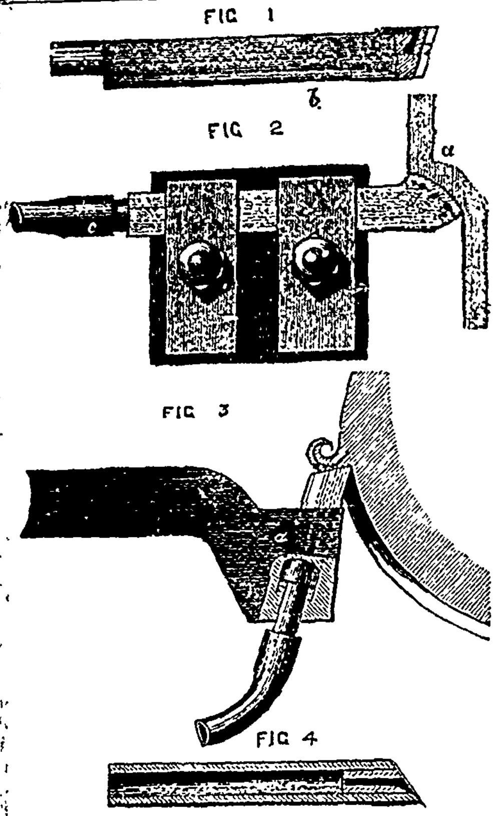
Kaolin Deposits.—The kaolin deposits of South Carolina and Georgia promise to become of great importance. This substance is largely used in the manufacture of porcelain, paper, paints and paper hangings. About 2,000 tons are annually imported from England into New York alone. New Jersey and Ohio potteries use 60 000 tons of it yearly. The best English kaolin is worth $30, and this kind of American only $20 per ton, for reason of its lesser purity.

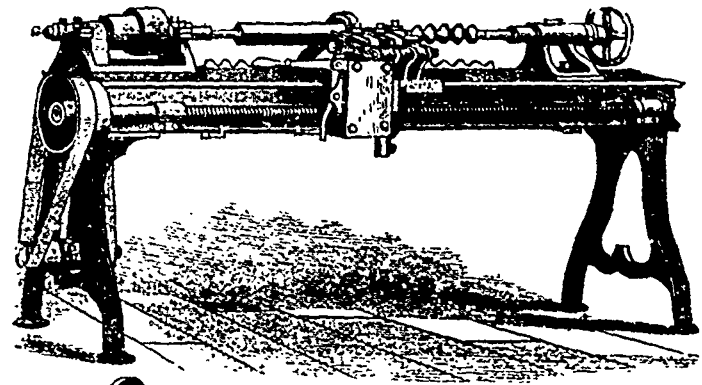
The Isthmus of Darien.—Commander Selfridge, of the United States Navy, has sailed from New York to survey another proposed route for an interocean canal by way of the Atrato and Bojaya rivers. This, it is understood, will be the last survey made, and when Commander Selfridge returns all the explanations of the proposed canal across the Isthmus are to be referred to a Board of officers to decide as to which of the routes is the most practicable, and also whether it is possible to execute a canal through any of them.

The Gladstone Gold Mine of Wine Harbor, N.S., appears to be situated on a remarkably productive lead. The Deputy Commissioner of Mines in a recent official report on the Eldorado mine (which is connected with the "Gladstone,") says:—"I here submit the official returns of the "Eldorado" Mine for November and December, viz: November—500 days labor, 230 tons quartz, yielding 321 oz. 12 dwts. December—531 days labor, producing 177 tons quartz, yielding 349 oz. 1 dwt. Gold, thus considerably exceeding my estimate." 531 days labor seem to have turned out nearly $7,000 worth of the precious metal.

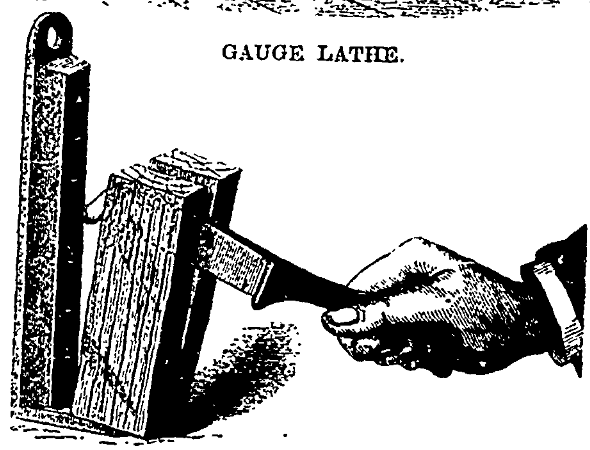


RAILWAY BRIDGE, ST. THOMAS, ONTARIO.



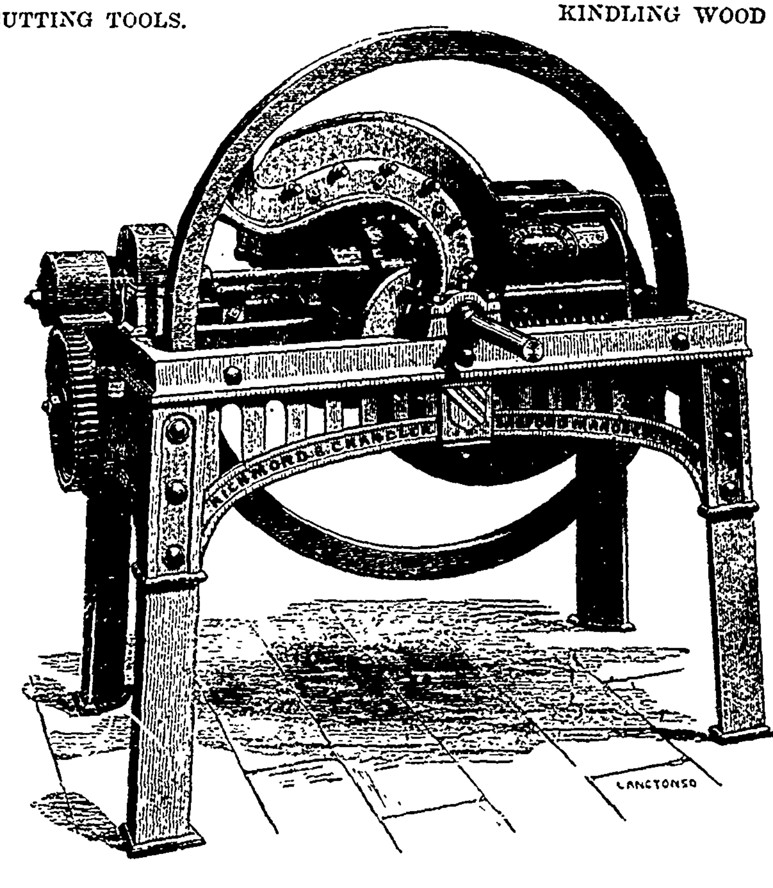


GAUGE LATHE.



CLAY'S CUTTING TOOLS.

KINDLING WOOD SPLITTER.



CHAFF CUTTER.

GOLD MINING IN ONTARIO.

Visit to the Marmora Gold Mines—The Rich Lodes and what they produce.

The Belleville *Intelligencer* gives an account of a visit paid to the Gatling gold mines in Marmora. It says:—Mr. Gatling has been operating in that vicinity for some years, for his operations have been carried on quietly and without that excitement which usually characterizes rich discoveries of the precious metal. Having satisfied himself of the existence of gold in paying quantities by various test methods, he went quietly to work to secure the land upon the surface of which were so many unmistakable demonstrations of its presence and richness. His explorations led him to adjoining properties where were distinctly traced extensive lodes—these also were secured, shafts sunk to a considerable depth, wide veins of quartz and ore found to exist in inexhaustible quantities, and assays made by Dr. John Fordy & Sons, Assayers to the United States Mint; Prof. Chapman, of Toronto; Dr. Hayes of Boston; and various other distinguished Assayers of the United States and Canada. But the tests most relied upon have been the frequent crushings and pannings of the ores made at the mines. We were shown a large 225 lb. mortar, having a stamp of about 40 lbs. weight worked by a spring pole, where hundreds of tests have been made. Besides these tests we are informed that the heaviest investors in the mines have spent weeks and months with shovel and pan taking the decomposed material beneath the surface and along the surface of the veins and panning out the same for themselves. The ground size of the Mill is 86x40 feet with engine room 25x37, and rock shed 25x30 feet, and is built in the most substantial character. The machinery for the mill, which is for twenty stamps, was all made at Belleville, and is of the most perfect description. There are two large vertical engines of 40 horse power each. The mill will contain one large Dunstan revolving furnace for roasting the ores.

The mines are on the great lodes first discovered on lot 6 in the 8th concession, and which run nearly due north and south, and are now traced from lot 5 to the north line of lot 10 in the same concession—a distance of about two miles and a half—the strongest out-crops of the veins being on lots 6, 9 and 10, in the 8th concession. These veins are situated on the western base of a long range of syenitic hills, and are found in a dark, trap-like range of rocks with talc slate and micaceous formation. A short distance west lies the lower silurian formation. In this belt, which appears to be only a few hundred yards to half a mile in its greatest width, there exists a number of well defined quartz lodes all carrying gold, and while several of these lodes differ somewhat in their character, all have qualities in common, showing them to belong to the same formation. It is said in all great mining districts that the ores of each district are peculiar to itself, and differ from all others. Such seems to be the case here. On lot 9, Mr. Gatling has sunk shafts on three veins running parallel to each other, and not farther apart than three hundred feet. In the easterly vein, which seems to be the great mother lode of the district, as it can be traced nearly a mile on the surface, the ore carries more quartz, and is a whiter, or more silvery-grey colored ore. The ore of the middle vein is a little darker colored, while that of the west vein is very dark—almost black. All the ore, however, is composed of iron, arsenic and sulphur, carrying gold and silver, and in each of the veins frequently showing free gold, oftenest in fine particles, but often in particles or nuggets as large as a wheat grain or pea. The east vein, or mother lode, seems to be the largest and strongest as far as developments go, the vein being at the present depth (about 80 feet) of Mr. Gatling's shaft over twenty feet wide, while in his west vein the width of vein seems to be from three to four feet in width, but mainly solid ore—we mean by solid ore, mineral free from white quartz. It seems that the mineral of the veins is far richer than the white quartz, and assays largely over $100 per ton. The developments already made by Mr. Gatling, place the fact beyond controversy that there is an inexhaustible amount of rich ore in these different veins. The great length of veins traceable, the depths of the various shafts sunk, and the continuing yield of ore as shafts are being sunk deeper, lead to the conclusion above expressed, irresistibly. We descended the shaft of 80 feet in depth, by means of wood and rope ladders, and when about 50 feet down knocked off with a pick about a pound of ore from the vein which is here about twenty feet wide, which was afterwards crushed in a small mortar and washed in pans, producing a fine show of gold. An inspection of the cabinet of specimens, containing a hundred or more pieces of quartz and ore, in which the precious metal is to be found in nuggets and distributed through the ore in fine particles, and of the products of a number of pans from the surface, which displayed a richness most wonderful, will well repay the visitor. During the last two years these mines have been visited by large numbers of persons conversant with mining, and of large experience in California and other gold-producing countries, who have tested the ore by various methods, and who have pronounced the mines to be inexhaustible in ore and not excelled in richness.

THE VIENNA EXHIBITION OF 1873.

We reproduce, on page 24, an illustration from *Engineering* of the interior of the Industry Palace of the Vienna Universal Exhibition of 1873. The design and arrangement were the result of considerable discussion.

It was considered when designing the Vienna Exhibition that no one system could combine in itself all possible advantages, and consequently it was determined to sacrifice that particular feature which least contributed to the general organisation of the whole. It was seen at once that if the juxtaposition of all objects of the same class were deemed unnecessary, then all the faults of the Paris Exhibition could be corrected. The gridiron plan was the special arrangement chosen to meet all these difficulties. It was originally the idea of the two Viennese architects, Sicardsbourg and Van der Null, the builders of the famous Opera House of Vienna, both of whom are now deceased. They left behind them nothing but a crude sketch of a ground plan, which as they designed it, was utterly impracticable. The idea was, however, retained and rendered feasible by Mr. Charles Hasenauer, who is the chief architect of the entire Exhibition. The rationale of the system is as follows:

The nave or great axis of the building is made to run as nearly as possible east and west. The transepts consequently point north and south. The countries are then arranged according to their geographical position on the surface of the earth. North and South America occupy the extreme western end of the building; England and the countries of Western Europe come next, and so on till we get to the far eastern transepts, which are appropriated to China and Japan. In the case of two countries being the same distance east or west of a given meridian, the one which lies most to the north on the face of the globe occupies the transept and part of the nave on the northern side of the axis, and *vice versâ*; this latter rule has, however, been sometimes disregarded, as it does not in the least injure the working of the system.

By means of this arrangement, any one possessing the most elementary notions of geography can find his way about with perfect ease. To give an example: if a visitor finds himself in one of the transepts belonging to France, and should he want to go to the Chinese portion of the building, knowing as he does that China lies to the east of France on the surface of the globe, he has only to go into the nave, turn towards the eastern end of the long axis, and walk till he sees the name CHINA hung up from the roof in large letters. If, on the other hand, he had wanted to visit the American department, he would have had to perform precisely the same operation, turning, however, towards the west instead of to the east. It is equally easy for visitors who are in the park to find their way from the outside to any particular part of the Industry Palace, for each transept is furnished with a portal at its end, over which is marked the name of the country occupying it.

It may be remarked with perfect truth that an equally simple arrangement could be obtained without the gridiron plan, by the use of one plane oblong building also running from east to west, the countries being arranged precisely as above. Such a construction would, however, have several grave defects. The façade of a building a kilometre long, unrelieved by transepts or other prominent projections, would have been, architecturally, intolerable. In order to obtain an equal area of ground plan with the same length, the width of the building, and consequently the span of the roof girders, must have been increased fourfold. In order to light such a wide building effectively, it would have been again necessary to have employed a glass roof. The area of wall available for hanging purposes and for side windows would have been diminished fourfold; and lastly the garden courts, one of the most pleasant and useful features of the present system, would not have existed.

From the above it will be seen how completely the gridiron plan meets all the requirements of an exhibition. The great nave presents a splendid coup d'œil. The difficulty of finding one's way about may be said not to exist. Thanks to the great extent of wall surface and the comparative narrowness of the nave and transepts, it has been found possible to light the whole building by side windows. The roof girders being of small span are very light, and the garden courts supply the amount of wall space which each country requires in the immediate neighborhood of its own section of the Industry Palace.

The general aspect from the outside is that of a long low line of grey buildings surmounted by an arched zinc roof; the long line is broken frequently by the numerous transepts, the end of each of which is a portico of considerable architectural beauty, the doorway in every case is surmounted by the name and arms of the country to which the transept belongs. Immediately under the cornice of the roof are the windows, oblong in shape, which run right round the entire nave and transepts in one continuous line, broken only by the porticos mentioned above; the windows are separated from each other by piers of brickwork, containing lattice iron columns which support the roof and its cornice; both piers and cornice are adorned by appropriate ornaments in dark brown on a grey plaster ground, in the cinque-cento style. Beneath the windows are the side walls of the building, which are also of brick covered with plaster, so moulded as to resemble blocks of stone. The transepts are of considerably smaller dimensions than the nave; in fact, the crowns of the roofs of the former do not quite reach up to the tops of the windows of the latter, consequently the windows of the transepts are formed quite below the bottom line of those of the nave. This arrangement was adopted for two reasons: first, because the intersection of two arched roofs—always a complicated structure—would thus be avoided; and, secondly, because at every crossing of the nave with the transepts the nave would be lighted up not only from its own lofty windows, but also by the diagonal rays coming through low windows of the transepts. The proportions of height of walls and windows in the nave and transepts are so arranged that the cornice or stringer at the top of the blank wall of the nave, below its windows, on being continued round the transepts forms the cornice of its roofs, and also the springing for the great arch of its portico, and thus runs round the entire building from end to end; while the corresponding stringers in the transepts form the springing for the arches over the doorways, and are also continued on to the blank walls of the nave, where, together with the first-named cornice, it encloses a large space on which are moulded ornamental tablets, which will be inscribed with the names of the famous men of each country taking part in the Exhibition.

This arrangement of the cornices on the two constituent parts of the building has the effect of bringing them into perfect relationship with each other, for thus each characteristic feature of the one is a characteristic but different feature of the other.

A building such as has just been described would, however, have failed in two or three respects; it would have lacked a grand hall for great ceremonies and festivities; the long low line of buildings would have had no striking architectural effect, and the perpetual breaks caused by the ever-recurring transepts would have given the building too much of a straggling appearance. In consequence of all this it was determined to build a grand central hall surmounted by a dome of a colossal proportions, which should at one and the same time serve as a great arena for festivals and ceremonies, and should also be of architectural use in saving the whole building from commonplaceness.

Mr. Scott Russell was applied to by the Imperial Commission to assist in carrying out this great idea, and at once undertook the design of the Rotunda, which now stands all but completed, in the middle of the Industry Palace. This building is entirely novel, both in its architectural and mechanical features; but as its description will form the subject of subsequent articles, it will not at present be necessary to enter into its details. It has been so designed that it will not crush the other buildings into insignificance, but forms, rather, their natural culmination and development. It is planted right in the middle of the axis of the nave, and in order to unify it with the remainder of the palace, the nave, where it meets it, is made to split in two, and encircle it; the semi-arch of the roof of the nave thus split rests against the walls of the Rotunda. The straggling appearance of the buildings was now the only remaining fault; this has been corrected by uniting the transepts which flank the Rotunda on either side by a transverse building parallel to the nave. This building forms a handsome façade for the centre of the palace, and makes up together with the Rotunda a grand central block of buildings, from which on either side stretches the nave with its numerous transepts. The four corners of this central group are, for the sake of further emphasis, formed of pavilions surmounted by domes, while in the middle of the front façade is a colossal triumphal arch, richly adorned with statuary and bas-reliefs, which forms the chief entrance into the Rotunda. Similar, but shorter, façades flank the Industry Palace at the two ends; they are also provided with corner pavilions and domes. The six transversal buildings thus obtained are made use of for exhibitors, and list property offices, waiting-rooms, &c. The *raison d'être* of each feature of the Industry Palace has now been described, and the account of its technical details will be reserved for a future article.

A CHAIN-HARROW.—(See page 29.)

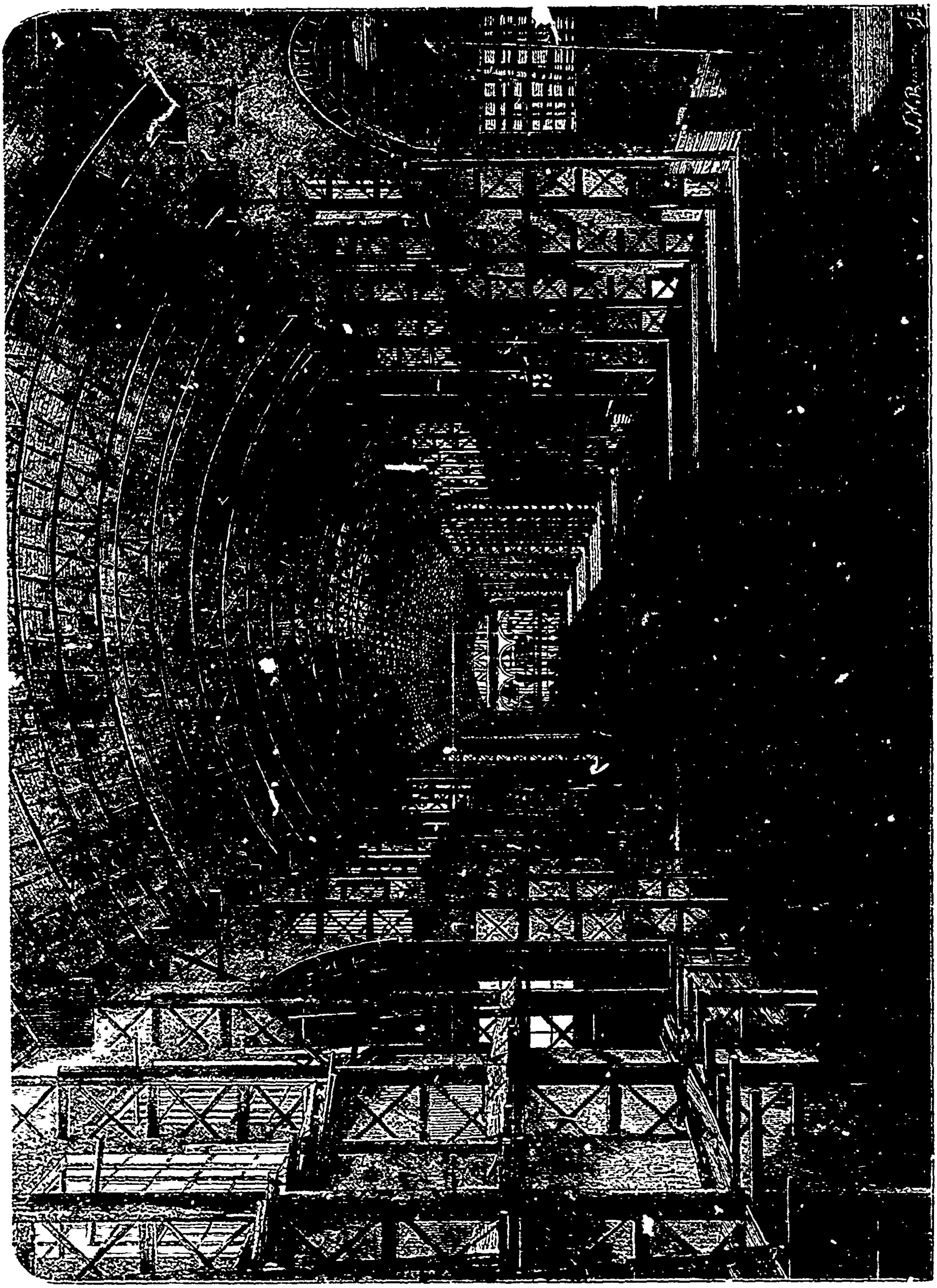
The harrowing of wheat in the spring, the spreading of manure, the harrowing in of grass seed, and the handsome finishing of the surface of sowed ground, and equally the harrowing of young corn and potatoes, need a peculiar form of harrow. The Thomas Harrow for all these purposes on some soils is excellent; for some of them, on other soils, it has failed. On a late visit to the farm of Mr. William Crozier, near Northport, L. I., we saw and tested a harrow of peculiar shape, which for many reasons we prefer to any toothed harrow whatever. One great advantage it possesses is that it has no teeth; repairing and replacing teeth, then, is saved in using this harrow, and it will last a life-time without perceptible wear. It also has the advantage of conforming itself to every sort of surface, and of harrowing equally hollows and hills. It is also very light, and one horse can draw it. The surface is left in a perfectly handsome condition, and no lumps or stones are torn up or sods left on the surface. It can not possibly clog either with weeds, rubbish, or manure, but passes over them and leaves them spread evenly upon the surface.

It consists of square links of half-inch square iron rod about four inches in diameter, connected in the manner shown in the engraving. Short chains connect it with a draw-bar to which the clevis of the whiffle-tree is attached. Two iron rods with a forked claw at each end are used to keep the links spread in width and bobs of cast-iron or any other similar weights or drags are attached to the rear by short chains to keep it spread in length when in use. In the harrow we tested, the links were welded, but we do not think this to be necessary. The harrow would be much cheaper and equally effective if the links were simply bent into shape and the ends drawn together after being linked. But the joints in the links should not be at any of the angles, but on one of the sides, half-way between two of the angles.—*American Agriculturist.*

Professor Cornwall, of Columbia College, N. Y., has, by means of the spectroscope, detected a notable amount of indium in various samples of zinc blende from New Hampshire and other States.

NEW SODA-WATER BOTTLE.

The public have been familiar for some time past with so many various forms of patent stoppers, more or less expensive, inconvenient, or impracticable, for aerated and other liquids, that we believe the impression arrived at by most people was that nothing could ever supersede the ancient system of corks and wires. The design we publish on page 29, from the *English Mechanic*, has, however, we think, advantages beyond any form of stoppered bottle that has yet come under our notice; and if it possesses the properties the patentee claims for it, we think it bids fair to cause a revolution in the soda-water trade. The principle of the bottle is briefly as follows:—Inside the top part or neck of the bottle is a glass ball, prevented from



INTERIOR OF INDUSTRY PALACE, VIENNA EXHIBITION.

FIG. 1.

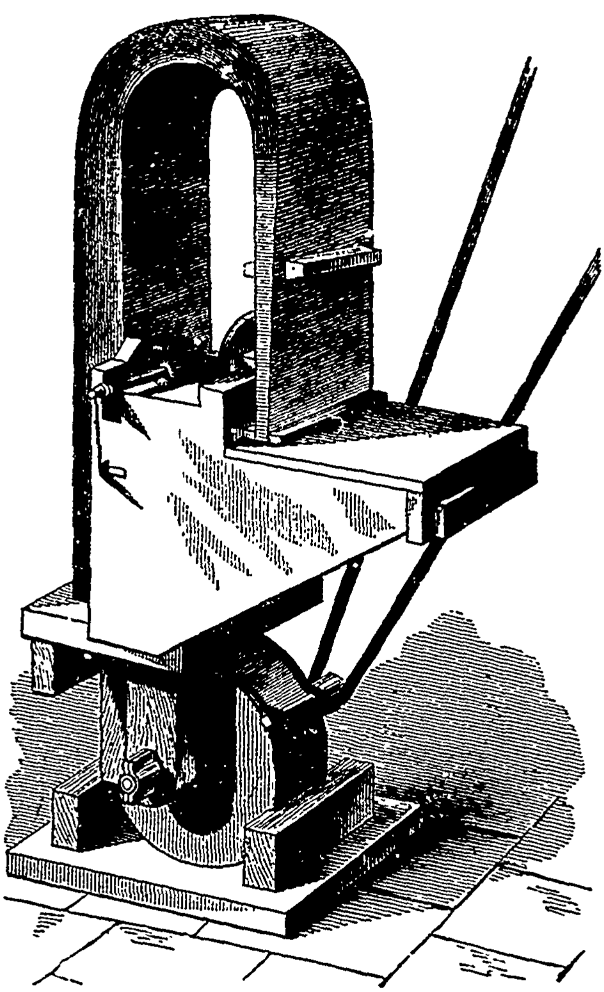
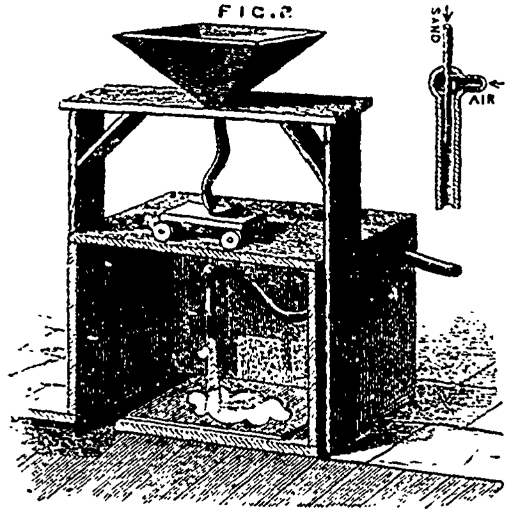
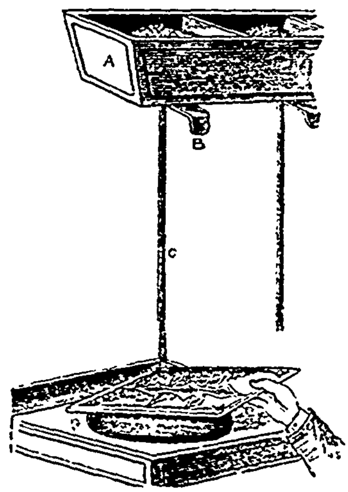


FIG. 2.





THE SAND BLAST.

dropping into the body of the bottle by a contraction, which can be seen in the drawing. The ball is put in the process of manufacture, and the mouth of the bottle being contracted afterwards, it can never come out. The next feature is an annular groove, which is cut or moulded in the inside of the mouth of the bottle, and in this groove is fixed an elastic ring. The bottle is now complete, the ball forming with the ring a perfect stopper by the pressure of the gas from within. Thus, glass is the only substance that the liquid comes in contact with To open the bottle all that is required is a small wooden cap, which, pressed upon the glass ball, causes it to drop, and the liquid can then be poured out. The filling process is equally simple. It consists merely of a rack—hung upon a swivel—which can be attached by a pipe to an ordinary cylinder or globe machine. The bottle is placed on the rack and filled with carbonised water, and the rack inverted, when the ball falls of its own weight into its elastic seating. There is no waste whatever in the process. The inventor and patentee is Mr. Hiram Codd, one of the proprietors of the Malvern Mineral Waters Company, Grove-lane, Camberwell.

THE SAND BLAST.

We present herewith, an illustration of this invention, copied from *The Science Record.*

In this process, a stream of sand is introduced into a rapid jet of steam or air so as to acquire a high velocity, and is then directed upon any hard or brittle substance, so as to cut or wear away its surface.

For ordinary rough work, such as cutting stone, where a considerable quantity of material is to be removed, a steam jet of from 60 to 120 lbs pressure has generally been used as the propelling agent. The sand is introduced by a central tube ⅛ in. bore, and the steam issues from an annular passage surrounding the sand tube, on the principle of the Giffard injector The impetus of the steam then drives the sand through a steel tube ⅜ in. bore, and about 6 in long, imparting velocity to it in the passage, and the sand finally strikes upon the stone, which is held about 1 in. distant when a deep narrow cut is desired, but may be 18 or 24 in. distant when a broad surface is to be operated on.

We will describe the process more fully in our next.

NEW GAS COMPANY.

The *Journal of the Society of Arts* says that a new gas company is now attracting considerable attention. Its object is to produce from water a gas capable of lighting and heating. The patents under which the process is to be carried on are those of Mr. Ruck. A practicable model gas manufactory has been built at Battersea, and experiments have been there exhibited of the working of the process. Steam is decomposed, by highly-heated coke or charcoal, into free hydrogen, mixed with carbonic oxide and carbonic acid gases, and some sulphurretted hydrogen, which last is separated from the gas, but the carbonic gases remain, unless when the carbonic acid is removed by the help of caustic soda. The resulting gas is to be used for heating purposes only, as hydrogen gas in burning gives little light but much heat. But the gas is also to be converted into gas for illuminating purposes by being charged with petroleum vapor, which is said to form, with the hydrogen, a more or less permanent combination, and a rich hydro-carbonaceous gas, yielding a light equal to 16 6 candles, burning 120 grains of sperm. The heating gas and the gas for light must either be separately prepared and distributed in two separate sorts of pipes, or else provision must be made for carburetting the gas at every point where it is to be used. Either plan appears open to grave objections. The decomposition of water or steam by highly-heated carbonaceous substances into hydrogen and oxy-carbonaceous gases is not new. Some account of what has been done appeared in a former number of this *Journal* (May 6, 1859). Of the various attempts that have been made, the most successful was that of Mons. Gillard, who produced hydrogen gas from super-heated steam, and utilised it for lighting purposes by igniting it under a cap of fine platinum wire gauze. This cap was rapidly raised to a white heat, and different an intense white light. An objection urged against the new gas is, that the fuel required to generate the steam would produce directly as much or more heat than can be obtained by combustion of the gas. How far this objection is valid can only be decided by practical experience. The great difficulty is the carburetting process, and if the new company have got over that, they will have conferred upon the public a very serious benefit, by rendering it independent of the fluctuations of the coal supply and the vagaries of coal owners.

CEMENTS.

A good rubber cement may be prepared by dissolving one part india-rubber in two parts linseed oil, and adding to the solution a sufficient quantity of bole, say about three parts.

For amber and tortoiseshell, a cement is made by mixing together equal parts of mastic and linseed oil, and warming gently. This cement should be used warm.

To unite wood to wood, a thick solution of shellac in alcohol may be used. It is well to put a piece of fine gauze or crape between the broken surfaces of wood, and then press them tightly together until the cement becomes perfectly firm. Another good, durable cement for woodwork is made by fusing together shellac, mastic and common turpentine, and adding some broken isinglass.

For attaching small objects to anything turned, a mixture of colophonium, turpentine and yellow wax, with the addition of a little pulverized sealing wax, answers nicely. The cement sets quickly and holds well.

To fasten knives and forks in silver handles, a mixture of 2 parts of melted black pitch and 1 part of fine brick dust may be used. It must be used warm.

A varnish of cement to protect wood from the action of mineral acids, alkalies and corrosive gases like chlorine, is made from 6 parts of colophonium and 3 parts of wood tar by heating together in an iron kettle on a furnace in the open air, and then stirring in 4 parts of fine brick dust. The varnish is applied with a brush while warm.

An excellent cement for glass is made by dissolving 1 part india-rubber in 60 parts of chloroform, then adding 34 of mastic, and letting it digest for a week at a gentle heat. This cement is also applied with a brush, and is especially distinguished by its transparency.

Another cement for glass and porcelain is made by digesting small pieces of isinglass in 16 times their weight of water for 24 hours. The solution is evaporated to one-half, strained, and while still hot, 8 parts of alcohol added, and at the same time a solution of 1 part mastic in 6 parts warm alcohol. One-half part of finely-powdered gum ammoniac is triturated in the warm solution until the whole mass is homogeneous. When used, both the cement and the object to be mended are warmed. This cement is highly recommended for its adhesive qualities.

GLUE AND GUM CEMENTS.

These are very tender and well adapted to mending ornaments. They resist the action of water and atmosphere. There are various kinds of these cements for bone, ivory, whalebone, mother-of-pearl and precious stones.

One of these is made by dissolving 2 parts isinglass and 4 parts colourless glue in 60 parts water, evaporating to half its volume, then adding 1–15 part mastic dissolved in 1 part alcohol, and stirring in 2 parts zinc white. The surfaces are warmed when the cement is applied to them. This cement holds well, dries easily, and may be kept a long time in tightly-corked bottles.

For bone, ivory, whalebone, mother-of-pearl, etc., a cement with a beautiful gloss may be prepared as follows:—Soak common cabinetmakers' glue in hot water, warm the jelly formed, add enough pulverulent slaked lime to give it consistency. Warm the object to be cemented, clean the surfaces carefully, apply the cement and tie the parts firmly together. In a few days it gets very hard. Even common glue, with pulverized chalk stirred in, makes an excellent cement for wood and metals.

For fastening leather to metal, the metal should be coated with a hot solution of glue, and the leather with a hot extract of nut-galls. Allow them to dry quietly, and they adhere well.

For a porcelain, the well-known white-of-egg cement is best. To prepare this it is only necessary to stir the white of eggs into quite a stiff solution of glue, and then apply to the fracture.

A cement of gum for porcelain is made by pulverizing 4 parts of oyster shells and mixing intimately with 2 parts pulverized gum arabic. The powder is kept in a well-stoppered bottle, and when needed for use is rubbed up with white of egg, or warm water, to a thick dough, applied to the object and dried by a gentle heat. Another cement for glass and porcelain is made from 8 parts well-burnt pulverized alabaster gypsum and 2 parts fine gum arabic, mixed with water to a thick paste, and 40 to 50 drops of oil of turpentine added to an ounce of the cement.

(To be continued.)

THE SOUDAN RAILWAY.

The numerous cataracts which oppose insurmountable obstacles to the navigation of the river Nile, form barriers which now effectually cut off the fertile districts of Upper Egypt from communication with the outer world, and place a bar upon the progress and development of the richest territory belonging to the Khedive. To overcome these obstacles, and to open up a means of communication, has been for many years past one of the great objects of the Egyptian Government. An expedition was organised in 1857 by the late Said Mehemet Pasha to examine the obstructions of the Upper Nile, and to report upon the possibility of removing them, but it was quickly found that the cost involved in the work would be so great as to render it prohibitory. In 1865 Mr. John Hawkshaw was instructed to survey and report upon the first cataract, and to ascertain what would be the best means of overcoming this, one of the least formidable of the obstructions, and to extend the navigation as far as the second cataract. Mr. Hawkshaw recommended the construction of a canal and locks to skirt the cataract, the cost of this work was estimated at £250,000, but the rock through which the cuttings would have to be made are of such exceptional hardness that no reliable estimate could possibly be made of the probable cost of the canalisation scheme. About the same time a general survey between Assouan and Khartoom was made. In 1871 the preliminary labors which had been undertaken assumed a more practical form, and Mr. John Fowler was instructed by the Khedive to prepare detailed surveys and estimates of the works necessary to complete the communications with the Soudan. Acting upon these instructions, a large staff was despatched to Egypt in 1871, and immediately commenced operations, which lasted during five months, and resulted in a complete survey of the country through which communications were required, and the collection of all the necessary data.

To overcome the obstacle to navigation presented by the first cataract, at which there is a difference in level of about 12 5 ft. at high, and 15 ft. at low Nile, Mr. Fowler departs from the proposal made in 1865 by Mr. Hawkshaw, and suggests a new and striking method of reaching the higher waters of the river from the foot of the cataract. He suggests the construction of a ship incline nearly two miles in length, on the right bank of the river, commencing at the bottom of the cataract between the Island of Sehayl and the river bank, and terminating on the higher level in the harbor of Shalall, north of the celebrated island of Philæ. Rails would be laid upon the incline, and suitable carriages would be constructed to run upon them. The vessel to be raised or lowered would be floated upon these carriages or cradles, the ship and carriage being then drawn over the incline by hydraulic engines which would be driven by water at high pressure, pumped into huge accumulators at the summit of the incline by a pair of large water-wheels placed upon pontoons, and moored in one of the rapids of the cataract. A speed of from 4 to 7 miles an hour can be imparted to the vessel, according to the height of the Nile, and weight of vessel.

When the first cataract is passed a long stretch of free navigation is available, until, indeed, the second or great cataract is approached, an obstacle of too much magnitude to be dealt with by a ship incline; before it is reached, therefore, the river has to be abandoned, and a new means of transit provided by the proposed railway, which would extend southward into the Soudan. In deciding upon the route to be taken by this line two alternatives presented themselves. Between the second and the sixth cataract, near Khartoom, the Nile takes a sweeping course of nearly 800 miles in two great irregular reverse curves, the northern of which skirts the Nubian Desert, and the southern the smaller desert of Bahiuda. The southern terminal point of the line would be, of course, the most central that could be selected with a view to the converging traffic from all parts of the Soudan. This point is found at Metemmeh, a village on the left bank of the Nile (16° 40' N. latitude, and 32° 25' E. longitude). This village is just opposite Sheady, on the right bank of the river, to which town the numerous camel routes converge, whilst 100 miles down the river is Berber, and about the same distance up stream is Khartoom, at the junction of the Blue and White Niles. As the river navigation for the 200 miles between Berber and Khartoom is obstructed only during two months in the year by rocks which are about to be removed, it will be seen that a better position for the southern terminus could not be selected. To connect the southern with the northern termini the line could be either carried from Metemmeh across the Bahiuda Desert for a distance of about 180 miles, until it again meets the Nile at Ambukol, and skirts the banks to below the second cataract, or the southern bend of the river could be followed from Metemmeh to a point called Aboo Hammed, and the great Nubian Desert traversed until the Nile was again overtaken at Korosko, about 90 miles below the second cataract.

There was little difficulty in selecting the former of these routes. Had the latter been chosen, some 90 miles of good river navigation between the ship incline and the second cataract would have been lost, an altitude of about 1900 feet above the water level of the Nile would be traversed, as compared with 393 ft. on the other line, and the drift sand would prove a very serious obstacle in crossing the Arabian Desert, where no water suitable for locomotives is to be found.

The line, then, as laid out, commences at Wady Halfa, on the right bank of the Nile, which it skirts for a distance of about 160 miles, then by a bridge crosses the river and forms a chord 32 miles long to a small bend in the stream, which it again touches and follows on the left bank as far as Ambukol, at the 375th mile; then commences the stretch across the Bahiuda Desert which terminates the line, after a course of some 550 miles.

The engineering difficulties connected with the work are comparatively small, there will be no tunnels, and but little rock cuttings, expensive works being avoided by the curves and gradients adopted, the minimum radius of the former being 500 ft., and the maximum inclination of the latter 1 in 75. The bridge crossing at Kohé will doubtless be an expensive undertaking, and might be avoided by following the left bank of the river for the whole distance, while the nature of the bank would perhaps allow of a better line being laid out, but on the other hand, the drift sand prevalent on the left bank as far as Kohé would make it difficult, if not impossible to maintain the railway.

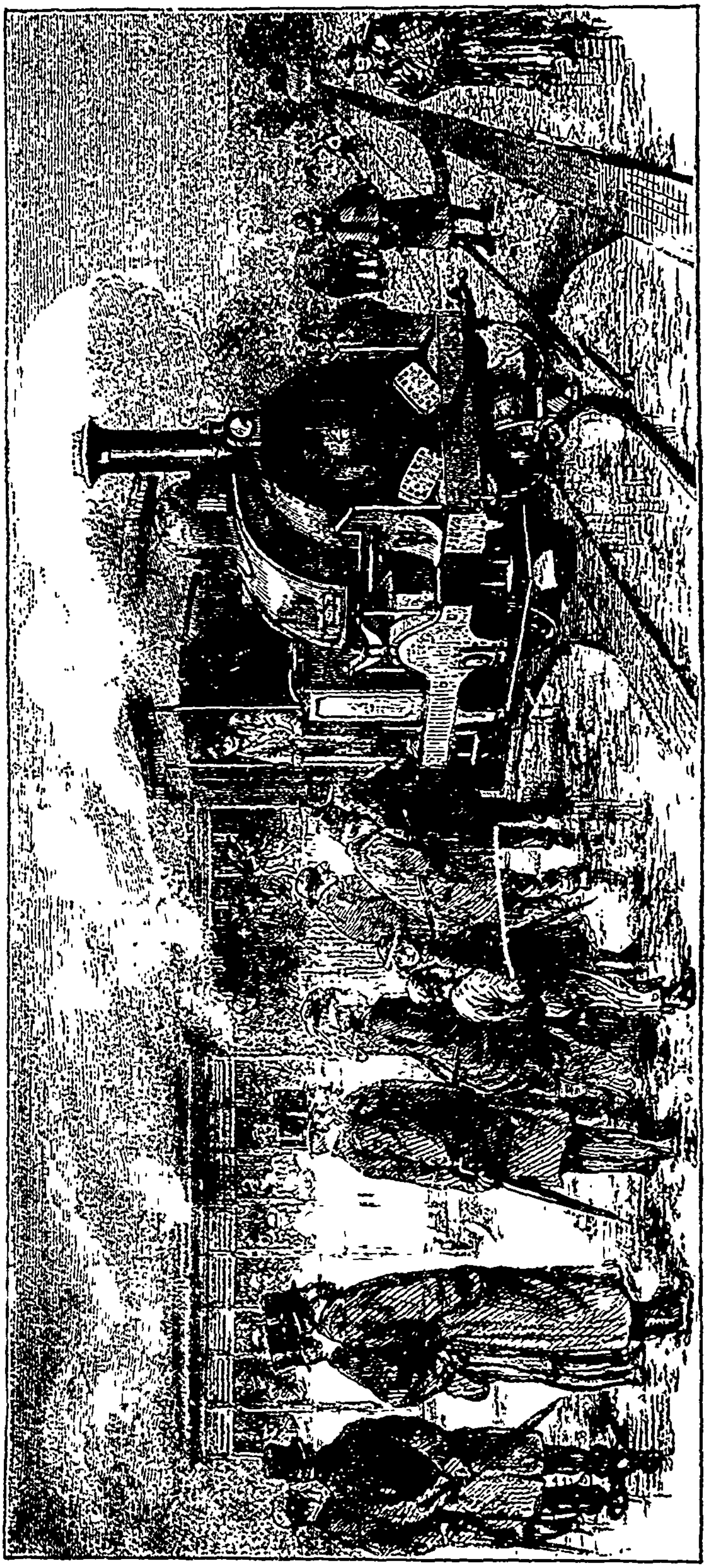
One of the special characteristics of the Soudan Railway is the gauge which Mr. Fowler has adopted—the same which Mr. Pihl has established with so great success in Norway. And in the choosing a narrow gauge for this important line, Mr. Fowler has not been guided by any estimates of probable insignificant traffic. On the contrary, the existing trade is considerable, and will be enormously developed when the line is made, as well along the banks of the Nile as in the Soudan itself, which, with inexhaustible natural resources, now lacks an efficient outlet for its produce. Grain, cotton, sugar, and all the varied animal and vegetable products of a tropical region, will be the staples descending the railway towards the north, whilst the return traffic will consist of machinery, fabrics, tools, and generally, the mixed freight required by a producing, isolated, territory.

Moreover, it is not anticipated that the Soudan Railway shall be simply a local line, built to connect the Soudan with Upper Egypt, but that ultimately it shall form only one link of a great through railway, extending to Massowah on the Red Sea, and opening an alternative and more direct route to India and the East. By establishing a service of steamers, suitable for passing over the ship incline at the first cataract, there would be a saving of one day effected as compared with the Red Sea route, whilst the inconveniences and dangers of that passage would be avoided. Looking further to the future, when the line is extended from the existing Egyptian railway system to the terminus at Wady Halfa, three days would be saved in the journey to India. We may thus consider it probable that before the lapse of many years, there will be constructed a great through narrow gauge railway route across Egypt, competing directly and successfully with the Suez Canal, and carrying, besides, the whole of the local export and import traffic. That Mr. Fowler should, after long consideration, have adopted a gauge of 3 ft. 6 in. for a line of so great immediate and future importance, is, we consider, a striking answer to the many arguments and objections urged against narrow gauge railways so persistently during the past few years, and it affords us satisfaction that so eminent an engineer should have adopted principles we have so strenuously advocated.

The general plan on page 32, which we reproduce from *Engineering*, will be found of considerable interest as it indicates the course of the intended railway.

TRIAL OF STEAM TRAMWAYS AT BUCKHURST HILL.

The question of working tramways by means of locomotive engines and light rolling stock is at present in course of receiving a practical solution in the kingdom of Portugal, where two lines of considerable length are now being made by the Lisbon Steam Tramways Company (Limited.) One line runs from Lisbon to Cintra, a distance of seventeen miles; whilst the route of the other is from Lisbon to Torres Vedras, about sixty miles. The first line is nearly completed; whilst the works of the second have progressed for about two-thirds of its length. The tramway consists of a central 42 lb. rail of the Vignoles section, flanked on either side at a distance of about 20 in., with timber longitudinal sleepers, the three being secured to transverse sleepers, also of timber. Upon this triple line run engines and carriages, having one pair of broad wheels placed central to their length, and running on the timber sleepers, and at either end a bogie frame carrying, for the engine two, and for the carriages one, double-flanged wheel, placed central to the width of the carriage, and working on the iron rail. In the locomotive the pair of broad wheels are the drivers, the small central wheels acting mainly as guides. In the carriages, however, the exact reverse of this arrangement is observed, the bearing being taken by the bogie wheels; whilst the outer broad wheels act simply as guides. They are allowed a very wide margin of vertical play by means of American springs made with an India-rubber core surrounded by a spiral steel spring. The bogie wheels are also carried by six springs of the same character. The carriages, in fact, are therefore, it will be seen, steadied, and prevented from overturning laterally by the outer wheels. The gauge of the line is determined by the outer wheels, which are 4 ft. 2 in. from centre to centre of tyres.



TRIAL OF STEAM TRAMWAY AT BUCKHURST HILL.

The engines are fitted with an ingenious hydraulic arrangement, by means of which the body of the engine is preserved in a horizontal position when it is either ascending or descending an incline, so that the tubes are not uncovered by the water, the level of which is indicated outside. The power of each of the engines already made has been tested up to 300 tons, which has been drawn by them on the level. The carriages are of three classes; the passengers enter from the sides and are seated back to back.

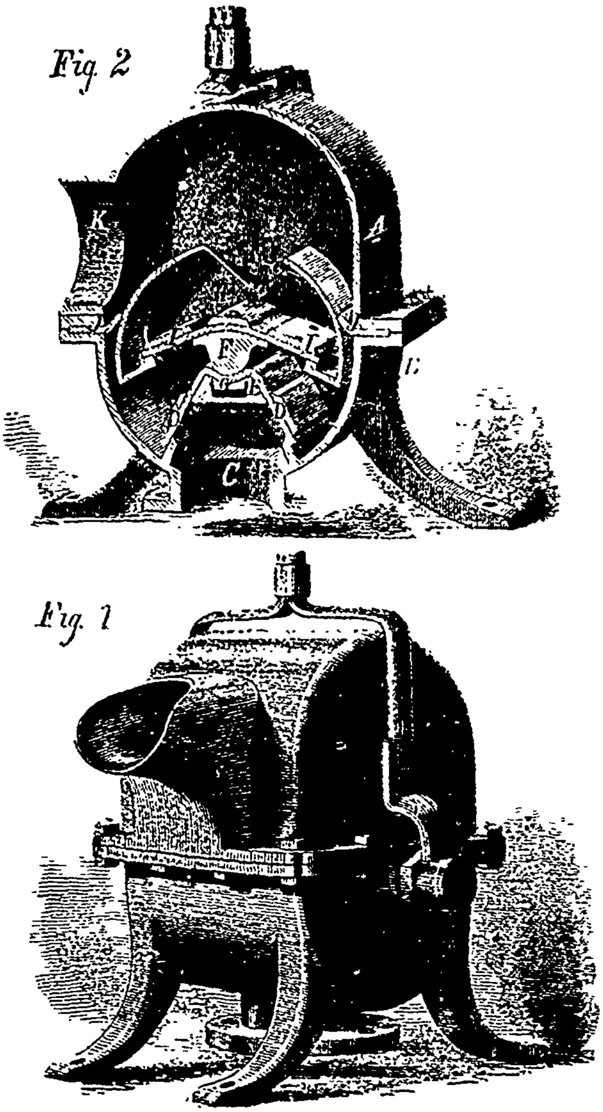
With an engine, a second and a third-class carriage, and a g ods waggon, of the type we have described, an interesting trial was recently made in the presence of a number of engineers and other scientific gentlemen. In order to test the system a strip of land has been obtained in Epping Forest, at Buckhurst Hill, where a piece of tramway road, 1,710ft. long, has been laid. The line is on an incline for nearly its whole length, the steepest gradient being 1 in 18¼ and the average 1 in 22¾. Up and down this line and round these curves, a number of runs were made, both with full and empty carriages, at good speeds, and with perfect success. Considering the saturated state of the land on which the line is made, the train ran with remarkable steadiness, giving a good earnest of what it will do on a sound piece of road. The time occupied in the run was exactly 60 seconds, or at the rate of about 20 miles an hour, starting and stopping included. The system h s been developed to its present degree of perfectness by Mr. F. H. Trevithick, the engineer to the Lisbon Tramway Company. The engine was built by Messrs. Sharp, Stewart and Co., and was an excellent specimen of workmanship.—*Graphic.*

To Make Pale Mahogany Darker.—The old way of darkening pale mahogany is to cover it with a wash of lime water, or milk of lime. This method is, however, open to the objection that some pores will become filled up with solid lime, and show afterwards white lines and white points, very difficult to remove. Other alkalies, like potash and soda, are not open to this objection, and will darken some kinds of wood more or less. A solution of bichromate of potash, in water, will also darken wood, but when the wood contains tannic or gallic acid it will be blackened more or less. The best method is, perhaps, simply a stain made of a decoction of logwood in water, a tincture of dragon's blood in alcohol, alkanet root in turpentine or oil We have often used, with great success, burnt sienna, or Vandyke brown, finely ground in linseed oil, and rubbed in with a flannel the sienna gives a richer red-brown, the Vandyke brown a darker brown. The latter method may be use to stain any kind of wood, and is in many cases preferable over stains put on by watery decoctions of dyewoods —*Manufacturer and Builder*

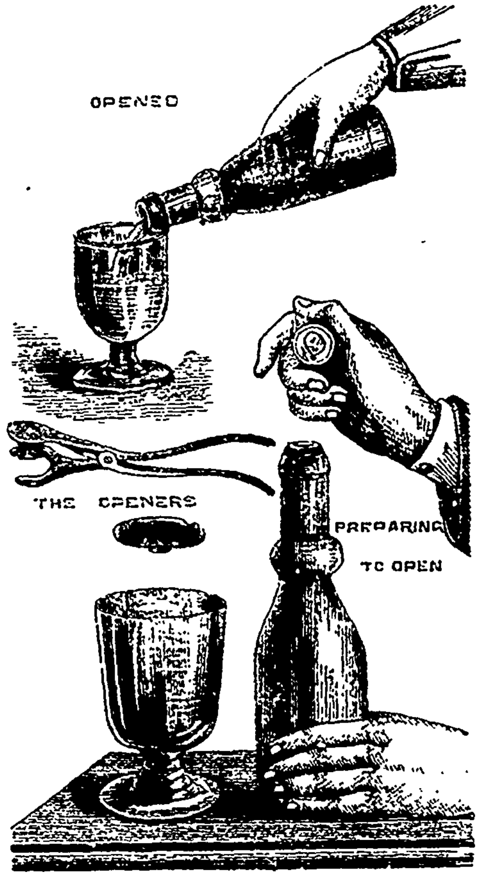
Iron Bolts in Wooden Structures are always liable to be attacked by rust, which diminishes their size and loosens their hold. The simple remedy of coating the bolt holes with a mixture of zinc filings and grease galvanizes the iron and thus preserves it from oxidation.

Fig. 2

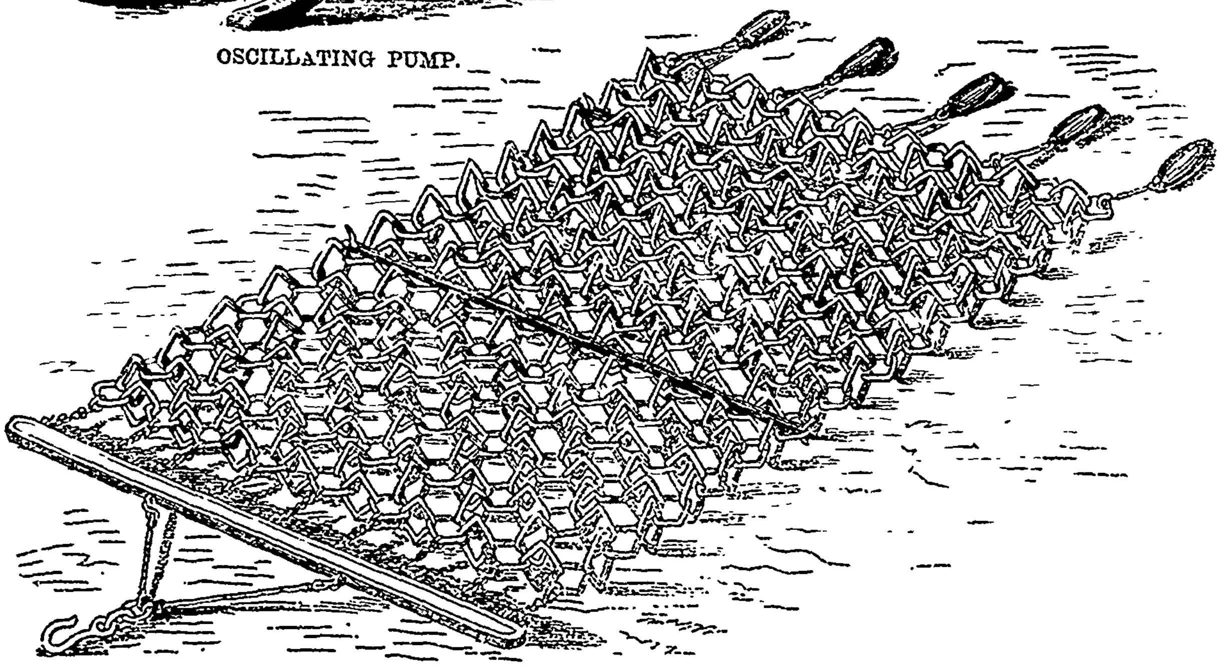
Fig. 1



OSCILLATING PUMP.



NEW SODA WATER BOTTLE.



CHAIN HARROW.

THE SILBER LIGHT.

The substitution of coal gas for the various oils in the production of artificial light has become so universal, and its superiority so well established that it seems hardly within the limits of possibility that we should—except under the pressure of extraordinary circumstances—ever return to colza or cotton wicks. Expensiveness and uncleanliness in use have ever been the chief drawbacks to animal and vegetable oils, whilst the dangerous nature of those produced from the mineral kingdom, as well as the objectionable smell, and other disadvantages attending their use, have greatly limited the demand for their services, of which otherwise the public would have been but too ready to avail themselves. But we are ever working in circles, and it is a fact simple and absolute, that to-day finds us returning to the use of those materials for illuminating purposes which, not many years since, we were anxious to resign in favour of coal gas. But then we are returning to them under widely different conditions, and in place of the costly and inefficient system of illumination by vegetable oils formerly in vogue, and instead of the dangerous and disagreeable method of burning mineral oils as now practised, we have an economical cleanly, safe, and efficient mode of utilising to the utmost every class of oil This result has been attained without a departure from the general principles observed in the construction of oil lamps although the details have been greatly modified and improved, until at length we have the apparent anomaly of a gas light produced from an oil lamp. It is true that all oil lamps are gas producers, but only to a limited extent, the impurities of the oil and the absence of exact proportion between oxygen and carbon, causing the wick to choke and char, and the light gradually to decline, whilst under the new system a wick will last for months, the lighting of the top edge being required only to give the initial start to the gas-manufacture it helps to carry on. The duty of the wick is simply to feed the flame, which it does without being itself consumed.

These great changes have been effected by Mr. A. M. Silber, whose new light bids fair not so much to supersede gas—a'though it may possibly do this to some extent—as to be used wherever coal gas is either inapplicable or cannot be obtained But this altered condition of things has not been brought about by mere accident or by a happy inspiration, it is the result of several years of careful investigation and experimental research during hours not occupied by business, for Mr. Silber is a London merchant. More than two years since Mr. Silber brought his system of producing artificial light before the the public through the Society of Arts, but the public were not then willing to accept the facts laid down. Now, however, that the inventor has demonstrated the correctness of his theories by actual practice, there can be no gainsaying these facts, nor resisting the conclusions to which they lead. The principle involved in the Silber light is the conversion of the oil into gas a short distance below the flame, and the exact proportioning of the quantity of the gas produced, and of the atmospheric oxygen supplied to it. These conditions having been complied with by Mr. Silber, he obtains as a result perfect combustion which means a clear, bright, and smokeless flame, unaccompanied by any offensive smell or other drawback, a light, moreover, which is as suitable for a railway carriage, or the masthead of a ship, as it is for a drawing-room table. In order to approximate the conditions of his system to those of the ordinary gas supply as much as possible, Mr. Silber lays on the oil for wall and ceiling burners by means of cisterns and pipes. A main cistern is placed in the upper part of the house, and from it the oil is conveyed by gravitation to every other part of the building. The impurities of the oil are arrested at the outset by a strainer, through which the pure oil flows by pipes to each floor of the building, at which point is a reservoir, the supply being governed by a stopcock and float. Each reservoir is placed on a level with the burners it has to supply, and by this means there is no overflow, nor are there any taps to turn on or off. The oil flows freely to the burner, at a constant level, several inches below the flame, which is fed by the capillary attraction in the wick. As the oil in the wick becomes heated it is vaporised in an annular chamber, which in fact becomes the gasholder. The supply is maintained with perfect regularity, the delicately-adjusted float following the rate of consumption, and opening the cock to the exact extent required to keep up the supply, and no more.

In the burner, of course, lies the secret of the Silber light, and in perfecting the adjustment of the admission of air, several thousand experiments have been made, and much time and money spent by the inventor. The burner consists of a series of concentric tubular cases placed vertically one within the other with spaces of variable width intervening. The inner space forms an air passage by which the outer atmosphere is conducted to the centre of the flame ; in the chamber surrounding this the wick is placed. On the outside of this chamber, which may be called the gas chamber—and surrounding it, is another passage for the supply of air to the exterior of the flame, whilst a fourth annular chamber contains the oil, and is in direct connexion on the one hand with the supply, and on the other with the wick Covering the mouths of all these chambers is a dome-shaped cap having an aperture through which the flame issues, and at which point the air and gas are focussed so as to produce perfect combustion. The details of construction vary slightly with the varying natures of the oils to be burned, whether sperm, colza, or the light hydro-carbon oils. The principle however remains the same in all, and it is that of so accurately adjusting their proportions as to obviate smoke, waste, and danger. On a recent visit to Mr Silber's warehouse in Wood-street, Cheapside, we examined a number of these lamps, variously fitted, for general, and for special purposes, and in no one instance out of many burners tried, did we meet with anything to lead to the alteration of a primary opinion that the Silber light was a practical success

But above and beyond all this comes the question of cost, and it goes for nothing, in commercial sense if the most perfectly successful invention be coupled with extravagant cost. In this respect, however, the Silber light comes out satisfactorily, the independent testimony of railway companies who have had the light in use for periods of—in some instances—over twelve months, being very conclusive on that point, and establishing the fact that in railway carriages the Silber light effects a saving of 6*l*. 18s. 8d. per lamp, per annum, as against the common rape oil lamps at the present market prices In other trials, including a long series of careful experiments made by Professsor Valentin, four times the light has been found to be produced, accompanied by a direct saving of 64 per cent in cost of production. Taking the result of its application to a train on the Metropolitan Railway, we find the saving in cost and the increase in illuminating power to be very marked. Each gas lamp in the carriages on that line consumes 4 cubic feet of coal gas per hour, or 1008 feet in 252 hours, at a cost of 3s 6d. per 1000, one lamp giving a light equal to 3 7 candles. On the other hand, the Silber light is reported to give a light equal to 12 candles at a cost of 1s. 7½d for 252 hours, besides which there is the saving of dead weight of the gas bags, and of time lost in filling them and attending to the lighting arrangements With facts such as these in view, and bearing in mind the extensive stores of mineral oil awaiting a safe and efficient means of conversion into light, we may certainly predict a very large demand for the Silber light, and an adequate reward for its ingenious inventor.—*Engineering*.

RAILWAY TIMBER BRIDGE.

We illustrate, on page 20, a timber bridge, constructed to carry the Southern Railway of Canada over Kettle Creek, at St. Thomas, Ontario. The work not only is an excellent example of type construction, but is remarkable for the rapidity with which it was completed. Its extreme length is 1366 ft., divided into 736 ft of trestle work, and 630 ft. of house trussing ; the latter is made up of 14 spans, resting upon timber piers, as shown on page 20. The extreme height of the structure is 92 ft. There were used in its construction 1,070,672 ft of timber, board measure, 4600 lineal feet of piling, about 35 tons of wrought, and 37 tons of cast iron. The work was commenced on the 20th September, 1871, and completed the 13th February last—a period of less than five months, and part of which lay in the severe season. Messrs. Dunn, Holmes, and Moore were the contractors, Mr. M Courtright being the president of the railway, and Mr. N. Finney the engineer-in-chief.

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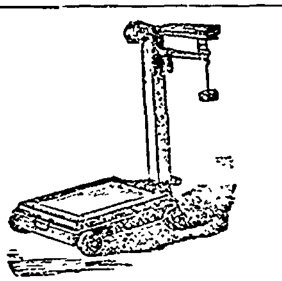

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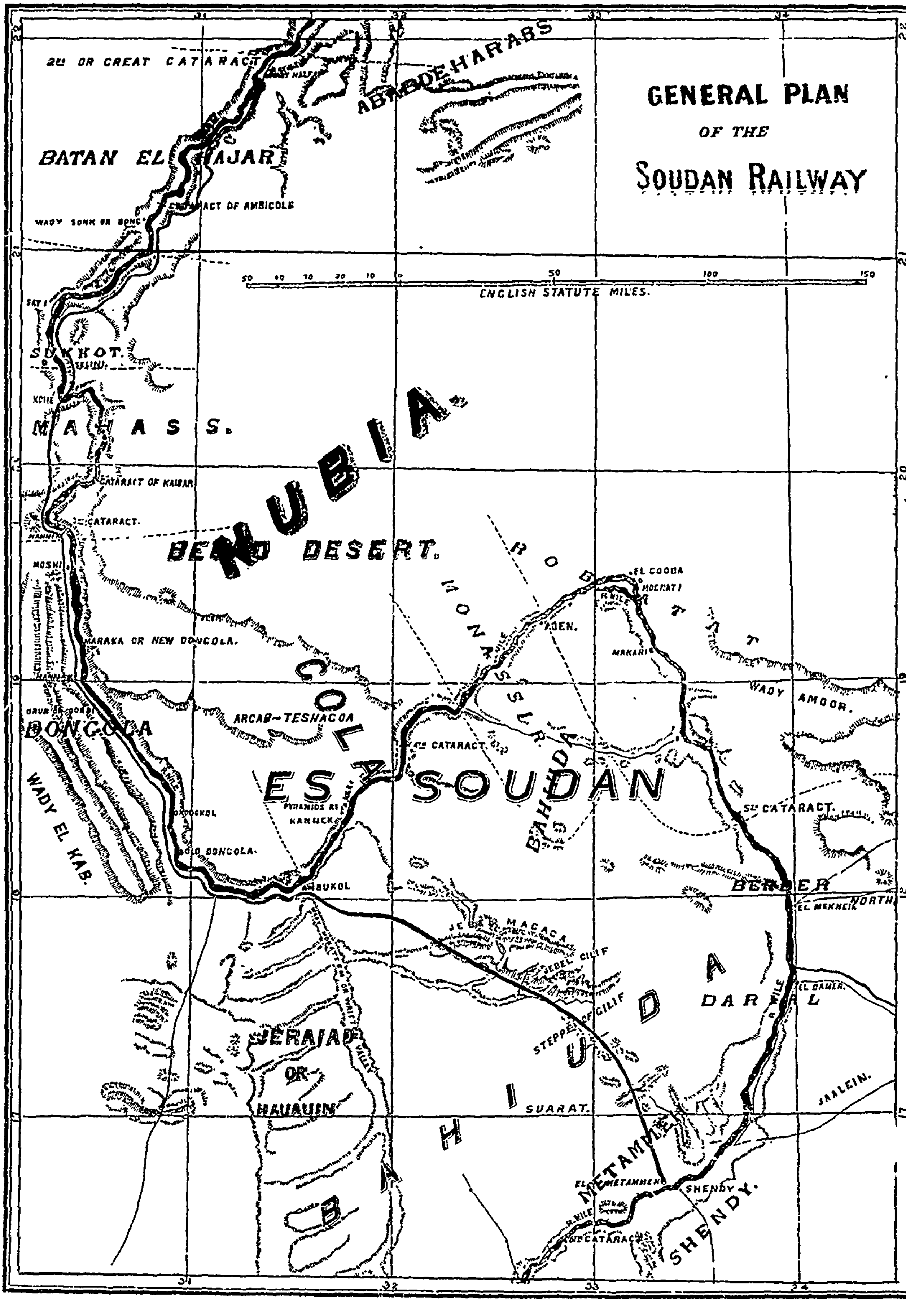
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