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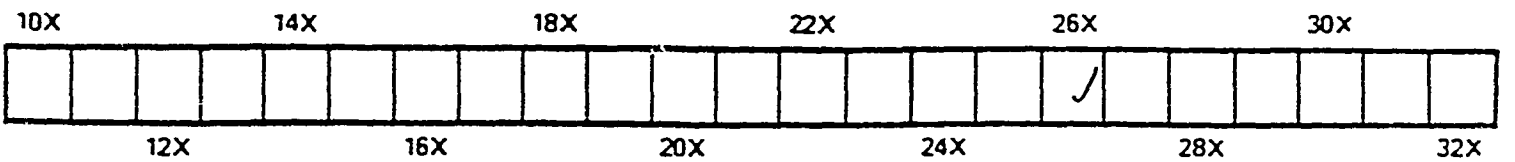

The Canadian Patent Office Record AND MECHANICS' MAGAZINE

Vol. 3.—No. 4. APRIL, 1873. Price in Canada $2.00 per An.
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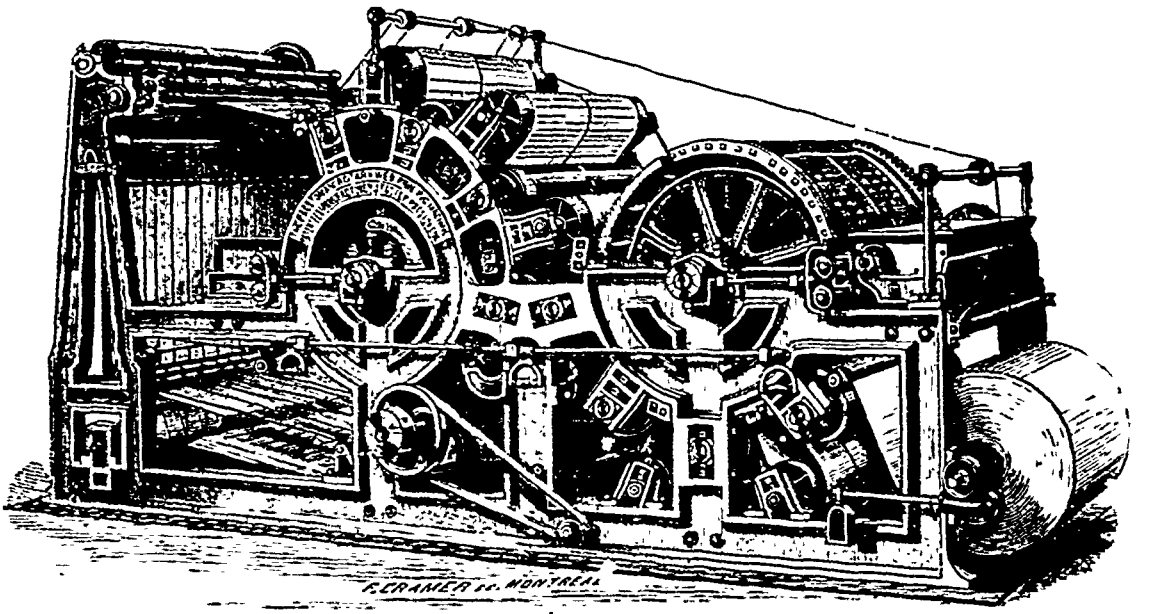


THE PRESTONIAN WEB PERFECTING PRINTING PRESS.

This press, of which we give an illustration above, is one of the favourite new fast presses which have been called into existence by the rapidly increasing circulation of modern daily journals. The Prestonian differs from other web printing presses in the fact that it is capable of printing not only from stereotype plates but also from movable type. This press has been introduced into Canada by the proprietors of the Montreal *Evening Star*, and is used in printing their daily editions. As may be seen from the illustration, the press contains two large cylinders on the interior of which are the type forms. In contact with the first type cylinder and immediately below it is the first impression cylinder, clad with thin blanketing, with the roll of paper to be printed fixed in close proximity. The almost endless sheet of paper, extending 3½ miles in length, is carried round this impression cylinder, and, as the machine rotates, the type, standing a little higher than the rest of the cylinder, imparts its first impression here. The sheet then passes round an adjacent cylinder called a carrier cylinder, and returns to the second impression cylinder, and is printed a second time on that part of the sheet immediately preceding the first impression. The same process follows with the third and fourth cylinders. It will thus be seen that in one revolution of the first type cylinder four impressions on one long, continuous sheet have been produced, and so long as this cylinder revolved an undivided length of paper printed on one side only would be produced; but it will at once occur to the reader that the same mechanical arrangement of cylinder and type that produced a succession of impressions on one side of the paper will be capable of doing it on the other. The sheet is now conducted to the second type cylinder, where, revolving over a succession of impression cylinders and carrier cylinders, identical with the arrangements already described in the first

half of the machine, each page is "backed" with the one necessary to its completion, and an endless stream of newspapers in one unbroken length is evolved. This web of paper is then carried by tapes through several small cylinders to the larger ones, in one of which is a perforating knife which cuts up the web into single newspapers. A very ingenious distributing arrangement then receives and carries off the single sheets.

The press is thus as nearly automatic as possible, requiring but two hands while printing at the rate of twenty thousand perfect newspapers per hour. The *Star* has now been printed for some time on this press and the proprietors express themselves perfectly satisfied with the working of the press. We have much pleasure in congratulating our contemporary on the acquisition of such a machine and also on the well-merited increase of circulation which has called for its introduction.

ABSTRACT OF SOMERVILLE LECTURE ON THE ADULTERATION OF FOOD.

By Dr. J. Baker Edwards, F. C. S.

Ever since our first parents partook of the forbidden fruit, the subject of Food appears to have been one of peculiar difficulty and temptation to mankind. What to eat, what to drink, and what to avoid, is as serious a problem to-day, as it was in the days of Moses, and has not been solved by the empiricism of the celebrated Dr. Culpepper. While the laborious researches of Liebig, Mulder, Lehmann, and Dr. Edward Smith have done much to extend and classify our knowledge, they still have left large unexplored fields to the investigation of future physiologists and sanitarians. Some find it a sufficiently hard problem in these days to live at all, but the still more difficult one of how to live well, is yet farther from a true solution, yet inasmuch as the priceless blessings of good health, and a ripe old age, are largely dependent on the due observance of the laws of this branch of Sanitary science they are at least deserving of our intelligent consideration. If the subject of good diet is of itself so difficult as to justify the proverb that what is one man's meat, may be another man's poison, how much more complicated does it become, when from selfish and sordid motives the adulterator steps in with stealthy tread, and unseen hand to mingle with the bread—a stone—and for a fish gives us a scorpion! Good and wise legislators have from time to time invoked the arm of the law against these insidious and cruel evils, and as society becomes better instructed in the laws of health and the causes of ailment the more possible does it become to alleviate and prevent a large proportion of human suffering and to rescue many of the innocent from sharing the fate of the guilty.

During the past twenty years the question of adulteration has received more or less attention from the governments of Great Britain and other countries, and the progress of British legislation on the subject was first sketched by Dr Edwards who then called the attention of the meeting to the first Canadian Act relating to this subject. It will be seen that Canadian Legislation begins at a point somewhat in advance of British Legislation. The great want of the British Acts has been central authority both in law and in science. The report of the Select Committee of 1874, points to the Inland Revenue staff as the most reliable and efficient Court of Appeal, and recommends a consolidation of districts, and limitation of the number of Analysts to those more throughly competent. The spirit and temper of local authorities in Great Britain render this most difficult of accomplishment, and the comparative weakness of this legislation hitherto, appears plainly to have arisen from commencing legislation at the wrong end, and from the inherent weakness of "Permissive Bills" The Dominion Government has, therefore, taken the bull by the horns," and commenced its legislation at the opposite end, viz. with the Central Authority, and under its well organized Department of Inland Revenue. It proposes to establish in a few central districts, well appointed laboratories, under the charge of the most experienced analysts the country will supply, aided by an efficient staff of assistants, and through its own officers to collect samples and report to Government the actual condition of the supplies of food, drink and drugs offered for sale in this country; what course future legislation or municipal regulation may take, will largely depend on the results obtained by the analysts of the Department.

It may prove that in this new country where trade competition is less severe than in the populous cities of Great Britain and America less temptation exists to fraudulent practices. Or it may on the other hand be found that the absence of such restrictive legislation in this country lays us peculiarly open to the importation of inferior food, which would be shut out of markets in which these restrictions exist. English experience seems to show that the central system is best adapted to discover the real condition of trade in this respect and the results obtained by the central government will be received with confidence by the people of Canada as free from any local bias or prejudice, and as based upon as perfectly independent scientific authority as the country can command. The Inland Revenue Act of 1875 provided that analysts be appointed for each district of Inland Revenue or such combined districts as may be deemed desirable, and that Inland Revenue officers shall be appointed to obtain articles of food, &c., in the several districts and forward them to the analyst of the Division for his report. The analyst will attend in Court to support his analysis when required to do so by the defendant, and will report quarterly to the Department of Inland Revenue the number of articles he has analysed under the Act, and the nature of the adulterations detected. The penalties for the act of Adulteration are, for the first offence, one hundred dollars and costs, for the second offence imprisonment for a period not exceeding six calendar months with hard labour The penalties for the sale of adulterated food are, $100 for the first offence, $200 for the second offence, with forfeiture of the adulterated food. Articles mixed with harmless substances must be so declared at the time of sale. The penalties for the sale of liquors containing ingredients injurious to health are for the first offence $100 or imprisonment, for the second offence $400 or imprisonment for 3 months with or without hard labour. The Act takes effect from the 1st January, 1875, and is therefore now in force. It will be extremely valuable to those who shall be entrusted with this enquiry to have so large an amount of experience already before them in the records of the British and American analysts. Dr. Lyon Playfair in the debate on the bill now under consideration of the Imperial Parliament remarks that much has been said in defense of "trade usages," but we have it in evidence that before legislation on this subject it was acknowledged to be a "trade usage" to dilute milk with at least 25 per cent of water, to mix alum with inferior flour in bread, to adulterate vinegar with vitriol, and poison confectionery with mineral pigments. These practices had been abandoned when brought to light, and even bad teas were driven to other markets. Legislation on this subject had therefore reformed "trade usages" to the great advantage of the public.

A full and vivid description of the most ordinary and most harmful cases of adulteration followed.

One of the most valuable means of eliciting truth and of forming sound and correct judgment on matters of public and scientific interest is *debate*.

And for this purpose the public analysts of the United Kingdom have formed an association to discuss and deliberate on the questions upon which a difference of opinion may be likely to arise, "to obtain a nearer uniformity of processes and results, a wider dissemination of new researches, and to raise the standard of analytical work, as applied to article of food, drink and drugs." This Society has given the first fruits of its labours in the "Definition of an adulterated article."

An article of food or drink shall be deemed to be adulterated—

1st. If it contain any ingredient which renders such an article injurious to the health of a consumer.

2nd. If it contain any substance that sensibly increases its weight, bulk or strength, or gives it a fictitious value, unless the amount of such substances present be due to such circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or unless the presence thereof be acknowledged at the time of sale.

3rd. If any important constituent has been wholly or in part abstracted or omitted, unless acknowledgment of such be made at the time of sale.

4th. If it be an imitation of, or sold under the name of another article.

B. In the case of drugs—

1st If when retailed for medicinal purposes, under a name recognized by the British Pharmacopœia, it be not equal in strength and purity to the standard laid down in that work.

2nd If, when sold under a name not recognized by the British Pharmacopœia, it differ materially from the standard laid down in approved works on Materia Medica, or the professed standard under which it is sold.

LIMITS.

Milk shall contain not less than 9.0. per cent. by weight of mil solids, not fat, and not less than 2.5 pr. ct. of butter fat

Skim Milk shall contain not less than 9. 0 pr. ct. of milk solids.

Butter shall contain not less than 30.0 per cent. of butter fat

Tea shall contain not more than 8.0 per cent. of mineral matter, calculated on the tea dried at 100° C., of which at least 3·0 per cent shall be soluble in water, and the tea, *as sold*, shall yield at least 30.0 per cent. of extract.

Cocoa shall contain at least 20.0 per cent. of cocoa fat.

Vinegar shall contain not less than 3 0 per cent. of acetic acid.

These results of the deliberations of a scientific body of practical analysts, will be an invaluable guide to the more isolated chemists, who enjoy a less extensive experience; and the publication from the same source of practicable processes will bring about more uniform results, and increase the confidence of the public in all such determinations.

With such rich experience, and such able guides, the Analysts of this Dominion will commence their labours without fear or favour, determined "nothing to extenuate, nor aught set down in malice." As public servants, their only desire will be for the public benefit, and although, in British experience, the progress has been slow, and the success partial, still they trust that starting on the vantage ground of the knowledge already obtained, they may in due time contribute their full record of painstaking and conscientious labour for the public good. By the aid of this law it is hoped, not only to protect the public against fraud, but also to aid society in its desire to promote sanitary science.

TYNDALL ON SOUND.

LECTURE BEFORE THE ROYAL INSTITUTION.

Professor Tyndall began by saying that in the philosophy of Locke an idea was defined as a mental picture, and in all his (Professor Tyndall's) teaching of science he had always attempted to give clear ideas—resting upon a physical basis—of the phenomena presented, avoiding all vagueness of phraseology, and in pursuance of this plan he would show a few experimental facts as a basis from which to start. He then took a large glass vessel filled with perfectly invisible carbonic acid gas, and held it between the electric lamp and the brilliantly illuminated screen, so that the large shadow of the glass vessel was seen upon the screen. Upon tilting the vessel the heavy carbonic acid gas began to pour out of it, and as it refracted light more than air, it became visible upon the screen as a falling stream full of waves. His assistant next began to blow through some invisible vapour of sulphuric ether placed between the screen and the lamp, and as the invisible mixed breath and vapour issued from the tube the stream was rendered visible by its unequal refraction of the rays of light. The same effect was produced by means of the hot gases from a burning candle placed between the electric lamp and the screen These facts, he said, would serve to give a physical basis for their ideas, by showing that in a perfectly transparent atmosphere there might be invisible layers, having an influence of their own.

If a wave of sound entered an invisible cloud of carbonic acid gas, then the velocity of the wave would be reduced from 11-20ft. to 900ft. per second, but on leaving the gas and re-entering the common air it would move with its original speed At every change of velocity a certain portion of the sound would be sent back as an echo, thus on first reaching a layer of carbonic acid a part of the sound would be reflected, and, after passing through the layer and reaching the other side, a further portion would be sent back as another echo; if there were many alternate layers of air and carbonic acid gas this action might take place so often as to quench an entire wave of sound and to dissipate it in echoes. Professor Tyndall here called attention to a small square wooden tube, into the air of which, he said, he could introduce at will seven vertical sheets of carbonic acid gas through pipes. One of the sensitive flames, which contracted at a shrill sound, was placed at one end of the tube, and a whistle continuously blown by a bellows was placed at the other. When the tube contained air only the sound passed freely and contracted the flame; when he let seven sheets of carbonic acid gas enter the tube, they broke up the sound into echoes, so that its action upon the flame was cut off, being intercepted by layers of invisible gas. He then showed that heated air would have the same effect, by doing away with the carbonic acid, and placing four gas flames below the tube, so as to heat it in four places, and produce four layers of heated air inside. Layers of unequally heated air prevented the sound from passing through the tube, and broke it up into echoes. The lecturer here remarked, "How could it be proved these layers produced echoes?" If they did so, of course he ought to be able to prove it experimentally, so some time since he asked his assistant to solve the problem practically, and Mr. Cotterill had done so. His plan was to take a large hot flame from a bat-swing burner, which had the power of reflecting sound, for the hotter the flame the greater was the reflection, and he placed this flame in a position to throw back the sound, which it actually did, as proved by the contraction of the sensitive flame.

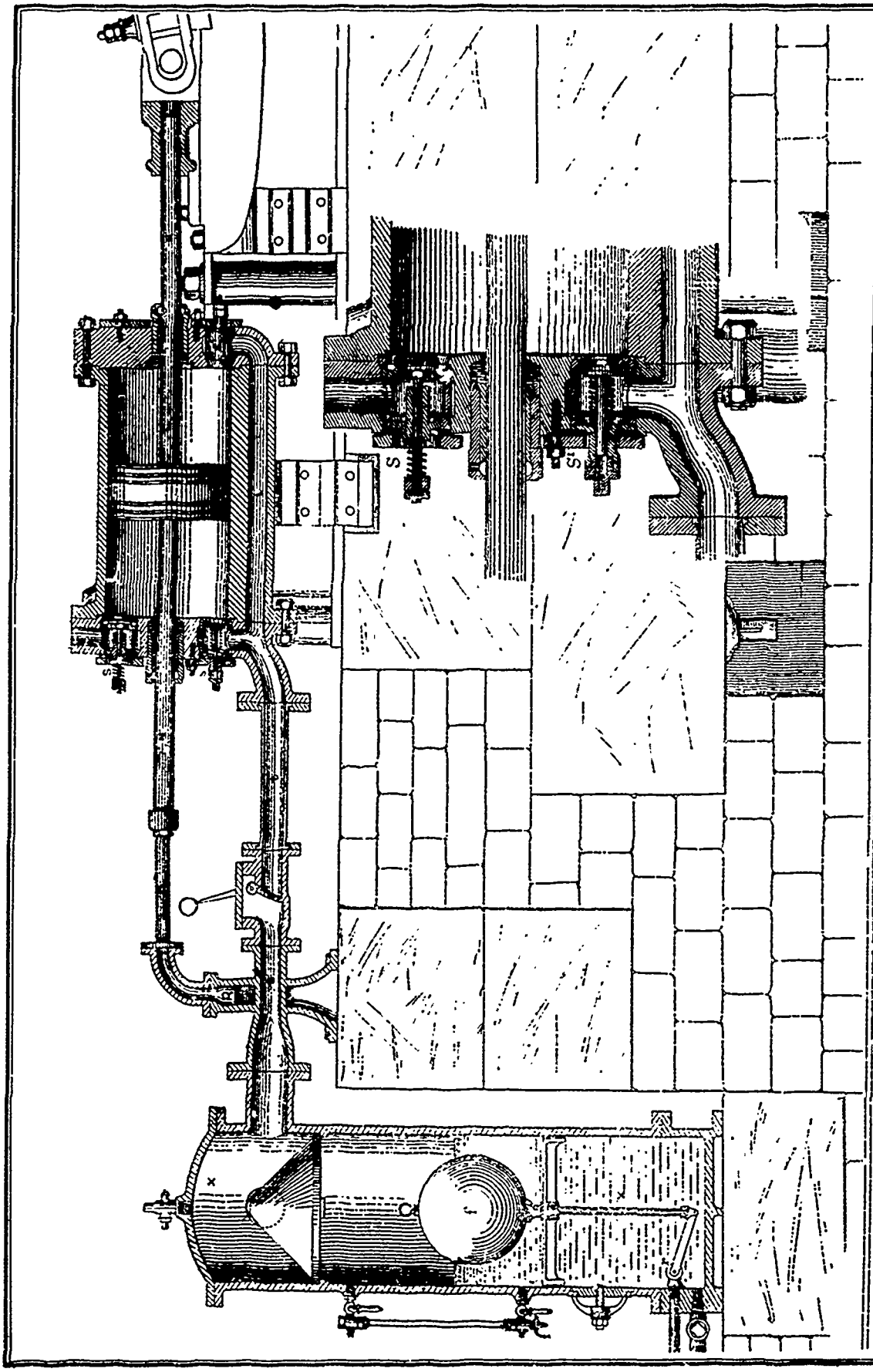
Strange to say, the flame could reflect sound much better than calico, muslin, and other woven fabrics. Professor Tyndall here borrowed a little boy's handkerchief, and showed that it would not cut off the sound even when folded four times; neither would green baize, nor felt ¼in. thick—so thick that it would entirely cut off the light of the noonday sun. Two hundred layers of muslin in a square pad had but a feeble power in cutting off sound. The lecturer remarked that this was because the air was continuous inside the fabrics. On wetting the handkerchief with water, so as to prevent continuity of the air, a single layer of the wet handkerchief cut off the sound. He remarked that after seeing these facts the listeners would be quite prepared to understand that a heavy snow storm would have little power in intercepting sound, whereas loud noises might be quickly quenched on a clear day, supposing the air to be heated unequally in different places.

Professor Tyndall narrated how in one of his laboratory experiments he had placed fifteen layers of calico, each an inch or two behind the other, and in front of one of his sensitive flames He discovered that the sound from the whistle would pass through the whole of the fifteen layers, and that each layer would reflect a portion of it so as to act upon the sensitive flame, thus in passing and returning through the fifteen layers, the sound passed through thirty layers in all.

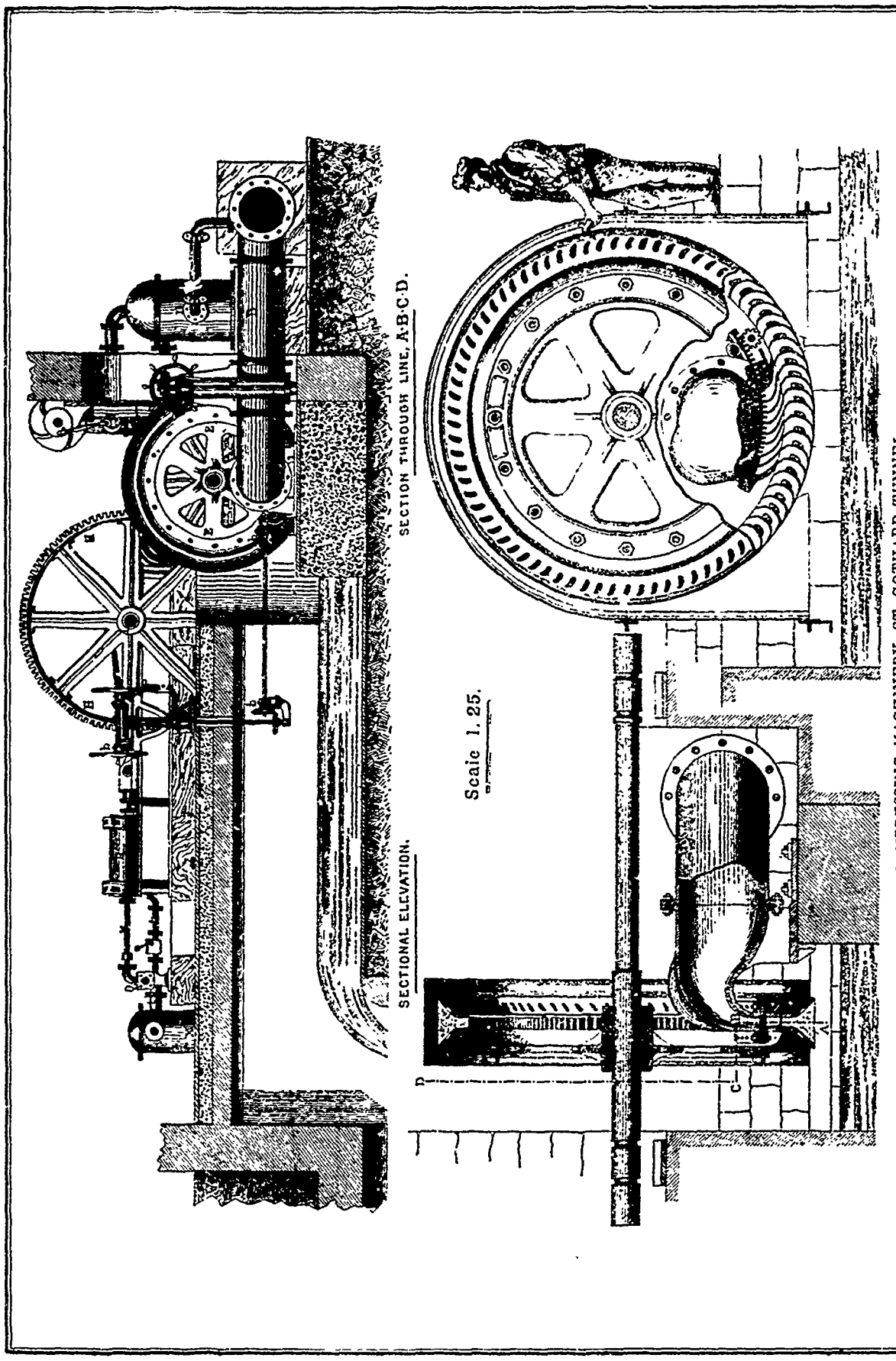
The lecturer also said that the experiments recently made at the South Foreland were to the honour of the Trinity House, the Board of Trade, and to the Government of this country for they had proved to be of practical importance, and had solved scientific questions which had been in a state of confusion for a century and a-half. Some of the experiments had consisted in the firing of guns and noting to what distance the sound would travel, also various facts were recorded connected with the echoes. Even in the most cloudless and fine weather the aerial echoes were always plentiful.

In 1822, a commission of the *bureau des longitudes* was instituted at the request of La Place to determine the velocity of sound Two stations were selected outside Paris, and guns were fired at each station. The time of the flash of each gun and the time of the arrival of each sound were noted by exceedingly careful observers, among whom were Arago, Gay Lussac, Humboldt, and other trustworthy observers. To their surprise they discovered that the sound travelled more rapidly in one direction than in the other, and the wind had nothing to do with this effect, for the very slight wind then blowing was in opposition to the direction in which the sound travelled fastest. Arago had the courage to say he could not explain this fact. He once or twice heard echoes, but then clouds were about, so he thought the echoes might be due to the presence of clouds.

Professor Tyndall here took a large glass cabinet about the size of a watchman's box, and he caused the sound from the whistle to enter it on one side, and to depress the sensitive



AIR COMPRESSING MACHINERY, ST. GOTHARD TUNNEL.


SECTIONAL ELEVATION.
SECTION THROUGH LINE, A·B·C·D.
Scale 1.25.
AIR COMPRESSING MACHINERY, ST. GOTHARD TUNNEL.

flames when it escaped on the other. In the lower part of the cabinet inside he lit two large gas flames, and the hot air from these rising in the cabinet intercepted the sound, so that the flame ceased to be shortened. He thus proved that invisible columns of heated air would cut off sound. He then put out the burners and lit a piece of phosphorus placed in a saucer at the bottom of the cabinet, the latter of course was soon filled with a thick smoke of phosphoric acid—so thick was it, that it cut off from view a lighted candle which was placed at the back of the cabinet, yet this cloud, which was so powerful in cutting off the rays of light, did not interrupt the waves of sound at all. Having thus proved that invisible warm air may act as an acoustic cloud, he said that when such clouds are close to the source of sound the echoes are immediate and mix with the original sound, but if the acoustic clouds are further off, then there are prolonged echoes. Further, the length of an echo is a measure almost of the depth of the acoustic cloud from whence it comes. In the experiments at the South Foreland he discovered that when a sound penetrated to a great distance, then the echoes were longest.

At the close of his lecture he argued that the phenomenon which Arago could not explain was due to warm air from the chimneys of Paris, forming acoustic clouds which surrounded the station at Villejuif, whilst the other station at Monthlery was free from this heterogeneous atmosphere.

AIR-COMPRESSING MACHINERY, ST. GOTHARD TUNNEL.

Machines for compressing air have of late attracted much attention as the best means at present in use of transporting power to considerable distances. The practical success of the system has been fully demonstrated at the St. Gothard Tunnel Works, where the mechanism used is the most powerful *of its kind that has ever been erected, the gross horse-power* that can be erected being not less than 1120-horse power The air compressers are driven by a fall of water with an effective head of 95 metres, or about 310 feet, and are described as follows in the *Engineer*.

They are of the Girard, or "free aeviation" type, which has been selected by Messrs. Roy, after thirty years' experience in turbines, as about the best yet produced. The construction of this wheel will be readily understood. In ordinary horizontal turbines the water is admitted through the fixed vanes all round the wheel, but in the Girard turbine there is a fixed internal guide, which is but a segment of a circle, and through this the water is directed on to the eighty buckets in the outer or "crown" wheel, as it is yet inaptly called. To a certain extent the action is that of a Poncelet wheel, the head of *water being very great, while its volume is small. The wheel* is surrounded by an iron casing to prevent splashing, and the water is led to the delivery vanes by a flattened tube D. The crown wheel is shown at E. The distributor, or delivery vanes, has eight orifices covered or uncovered by a curved sluice, which can be worked by a rack and pinion and the gearing *b b b*. A large sluice C, is provided for each wheel, between it and the water main A, in the branch pipe B. By the use of these sluices the water can be cut off from any particular turbine when required by the gearing *a*. The turbines make 160 revolutions per minute, consuming 300 litres, or 66 gallons of water per second. The outside diameter of the wheel is 7·8 ft. nearly, and under these conditions each wheel gives off 280-horse-power. The shafts F, of the turbines are all in line, and united by coupling boxes K X. These shafts *carry six pinions G G, which gear into six spur* wheels H H, mounted on the three-throw crank shafts L L. These drive three air compressers R R, by the connecting rods M. In order to diminish as much as possible the irregularity of the resistance due to the compression of the air, the compressing cylinders have been combined in threes, as shown.

The work required from each pump and compresser is to deliver 141 cubic feet of air per minute under a pressure of 7 atmospheres, or nearly 105 lb. on the square inch. If necessary, however, the air can be compressed 9 atmospheres, or 135 lb. nearly, on the square inch. When the turbines run at 160 revolutions the compresser shafts make 80 revolutions. The diameter of the cylinders inside is 0 420 metres, and the piston stroke is 0·30 metres. These dimensions give 175 litres per revolution, or 42,024 litres per minute for each group of three cylinders. This volume of air is reduced to 5,253 litres net, at a pressure of 7 atmospheres, and 1,253 litres are allowed for clearance and port spaces, or 0 31 of the required volume. The theoretical power required to effect the compression of the stated volume of air is by the formula $p\ v\ \log.\frac{P}{p}$ 152-horses, which it will be seen is well within the power of the turbines, which can develope if necessary 280-horse power each

Hitherto one of the great troubles encountered in working air-compressing machinery lies in the difficulty met with in keeping the cylinders cool The temperature, if unchecked would rise in the cylinders under notice to about 500 deg Messrs Roy have adopted an extremely ingenious device to prevent the elevation of temperature The pistons are so constructed as to permit a continuous circulation of water to go on inside them, and besides this, they are practically water-packed in the following way. Each piston is hollow and placed in communication with a special set of water pipes by the tube N, within which is a second tube Q, a stuffing box being fitted to N, which slides on Q. The packing of the piston consists of four brass rings in grooves, these grooves communicate with the interior of the piston The water is admitted to the piston under a head which is greater than that which could be sustained by air of the given pressure, and the water therefore forces the rings out, but the rings are not quite tight in the piston, and a constant small leakage of water goes on, which is evenly distributed over the whole interior of the cylinder, and at once serves to make the piston air-tight, for lubrication, and to keep down the temperature. We understand that the device acts most efficiently. This water is taken from the main A under a head of 310 ft., and this suffices, when the compressers are working up to 7 atmospheres. When, however, a pressure of 9 atmospheres is required, the water would not enter the cylinder under the given head, and in order to obtain the required supply a small pump *d* is provided, which can be driven by belt pulleys from the shaft I. This pump draws from the main E. It makes 26 revolutions per minute, and thus delivers 2 litres or 1·76 quarts per second. As it is essential that the water should be perfectly clean, it is passed through the filter or strainer *e*, which contains three wire sieves of smaller and smaller mesh, by which impurities are removed. On leaving the filter the water either passes direct to the air compressers or to the pump by which its pressure is to be augmented.

The air enters the compressing cylinders through two valves near the upper edge of the cylinder covers, as shown in the enlarged section of a compresser at page 100, and escapes through three smaller valves fixed near the lower edges. The air mixed with the water required to cool it then passes through the self-acting valves to the receiver X, at the base of which is a cock, worked by a spherical copper float, and in such a way that when water accumulates in the receiver the cock opens and discharges it, the action being precisely that of a well-known form of steam trap. A plate iron cone is fixed over the float to prevent the incoming rush of air from affecting it. In practice the discharge of water is constant, being regulated with the utmost nicety by the float. The air ultimately passes away by the pipe T to the main reservoirs, from which the rock drills are supplied

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The Cape Breton *Times* is informed by Mr. Gisborne that, with the exception of small sections of one or two earth cuttings, the remaining half of the entire railway route is now ready for laying the rails, both sleepers and metal being already delivered upon the line. The early completion of the railway next spring is thus assured, and the wishes of the sub-contractors to suspend operations until the enormous accumulations of snow have disappeared has been agreed to, £5,000 to £6,000 additional expenditure is all that will be required to complete the contract.

At a recent meeting of the First Judicial District Dental Society, W. G. A. Bonwill recommended the diamond drill for the permanent separation of the incisors. The shape is pyramidal. It makes about five thousand revolutions per minute, and, in consequence of its extreme rapidity, causes not the least pain, even when cutting upon the most delicate enamel. Working so rapidly and perfectly, it will cut through or over the surface of the poorest fillings, without disturbing them in the least.

THE THUNDERER.

One of the results of the battle now raging between guns and defensive armour has been the building of ships whose appearance as ships would in all probability cause much surprise and not a little disgust in the mind of Nelson's old captains could they be brought back for a moment to see the present English navy. One of the most peculiar types of this new system is the "Thunderer." This immense turret ship is from the plans of Mr. Reed. She is not intended for distant service but to be devoted to the guarding of the coast, to aid in the defence of forts and to assist in or hinder the disembarking of troops. For this service her light draught makes her peculiarly fitted. She is in fact a sort of enormous raft supporting two turrets in which are mounted the enormous and constantly increasing in size, guns to which the British government are now devoting so much attention. The guns in these turrets are worked entirely by machinery, the enormous charges themselves being brought up from the hold in this way. A strange-looking feature is the platform between the turrets. This serves as a post of observation merely and will be almost entirely deserted when the ship is in action. The "Thunderer" is propelled by two screws, one on either side of the rudder, these screws can be made available in handling the vessel and will make her capable of turning in a circle of very short diameter. The engines are of 8000 horse power nominal, but can be worked up to four times that power.

COMBINED ICE-BOAT AND FIRE-ENGINE.

Quebec is not the only city where the inhabitants have occasionally to fight the frost so as to keep open their communications; Cronstadt, in the Baltic has to wage a similar conflict. We illustrate, from the *Engineer*, on page 105 a remarkable little steamboat lately built for the Russian Government and which is specially intended to maintain communication between the island of Cronstadt and the main land. For a considerable portion of the winter, the ice will carry any weight that can be put on it, but in the spring and autumn the ice, though too strong to prevent the use of ordinary boats, will not carry horses or sleighs. During the prevalence of westerly winds the ice, though broken up, becomes densely packed The ice-boat we illustrate is built of unusual strength, her skin being of $\frac{7}{16}$ in. and $\frac{1}{2}$in. best boiler plates, double riveted throughout, her frames being of corresponding strength. A reference to the drawing will show that she has a peculiarly-shaped bow. In work she is driven straight at the ice, on which the bow runs up until her weight breaks down a large mass, while at the same time fifty sailors roll her to keep her free from accumulations of ice on her sides, and this rolling is kept up all the time she is under weigh. She often sticks fast nevertheless, and has to back 100 yards or so before she goes at the ice again with a rush. Some idea of the difficulties of this navigation in winter may be gathered by the fact that while in summer the passage is done by steamer in thirty minutes, the ice-boat is often seven hours in making it.

The boat is certainly remarkable, and cannot fail to prove useful in such a harbour as Cronstadt. She was only placed on the station a short time since, and her services as a fire engine have not yet been put in requisition. She is apparently exceedingly well designed for her intended purpose, and will no doubt give complete satisfaction.

SCIENCE AND ART IN THE MIDDLE AGES.

A very interesting work has just been published entitled "Military and Religious Life in the Middle Ages and the period of the Renaissance," by Paul Lacroix, Curator of the Imperial Library of the Arsenal, Paris. The work is beautifully illustrated and gives some good and clear ideas of the condition of science and art at that period. One of the most interesting subjects is a representation of the Spanish caravel in which Columbus discovered America, a facsimile from a drawing said to be by Columbus himself, and placed in the undated edition of the "Epistola Christofori Columbi." It would be very interesting to know certainly whether this was really the handiwork of the great navigator; for it shows power and freedom in the drawing of the foreshortened curves of the hull. It is singular to think that the first voyage across the Atlantic, with all its new experiences and dangers, should have been achieved in a ship which (for it must have been something like this representation) no company would now dream of insuring for such a voyage, and the mere appearance of which in a dock would furnish Mr. Plimsoll with a stronger case than he has ever had yet. That energetic reformer might find something to quote from M. Lacroix too, for the author places on record that "it is to the credit of these benighted ages, too often accused of barbarism and social anarchy, that in most of the Mediterranean ports overseers were appointed, whose duty it was to inspect and survey everything"; and that it fell among their duties to measure the space allotted to each passenger, and to see "that all merchandise entrusted to a ship's captain was properly stowed away in the hold, and not left on deck", that when a large powerful ship fell in with a smaller one, which claimed its protection, it was bound to throw it a hawser, "so as to fasten the two vessels together, and enable them to assist one another", a provision in which the philanthropy is eminent, even if the sea manship be doubtful; and that in cases of attack by pirates, the merchant passengers were expected and prepared to give all aid in defence. It is only the other day that a proposition was made in a letter to one of the papers that passengers in our crowded emigrant-ships should be put through a drill, so as to enable them to give efficient help for themselves and the ship in case of fire or wreck. Altogether, the mediæval seamen and shipowners seem to have been beforehand with us in some important matters in the regulation of maritime traffic.

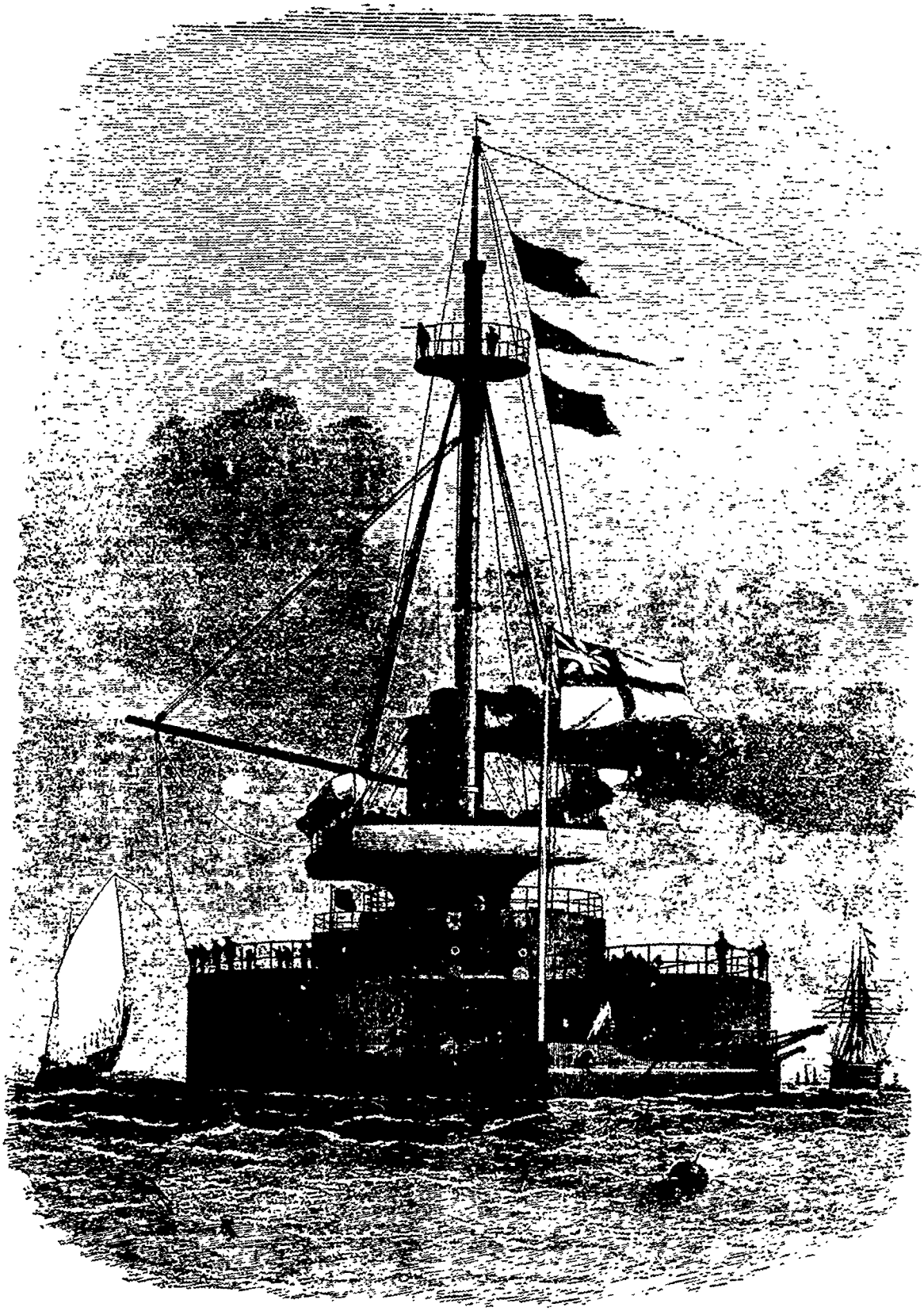
On page 108 we reproduce from the *Builder* a few of these illustrations. The view given of the fortress of the Knights Hospitallers in Syria is interesting as showing the importance and power of such orders at that time. The erection of such a large portress in a foreign land where they were making but a temporary stay indicates the possession of much wealth and power. The embroidered gloves were those worn by the King of France as head of the order of the Holy Spirit, a body of 100 Knights selected from the most eminent ranks and presided over by the Monarch himself.

CURIOSITIES OF WELDING.

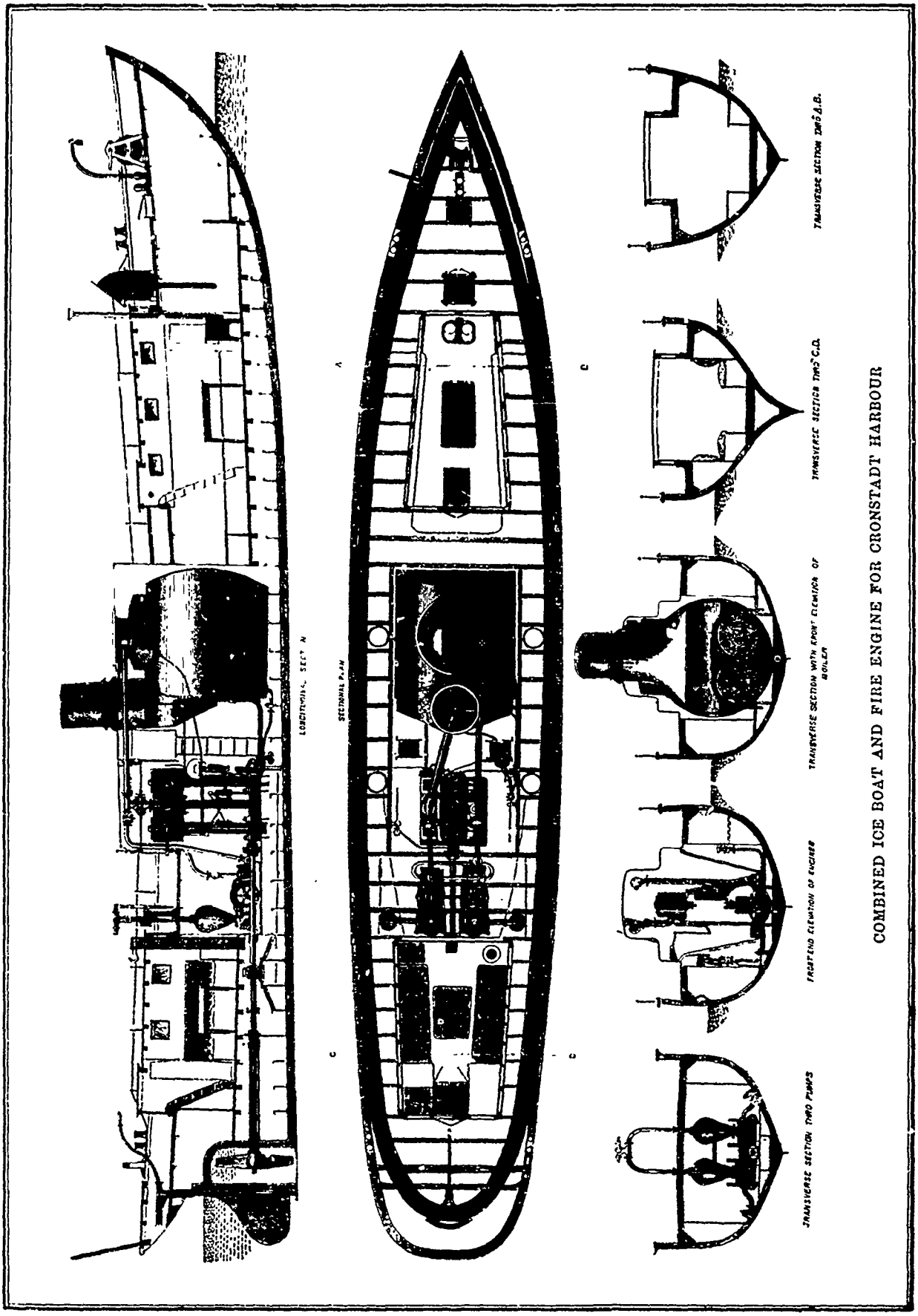
There has lately been shown in the United States a very interesting specimen of blacksmith work. By means of Schierloh's welding compound, it is alleged that, in one example of a bar of Bessemer steel, five different kinds of iron and steel have been perfectly welded, without changing its shape in the least. The bar was rolled into form at Thompson's steel works, in Jersey City, and is $\frac{1}{2}$ by $2\frac{1}{2}$ inches in the cross section.

First a piece of Bessemer steel, cut from the end of the bar, was welded fast to it again, the heating and welding occupying eight minutes. On the reverse side of the bar a piece of fine cast steel was welded in six minutes. Further along on the bar a piece of blister steel was welded in eight minutes. This same steel cannot be welded with borax, as the high temperature needed with that flux makes it as brittle as cast iron under the hammer. Opposite this a piece of wrought iron was welded in six minutes, and further along on the bar a piece of cast iron was welded in three minutes. This was a piece of the mold board of a plow. The bar, with its additions, was then ground and polished on the edge, so as to show the points at which the welded metals came into contact. No weld was visible on any one of them, and the difference in the metal could only be told by the color after polishing. This solves a great many important problems in iron manufacture, among others the welding of Bessemer scrap.

GAUGING BOILER EVAPORATION.— A German chemist determines by chemical analysis the amount of water evaporated in a steam boiler. By means of a standard solution of nitrate of silver he first determines the quantity of chlorine in the feed-water and then the quantity of chlorine in the water of the boiler at two different times several days apart. From the increased quantity of chlorides he calculates the amount of water evaporated. He recommends as a suitable normal solution of silver to dissolve 2394 grains nitrate of silver in 1000 cubic centimetres of distilled water Each cubic centimetre of this solution will precipitate exactly five milligrams of chlorine. To indicate the end of the reaction when all the chlorine is precipitated, he employs the neutral chromate of silver, which produces with any excess of silver solution a bright red colour.



THE "THUNDERER."



COMBINED ICE BOAT AND FIRE ENGINE FOR CRONSTADT HARBOUR

PROTECTION FOR INVENTIONS.

By F. J. Bramwell, C.E., F.R.S.

Paper read before the Society of Arts.

(*Continued from page 66, vol. III.*)

I have by a few typical cases, exposed (at least I trust I have) the fallacy of those who say the inventor, in the absence of any patent law, would still invent for the hope of reward, because he might reckon on gaining that reward by becoming the manufacturer of that which he had invented, but there are other opponents of patents who do not hold forth a hope of gain in this way, they say, a wise and beneficent Government should reward the "citizens who have deserved well of their country.' I believe I have caught the language of the formula. I don't think these men talk about fellow-subjects of the Queen. However this, may be, they gravely propose that a portion of the revenue of the State should be adjudged each year to meritorious inventions. I find it difficult to treat such a proposition as this seriously, but I suppose I must do so.

Let us see how it would work. What inventions should be rewarded? None but those which had come into actual use, or in addition to these inventions which were only just published. If the former, how deal with objections that would be urged by a host of men who would spring up to allege that the man who put himself forward as the first inventor was the merest visionary, and that had it not been for their real practical skill the whole thing would have remained a useless scheme. Moreover, as I shall, I hope, hereafter show, years in all probability would elapse between the publication of an invention and its adoption, if there were not protection for inventors, and in this way the unhappy inventor might be dead, or in his dotage, worn out by hope deferred, before the reward was adjudged to him, even if it were ever so adjudged, looking at the competition of pretenders that would be sure to arise But take it to avoid this delay in compensating the inventor, it should be in the power of the tribunal to give the reward to originators of untried inventions, only imagine the cloud of schemers, both in and out of Bedlam, who would commit their crude conceptions to paper and send them to the tribunal, confident that they must get the reward. By what possible machinery could such a tribunal act to investigate novelty, degree of merit, and practical feasibility of inventions that had nothing but a paper existence. I believe that in their despair and disgust many men of intelligence and character who might have been on such a tribunal would retire from it, and that it would degenerate into a clique for perpetrating the vilest jobs.

Fancy the pressure brought to bear on such men by the member for some borough who has been assured by half a dozen of his constituents that their "talented townsman," Mr. Smith, is a most meritorious inventor, that he has designed a machine, which on being worked by one man, succeeds, through an arrangement of leverage and the aid of a screw, in giving off as much power as has been estimated to be equal to a good 10-horse engine. Models have been tried which conclusively proved that if (there is always an if) they had been properly made these results would have been fully attained. I may perhaps be told there must be on the committee men of sufficient sense to know that such statements were ridiculous: but in some cases I should be very sorry to abide by the opinion of any body of men, in the absence of trial, whether an invention could succeed in practice, or not. I will give you an instance. Next to Earl Dundonald, one of the earliest inventors in the art, now so extensively followed, of sinking cylinder foundations, was Dr. Potts. He published an invention in which he told you, that if you placed a cylindrical hollow cast-iron pile with its open mouth upon say the gravel bed of a river, and if you covered the top of the pile, and then exhausted the air from its interior, the pile would penetrate the ground, and would do so although, from the nature of the soil, it would be all but impossible to get the pile down, even a short distance, by the heaviest blows that could be given to it by a powerful pile driver. Dr. Potts was right in this, but, in the absence of experiment, would not the members of the Inventors' Reward Committee have come to the conclusion that the doctor was a visionary, and that his invention could be proved to be chimerical; would they not have said that, in the instance of a pile of a foot in diameter, the utmost pressure that could be got upon it by the exhaustion of the air, even in the impossible event of a perfect vacuum, would not be quite three-quarters of a ton, that in practice it would not be more than half a ton, and that such a force, a statical one, must obviously be far less powerful than the effect of a ton weight suffered to fall on the pile through a drop of several feet, and that thus Dr. Pott's exhaustion plan could not send the pile down at all, or if it could, the pile, when down, would clearly be unable to support any load worth speaking of?

But those gentlemen who thus would have withheld all share of the national reward from Dr. Potts, on the ground that his invention must be useless, would have been wrong, for the fact is that Dr. Potts's plan, although it only imposes on the heat of a 1 foot pile a pressure of about half a ton, does send such a pile down into soils which offer so much resistance that the pile when thus driven will support many tons weight without the least yielding. It being a fact that the pile did go down, and equally the fact that the mere pressure of the air upon its top was wholly inadequate to account for its being driven, attention was directed to the subject, and we know that the pile descended in consequence of the removal of the soil from below its bottom edge caused by the rush of water into the exhausted cavity of the pile.

It appears to me the suggestion of rewarding inventors generally by Government grants is an absolutely impracticable one, and that it never could be successfully carried out. There have been some particular instances of this mode of reward. I will only allude to one, and again it is Crompton to whom I wish to direct your attention. After years of the disappointment and loss to which I have referred, and after not only his townsmen and neighbours, but the kingdom itself had become enriched by the general adoption of his invention —there being between four and five million spindles at work —some persons in his neighbourhood backed up a memorial he presented to the ministry of the day, and, after much discussion, Government awarded to Crompton the munificent sum of 5,000*l.*, and at the age of 60, after having devoted 30 years of his life and all his property to the advancement of his invention, one of the very greatest that has up to the present time been made in the spinning of cotton, he received a sum equal to a stipend of 75*l.*, a year paid to him throughout those 30 years Probably among those who supported Crompton's memorial to the Government were to be found some of the honourable men who did not pay their promised subscriptions: perhaps their consciences had awakened, and these gentlemen thought a cheap way of satisfying them would be to make the nation discharge their private obligations, thus reminding one of the definition of charity, that A never sees B in want without feeling a strong desire to relieve those wants out of the goods of C.

If a system of national rewards were instituted, I am certain that the sums to be awarded must be wholly inadequate to compensate the really meritorious inventor, who thus would not be tempted by them to invent. That if awards were not to be made until commercial success had certified to the value of the invention, reward would be delayed and would be tittered away among numbers; that if untried inventions were to be rewarded, good inventions might be rejected, because as in Dr. Potts's case, they would not be understood, while the whole host of pure visionaries would be encouraged, and finally that the invention which was supported by the most plausible and persistent advocacy, whether of the inventor or of his supporters, would obtain the reward that should be given for real merit only.

I now come to the last class of reward suggested as being sufficient to secure new inventions, and not mere inventions, but inventions carried to practical result.

This class of reward, if rather shadowy, is cheap—it is honour. The meritorious inventor who has "deserved well of his country" is to be rewarded by some honorary distinction. A statue, a tablet, a public recognition in his town-hall, and an address from the recorder, or something of that sort; and, moreover, after such public recognition, the honoured inventor, as he went along, would hear, "Look at that man; he is the great, the celebrated Mr. Smith, who invented" — what? — if the steam engine or the electric telegraph, the power used might be understood and command respect whatever civilisation extends; but there are many great and most useful inventions which relate to manufacture, having technical terms — terms which are absolutely gib-

berish to those outside the trade, or if they convey any meaning at all, convey an erroneous one, and frequently an absurd one

Once more—take Crompton—there goes the man who invented "the mule;" that does not sound very well, but the mule itself has details. One is "Twist at the head;" imagine a man being introduced into London society as the inventor of "Twist at the head," a pretty burden his life would be made to him Imagine Stephenson's claim to respect and attention being based upon his improvement of the "Gab motion" It would be an unpardonable waste of your time to multiply examples Moreover, statues, even if good, and public addresses, though eloquent, would not pay our taxes nor find us in clothes I feel that in this room I ought not to undervalue honorary rewards. Its walls are adorned with pictures showing that in times gone by competitors were content with the applause of their fellow-men, or at the utmost a crown of leaves gratified all their ambition, but I doubt whether those ages produced many inventions, except improvements in weapons, to enable man to more conveniently kill his fellow-man. Further, in those golden ages and genial climes, I think we may take it men were but lightly taxed, and certainly the tailors' and dressmakers' bills (to judge by the representations on the wall) must have been at a minimum. Under such circumstances men might be content with honorary rewards, the hard realities of our times and our climate, however, make such rewards, alone and unaccompanied by something more substantial, a mere mockery of the need that they were destined to cheer. For the last time I will refer to Crompton; he, or rather his spirit, has had honorary reward. Long after his death the town of Bolton erects a statue to his memory: there was an unveiling, there were speeches. The opponents of a patent law might say, "What more can a man want, to cause him to devote his life to improvement, than such a posthumous reward as this?" In answer to such a demand, I think the inventor would refer the opponent of a patent law to Shakespeare. What says he of honour?

"Who hath it? He that died on Wednesday. Doth he feel it? No. Is it insensible, then? Yes, to the dead. But will it not live with the living? No Why? Detraction will not suffer it, therefore I'll none of it."

Among all the papers on the patent law that I have read, and among all the discussions on that question I have attended, I do not recall any other suggestions put forward by the opponents of patent law, as affording adequate grounds for the continuance of invention in the absence of such a law, than those I have now considered:—1st. That an inventor cannot refrain from inventing; 2nd. That the inventor is the man who of all others can best reap a profit from the commercial exercise of his invention; 3rd. That there should be a system of national rewards; 4th. That there should be a system of purely honorary rewards.

I can have left you in no doubt as to my opinion of the inadequacy of each and all of these suggested incentives to invention, and I will trust that most, if not all those, who honour me by their presence here to-night concur in my views; but there are men who say, "Be it even as you state, and take it that in the absence of a patent law there will not be an adequate incentive to invention, still it is expedient that such a law should not exist, because greater evils arise from it than would arise from a cessation of invention."

They say the evils are:

Interference with the freedom of trade.

That British manufacturers are put at a disadvantage, as compared with those of countries where there is not a patent law

That a patent for an invention, by barring the road, stops further inventions.

That patents are granted for useless things.

That patents are granted for things which are old.

That the existence of patents gives rise to expensive and difficult litigation.

That patentees are great losers by patents, and that it would be a charity to protect them against themselves.

Let us, as briefly as possible, examine into the value of these charges.

"Interference with freedom of trade." This I admit has a solemn sound; it is enough to cause many wise heads to be shaken; but don't let us be frightened at an expression, let us examine and see what it means.

Some forms of words are very startling when heard for the first time.

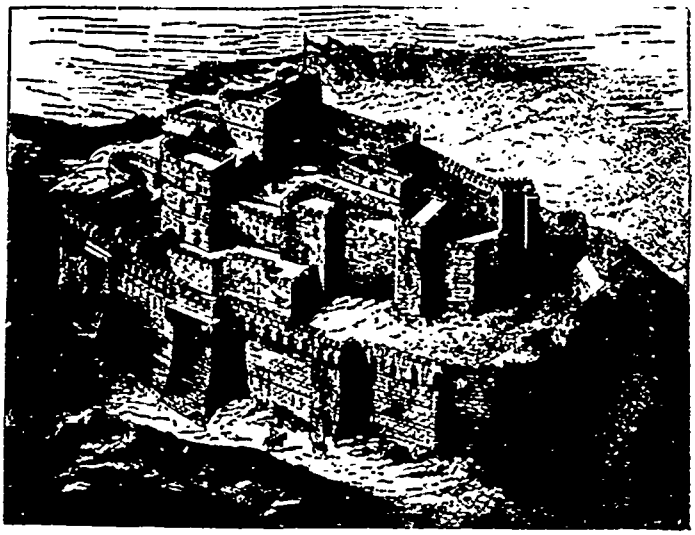
Let me give you an instance. Within the month, a letter was written to the *Times*, by a person using the initials F. R. S., entreating that the Devastation should not be sent to sea, as she must be unsafe because she had "heavy weights above her centre of gravity." This is a most alarming statement until it comes to be considered, and then it turns out to mean no more than that the Devastation is not a floating miracle, as she must have been if she were the first body in creation that had not as much effect from the weights above its centre of gravity as from those below it.

Now, as to interference with freedom of trade It is said, were it not that the inventor blocks the way with his patent, manufacturers generally would use the invention, and thus the public would be benefitted. I unhesitatingly assert, as the result of many years' close attention to this question, that such a statement is entirely at variance with the fact and before I have done I hope you will agree with me.

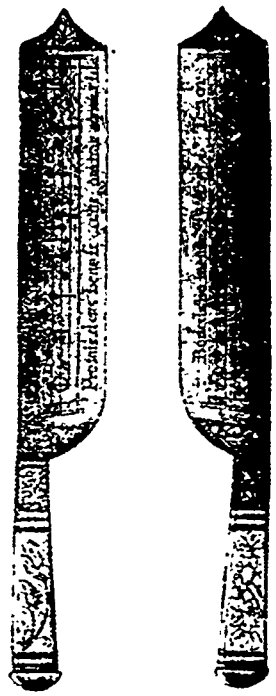
Take any one of the important industries, industries such as cotton or wool. The very last thing the established manufacturer wishes for is a substantive improvement, and for the following obvious reasons: He has got his good business and his connexion; his customers are pleased with that which he makes and are satisfied with the price they have to pay for his production, because they have no experience of any better quality or of any more advantageous price, inasmuch as, by the supposition, this manufacturer is a man doing as well as the bulk of those in his trade He, his foremen, and his workmen are all accustomed to their own way of work, and they don't want to learn a fresh system. But there is one reason of far more consequence than all these together, and that is, the manufacturer has many thousands of pounds embarked in the machinery with which he conducts his manufacture, and that machinery is of the full value at which it stands in his books, but compel him to adopt a substantive invention in his manufacture, what will then become of those thousands of pounds' worth of machinery? They will lose their worth at once, they will be degraded from their condition as machines to the state of old metal, and their value will fall from many thousands to perhaps not the same number of hundreds, and contemporaneously with this fall will be the necessity of finding a large sum to be expended on the machinery required by the new process. Coupled with this, there is the annoyance of partial stoppage of works during alteration, of bad work being produced for some time under the new process, because it is new, and has to be learned, of the chance of offending customers by delay, and by the inferiority of products arising from the bad work of which I have spoken, and all this has to be incurred in the the hope of success by the new process, with the certainty that directly it is found to succeed, competitors in trade will one by one follow the example, leaving the adopter of the new method no better off in comparison with his competitors than he was before the alteration, and with the certainty that if the plan fails, even if he be not ruined, he will be laughed at for his pains. Moreover, there is not only the difficulty of teaching men new ways, there is also to be overcome the frequent exhibition of sullen ill humour which breaks forth when a proposition is made to some trusted and honest, but narrow-minded manager or foreman, that the process he has so long followed can be improved. What is the "consecrated" expression used under such circumstances? "Here have I been working man and boy for forty years at this work, and my father before me, and I am to be told that some man, who is ten years my junior, and who never worked at the trade at all, knows more than I do, and can teach me my own business." This is a dire offence. I have seen much of it, and it has practically a greater weight than might, on a first consideration, be attributed to it. Remember that frequently the principal of a manufactory has to rely on such men for all questions connected with the manufacture, and that even in those cases where he knows enough of his own business to be able to judge for himself, the amount of resistance to improvement that can be offered by men of the class I have been considering is most serious, and they can offer such resistance covertly and passively, without the possibilty of their employer being able to fix them with an absolute disobedience of orders, or with an active opposition.

(To be continued.)

MEDIÆVAL AND RENAISSANCE ART.

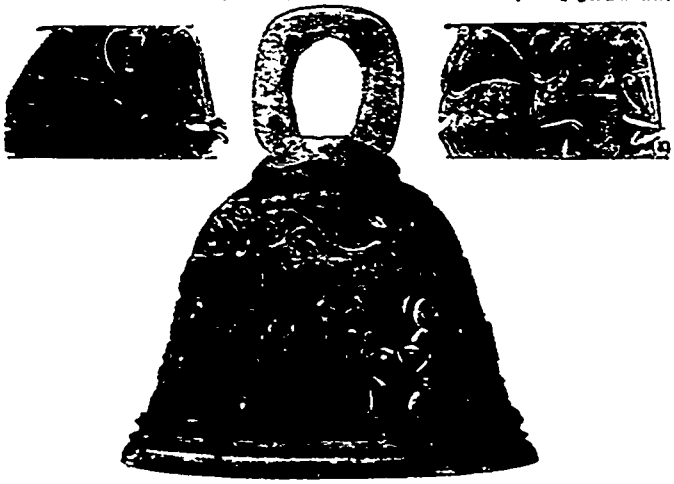


Fortress of the Knights Hospitallers, in Syria, taken from the Kurds by the Franks about the year 1142, and rebuilt in 1200. As restored.

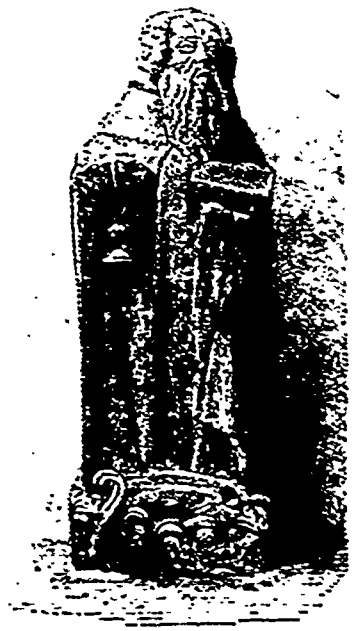


Knife with which the consecrated bread was cut, on the basis may be read, on one side, a prayer for a harvest on the land, on the other, a thanksgiving: both with music, fifteenth century.

State Gloves, of embroidered silk, gold, and silver, with the monogram of Louis XIII, formerly belonging to Louis XIII.



Romanesque perforated Handbell, representing the symbols of the four Evangelists. Twelfth century.



Seven statuettes of St Anthony,—third century,—shewing what the holy doctor thought of the great anchorite of Egypt. He is treading under foot the devil. The closed book is to shew that he learned the Scriptures, without study, by hearing them read. The bell signifies the power of driving away the evil spirit.

ART IN THE MIDDLE AGES.

THE LATE SIR CHARLES LYELL, BART., D. C. L., F. R. S., ETC.

MECHANICS' MAGAZINE.

MONTREAL, APRIL, 1875.

THE CHANNEL TUNNEL.

We have, already, frequently drawn the attention of our readers to the project of uniting the shores of England and France by a tunnel under the English Channel. This project is now every day making rapid strides towards becoming an accomplished fact, and we are now able to give our readers some idea of the manner in which the cutting of the channel is proposed to be effected. The nature of the stratum, the lower chalk, through which the boring will, in all probability be made, is such as to afford an opportunity for the mechanical boring of the entire tunnel without having recourse to blasting An English engineer, Mr. Brunton, has, accordingly, devised the machine we illustrate on page 113. This machine, which is mounted on rails is pushed forward against the chalk which it cuts away, as it advances, with two broad disc-shaped, rapidly revolving steel knives. As the chalk falls it is caught by buckets on a revolving wheel, and by these, deposited on an endless band carried on rollers. The band carries off the cuttings and dumps them into wagons in which they are transported to the shore. The machine is in fact a large auger and it is estimated that it will be capable of boring a tunnel of the dimension required at the rate of about three to four feet an hour. It is proposed to bore a gallery at first, by this machine, of a diameter of six and a half-feet, and if the boring is successful to enlarge this gallery subsequently to its proper dimensions of about nineteen feet high and twenty-six feet broad and then brick it.

THE Gardiner Mines, Cape Breton, have commenced raising coal Twenty pairs of cutters are employed at full time.

SINGING FLAMES.

At a recent meeting of the Society of Arts in London a very interesting paper was read on a new musical instrument, the Pyrophone, in which the notes are produced by singing flames. The phenomenon is one which is well-known as occasionally and accidentally produced in ordinary gas jets. It has, moreover, been investigated to some extent by scientific men during the past few years. Professor Tyndall especially has devoted attention to it. Musical sounds are produced by a flame traversing a tube under a certain pressure, and Professor Tyndall comes to the conclusion that to render a flame musical, it is necessary that its volume should be such that it should explode in unison with the fundamental note of the tube or of one of its harmonics, and he has also called attention to the fact that, in order that a flame may sing with the maximum amount of intensity, it is necessary that it should occupy a certain position in the tube.

Mr. Kastner, the inventor of the Pyrophone, claims the merit of having shown that when two or several flames are introduced in a tube, they vibrate in unison and produce the maximum of sound when they are placed one third the length of the tube, and that if these flames are brought in contact, all sound ceases directly. By means of the latter fact Mr. Kastner has obtained control over the musical sounds produced. A very simple mechanism, in the form of a piano, has each key communicating with the supply pipes of the flames in the glass tubes. On pressing the keys the flames separate and the sound is produced, when again the pressure on the keys is removed the flames join again and the sound ceases.

An instrument may thus be constructed from one octave to a most extended compass, whose strange and beautiful tones are capable of producing the most wonderful effects. The sound of the pyrophone is be said to resemble the sound of a human voice, and the sound of the Æolian harp; at the same time sweet, powerful, full of taste, and brilliant; with much roundness, accuracy, and fulness; like a human and impassioned whisper, as an echo of the inward vibrations of the soul, something mysterious and indefinable; besides, in general, possessing a character of melancholy, which seems characteristic of all natural harmonies. Among the proposed uses of this strange instrument is its taking the place of the orchestra in theatres and ball-rooms where the chandeliers besides serving the purpose of lighting will be converted into an immense musical instrument. This will, if the invention be perfected, be a most magical result. Fancy the effect of ball-room lustres bursting into music at the will of a performer in an adjoining room who by electrical communication has perfect command over all the lights, playing on them as on the keys of a piano of almost unlimited compass.

SIR CHARLES LYELL, BART.

This eminent geologist, some of whose work is of special interest to Canadians and Americans generally, died in London, Eng., on the 22nd of February. He was born in Forfarshire, on the 14th November, 1797, and was knighted, as a mark of her Majesty's recognition of his services to the cause of knowledge, in 1848. The baronetcy was conferred upon him in 1864. Being possessed of an independent fortune he was enabled to devote his whole labour and time to the science to which he has rendered such able service. He was the first to publish a good general treatise on geology, and his "Principles," and "Elements of Geology" revised and brought up to the present condition of the science is still the favourite and most

extensively used manual in private use and in our colleges. Sir Charles Lyell visited America twice, once in 1841 and again in 1845. On the occasion of this first visit he travelled through Canada and the Northern and Middle States, going as far South as Kentucky. His visit in 1845 was mainly to the Southern part of the Continent, when he spent six months in the study of the tertiary deposits of the Gulf of Mexico, the effects of the Mississippi and the sunk country of New Madrid. He made very interesting investigations into the chronological character of remarkable geological revolutions, estimating the length of time which must have been required to form the delta of the Mississippi from the amount of annual deposit. In like manner he estimated that, from the present rate of recession of the Falls of Niagara, not less than 30,000 years must have been occupied in cutting its present gorge. His last work of importance "The Geological Evidences of the Antiquity of Man" is a very complete and masterly review of the main features of this, probably the most interesting branch of the science being at present specially investigated.

FREEHAND DRAWING.

By Robert S. Weir.

Freehand drawing is at present taught in quite a number of the public schools of this city, and a few remarks concerning it will we hope, not be considered uninteresting.

Drawing has for many years occupied a distinct position from the other branches of education, and has had many erroneous ideas and impressions connected with it.

An impression has prevailed on the public mind that while one with tolerable ability may make progress in classics, or physical science, something special is required for drawing. It has been the popular idea that a special aptitude is necessary for the successful prosecution of drawing in any of its departments, and the system of drawing which it has the custom and the fashion to teach in many of the schools of America and Britain we should say, does most certainly require a special aptitude—a very special aptitude for its satisfactory pursuit. It is impossible to expect encouraging results from a system which requires natural ability for its prosecution on the part of every student of it There are distinctions between light and shade and problems in perspective which require the aid of a special taste for their proper appreciation and expression, and in the absence of which we find results similar to the efforts of those, who destitute of a musical ear, annoy the possessors of one by their inharmonious blacksmithing. Freehand drawing, however, possesses the advantages having usefulness and practicability associated with the general desire and ambition for this art. No special natural ability is necessary for the attainment of proficiency in this study. Of course one favored with large natural endowments will progress more rapidly than one not so highly endowed, just as one may excel in mathematics, but as the absence of great natural mathematical talent does not necessitate inefficiency for progress and even considerable progress, in that science, so, the absence of a very vigorous conception of forms is by no means to be regarded as an insurmountable obstacle, inasmuch as the faculty necessary for this art however small is not insusceptible of development. But, as the student of mathematics recognizes the importance of certain principles, and regulates himself by them, so, he who would draw, must proceed from fundamental principles before he can make progress in his art.

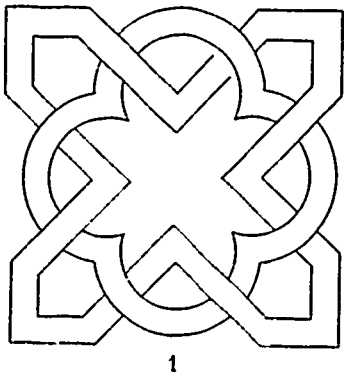
Freehand drawing requires the student to avail himself of his powers of invention as well as those of imitation. The latter enable him to reproduce, restricted by regulations not too arbitrary, copies of certain forms, which are made from a definite number of points, which mark the extremities of lines and the prominent terminations, while the former enable him from these points to invent other forms. Simple as is this process its results testify its efficiency. A developement of inventive power is not attained by any other branch of education in a direct manner, and this developement is sure to lead on its application to the various branches of manual and mental industry to very important results. In this system we find one peculiarity, the following: The greatest importance is not attached to the execution, although that is an important object. One person may conceive a brilliant design and yet may be unable to express it in a proportionately excellent degree, while another who may copy so well as to excel an original, may be defective in inventive power. Of these two persons we do not think it would be correct to say, that the latter excelled the former, and in this department more credit might be given to the former and for this reason; the one has more genius if we may use the term, and the other excels in *technique*, the one commands his brain efficiently while the other has more control over his eye and his hand. This is very different from that system where every thing depended upon execution. The execution of a drawing has been much fettered by arbritrary regulations, and the prohibition of any mechanical aids whatsoever, such as ruling or measuring. But if we observe the habits of great artists, we find they have used every possible mechanical aid Considering their art to superior to others, they have used others for the promotion of their own, making everything subservient to its ends. Measuring has been prohibited in order that the eye may be trained. Now the eye is by no means such an instrument as may be relied on, as the abundance of optical illusions testifies; and it is very obvious that no one can produce anything creditable with an imperfect instrument And if one persists in attempting to do so, he is only accustoming his eye to its infirmity The eye requires training just as all our faculties do and is capable of performing functions proportionate with its proper developement, but to expect it to judge correctly, untrained is absurd.

A student unaided, in attempting to make two points equidistant from a third, is in many cases sure to fail, but if, after he has judged according to his ability he apply his measure to ascertain his correctness, he will employ the most natural remedy in existence for the training of his eye.

We think that the regulations in this respect should be reduced from their arbitrariness and that mechanical aids will be frequently found to be valuable as corrective instruments; We advocate their regulated use not that the student may be saved the exercise of his judgement by any means, but that he may be properly trained.

The specimens here represented, are the efforts of some of pupils of one of our public schools. They are *original* designs, constructed from a given number of dots, and present the different varieties of form which are to be expected from different minds. A considerable, and we hope, permanent interest has been excited among these pupils, and the advantages resulting from their apprehension and application of the principle of freehand drawing are already apparent and will be acknowledged in the future.

Every boy or girl with average ability who has applied himself in this direction has succeeded: and the discovery by himself of power in himself forms a very pleasant gratification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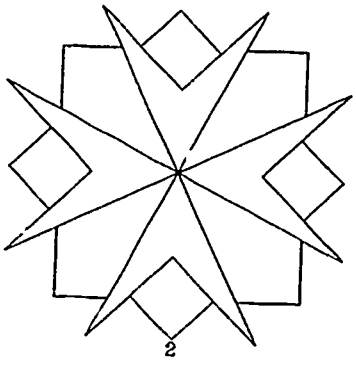
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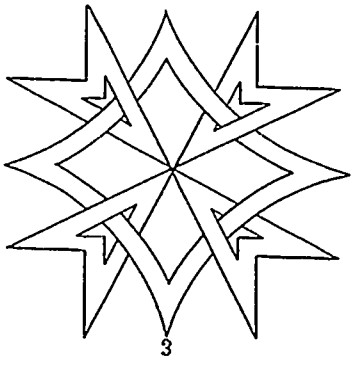
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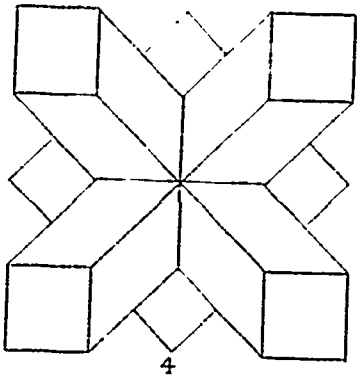
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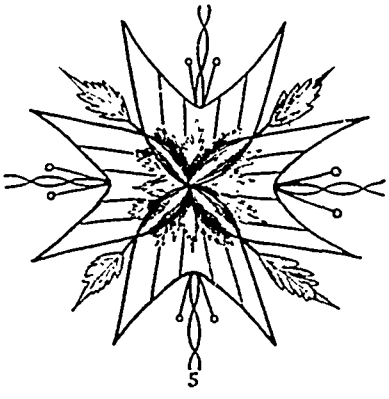
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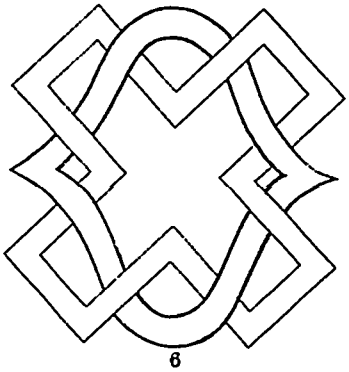
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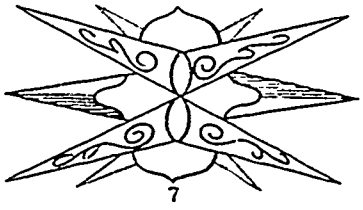
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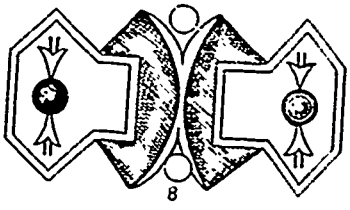
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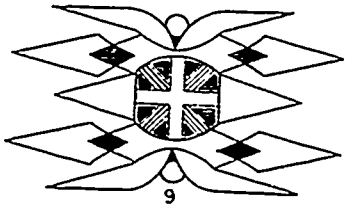
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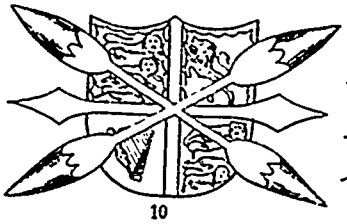
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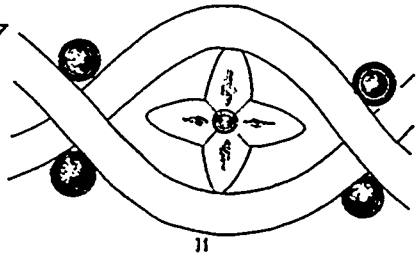
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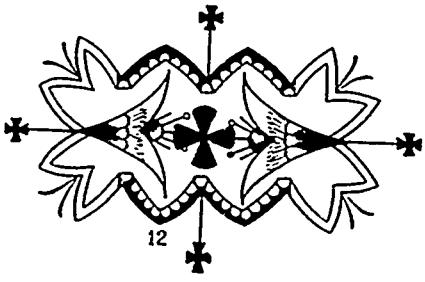
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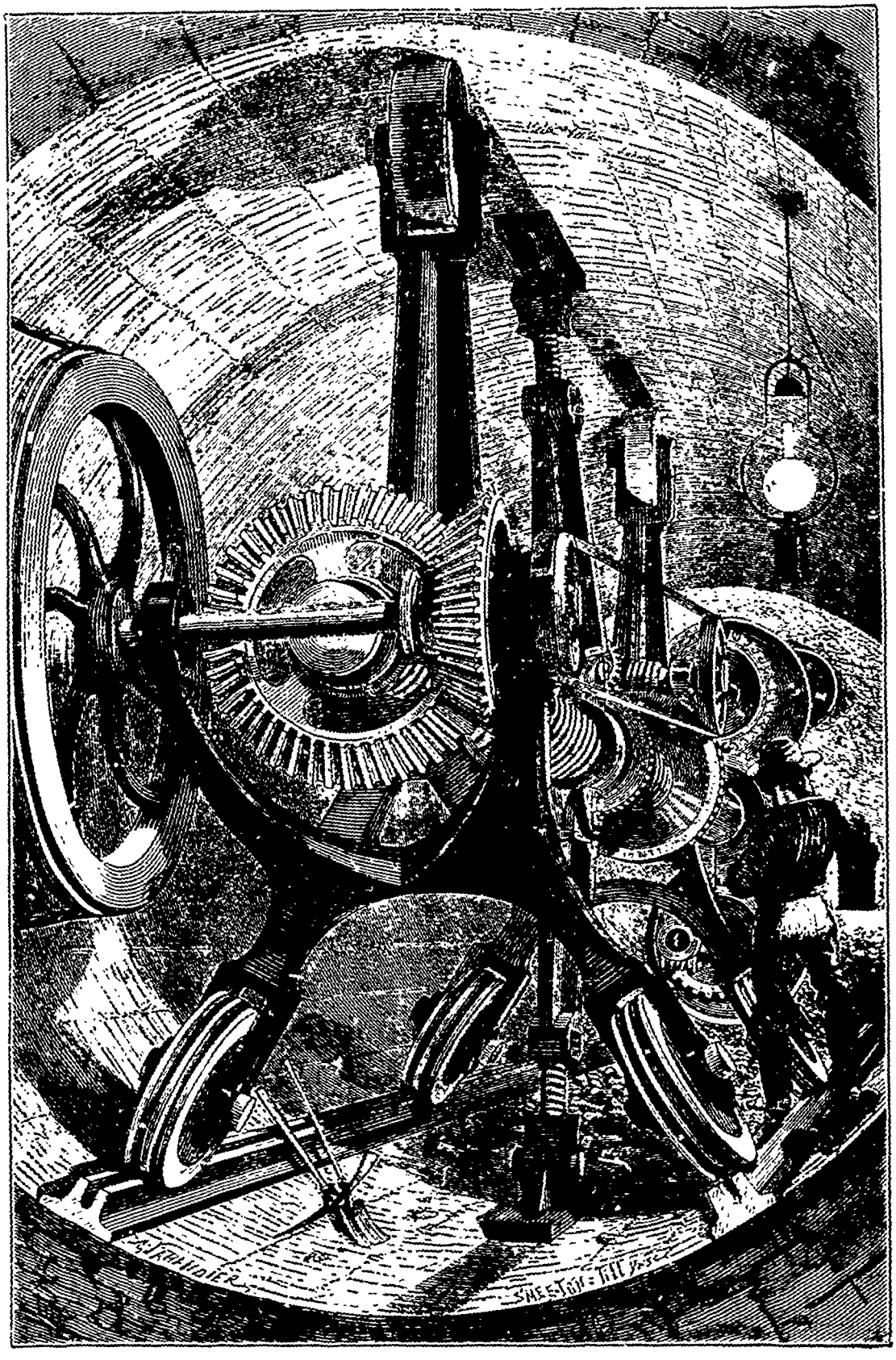
DESIGNS IN FREE-HAND DRAWING.



BRUNTON'S TUNNELLING MACHINE.—(See page 110)

and a powerful incentive to renewed effort. Nos. 1, 2, 3, 4, 5 and 6 are original designs made from 25 dots arranged in 5 rows of 5, the interlacing of the double lines indicates considerable fancy and skill combined with inventive power. Nos. 7, 8, 9, 10 and 12 are excellent and would make very pretty designs for fancy work, and for japanning. These designs were invented by boys attending the McGill Model School in this city, the oldest of whom is not over 14, and many like whom, we are confident, may be found in our public schools capable of producing similar results, from similar training.

CABMENS' RESTS.

In England and Scotland people seem to have suffered so much and so continually from the only sometimes ceasing rain that they have, at last, in very pity, been constrained to erect shelters at frequent intervals, in their large towns for cabmen. Cabmen, out at all hours of the day and night, in all weathers must undoubtedly suffer occasionally great bodily hardship. Cabmen have, moreover, in spite of these reasons for surliness and bad-temper, risen much of late in the scale of public opinion, and this mark of public favour cannot but have a further good effect upon them. Our readers will see clearly by our illustration on page 128 what the shelter consists of and will agree with us that a cup of warm coffee in such a place is better both for the Cabman and the public than a dram at the nearest bar. We are of opinion that a few shelters similar to these might with advantage be sprinkled about our Canadian towns and cities, when, in the winter with the thermometer so low as we have it sometimes, they would prove welcome havens to many besides Cabmen, and prevent many painful cases of frost-bite.

FIRE-BRIGADE SERVICE AT CONSTANTINOPLE.

Constantinople looks well at a distance, its high minarets, serais and cupolas alone show and afford a strange and pleasing view, but the interior is quite a different affair. The streets are narrow and without names, and the houses, for the most part wooden, are not numbered, the streets, moreover, are not lighted at night. Under these circumstances and with the lack of system which prevails it may be imagined that the fires, which are of frequent occurrance, are likely to spread rapidly and widely. However, with the customary Turkish indifference there seems to be a plentiful lack of proper means of extinguishing conflagrations. The touloumbadgi, as the fireman are called, never hurry to a fire, and when they arrive there with their pumps on their shoulders they often refuse to go to work until they are handsomely paid in advance. When, however, they do get to work the noise and fuss is indescribable, and the effect in an inverse ratio to the fuss. This state of affairs is said to be now passing away. The Emperor of Russia has sent to Constantinople a company of firemen who are to reorganize or rather organize the entire service. This kindness may possibly be dictated by a desire on the part of Russia to preserve as much as possible of the ancient capital for itself whenever the "manifest destiny" of Southern Europe may be worked out.

TIN IN POWDER.—A French journal gives the following method of preparing tin for tinning brass, copper, and iron.—Melt the metal in a crucible which has previously been slightly warmed, and at the moment the metal begins to set and when it is very brittle, pound it up rapidly, and when quite cold pass it through a sieve to remove any large particles that may remain.

THE NEW FRENCH MILITARY RIFLE.

Through the courtesy of a Paris correspondent, says the *Scientific American*, we have lately obtained tracings of the official drawings of the new gun which a board of officers, under the presidency of Marshal Canrobert, adopted, on the 13th of August last, as the weapon with which the army is to be provided. Out of the various designs submitted to the examiners, it appears that but two were favourably regarded. One known as the Beaumont, the invention of Hollander, found support from four of the eight members of the board, while the remaining half advocated the Gras gun, a French invention. The casting vote of the president, probably influenced somewhat by a patriotic feeling, decided the question in favour of the Frenchman, and so the weapon of which Captain Gras is the reputed inventor is that of the French army of the present future. We give an engraving of the Beaumont gun, and also illustrations of the Gras arm, prepared from the tracings above referred to, to enable the reader to draw his own comparison. In the Beaumont (Fig. 1), the spring A, is contained in the lever of the movable breech piece, and its longer branch exercises a pressure in the rear of the needle B. The dog C, has beneath its lower forward portion a helicoidal projection, which at the firing, lodges in a corresponding recess in the bolt B. The rotation thus impressed upon the latter causes a pressure against each other of the spiral surfaces, and consequently, the reccil of the dog and needle sufficient to bend the spring. All the movable portion is then drawn to the rear, so as to expose the end of the spent cartridge, in order to remove the same, and to introduce a new one. This done, the movable part is brought forward until the stop on the bottom of the dog takes against the trigger catch at D. The breech lever, which has hitherto been in a horizontal position, is then turned upward, closing the mechanism, when the parts are as shown in our illustration, and the weapon is ready to fire. From this arm the Gras gun, represented in Figs. 2 and 3—section in the latter—will be found to present much material difference. Fig. 2 shows the position of parts as the cartridge is being extracted, and Fig. 3 the mechanism just before it is closed together for firing. A, is the movable breech piece operated by the lever B. C, is the dog, at the end of which is a button, to which the rod D, of the firing pin E, is attached. F, is the coiled spring, which throws the pin forward. For loading the gun, the parts are drawn back as shown in Fig. 2. The cartridge is inserted, and the bolt A, by the lever B, is drawn forward. While this is being done, a stop G, enters a cam groove H, in the side of the bolt A, so that the latter is forced to turn as it is brought forward. In Fig. 3, it will be noticed that the notch on the dog C, is almost in contact with the spring stop I, governed by the trigger. By pulling on the latter, this stop is withdrawn, and the needle is thrown forward by its spring, striking and exploding the cartridge. At J, is the extractor, the part containing which, though drawn back, does not turn with the movable breech, so that the spring hook always grasps the rim of the cartridge case from above. With this gun, it is stated that forty-five shots can be fired in three minutes effective at a range of 5,120 ft. to 5,440 ft.

BROCKLEBANK'S PATENT RAILWAY COUPLING.

Railway couplings are a very favourite field for inventors, and there is no doubt but that a large reward awaits the man who shall devise a coupling, which shall be safe, strong and capable of being worked without requiring the presence of a porter between the carriages. We illustrate on page 120, from the *Engineer*, one of the latest improvements in this line. It will be seen that the two stirrup-hooks are so arranged that whenever two vehicles are brought together one or other hook must automatically enter a stirrup and so unite the carriages. Several schemes nearly similar have been proposed at various times, but they are all open to the objection that the coupling cannot be tightened up. This difficulty Mr. Brocklebank gets over by putting a right and left-handed screw on the tie-bar, on this works a box screw, square outside, and on this square is fitted a small spiked-wheel driven by a chain and second wheel placed at the side of the carriage and worked by a handle, as shown, by this means, while the draw-bar is free to move under the pull of the engine, the draw-wheel, which can slide in the square, is always at rest. To uncouple it is

only necessary to turn the wheel so as to slack the tie-bar, when the chain at the end or tail of the stirrup comes into play and lifts the hook in a way that will be easily understood. The couplings can be tightened up as much as need be by turning the chain-wheel and screw nut in the opposite direction This invention has already been tested on one of the English railways with marked success.

THE TIDES

Sir William Thomson recently delivered a very important and instructive lecture on this subject in the City Hall, Glasgow. There could not have been less than two thousand persons present on the occasion. We do not propose to give our readers a *resume* of the lecture, but it may be interesting to note in passing that Sir William has somewhat upset the popular notion about the fluidity or liquid state of the centre of the earth. He maintains that unless the material of the supposed shell of the earth were preternaturally rigid—say scores of times more rigid than steel—the shell would yield so freely to the tide-generating force, that it would take the figure of equilibrium almost as freely as water would, and there would be no rise or fall of the water relatively to the solid land left to show to us the phenomenon of the tides. The greater the mass the more it was disposed to yield, and a careful calculation of force showed that in virtue of the greatness of the mass, it would require enormously increased rigidity in order that the earth might keep in shape. The earth had on the whole a rigidity greater than that of a globe of glass of great dimensions, perhaps greater than that of a globe of steel of the same dimensions. The earth must be exceedingly rigid; and whatever view geologists might take as to the underground temperature, and the past history of the earth's conformation, they had no right to assume interior fluidity. After a most interesting series of experiments assisted by elaborate diagrams, explanatory of solar and lunar tides he remarked that the phenomena of diurnal tides were altogether overlooked in the Admiralty tide tables for the whole earth, although there were places where the diurnal tides were greater than the ordinary tides; and he was surprised at the supineness of the Hydrographic Department of the Amiralty on the point, considering that their attention had been called to the facts.

Sir William then passed on to explain his self-registering tide gauge, which would show the height of the water at every moment during the whole time the intrument was in action. it was not yet in use, but would be tested soon at the island of Madeira. In connection with this instrument there was a tide calculating gauge, which by an ingenious arrangement of pulleys calculated of itself the condition of the tides at Liverpool. We reserve any notice of this latter instrument at present, as it is undergoing some important modifications.

The self-registering tide gauge is shown in the engraving on page 116 and consists of a timepiece or pendulum clock A, secured on the top of a supporting frame B and brackets B. This clock, in addition to keeping time, actuates the large drum or cylinder C, at a slow uniform speed, by a bevel pinion and wheel at the upper end of the drum spindle, which is carried in journal and footstep bearings in the frame B. The continuous web of paper, upon which the figure of the rise and fall of the tides is registered, is first wound on to the small cylinder D, which revolves loose in its journal and footstep bearings in the same frame, and has a slight frictional piece or spring, so that when the front end of the paper is fixed in a slot or clip on the cylinder C, it is gradually wound thereon close down to the guiding rim on the lower end of both cylinders, so that the point of the lateral tubular pen projecting from the lower part of a small ink vessel attached to the weight *d*, describes the figure on the paper, as indicated at *a'*, up and down in an acute-angled zigzag manner, every rise and fall of the tide, as the weight *d* with its float rises and falls with the parallel guiding frame d', which is set on pivots so as to be tilted slightly every hour by a motion taken from a notch in a disc on the hour shaft of the clock; an arrangement of levers and spring at *e* bringing back the frame *d'* and pen *a* to their normal position. The small lateral marks or projections on the up-and-down angled lines of the figure on the paper indicate the height of tide at every hour and the extreme points of the angled lines indicate the extent of rise and fall of the spring and neap tides to a proportionally reduced scale through the reducing gearing EE'. A cord of fine wire is attached to and wound round the large rim pulley E, and has its free hanging end attached to the weight F, which has the actual tidal float attached to it working or floating in calm water, or within an open pipe or tube immersed therein, so as to insure that the water and float, wherever the instrument may be placed, may be as little as possible affected by local or shore influences, or by the winds or waves. A pinion on the end of the shaft of the drum E works into a large wheel on the second shaft E', so as to drive it at such slow or reduced speed that the cord or wire carrying the weight and ink bottle *d*, and which is wound round and attached to the small pulley or E'', will cause the pen *a* to traverse up and down proportionally to the rise and fall of the float F and of the tides where it is at work. The weights E and *d* are made to exactly counterbalance each other, and the paper may be ruled in divisions either from the top or bottom edges, or from a centre line of the tidal figure, corresponding to feet and inches of the actual rise and fall of the tide, or of the float F, or other measurements desired.

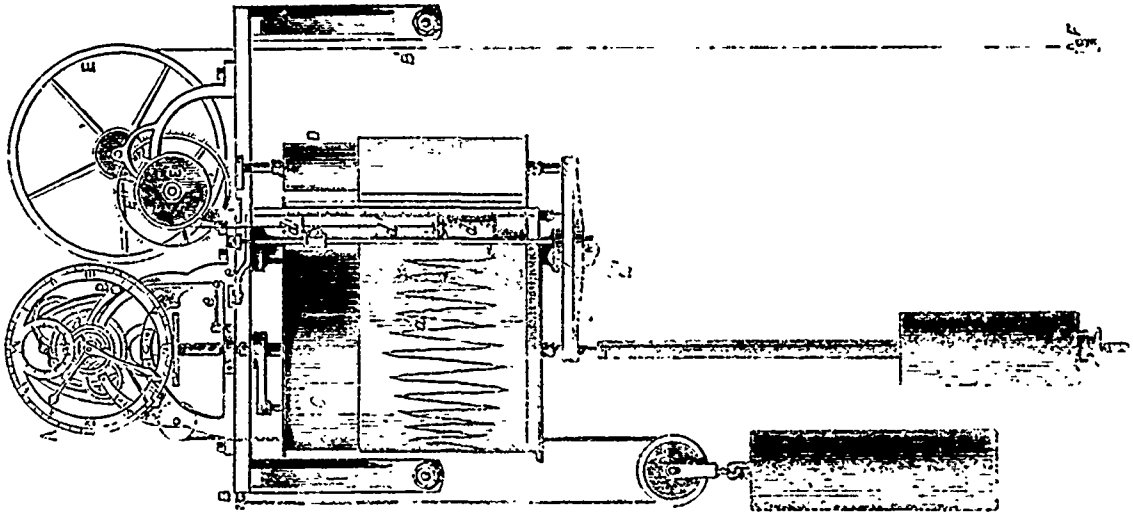
We understand that Sir William Thompson is making some improvements upon this instrument with the view of making its action and application even more perfect, particularly in reference to the feeding and unwinding of the web of paper, which improvements we may describe and refer to in a future number.

WIER'S HYDRO-GYROMETER.

The object of the speed indicator, or "Hydro-gyrometer," of which we annex a plan and elevation, is to enable those in charge of an engine to ascertain by mere inspection the number of revolutions which it is making at any moment. In many cases this becomes a matter of considerable practical importance. In a steamer or upon a locomotive for example, the number of revolutions per minute gives a tolerably accurate measurement under ordinary conditions, of the speed at which the vessel or engine is moving. In many factories it is of great importance that a uniform speed of engine shaft should be maintained under continuously varying loads, and wherever very much steam power is employed it certainly becomes more than a matter of mere curiosity to know to what extent, if at all, the engine is deviating from the speed which has previously been determined as the most convenient and economical.

To obtain the rate of revolution from a counter, or by counting with a watch, is obviously both troublesome and inaccurate, what is wanted is an apparatus by which the speed is absolutely indicated continuously, just as the total number of revolutions run is indicated by the ordinary counter. The hydro-gyrometer is the invention of Mr. M. A. Wier, Junr (of Messrs. M. A. Wier & Co., telegraph engineers, Abchurch-lane). In its simplest form the hydro-gyrometer consists of a vertical cylinder partly filled with a suitable liquid, in which a screw is caused by the engine to rotate continually. The bottom of the cylinder communicates with a vertical glass gauge tube fixed upon a properly graduated dial board. When the engine is at rest the liquid stands at the same level in both cylinder and tube, and the corresponding point on the dial is marked zero. When the engine is in motion the action of the screw either forces the liquid up in the glass tube or draws it down (according to whether the engine is running ahead or astern), and the graduation upon the dial is so arranged that the number which is level with the surface of the liquid always corresponds with the number of revolutions made by the engine, ahead or astern as the case may be.

The type of instrument we illustrate is the same in principle as the one just described, but is rendered more complete by the addition of a counter and a self-registering apparatus. A in this case is the cylinder and B the screw, the latter being driven by the engine shaft by suitable means through the spindle N and the screw wheel and worm P. The screw therefore revolves with a speed definitely proportioned to the speed of the engine. The cylinder A is in free communication through very small holes in the nozzles at its lower end with two smaller brass cylinders C and D placed beside it, which take the place of the glass tube in the simpler instrument. A float in the cylinder D is connected by a fine cord passing over a system of pulleys K, with a pointer placed upon the circular dial L, which is graduated so that the pointer shall at each instant indicate the number of revolutions (astern or ahead)



SELF-REGISTERING TIDE GAUGE.

THE NEW FRENCH MILITARY RIFLE

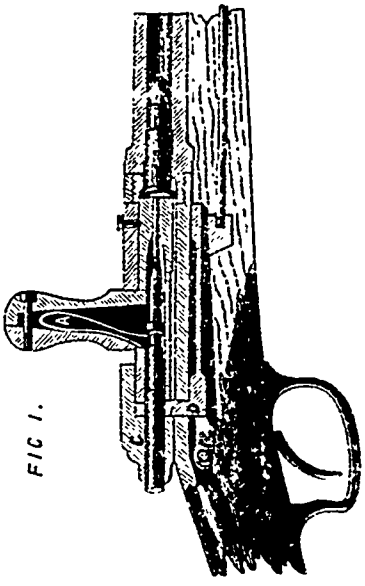


FIG. 1.

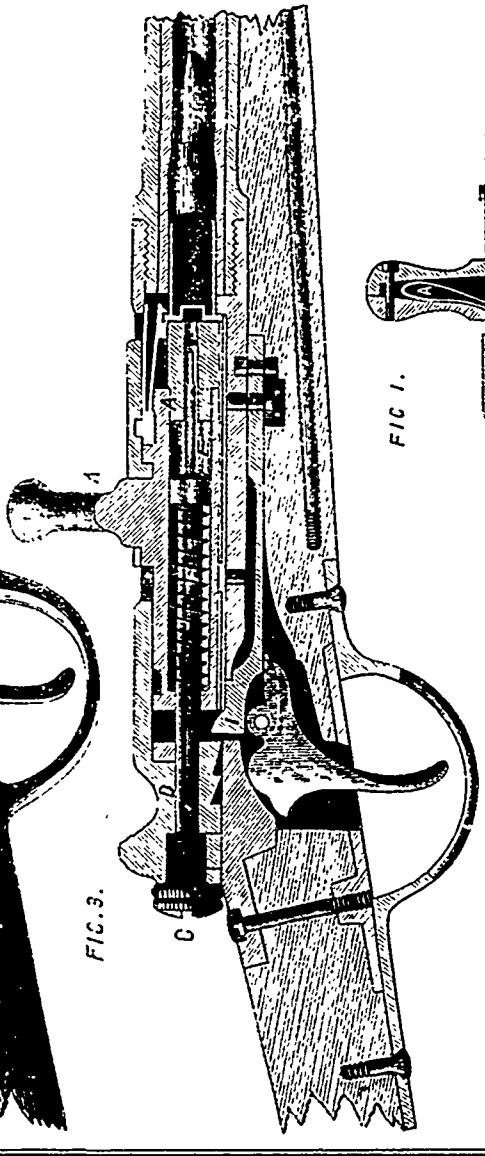


FIG. 3.

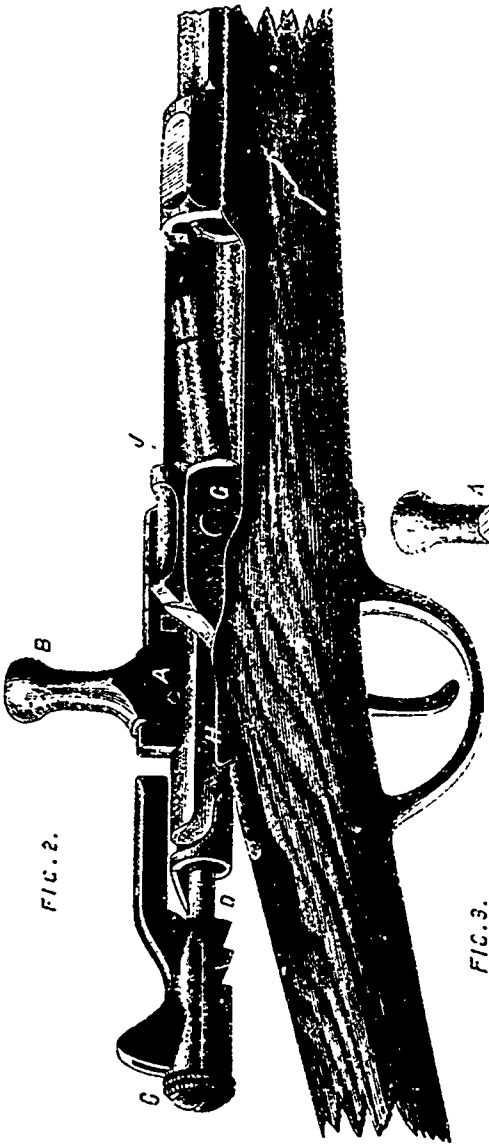


FIG. 2.

Fig 1.

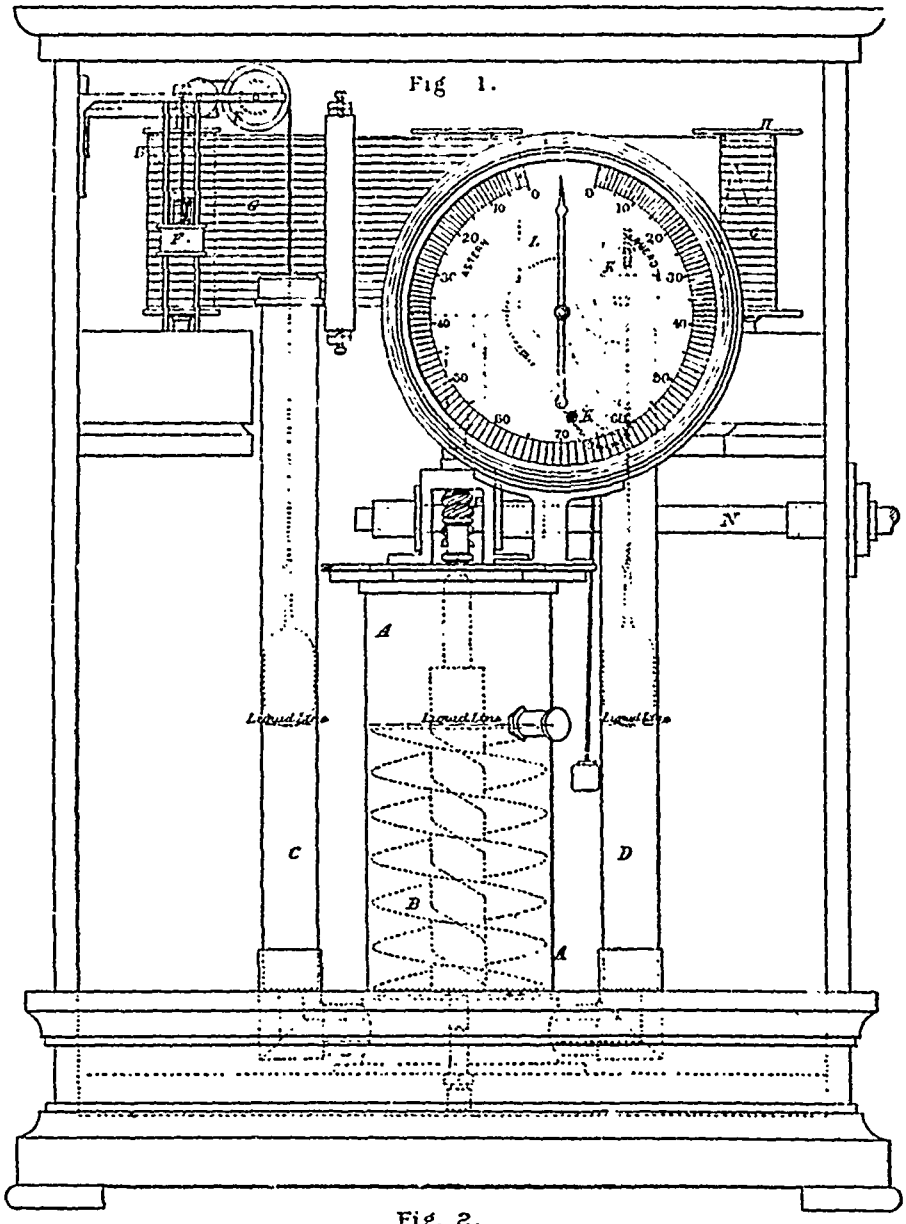
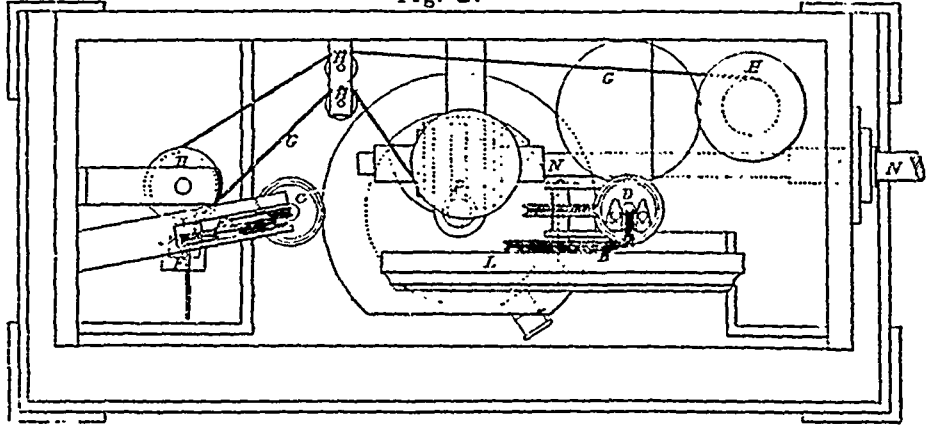


Fig. 2.



WEIR'S HYDROGYROMETER.

corresponding to the position of the float at that instant. Another float in the cylinder C determines (by means of the system of pulleys E) the position of a pencil frame F working between vertical guides. This pencil (or pen) is kept in contact with a sheet of paper G G carried by drums and guide rollers H at the back of the instrument (and moved by clockwork) and makes a continuous line upon it. The paper is ruled with horizontal lines corresponding to the different speeds, and as it is coiled round the drums, prickers make upon it suitable marks at every quarter of an hour, the motion being so arranged that 5 in. on the paper corresponds to one hour. The sheet, therefore, when taken off the drums, forms in itself a complete record of the speed at which the engines have been running throughout an entire day, or week, or voyage, as the case may be. A counter of the ordinary construction is added to the instrument, which therefore shows the engineer at every instant the speed at which the engine is running at that instant, and the total number of revolutions run since the counter was set, and at the same time registers the speed in a simple continuous diagram.

The liquid used in the tubes is a mixture of glycerine and water, with some colouring matter to render its indications more distinct. This mixture has been found to evaporate very slowly at ordinary engine-room temperatures, but means are provided for supplying small losses from this cause should it be necessary to do so. We understand that the hydro-gyrometer is being applied both to locomotives and to steamers, as well as to stationary engines. In steamers, if the instrument is placed amidships, with the cylinder in a fore and aft plane, the accuracy of its indications will not we think be sensibly affected in ordinary weather. Care will have to be taken, however, as to placing it in the first instance in a proper position.

We have seen a modification of this instrument which is interesting enough to deserve mention, although in its present form it does not seem well adapted for self-registration, nor for giving indications which can easily be read with great accuracy. It consists simply of a glass cylinder half filled with liquid, with a graduated scale placed behind it, so that the graduations can be read off through the cylinder The zero of the scale corresponds to the level of the liquid, when the cylinder is stationary. The cylinder itself is in this instrument caused to revolve, and by its revolution a vortex is formed in the liquid, the depth of which is the greater the velocity of rotation. The speed is read off at any instant by simply looking at the scale through the cylinder, and noting the graduation which seems to be upon a level with the lower end of the vortex. This is certainly a very neat application of a simple physical fact to practical use.—*Engineering*

THE INVENTORS PARADISE.

"A thousand Patents," says Haseltine, Lake and Co's circular, "are granted every month in the United States for new inventions. This number exceeds the aggregate issue of all the European States, yet the supply does not equal the demand, and the average value of patents is greater in America than in Europe by reason of the vast number of new industrial enterprises and the higher price of manual labour.—A hundred thousand dollars is no unusual consideration for a 'patent-right' and some are valued by millions. The annual income from licences granted on the 'Blake Sole Sewing Machine' is over three hundred thousand dollars—and other patented inventions are equally profitable.—Inventors are encouraged by the moderate government fee of thirty-five dollars, which secures an invention for seventeen years without further payment—the rights of patentees are generally respected by the public, and no National Legislator, with a single exception, has ventured to proposed the abolition of a system which at once secures substantial justice to inventors, and proves of incalculable advantage to the nation"

In dry oxygen gas eggs are unaffected unless punctured. Moist oxygen decomposes the eggs. In moist nitrogen eggs will keep three months. Hydrogen the same. Eggs, whether pierced or whole, were perfectly preserved in carbonic acid, dry or moist. Illuminating gas the same. In chlorine water 1 to to 500 eggs kept eight months in a closed vessel. In a solution of dilute chloride of lime, eggs would not keep ten days. Lime-water and sulphite of lime kept them a little longer. Carbolic acid solution 1 to 500 preserved them about six weeks.

THE WESTINGHOUSE VACUUM BRAKE

We illustrate on page 121, an arrangement of vacuum brake constructed by the Westinghouse Continuous Brake Company, and applied by them in cases where the plan of working with a vacuum is preferred to that of using compressed air. As most of our readers are aware, the application of the brake blocks is in the case of the ordinary Westinghouse brake, effected by the admission of a supply of compressed air to a double line of pipes running through the train, these pipes being in communication with cylinders having pistons which are forced outwards by the action of the compressed air, and which, by this movement, apply the brakes. In the vacuum arrangement we now illustrate, but one line of pipes is carried through the train and the pistons of the cylinders connected with this line of pipes are forced inwards by the pressure of the external air, when a partial vacuum is formed in the pipes and cylinders. As the external atmospheric pressure thus made available is far less than that which can be applied in the opposite direction by the use of compressed air, the cylinders of the vacuum brake have of course to be larger than those used in the case of the ordinary Westinghouse brake, or else the stroke of the pistons has to be made longer and the leverage of the brake gear increased to obtain the necessary pressure on the blocks. In what is termed the Westinghouse "automatic" brake, worked by compressed air, the application of the brake blocks takes place instantly in the event of a train parting, while the brake can be applied from either end of the train, or, if desired, from any carriage. The automatic brake also provides at very slight extra expense for a very perfect system of intercommunication signals. These advantages are not possessed by the vacuum brake, but the latter is nevertheless preferred on some lines, and this being the case we think the Westinghouse Continuous Brake Company have acted wisely in not confining themselves to supplying brakes worked by compressed air only.

The details of the brake we illustrate have been worked out with much care and ingenuity. The exhaustion of the air from the pipes when the brake has to be applied is effected by a steam jet of the construction shown by Figs. ' and 2. Referring to Fig. 1, it will be seen that the apparatus consists of an outer casing having at its under side a branch which is connected by a pipe to the boiler, this outer casing being thus at all times charged with steam when the brake is in working order. Within the casing just mentioned is a tube or nozzle extending its whole length, this tube having at its upper side a valve seat fitted with a conical valve, which can be raised by a spindle which passes out through a stuffing-box, as shown. By raising this valve the steam is admitted from the outer casing or jacket to a space forming an annular jet, and also to a smaller central jet, as shown. The steam issuing from these jets produces an exhaustion, and draws the air from the line of pipes extending along the train, the line of pipes being coupled to the branch shown at the left-hand end of the apparatus in Fig. 1. At the right-hand end the apparatus joins an expanding or trumpet-shaped discharge tube. The constant steam jacketting of the jet tends to produce great promptness of action.

On the steam being shut off the communication between the external air and the line of pipes is also shut off by a light conical valve provided just behind the steam jet, as shown, this valve being forced on to its seat by the pressure of the external air. To take off the brekes the air has to be re-admitted to the pipes, and this is effected by raising another conical valve which is shown to the left in Fig. 1. On this valve being lifted the air enters the pipes from an annular space with which the valve communicates, this space being placed in communication with the external air by a series of holes, as shown in Fig. 2.

The arrangement for working the steam and air admission valves—or in other words for applying and releasing the brake—is very neat, the spindles of the valves being carried up as shown in Fig. 1 and 2, so that they can be acted upon by the opposite ends of a rocking lever which is worked by a side handle, as shown in Fig. 2. Thus by moving this handle in one direction the brake is applied, or by moving it in the other it is released, while by allowing the handle to remain in a middle position both valves are closed, and the brake remains either on or off according to which valve was opened last The whole brake action is thus controlled by a single handle and the arrangement is a very convenient one.

The line of pipes fixed on each carriage terminates at each

end in a length of flexible tubing, and these lengths carry the couplings for making the connexion between the vellicles. The construction of these couplings is shown by Figs. 3 and 4. From these views it will be seen that the two parts of the coupling are exactly alike, and the carriages thus couple together indifferently, no matter which ends may come together. Each half of the coupling carries a pair of springs, which clip into a recess turned in the circumference of the other half. In Fig. 3 but one pair of these springs is seen, the two halves being brought together so that the springs on the left-hand half are situated a quarter of the circumference from those on the right-hand half. These springs have merely to hold the couplings together when the brake is out of action; as soon as a partial vacuum is formed in the pipes, the abutting surfaces of the two halves are forced tightly together by the pressure of the external air.

As shown by the left-hand half of Fig. 3, each half of the coupling contains a spiral spring, thus closing the end of the pipe, and preventing the ingress of air. The valve, it will be noticed, has a kind of tubular stem very little smaller in diameter than the orifice which the valve closes, and the spring has thus to act only against the pressure of the air exerted upon a small annular area by a hole through the valve admitting air to the interior of the tubular stem, and thus placing the chief portion of the valve area in equilibrium. The valve strikes against a seat of hard india-rubber, protected by an internal brass ferrule, the external part of this seating forming also the abutting face of the coupling. When the two halves of a coupling are placed together, projections on the valves come into contact with each other, and each of the valves is thus forced off its seat as shown in Fig. 3, and a free through communication is provided. In the event of a part of the train breaking away, the valve in the last coupling, of course, closes, and the brake can thus still be applied to the part of the train which remains attached to the engine.

The arrangement of cylinder which it is preferred to use for applying the brake, is shown by Figs. 5 and 6, the latter figure being an inverted plan. Referring to these figures it will be seen that the cylinder is placed vertically, and that at each side of it there is hung a lever having jointed to it, at an intermediate point, a toggle lever. The two toggle levers have curved abutting surfaces, and each is traversed by a bin, which rests upon a cross-head attached to the piston rod. The effect is that as the piston rises on the air being exhausted from the cylinder, the toggle levers are drawn upwards, and the hanging levers are forced outwards. To the lower end of the hanging levers are coupled the thrust rods leading to the brake blocks, and thus the latter are applied to the wheels by the upward movement of the piston.

The whole arrangement we have just described is exceedingly simple and effective. The toggle levers rolling on each other move with little friction, and they give just the motion required, namely, a quick movement at first to take up the slack, &c, and a slow movement and severe pressure subsequently, when the blocks are in contact with the wheels. The arrangement shown by Fig. 5 and 6 is, as we have said, that which the Westinghouse Continuous Brake Company prefer to apply, but instead of the cylinder and piston they provide, if desired, a collapsing bag arrangement, the bag being of a cylindrical form, and of a special construction tending to reduce as much as possible the wear and tear and risk of failure to which all such arrangements must necessarily be liable.

The remaining views, Fig. 7 and 8 show the mode of arranging the brake gear which it is preferred to adopt, whenever it is desired to apply the brake blocks to one side of the wheels only. As will be seen from the plan, but one vacuum cylinder is used, this being placed at the centre of the underframe, and the hanging levers being connected by thrust rods with transverse bars, which connect the brake blocks of each pair of wheels. These transverse bars are constructed so that each forms a kind of triangular truss having great strength, while it is at the same time light.

The brake blocks are of cast iron, and each is hung by two links as shown, the one link being attached to the centre, and the other to the lower end. The effect of the whole arrangement is that the blocks fall back clear of the wheels by the action of gravity as soon as the air is re-admitted to the vacuum cylinders, and the whole of the brake gear is very neat and simple.—*Engineering*.

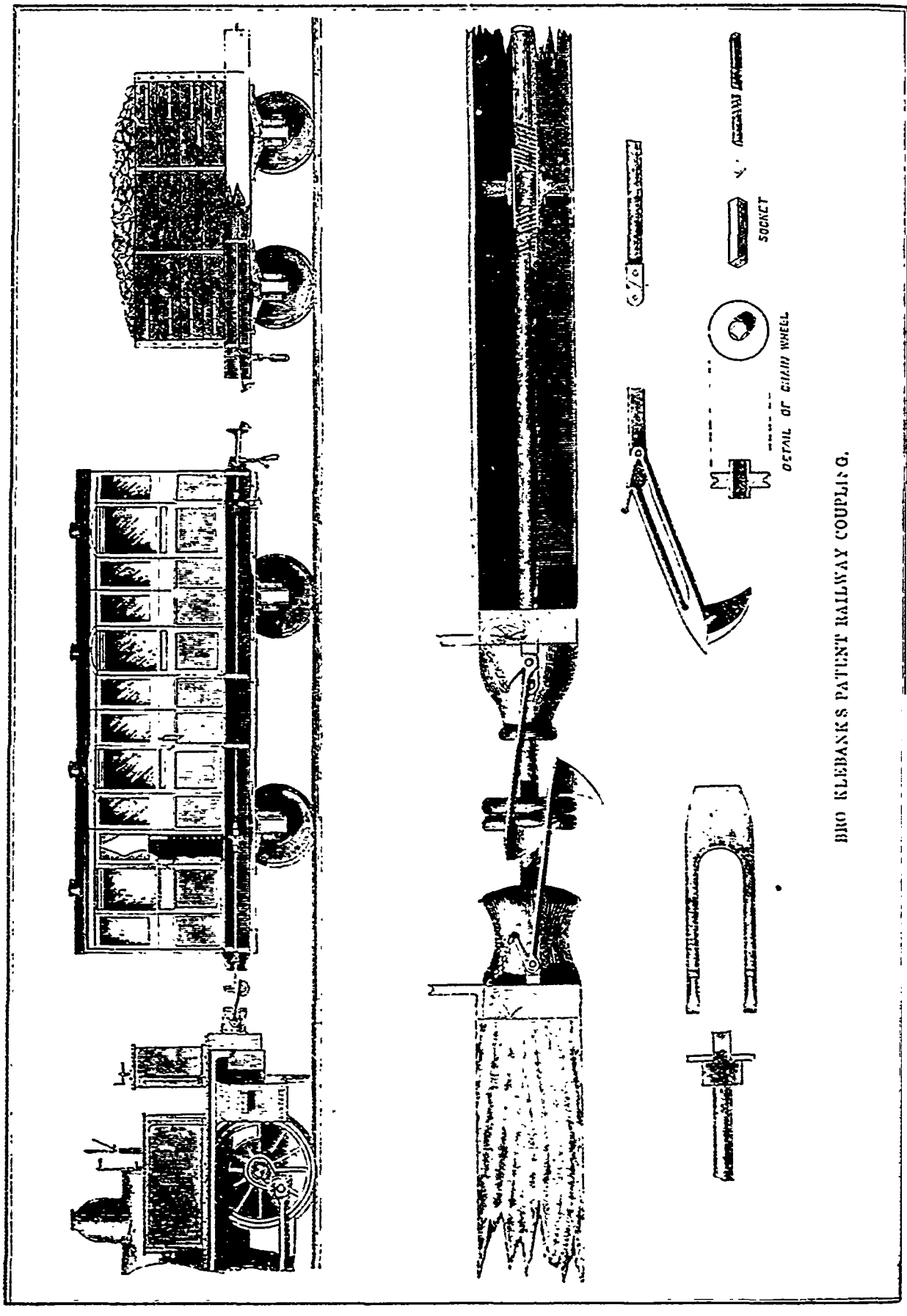
PATENT COTTON GUNPOWDER.

The history of great inventions is full of the most curious anomalies and puzzling inconsistencies. Among the most remarkable of these we may count the fact that so little progress has been made in the manufacture of explosives since the almost pre-historic epoch when gunpowder was added to the list of destructive agencies at man's command. True it is that modern chemistry and modern enterprise have launched on the world, within the present century, various compounds possessing a destructive power far exceeding that of gunpowder, but the old fashioned black powder still holds its own, with almost the indentical form and composition which was devised by its first discoverer.

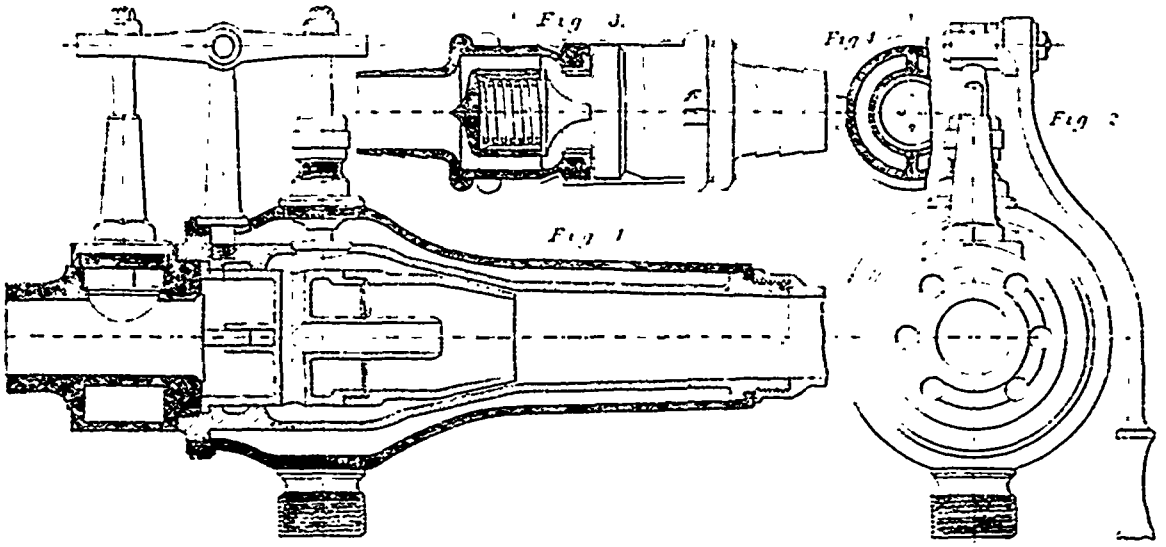
Like most other great discoveries (of pre-Yankee date) the secret of the direful properties of a properly-proportioned mixture of sulphur, charcoal, and nitre, proceeded from the far East. There can be little doubt that the receipt had penetrated from China, or some other Asiatic country, into Europe before the eight century, long prior to the time of Roger Bacon—first of English scientific worthies—or of the German, Schwartz. Be this as it may, for considerably over a thousand years there has been little or no advance on the quaint injunction of Marcus Græcus, which might well be taken as a guide for the modern powder-maker—granting, of course, the improved mechanical appliances of these later times. How it was that a composition, closely approximating to that which an ultimate knowledge of chemical reactions and equivalents would have prescribed, should have been hit on, is a matter for curious speculation; unless, indeed, the secret was one of those dire gifts to mankind which escaped, alas! from Pandora's casket of evil.

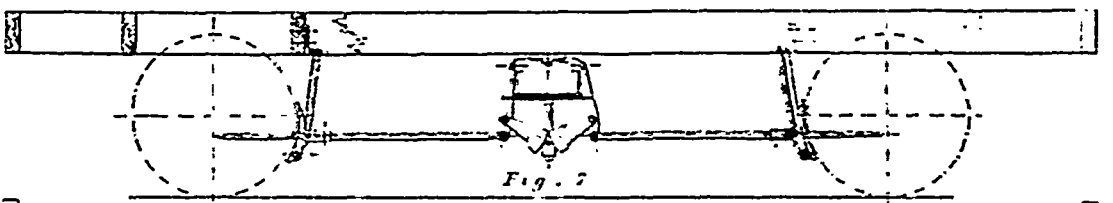
Of late, however, as we have said, there have been strenuous efforts made to turn to profitable account other and more energetic explosives whose powers have been brought to light in the course of chemical research. Chief among these we may note gun-cotton whose properties, and their applicability to military and technical purposes, have been studied with admirable perseverance by Continental *savants*, and subsequently in England by Professor Abel. After having fallen into disrepute, on account of the danger attending its manufacture and use, it received fresh importance from the improved process introduced by Lenk, which was adopted with the best results by Messrs. Prentice, at Stowmarket, till a disastrous explosion shook the confidence that had been established. Nitroglycerine, first brought into prominence by Nobel, a Swedish engineer, seemed also to promise great results, till it was shown to be far less under control and more dangerous than even gun-cotton. In the diluted and safer form of dynamite, Messrs. Krebs, of Cologne, have been indefatigable in placing nitroglycerine again before the public, and it may be held to be still on its trial The dilution of an agent whose energy depends on its concentration is, however, an undesirable expedient, and, as in the somewhat analogous case of Gate's protective system of mixing gunpowder with powdered glass, is open to considerable objection. Lithofracteur, a modification of dynamite, dualin, an American explosive of great power, formed by adding nitroglycerine to sawdust, and alleged to have fifteen times the power of gunpowder; with Horsley's, and other "white" powders; are all competitors for public favour as a substitute for gunpowder in ammunition, and for engineering purposes.

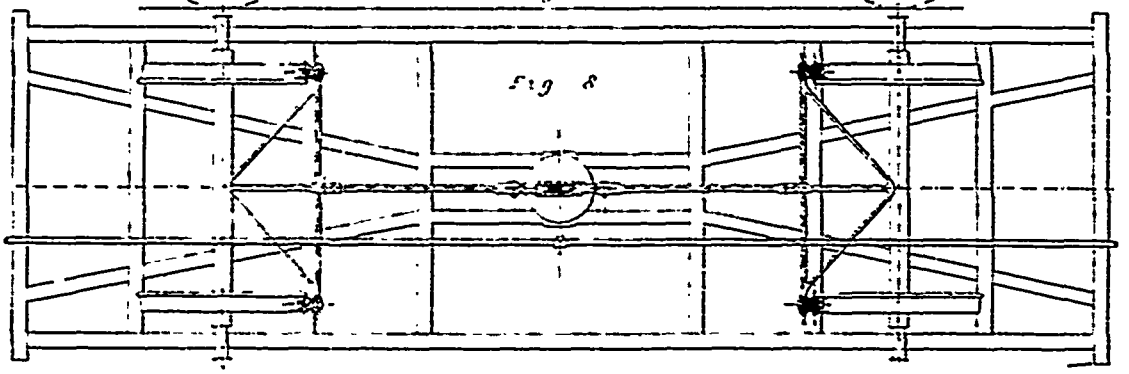
The most important undertaking in this direction at present existing in this country is, however, unquestionably that of the Cotton-Gunpowder Company, formed some time since to work what is known at Punshon's Patent. To their works at Oare, some four miles from Faversham, a goodly party of engineers, mining agents and others, including several representatives of the army and navy, proceeded on lately to witness a series of experiments intended to illustrate the peculiar properties of the new powder. The company has secured about fifty acres of ground, swampily situated on the estuary of the Swale, a location which, for isolation, leaves little to be desired. The visitors being received at the gate by the courteous manager, Mr. S. J. Mackie, C. E., were first shown, as a preliminary to the trials, with the utmost frankness, the whole course of manufacture, which consists of the following processes Ordinary raw cotton, after being roughly dressed, or "devilled," and cleaned, is soaked in a vat of strong mixed nitric and sulphuric acids. After a prolonged soaking of the cotton, the greater part of the sulphurous acid is squeezed out

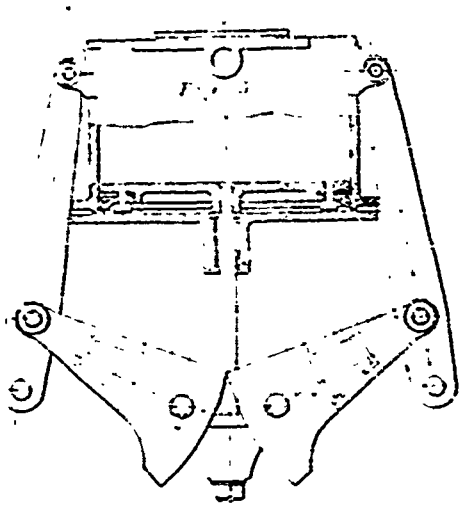


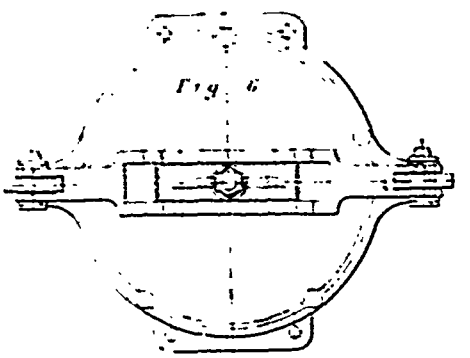
BRO KLEBANKS PATENT RAILWAY COUPLING.











THE WESTINGHOUSE VACUUM BRAKE.

by an hydraulic press, the removal of the acid being carried a step further in a centrifugal machine, which reduces the weight by 50 per cent. After a long course of washing, to remove all traces of free acid, the cleansing being in the final tank assisted by the agitating effect of a current of air which passes through the water, the pulpy product is dried in a centrifugal revolving about 1800 times in a minute. The dried gun-cotton is then weighed, and a definite proportion of an oxidising agent is added. Though the nature of this substance was confided to us under no reserve, it would possibly be considered a breach of confidence to publish it The mixture is completed, and the mass thoroughly disintegrated into a fine powder under two copper edge-runners in a pug-mill. The resulting powder having had the last particles of moisture removed under the influence of a stream of hot air passed through the perforated trays in which it is exposed, is now ready to be placed in cartridges.

There is a separate building devoted to the preparation of sporting powder. To produce this, the ordinary powder has to be pressed into cakes and otherwise manipulated in a manner which has been productive of more than one explosion, and its manufacture has been for the present discontinued. That the fact of the attention of the staff being devoted to the production of blasting powder alone has been productive of the most satisfactory results, was demonstrated by the succeeding experiments. These were arranged to demonstrate alike the safety and power of the powder used, which was throughout that known as blasting powder No. 2 and No 3. To illustrate the fact that the cartridges are harmless unless fired with a special detonator, various cartridges were burnt with impunity in the naked hand, while similar ones, fired by a detonator, produced explosions that induced the experimenters to keep at a respectful distance. Then followed an experiment which, through it resulted in an unexpected *contretemps*, was valuable as an indication of the perfect *bona fides* of the operators Two cartridges having dynamite detonators attached, exploded in defiance of the programme, which insisted that they would *not* explode. It was explained, however, that these particular detonators were of extra quality, and that the occurrence was most unusual, while the probability of a lighted dynamite detonator being brought into proximity with the powder accidentally, is indefinitely small.

After two large barrels of the powder had been peacefully consumed on bonfires, affording nothing more alarming than a beautiful sheet of yellow flame—while the fall of half a ton of iron from a height of 15 feet failed to induce any action in the large bulk of powder on which it fell—it was pretty generally conceded, that so far as experiments can prove anything, they had demonstrated the possession by the patent powder of a singularly large measure of safety under ordinary and even extraordinary conditions It seems at first sight so contrary to all that we should expect that a detonator should cause the violent explosion of a cartridge which no other treatment, whether by chemicals, by fire, or by impact, can prevail on to do more than harmlessly burn away, that it may be satisfactory to explain the probable *rationale* of the phenomenon The miniature explosion of the detonator doubtless communicates simultaneously to each molecule of the powder vibrations of precisely the same periods or length of swing—which the explosion of the powder itself would give rise to; thus by a species of inductive action does the trifling wave motion of the detonator find its expansion and *concurrent* in the extended, but synchronous, agitation of the exploded powder This opinion is confirmed by the observation that while fulminating silver and iodide of nitrogen will not explode gun-cotton, the much milder detonation of fulminating mercury will do so instantaneously, this would of course follow on the hypothesis that the explosion of the latter substance propagates isoperiodic waves with that of gun-cotton, while the more violent explosives do not do so. Similarly may we account for the difficulty of preventing the concussion of an explosion of gun-powder from exploding adjacent magazines.

The destructive portion of the programme was not less decisive and conclusive in its teachings than the prior experiments. Among the most striking results attained was the rending into fragments (which were projected aloft in every direction) of four solid ingots of steel measuring 42 inches long by 11 inches square and weighing 12 cwt. each, by a charge of 2½ lb. of the blasting powder in cartridges simply fixed in between the ingots with clay. A similar group of smaller ingots, weighing 8 cwt. each, fared no better with a 2 lb. charge. The huge fragments, rushing hurtling through the air and ploughing rugged tracks over the fields, presented a most impressive spectacle, which was enjoyed by the visitors at a discreet distance, being, in fact, productive of an incipient stampede A less imposing, but practically valuable, illustration was afforded by the splitting-up a large block of freestone by a 2-oz. cartridge placed in a shallow cavity. A heavy rail was also cut to pieces by an 8-oz charge simply laid on it without tamping, and a post 12 inches square was neatly snapped off by a cartridge (2 lb.) hung loosely against it, being exploded.

As a variation, we were shown a 30-lb. charge, lightly covered with sods, instantaneously excavating a grave-like cavity over 20 feet long and 8 feet deep. Lest a suspicion should exist that interment, with its consequent damp, might prove fatal to its destructive power, it was demonstrated that powder, said to contain 20 per cent. of moisture, and to be incombustible by ordinary means, was by no means harmless.

An appropriate conclusion to a uniformly satisfactory series of demonstrations was found in the firing of a 50-lb. torpedo, sunk under 10 feet of water, which threw up a magnificent jet of water, some 200 feet high, with a force that would lead to the inference that the stanchest ironclad would prove an easy victim to such an infernal machine, were it once located under her hull

Two additional points respecting the new powder, gathered from the day's investigations, are, that its state of minute division gives it a more certain and uniform composition with a smaller chance of any unduly acid portion escaping detection: the addition of an alkaline body also neutralises any free acid and diminishes the chance of spontaneous combustion. Of its strength there can be no question, and the improbability of its exploding with any provocation short of the contiguous firing of a particular class—or classes—of detonators seems also tolerably evident. That so few precautions were taken on Wednesday, while the whole process was being peered into and explored by some score of inquisitive mortals in ordinary attire, appears to indicate that the company's officers share the opinion of Professor Attfield "that the patent cotton gunpowder is less dangerous to handle, transport, or store, than common gunpowder."—*Iron*.

EGGS AS FOOD.

The *Poultry Review* gives the following estimate of the relative value of eggs as food:—Would it not be wise to substitute more eggs for meat in our daily diet? About one-third of the weight of an egg is solid nutriment. This is more than can be said of meat. There are no bones and tough pieces that have to be laid aside. A good egg is made up of ten parts shell, sixty parts white, and thirty parts yolk. The white of an egg contains 86 per cent. water, the yolk 52 per cent. The average weight of an egg is about two ounces. Practically an egg is animal food, and yet there is none of the disagreable work of the butcher necessary to obtain it. Eggs are best when cooked four minutes. This takes away the animal taste that is offensive to some, but does not so harden the white or yolk as to make them hard to digest. An egg cooked very hard is difficult of digestion, except by those with stout stomachs, such eggs should be eaten with bread and masticated very finely. An excellent sandwich can be made with eggs and brown bread. An egg spread on toast is food fit for a king, if kings deserve any better food than any body else, which is doubtful. Fried eggs are less wholesome than boiled ones. An egg dropped into hot water is not only a clean and handsome but a delicious morsel. Most people spoil the taste of their eggs by adding pepper and salt. A little sweet butter is the best dressing. Eggs contain much phosphorus, which is supposed to be useful to those who use their brains much.

The *Revue Industrielle* states that sour milk, after protracted exposure to the sun, developes a poisonous quality, sufficient to cause disease and death to pigs fed thereon.

By rubbing metallic surfaces with soda amalgam, and pouring on a solution of chloride of gold, gold is taken up by the amalgam: and it is only necessary to drive off the mercury by heat, to obtain a gilded surface that will bear polishing.

SCIENTIFIC NEWS.

THE ARCTIC EXPEDITION.—It is reported from Malta that Captain H. E. Feilden, Paymaster of the 12th Brigade, Royal Artillery, serving in that garrison, and author of "The Birds of the Faroe Islands," &c., has been selected by the Royal Society to proceed as naturalist with the forthcoming Arctic expedition. The plan of the Arctic expedition will be as follows:—Two ships are to proceed to the entrance of Smith's Sound this year. One will stay there and set to work, establishing depots northwards, and the other will sail northwards, and, when stopped by ice, or when arrived at the farthest point from which it seems practicable to keep up communications with its consort, will, in the same spider-like fashion, begin stretching out a line of depots northwards. This will be the work of the autumn and winter of 1875, and in 1876 the advanced ship will send out a sledging expedition towards the Pole, which, instead of carrying all its commissariat along with it, will find much of it *each* in the depots of the previous year.

PAPER FROM PEAT.—M. Bertmeyer has recently exhibited, in the Polytechnic Society of Berlin, specimens of paper and pasteboard obtained from the products of the peat beds about Konigsberg, the quality of which is said to be excellent. The pasteboard was 2.4 inches thick, and sufficiently hard and solid to admit of polishing. The paper made from peat alone was brittle, like that manufactured from straw, but the addition of fifteen per cent. of rags produced the requisite toughness.

DIMENSIONS OF THE EARTH.—Two German scientific men, Messrs. Behum & Wagner, have recently published the results of some very accurate measurements that they have made respecting the dimensions of the earth. From these it appears that the length of the polar axis is 12,712,136 metres, that of the minimum equatorial diameter which is situated 103 deg. 14 min. east of the meridian of Paris, or 76 deg. 46 min. west, is 12,752,701 metres, whilst the maximum diameter at 13 deg. 14 min. east, and 166 deg. 46 west, is 12,756,588 metres. They estimate the total surface of the globe at 509,949,000 square kilometres, whilst its volume is equal to 1,082,960,000,000 cubic kilometres. The circumference of the globe on its shortest meridian is 40,000,028 metres, whilst that of the longest is 40,063,903 metres. The oceans and glaciers occupy 375,127,950 square kilometres. The total number of inhabitants of the earth is estimated at 1,391,000,000, viz., 300,530,000 in Europe, 798,000,000 in Asia, 203,300,000 in Africa, whilst the population of America is 84,542,000, and that of Oceania 4,438,000. The population of the towns and cities exceeding 50,000 inhabitants is 69,378,500, or about one-twentieth part of the total population of the globe, leaving nineteen-twentieths of the inhabitants for the villages and smaller towns.

M. P. TREMOR states that glass vessels in which various liquids, and even pure water, are boiled give up by degrees a small quantity of their substance, silica, potash, soda, and lime. The analysis is the more erroneous the longer the boiling is kept up. This, at least, is what results from the use of glasses brought from Germany, and sold at Nancy in 1873 and 1874. This fact may be shown by boiling in a flask pure water mixed with a tincture of red cabbage or sirup of violets, slightly reddened by an acid. After boiling for a few minutes, the liquid turns green. French glasses, with a base of soda, are not sensibly attacked, and therefore do not offer this inconvenience.

THE physical influence of the solar forces in exciting life in germs has of late years attracted much attention. M. de Candolle has especially selected as an illustration of this, some observations recently recorded by Prof. Von Heldreich, of Athens, which seem to show that certain seeds may germinate after having lain dormant in the ground for at least fifteen hundred years. A species of *Glaucium*, one of the poppy order, has sprung up in localities which have been covered with a great thickness of old slags from the smelting works in which the silver ores from the Laurium mines were reduced, these slags being re-worked for the sake of the metal which they still retain. It is known that the accumulation of slags cannot be less than fifteen hundred and may be as much as two thousand years old. The plant appears to be a new species—if, indeed, anything can be called "new" which was known fifteen centuries ago—and has received the distinctive name of G. Serpieri. These observations, says the *Athenæum*, go to prove the correctness of Lavoisier's statement, that organisation and life are directly dependent on light.

PROFESSOR William North Rice, of Middletown, Conn., states that among the most interesting results of his experiments was the observation that certain poisons, which act with extreme violence upon the mammalia, are very feeble in their action on mollusca. This is especially true of hydrocyanic acid and woorara. Specimens of *Illyanassa obsoleta*, immersed in dilute hydrocyanic acid on Friday, showed somewhat feeble signs of life on the following Tuesday. A specimen of *Lunatia heros*, into which a quantity of woorara had been injected, was found the next day to show no sign of any injury. Indeed, both of these poisons seemed to produce death very little sooner than the animals would have died in stale water. The sudden introduction of a large amount of carbonic acid in the manner which has been described, seemed to produce no decided effect. On the other hand, chloral hydrate seems to be very suddenly fatal, the animals treated with it becoming instantly contracted, and not resuming their activity when kept for a number of hours in sea water. Cyanide of potassium is similar in its effects, though not quite so instantaneously fatal. The effects of quinine are similar, though less energetic. Chloroform produces instantaneous contraction, and probably death.

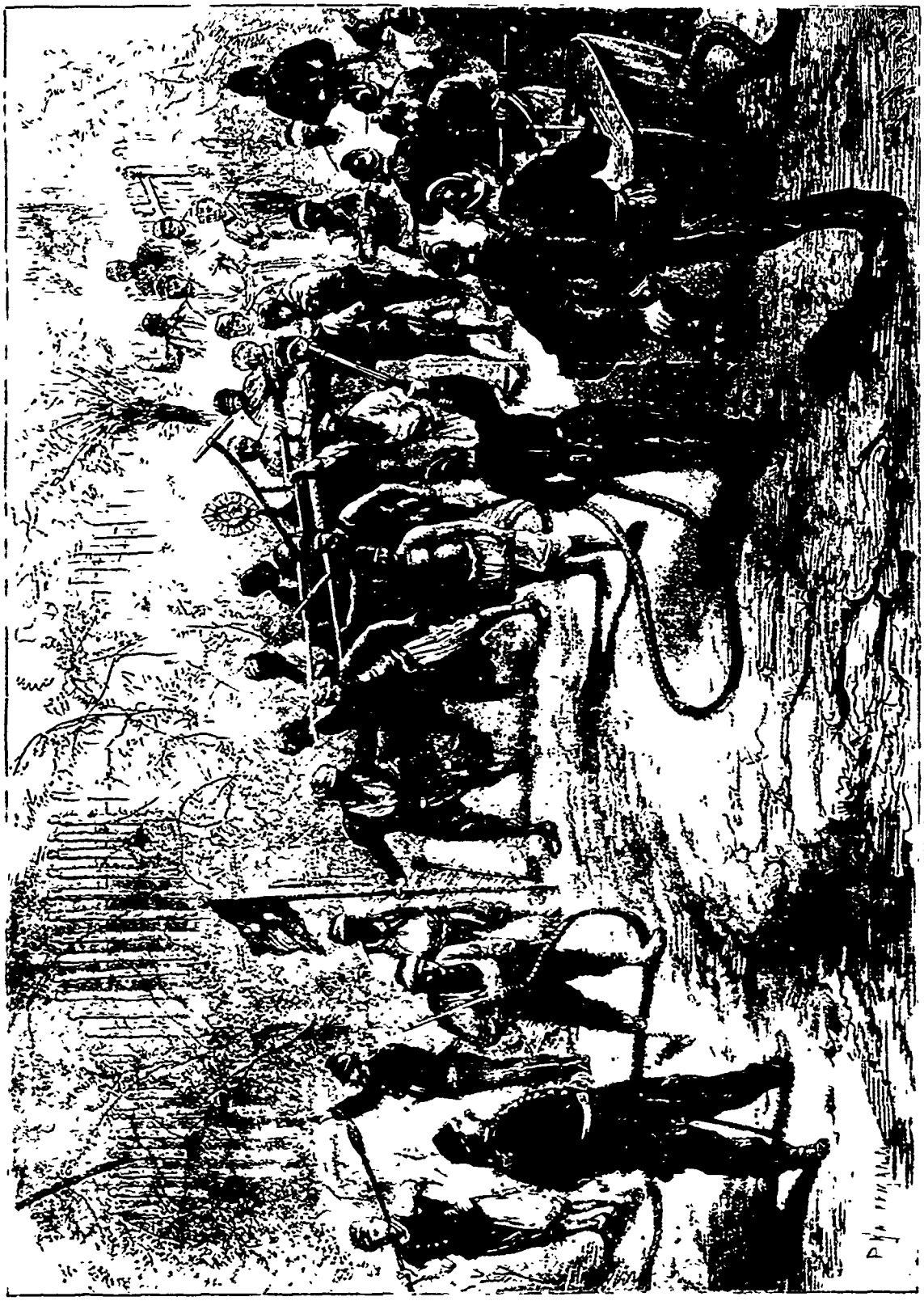
M. TELLIER suggests the use of sulphur as a means of extinguishing fire on board ship. The material when burning in the air, as is well known, generates sulphurous acid, in which flame is not sustained. M. Tellier proposes to cover wicks with the sulphur, and to let them down into the burning portion of the vessel, through holes in the decks. Sixty-six pounds of sulphur ignited will entirely absorb the oxygen in 3,360 cubic feet of air; but as only half the oxygen need be removed in order to render the atmosphere unfit to support the combustion, thirty-three pounds are sufficient for the volume mentioned.

A RECENT French process consists in obtaining sugar from molasses by the addition to the latter of certain salts which provoke crystallisation. The plan is to add to spent molasses—containing, say, fifty per cent. of sugar, fifteen per cent. of salts, and twenty per cent. of water, crystallised sulphate of magnesia in the proportion of twenty per cent. by weight, together with a little water, to make a solution of the sulphate marking ten degrees Beaume. The whole is then subjected to centrifugal action in a machine having either perforated sides or very fine wire cloth. The sulphates of lime and potash precipitated are retained, and the liquor is then filtered through charcoal, and boiled in *vacuo*. After cooling, a certain quantity of pounded sugar is added to form nuclei, and the syrup is lastly subjected to the ordinary temperature of fillings, the heat being alternately raised and lowered. After a few days crystallisation becomes exceedingly abundant, and continues to increase for some time, after which the hydro-extractor is employed. The crystallisation of the sugar results from elimination of the potash, the salts of which are prejudicial, its place being taken by the magnesia, whose salts are favourable.

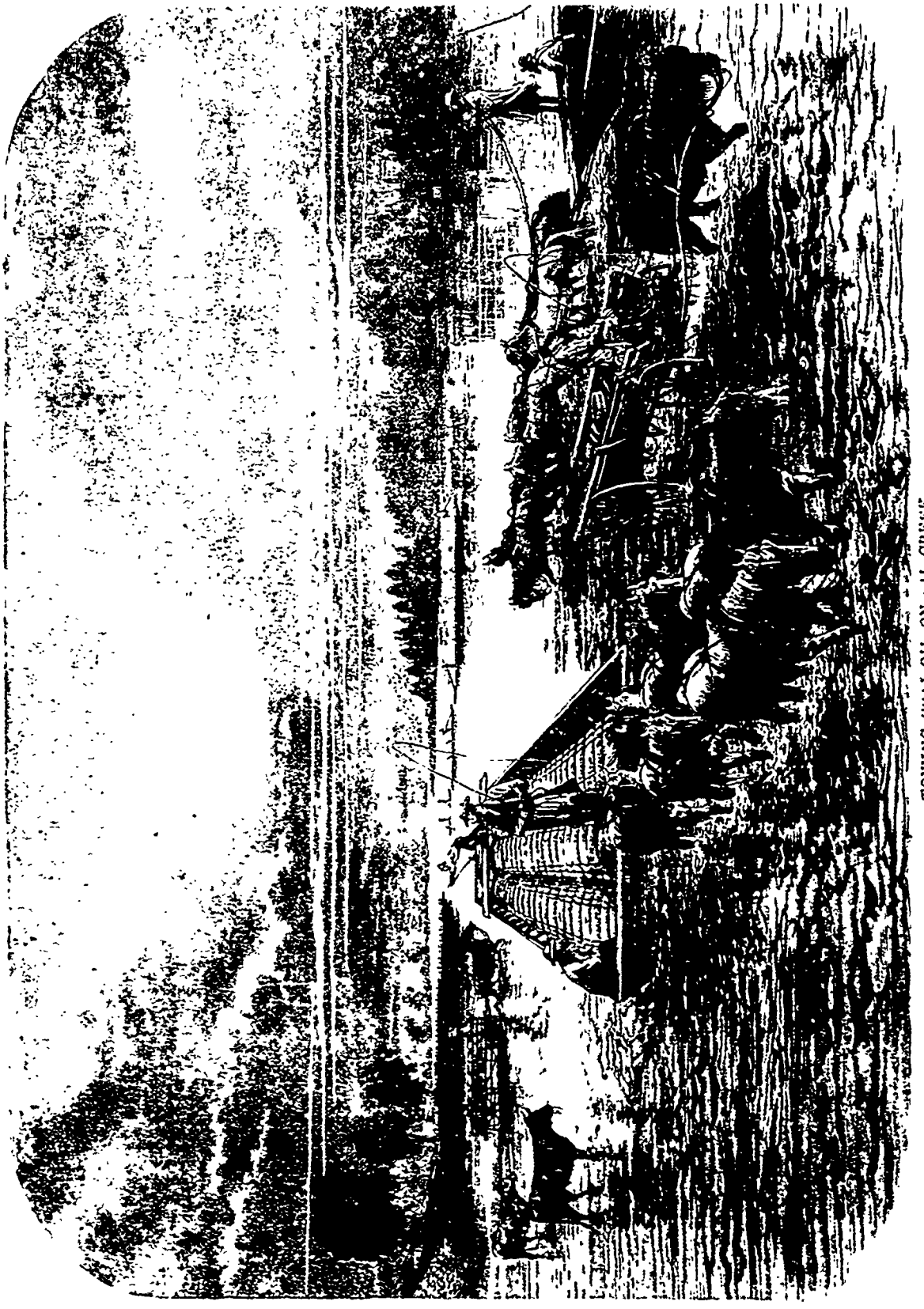
The Cariboo *Sentinel* of the 9th of January contains the following mining intelligence.—All the claims on Williams Creek have been obliged to stop work on account of the cold weather. The claims above the Cariboo are now dry, and the bed-rock drain will be cleaned out next week. At Lightning Creek the Van Winkle Company washed up 256 oz. last week, and 110 oz. on Wednesday. Victoria Company 70 oz. last week, only worked part of two days. Vancouver Company 326 oz. last week, and 140 oz. on Wednesday. Vulcan Company prospecting on both sides of their main drive, and running ahead. Costello Gladstone Companies are unable to work to advantage, on account of scarcity of water.

THE HUDSON RIVER BRIDGE AT ALBANY.—The immense traffic which passes over this bridge may be learned from the following item:—Every day of the year 700 passenger and freight cars pass over the bridge into this State. Every passenger of the hundreds on the trains has to pay five cents toll, and every ton of merchandise has to contribute to the revenues of the Bridge Company. Every barrel of flour is assessed four cents, and every car of coal or lumber is levied on to the extent of $5, and each car-load of cattle or sheep has also to pay toll. The bridge earns $1,500,000 per year, and paid for itself in a year and a half.

CAPTAIN Lull, who is surveying the route for a canal along the line of the Panama Railroad, finds the result more favourable than was expected, and has discovered a lower summit level than that of the railroad, which is 262 feet.



THE BRIGADE SERVICE AT CONSTANTINOPLE



TOWING COAL OIL ON OIL CREEK.

TOWING COAL-OIL ON OIL CREEK.

The scene of our illustration on page 125, for which we are indebted to the *Ill. London News*, is in the North-West corner of Pennsylvania towards the shore of lake Erie. It is in the counties of Venango and Crawford, beyond the Alleghany river, that the Oil Region is mainly situated. Its special industry has given rise to an immense trade, which had, even ten years ago, reached the proportion of four and a half millions of barrels annually, worth from twenty-five to thirty millions of dollars. A large population has been attracted to the Land of Oil, as in other parts of America to the gold-fields; and new towns have not less rapidly grown up, such as Corry, which before were not in existence, while towns of older foundation, like Franklin and Meadville, have become great places of profitable business.

The country traversed by the railway leading to the oil-fields is characterised by some very striking and picturesque scenery. Having quitted Salamanca, where the Atlantic and Great Western line runs towards the west, the influence of the new commerce on all the surrounding district becomes apparent. The forests have fallen under the axe, and cultivated fields occupy the space once covered with thick wood. Handsome farms and immense granaries occupy the higher lands, while new cities in transition are to be seen at several points along the route of the railway. By this line the traveller will reach Corry, the point of departure for the oil regions, but which is not the usual route taken by travellers from the east. The proximity of the valleys where the petroleum is found is now evident. On the numerous tramways may be seen trains laden with black barrels reeking with the unctuous fluid on their way eastward, and other trains carrying small steam engines on the road to Oil Creek, where they will be used for extracting fresh supplies from the greasy earth. The number of these machines affords a good indication of the increasing development of the petroleum country. The sudden rise of Corry is in itself sufficient to prove what an enormous influence the new commerce is destined to assume. A few years ago the site of the town was a thick wood, where not a single house was to be seen, and with no sign of civilisation except the new railway which crossed it; now it is a city, full of activity and bustle, with 4000 inhabitants, all hard at work in the staple industry by which they are seeking to become rich. The creation and growth of the place are solely due to the first operation known as "striking ile." One immense refinery deals with something like 300 barrels of oil a day, and is situated close to the roadway. On the other side are deposited vast piles of barrels of petroleum waiting to be taken away by the trains of the Oil Creek branch railway line and dispatched to their various destinations. The people of the town are so completely absorbed—so steeped, as it were—in petroleum, that they have no leisure for any pursuit unconnected with the ceaseless industry of the place.

The railway from Franklin to Oil City runs along the bank of "French Creek" — the American meaning of the word "creek" being a stream which debouches into a larger stream, so that the creek is, in fact, navigable for barges and flat-bottomed boats even in its shallows. The aspect of the country is very pretty, not unlike that of the Thames at Reading. Of course the occasional appearence of tall poles and stages for machinery show the locality of the oil-wells, and both here and on the banks of "Sugar Creek" the barrack-like sheds are the principal signs of habitation. It is at Franklin, an old town, with its Fort Venanga, which guarded the French border in former years, that the sales and transfer of land are completed and most of the business done; but Franklin is not the capital. Oil City is the real capital, seven miles higher up the Alleghany, where that river receives the waters of Oil Creek. The voyage can be made on the stream by means of the "petrolia" steamers, which are crowded with greasy passengers but the journey takes two hours, because of the rapidity of the current, while the return voyage can be completed in forty minutes.

Our Illustration is a view of Oil Creek or River, with the long six-horse waggons conveying barrels of petroleum oil across its wide and shallow fording-place

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The Rice Lake Railway bridge is making satisfactory progress. The contractor is making every necessary exertion, and the bridge will be open for traffic next summer.

THE ROMAN CAMPAGNA.

Once more an attempt is to be made to drain this pestilential tract of country, which contains about 3,900 square miles, or 3,000,000 acres. Independent of the indelible associations with which it is connected, and the glorious deeds of which it has been the theatre, its appearance produces an extraordinary impression on the mind of the beholder. Silence and desolation are around. A space extending from Otricoli to Terracina, above sixty miles in length, and on an average twenty in breadth, between the Apennines and the sea, does not maintain a single peasant. You look in vain for a ploughed field, a sheaf of corn, or even a house There is nothing to indicate the present existence of man, but his former existence is marked by the tombs which line the road, and the gigantic remains of aqueducts striding across the plain, which once brought, and some of which still bring, the water cool and clear from the fountains of the Appennines to Rome.

Dickens thus graphically sketches the scene:—"An undulating flat, where few people can live, and where for miles and miles there is nothing to relieve the terrible monotony and gloom. Of all kinds of country that could by possibility lie outside the gates of Rome, this is the aptest and fittest burial-ground for the Dead City. So sad, so quiet, so sullen; so secret in its covering up of great masses of ruin, and hiding them, so like the waste places into which the men possessed with devils used to go and howl, and rend themselves in the old days of Jerusalem." But though a curse seems to have fallen on the country, as far as man is concerned, it is far otherwise with the powers of physical Nature. Vegetation springs up yearly with a vigour undiminished, since the days when Cincinnatus guided his plough through the fields of his Sabine farm. The herbage is so rich that the herds of savage buffaloes and cattle which pasture the district, are unable to keep it down, and the greater part of it becomes rank. The prolific powers of nature are still more marked in the Pontine Mashes during the hot months, when the air is so laden with poison that it is dangerous, and felt as oppressive even by the passing traveller.

It was not thus in former times. The Campagna, now so drear and desolate, was once thickly inhabited, an historical fact of which its numerous ancient cities are alone sufficient evidence. The Pontine Marshes were inhabited by thirty nations. The freehold of Cincinnatus, the Sabine farm, stood in the now desolate plain at the foot of the Alban Mount. We read that so rich were the harvests, and so great the agricultural treasures to be collected in the plains round the Eternal City, that for two hundred years and more after the days of Romulus and Remus it was the great object of their foreign wars to gain possession of it. It is certain also that at a later period the vicinity of Rome was deemed insalubrious, for Cicero describes its site as "locum in regione pestilenti salubrem", and Livy, speaking of the mutiny of the Roman garrison of Capua, in the year of the city 413, says that among other grievances they complained of having to fight in the pestilential marshes round the city. Strabo says that in his day the insalubrity of the air was confined to a few places in the neighbourhood of Ardea and the Pontine Marshes, and it is well known that during the first three centuries of the empire, the Campagna was studded with numerous villas, as their ruins still attest. At present it has returned to the state of abandonment and consequent insalubrity mentioned by Cicero and Livy, and this evidence proves that the air of the Campagna has differed at different periods. It has been healthy when peopled and cultivated, and insalubrious when comparatively reduced to a desolate wilderness. so it would seem that its healthiness or the contrary depended on its population and cultivation. We must seek for the active causes of the unhealthiness of the Campagna in its low level, in consequence of which it must, without proper drainage, retain the stagnant waters that fall in rain, that descend in torrents from the hills in the vicinity, or escape from the ruined aqueducts in the quantities of animal and vegetable matters decomposed on its surface during the hot season, in the evaporations from its marshes and morasses; and, perhaps, in its proximity to the Pontine Marshes, for it is recorded that in the days of Trajan it was the opinion of many persons that Rome itself, although forty miles distant, was affected by the Pontine malaria. We learn from Gell's "Topography" that in the time of Theodosius the Campagna was a desert, and Gregory the Great expressly says, "The lands are depopulated. No one

dwells in the fields." The only inhabitants of the Campagna are the shepherds, armed with long lances and mounted on small and hardy horses, who are occasionally seen following or searching in the wilds for the herds of savage buffaloes and other cattle; and the few wretched beings that are to be found at the post-houses.

Many attempts have been made, but with partial success, to drain the Campagna About three centuries before the Christian era, Appius Claudius, the censor, surnamed the Blind, stood forward as the first restorer of this tract of country. He carried across the morass the road which is still known as the Appian Way, which in magnificence has never been surpassed. It was not, however, till a century and a half after the making of the Appian Road that Cornelius Cethegus, the consul, undertook to drain the Pontine Marshes. Dugdale, in his "History of Imbanking and Drayning," quaintly tells the story:—"In the year 593, when L. Amicius Gallus and M. Cornelius Cethegus were consuls, the Senate being in counsel concerning the provinces, because these seemed not sufficient use against the enemy for the ordinary forces of both the consuls (which are four legions besides the Auxiliaries and Socii), there was a motion made concerning the improvement of a great level of waste land lying under-water about forty miles from Rome, in Latium, which business was entertained with great approbation.....The consuls A° 566 had herein given a president, who, lest their soldiers should be idle, employed them in making highwayes. Hereupon it was decreed that one consul should attend the enemy (in Gallia), and the other undertake the drayning of the Pompeine (Pontine) Marshes." The efforts of Cethegus were transient and impotent. Julius Cæsar found this large tract of country a prey to new desolation, and was about to restore it to fertility, when death suddenly put a stop to his plans. Augustus took up the work, and cut alongside the Appian Way a canal which was destined to receive the stagnant water, and to afford it an outlet. It was on this canal that Horace and Mæcenas embarked on their way from Rome to Brundusium After Augustus came Trajan, who was followed by Theodoric, and in more modern times by several of the popes, who attempted, with partial success, the restoration of the territory. It remained for Pius VI. to do more for the Campagna than any of his predecessors had been able to effect. Immediately after his accession, he went to visit the Campagna. One of his biographers states that "He shuddered when, from the top of a hill, he saw at his feet the deep ravages of time, and of the inundations, the pestiferous fogs, which extended far and wide, and the dangers which ever threatened his sacred person, should he dare to tread the unsolid ground." On his return to Rome, he established a bank, under the name of Monte dei Marecagi, to receive the funds necessary for the enterprise, and in a little time the voluntary subscriptions amounted to 120,000 Roman crowns. Belognini, one of the engineers whose plans had been submitted to Pope Clement XIII, was immediately put at the head of the undertaking, and in 1777 Sain, an eminent surveyor, was ordered to draw a plan of the ground, and to indicate the spots in which the works might be begun with the greatest probability of success Pius succeeded in draining 9,000 rubbi which were constantly under water.

The work that Pius VI left off is to be taken up—in fact, is already begun—by the King, at the earnest entreaty of Garibaldi. The king has headed the subscription lists, which are being rapidly filled up With the wonderful appliances of the present time, it is to be hoped that in a few years more improvements will be effected than in the hundreds of years that have elapsed since Appius Claudius was Censor of Rome. It is scarcely too much to expect that Garibaldi may guide the ploughshare through the same fields which were cultivated by his great prototype, Cincinnatus.*—*The Builder.*

* For General Garibaldi's scheme for diverting the course of the Tiber and improving the Campagna 100,000,000 francs are needed The shares are to be 100 francs each. The King promises to use his influence in order to induce the Government to guarantee 5 per cent. His Majesty heads the share-list. Garibaldi is said to be anxious to put himself in communication with engineers. He has addressed a circular to the English newspapers, in which he says.—"I hope that the English people will support the project for the diversion of the Tiber and the improvement of the Agro Romano. I propose that the shares should be 100 lire each, with a guarantee from the Italian Government."

☞ It is expected that 500 men will be at work on the railway in Pontiac county by the 1st of June next.

MISCELLANEA

Canada owns 6783 vessels of various kinds, gauging 1,073, 718 tons.

The long pending contract for building a railroad 850 miles long from Laredo, on the edge of Texas, to Leon, 283 miles from the city of Mexico, has been signed by the Mexican President. The building of the route from Leon to the city of Mexico will be in the hands of a different company.

With the exception of small orders which are sometimes sent to Smyrna commission agents for crude stone to be directly shipped to the United States for use of American crushers, the entire product of emery is sent forward by the contractors to England, and all crushers are supplied from the stock of crude stone there.

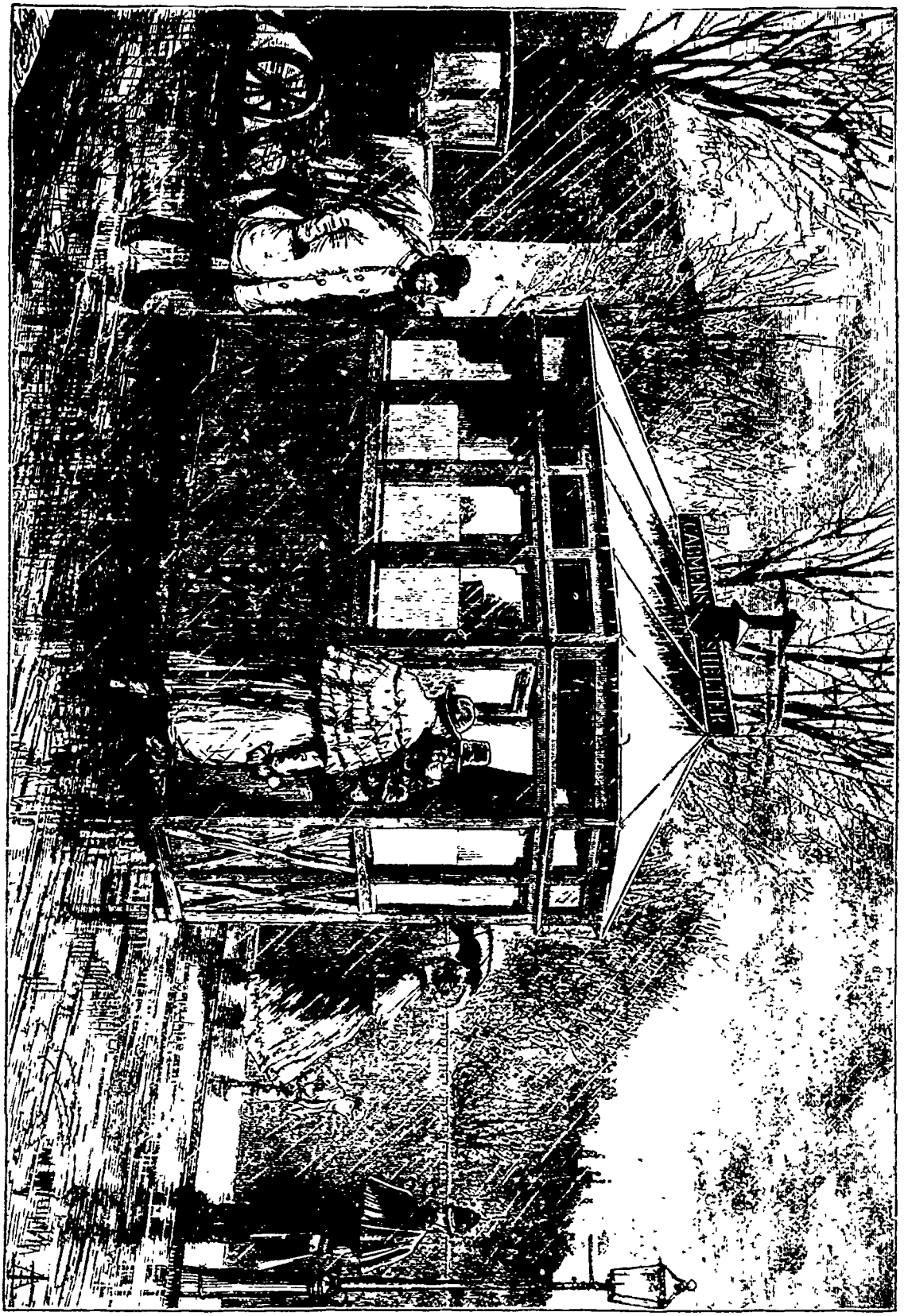
The Mount Cenis tunnel cost about £60 per lineal foot. This outlay included, however, the equipment of the road, &c. The Terre-Noire tunnel on the Paris, Lyons, and Mediterranean Railway, cost about £10 per foot. The Hoosac tunnel, which is carried through a formation of mica slate, and quartz, cost £60 per lineal foot.

Experiments in Sugar Beet Culture—The following is a summary of the results of field experiments on thirteen farms in various parts of Germany in the culture of sugar beets. Eight tons of farmyard manure per acre gave upon a plot of a certain size 2,020 pounds of beets, with 13 5 per cent. of sugar, 1,120 pounds of Peruvian guano, "dissolved," or treated with sulphuric acid, per acre, gave 4,592 pounds of beets, with 14.1 per cent. of sugar. The manured plot gave at the rate of 289 pounds of sugar per acre in excess of an unmanured plot, and the plots in which guano was applied an excess of 508 and 640 pounds respectively.

Tree culture in the United States is becoming quite extensive. Under the Act of Congress offering 160 acres of land to any person who would plant 40 acres of them to trees and cultivate them for eight years, about 1,100 persons, it is stated, had taken up 170,000 acres of land in Minnesota, up to January. By the effort of the State and private and associated effort, it is estimated that 25,000,000 trees are now growing in Minnesota, besides those planted under the congressional act. A report on the subject says that the cost of planting and of cultivation is marvelously small, in many cases not exceeding from two to five cents a tree. The artificial culture of trees is coming more and more in vogue in California, and the demand for young trees to set out, this spring, is said to be very large.

Work on the bridge over the Missouri river, at Atchison, is progressing as rapidly as possible, and the structure will doubtless be complete within the stipulated time. The American Bridge Co., of Chicago, is performing the work. The bridge will be 1144 ft. long, exclusive of approaches. It will consist of three fixed spans, each 260ft. in length, and one draw span 364ft. in length. The grade of the bridge will be 10ft. above the high water mark of 1814. The approaches to it will descend so as to reach the second grade at Second-street, and the eastern approach will descend with a grade of 52ft. per mile, for about a quarter of a mile, where it reaches the level of the Hannibal and St. Joseph and the Chicago, Rock Island, and Pacific railroads track. The bridge is located just south of Main-street, directly opposite the termini of the Atchison, Topeka and Santa Fe and the central branch of the Union Pacific Railroad tracks, and nearly opposite the depots of the Atchison and Nebraska and Missouri Pacific railroad.

An enterprising Canadian has created a good deal of jealousy among American contractors who are anxious to improve the Sault Ste Marie Canal by underbidding them. The Oswego *Times* alludes to the matter as follows:—An interesting question has been submitted to the Secretary of War. There are twenty-seven American bidders for the stone contract for the improvement of the Sault Ste. Marie Canal. The amount of appropriation is $300,000. The Marblehead quarry near Toledo is the lowest American bidder. There is a Canadian bidder, who has quarries near St. Catharines, Ont, who has slightly underbid all the American bidders. The point raised is whether the Secretary of War is to construe the words of the lowest bidder to comprehend foreigners.



A CARMEN'S SHELTER.