Technical and Bibliographic Notes / Notes techniques et bibliographiques

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

- [ ] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [x] Bound with other material/ Relié avec d'autres documents
- [x] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

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

- [ ] Coloured pages/ Pages de couleur
- [ ] Pages damaged/ Pages endommagées
- [ ] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] Showthrough/ Transparence
- [x] Quality of print varies/ Qualité inégale de l'impression
- [x] Continuous pagination/ Pagination continue
- [ ] Includes index(es)/ Comprend un (des) index

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

- [ ] Title page of issue/ Page de titre de la livraison
- [ ] Caption of issue/ Titre de départ de la livraison
- [ ] Masthead/ Générique (périodiques) de la livraison

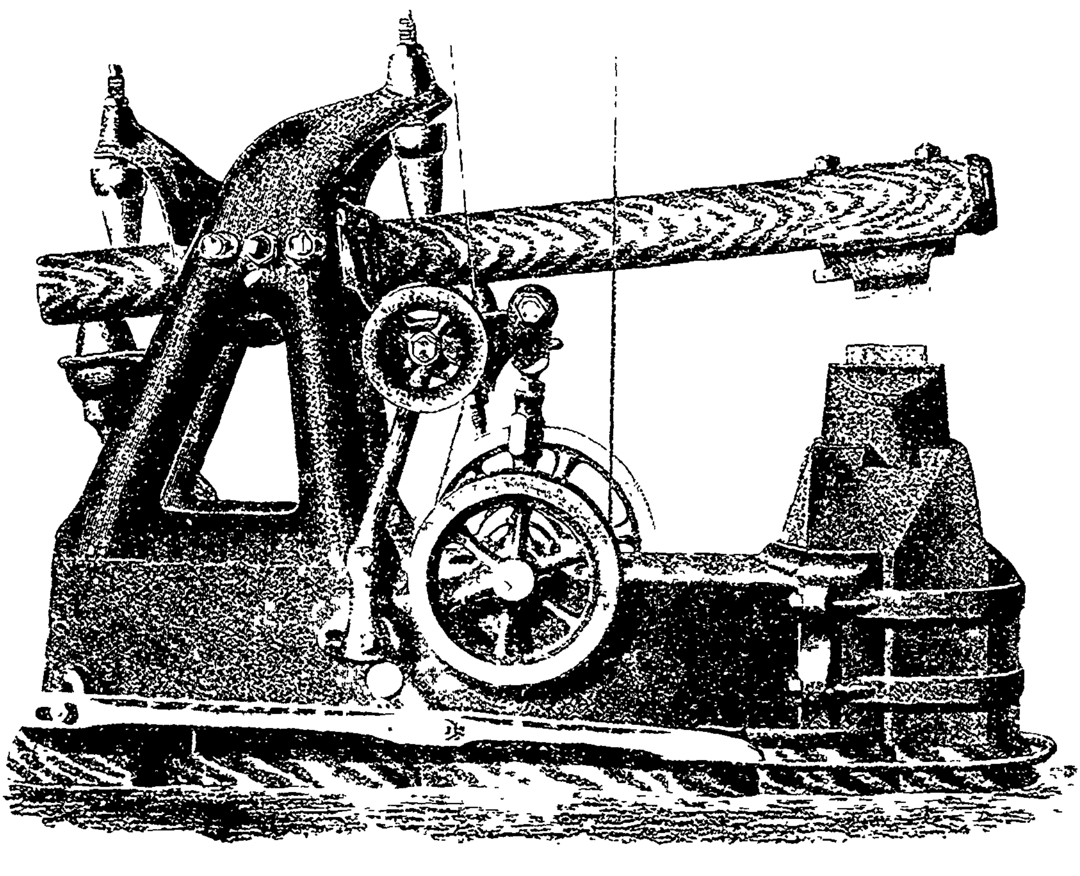
- [ ] Additional comments:/ Commentaires supplémentaires:

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

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

The Canadian Patent Office Record and Mechanics' Magazine

Vol II.—No. 2. MAY, 1874. Price in Canada $1 50 per An
United States - $2 00 "



BRADLEY'S CUSHIONED HAMMER.

BRADLEY'S CUSHIONED HAMMER.

We spoke in high terms of this invention upon the occasion of its exhibition at the fair of the American Institute in this city. Since that time its use has been greatly extended, and it is now introduced into many of the most important manufacturing establishments in the country. Its manufacturers have received a great number of favorable testimonials from those who have proved its merits in practical and continued use The hammer is adjustable in line of action, length of stroke, rapidity of motion, and in weight and force of blow Each or any of these may be changed, and most perfectly controlled at the will of the operator. In addition to these desirable qualities, it is adaptable to any work which requires continuous, exact, positive, and forcible yet an elastic stroke The exceedingly difficult swaging of cotton-spindles, to which this hammer has been found eminently adapted, may be instanced as an illustration of the advantages possessed by it in work of this kind It is stated that no other hammer has been able to turn out cotton-spindles in quality and quantity as satisfactorily as this The capacity of the hammer is increased far beyond that of other hammers of its class, and at the same time it is compact and portable. As the use of the rubber springs obviates the stubborn jar of other hammers, it is far more durable and involves much less outlay for repairs All parts of the hammer are made of iron except the helve. The anvil-block has a foundation independent of that of the main bed, but the parts are so united as to transmit nearly the entire jar from the stroke of the hammer to the anvil-bed alone. The helve is nicely balanced, and swings upon two adjustable hardened steel eccentrics Motion is imparted to it by a broad steel eccentric, operating in connection with the clinch and the rubber cushions, the length of the stroke being governed by the adjustable eccentric The force of the blow is greatly influenced by the reactive and united action of the cushions. The action is so perfect that when the hammer is in rapid motion the hand, when placed upon the machine, can scarcely identify the strokes of the hammer. The action of the helve, through the use of the yoke and cushions, has a flexibility which resembles that of the smith's arm. It is claimed that the helve never breaks, and that the broad steel eccentric obviates friction and heat. The adjustable cushion at the apex of the standard assists the lower cushion in heavy work, and also checks the upward motion. A universal joint connection prevents any twisting of the yoke and consequent bind or friction A foot-treadle is used to apply and regulate the power, and is so arranged that the operator can stand in front or on either side. A gentle pressure of the foot upon the treadle causes the tightener to operate upon the belt, and thus varies the stroke in proportion to the pressure applied. On removing the foot, the treadle flies up, bringing a brake upon the balance-wheel, stopping it instantly. The hammer is thus always left up, and it cannot stop with the dies closed. This is considered a very important feature. — *American Artisan.*

VERTICAL ENGINE.

We illustrate on page 36, a very neat vertical engine of a type designed and patented by Mr. Jeremiah Head, of Middlesbrough, the particular engine shown being one constructed for the Middlesbrough Wrought Nail Company (Limited), by Messrs. H. Alexander & Son, of Cirencester. The conditions required to be satisfied by this engine were: that it should work direct upon a line of shafting on either side; that it should make 120 revolutions per minute; that it should go at a uniform speed, whether all the nail-making machines were in action, or some only, or none at all; that it should work as economically; that it should occupy little floor space; that there should be small liability to wear; and that repairs should be easily executed if necessary. To fulfil these conditions the following arrangements were made, embracing some mechanical novelties.

The crank-shaft is of cast steel, carried upon four bearings; the crank pin is larger in section than the rest of the shaft, to prevent the usual risk of breaking there. There are, as will be seen from our engraving, two flywheels, one on either side, equi-distant from the crank, and each close to a bearing. The crank and half the weight of the connecting rod are compensated for by weights upon the flywheels. The inner bearings are close to the cheeks of the crank. Within either flywheel is a sheave with a strap passing thence to corresponding sheaves upon the extremities of a horizontal spindle which drives the governor. On either side of the crank between the inner and outer bearings is an eccentric, the one for working the main slide, and the other for the expansion slide. These arrangements secure symmetry, equality of wear, and freedom for shaking at high speeds. The cylinder is intended to be steam jacketted in this type of engine, though it was not made so in the present instance. In the engine we illustrate the cylinder is 22 in. in diameter with 24 in. stroke.

The piston is one of the solid class, and is packed with Ramsbottom rings, but instead of being placed each in its own groove, as is the usual plan, these are inserted in pairs, in two grooves of twice the ordinary width, as shown at *y. y,* Figs. 4 and 5, on the opposite page. The rings forming each pair cross joint one with another, each one being prevented from turning by a small stud screwed into the bottom of the groove, and situated between the butt-ends of the ring. It is found that whereas Ramsbottom rings often stick, when placed between the two fixed surfaces of a single groove, they never do when one surface is a moving one, as in this arrangement. Greater security against leakage of steam past the piston is also obviously secured by crossing the butt joints of two rings in contact.

The main slide (see Figs. 4, 6, 7, and 9,) is cylindrical, controlling the steam in the ordinary way, so as to give a certain amount of lead and constant cut-off towards the end of the stroke. As will be seen from the detailed view Fig. 9, it has small grooves cut round it to prevent leakage past of the steam, but they do not make the entire circuit of the valve for a reason which will presently be explained. The main slide spindle is of cast iron, as well as the slide itself, for the latter being perfectly balanced but little force is required to move it Within the main slide is an expansion slide, similarly constructed, and actuated from the opposite end of the slide chest. The expansion slide *l,* is shown separately by Fig. 8. The two slides are carefully fitted and ground into their places, as is now frequently done with steam hammer valves, and in other cases where the cylindrical construction is used. When, however, these valves wear slack, which they are liable to do after a time, it is proposed to split them down one side from end to end, first drilling a series of holes, as shown in Figs. 8 and 9. By this device the internal pressure of the steam is utilised to keep them tight, while at the same time the stregth of the opposite side of the valve is so regulated as to prevent too much yielding, which would result in friction. When split the joint of the outer valve will be on the side towards the cylinder, while that of the expansion valve will be eactly opposite. Corresponding facings pass from top to bottom of the inner surface of the slide chest and of the main valve.

As will be seen from Figs. 4, 6, and 7, the slide chest is made removable from the cylinder, so that it, together with the valves, may be kept in duplicate if desired, and at any time changed in two or three hours' time. The main slide valve is worked direct by the corresponding eccentric. The expansion slide is worked from a weigh-shaft passing below the cylinder. The rod connecting the expansion eccentric with the lever upon this weigh-shaft is severed about half way up, the two ends terminating in blocks, working in two radial grooves in a horizontally situated vibrating link. By means of a weigh-shaft operated by the governor, as shown in Fig 3, two levers upon this shaft, and two curved links passing from the ends of these levers to the two parts of the eccentric rod, the link blocks already mentioned are held in position. The rise and fall of the governor obviously regulates the length of stroke of the expansion valve and so controls the cut-off of the steam.

The governor is of the cross-armed description, but has been improved in several particulars. It is driven by the horizontal spindle connected by two straps with the crank-shaft, as previously described, and as shown in Figs. 1 and 2 The pendant arms of the governor are furnished with links passing upwards to a small cylinder, which rises and falls around a piston secured to the top of governor spindle. A single stud placed vertically in the centre of the top cover of this cylinder and furnished with a small crosshead, forms a very simple and efficient means of connecting the rotating and vertically moving cylinder with the weigh-shaft and expansion gear already described. This arrangement of governor admits also of the pedestal being carried up much higher than ordinary, thus securing great stability to the enclosed spindle. The governor controlling cylinder is filled with creosote, which does not congeal in frosty weather, nor is it liable to rust the vessel containing it. A small cock attached to the creosote cylinder regulates the rapidity with which the governor is allowed to effect any change in the throw of the expansion valve. The mischievous alternations of speed, which are usually liable to occur from the momentum of the balls, can thus be entirely avoided. The bed-plate of the engine and the stonework below are chambered out so as to enable the engineman to enter, if necessary, and work comfortably below the cylinder. Relief valves pressed upon their seats by springs, are placed upon each of the steam passages of the cylinder to prevent danger from water in case of priming. The principles embodied in this engine are equally applicable to the inverted type. The particular engine referred to is driven with steam at a pressure of 70 lb. per square inch; it has been at work for nearly a year at Middlesbrough, and has realised all that was expected of it.

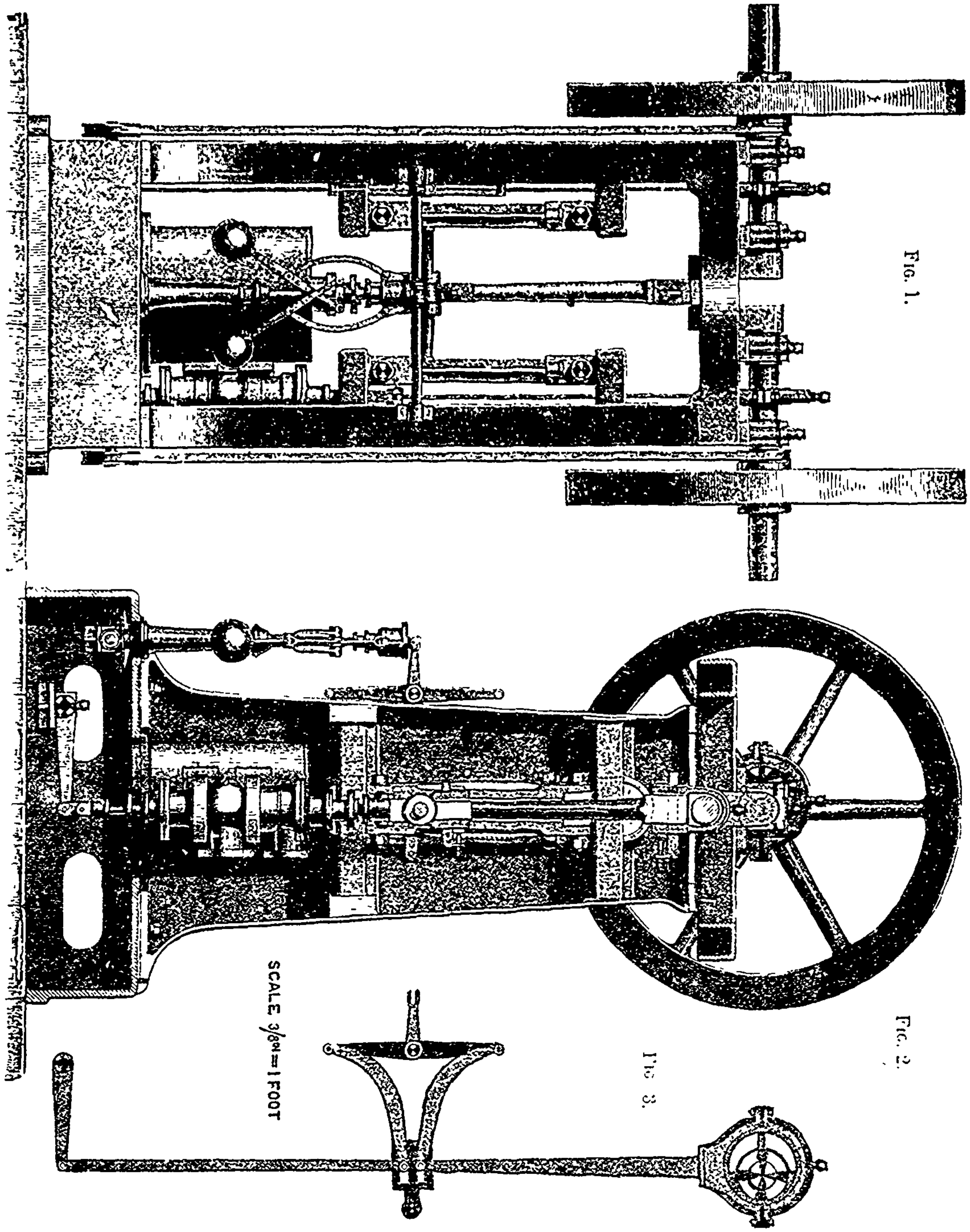
THE WASTES OF THE UNIVERSE.

Mr. Proctor, the well-known astronomer, after delivering above a hundred astronomical lectures in the United States, has been summing up in New York the general lessons which astronomy teaches as to the divine methods of creation, in a somewhat remarkable lecture on the principle of what would seem to men, judged by human standards, as divine waste. By "waste" he means of course, not absolute fruitlessness, but the lavish employment of forces acting on an immense scale, to produce results which seem comparatively very infinitesimal and very short-lived. When we say "to produce," we assume, perhaps, that what we regard as the end of creation is the end, simply because it is nearer akin to human ends But what Mr Proctor refers to is something of this sort:—In the first place, if Life of any kind at all resembling our own, is supposed to be one of the ends of physical nature, then it must be admitted that the spots in the universe where such life is possible are infinitely small, as compared with the spaces where such life is not possible. Concede, for instance, that such life cannot exist except on the surface of solid worlds, and you admit at once not only that the subterranean interiors of all these worlds are, as far as such life is concerned, wasted, but that the vacuum of the intermundane spaces, of course far more vast than the infinitesimal continents of the globes scattered about amongst them, is for the same purpose "wasted." But Mr. Proctor goes much further Assuming that, as far as we know anything whatever of the laws of physical life, a certain amount of heat and a tolerably dense atmosphere are necessary to it, while any very considerable excess of heat and any great deficiency of atmosphere would be fatal to it, Mr. Proctor at once excludes the great central suns from the class of habital worlds, as being centres of heat far too intense for anything like such life; while at the other extreme of the scale, he excludes a burnt-out ash like the moon, which has neither atmosphere nor water, from the category of worlds fit for any organisation known to us. And even between these limits Mr. Proctor finds but few planets which he thinks fit for such life as ours at the present moment. Venus and Mercury are both too much scorched up by the sun's rays, he holds, for any organisation we know. Mars, if not already too cold, is fast becoming so, with his comparatively small supply of watery vapour, and his immense fields of winter snow. Jupiter and the other known major planets are still, says Mr. Proctor, glowing masses of detached solar fire, not sufficiently cooled down for their surface to be the abode of life of our sort. In short, except the planet Mars, which Mr. Proctor thinks nearly, if not quite, past the stage at which there is sufficient heat to support life like ours, and one of the satellites of Jupiter, and possibly an asteroid or two, Mr. Proctor does not hold it possible that any life of the kind we know now exists elsewhere in the solar system. As for the other stellar systems, the stars themselves are centres of heat far too great for the existence of such life, and of their planets we know nothing. And he argues from analogy that but a very few even of the planets can be under the conditions which render organic life, as we know it, possible. At any one moment the vast majority of physical worlds in existence are, in Mr. Proctor's belief, unfit to support life, though each one of them may be, or may have been, for some small fraction of its career, the theatre of such life. The earth, for instance, must have been unfit to support life for ages before it had cooled down sufficiently for the purpose, and for ages after it shall have shrunk into the condition of the moon, it will again be unfit for the support of life. In a word, not only is the proportion of space devoted to organised life at any one moment an infinitesimal one, but if you take the career of any single world separately, you will find that its period of waste is an infinitude, in the midst of which its little age of habitability resembles a mere island in the wide and barren ocean of its desolation. The proportion of space utilised (if the support of organic life be the definition of "utilisation") to waste space is infinitesimal, and the proportion of time utilised (in the same sense) to waste time, in the history of any one among the material worlds, is infinitesimal also. For the most part, this is Mr. Proctor's inference from his astronomical surveys; the map of the physical universe is a map of vast solitudes, most of which, namely, the interstellar and intermundane spaces, were never adapted for organised life at all; while of the spots which are so adapted, the time during which there is a capability of supporting life is a mere narrow strip of isthmus between two infinite oceans of perpetual solitude, the infinite antecedent history of gradual preparation, and the infinite subsequent history of exhausted powers. According to this view, if life in any way like ours is the end of the material universe, almost the whole universe is either a blank, or a becoming, or a passing away, and the portions of time and space in which organic life has appeared, but not yet passed away, count but for a few drops in the ocean of perceivable space and recordable time.

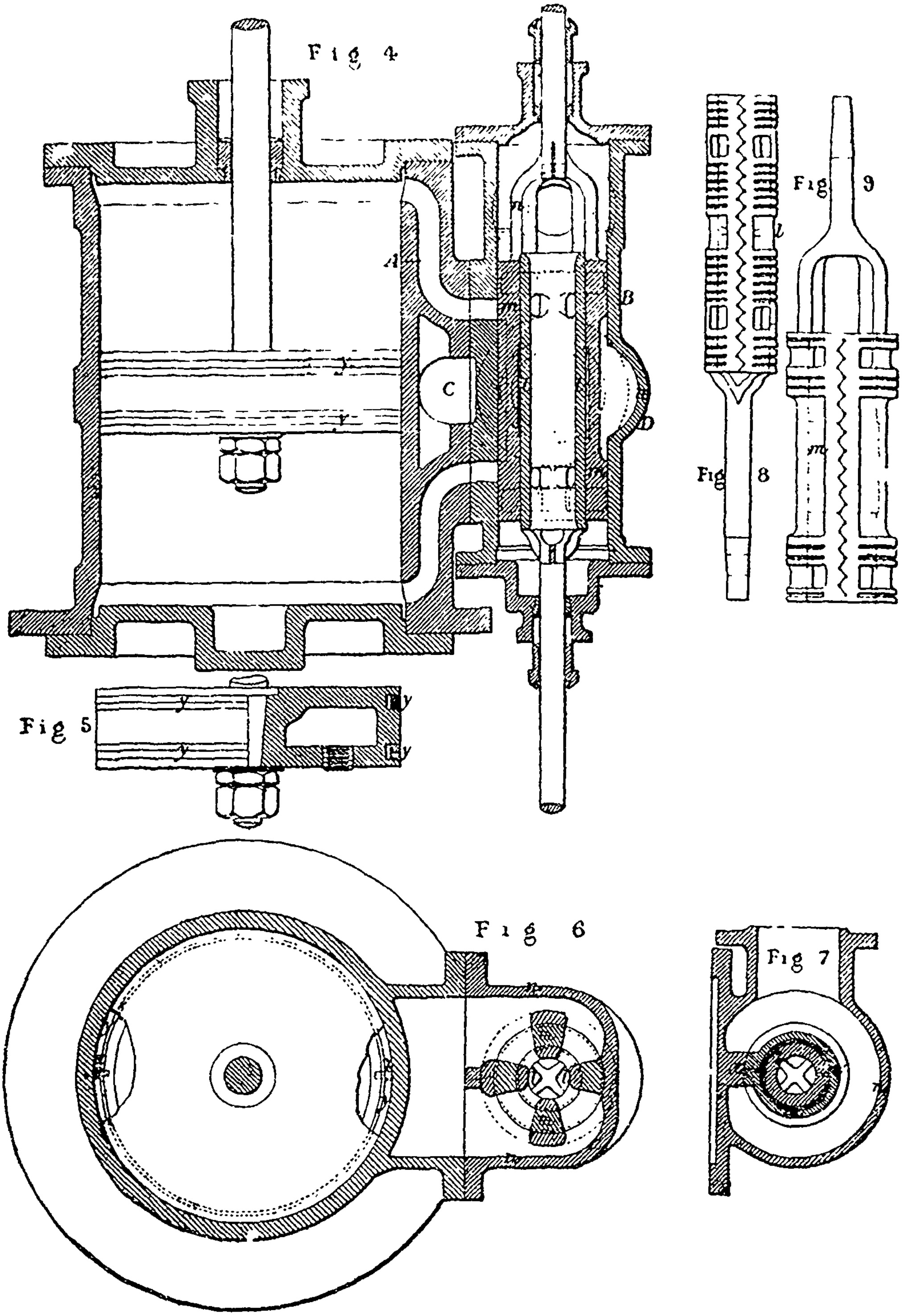
To an imagination so bewildered, as human imaginations so often are—not with the infinite repose of the universe, the lavish expenditure of time and force on apparently small results, but rather with the hurry, the crowding, the human frettings and fumings, of this vivid little world of misery and joy—there is something at first rather resting and solemn in thus realising for ourselves the infinite tracts of space and time which seem secure from the invasions of the swarms of organic life. A fanciful mind might even expect the earth herself to feel as if relieved of something of a fever-fit, after the comparatively short period during which she is fit for the support of organic life shall have elapsed, and the passionless calm of the lunar solitudes shall have succeeded to the tread of busy feet, and the crush of eager appetites. But that, of course, would be the mere fancy of minds solicited by too many competing interests, and yearning for a better adjustment between their thirst for peace and their impulses to action.

THE MAGIC OF AN AUCTIONEER'S ADVERTISEMENT.

The *Building News*, London is responsible for the following:—An English country gentleman recently became tired of his house, and determined to sell it. He instructed an auctioneer, famous for his descriptive powers, to advertise it in the papers for private sale, but to conceal the location, telling persons to apply at his office. In a few days the gentleman happened to see the advertisement, was pleased with the account of the place, showed it to his wife, and the two concluded it was just what they wanted, and that they would secure it at once. So he went to the office of the auctioneer and told him the place he had advertised was such a one as he desired, and he would purchase it. The auctioneer burst into a laugh, and told him that that was the description of his own house, where he was then living. He read the advertisement again, pondered over the "grassy slopes," "beautiful vistas," "smooth lawn," etc, and broke out, "Is it possible? Well make out my bill for advertising and expenses, for, by George I wouldn't sell the place now for three times what it cost me.



NEW VERTICAL ENGINE.—(See page 34.)



NEW VERTICAL ENGINE.—(See page 34.)

CELLULOID—A NEW AND IMPORTANT INDUSTRIAL MATERIAL.

(From the *American Artisan.*)

About eleven years since, Messrs. Phelan & Collender, of this city, offered a large premium for the invention of a substitute for ivory for billiard-balls. The offer having come to the notice of Mr. J. W. Hyatt, then a resident of Albany, N. Y., this gentleman set to work to discover a substance which should possess the required qualities. He manufactured various compounds, one of which was found to be sufficiently strong and elastic, but the surface was not sufficiently fine and the colour was bad. This compound was a mixture of shellac and paper-pulp, combined by a new process, the same now used by the Hyatt Billiard-Ball Company at Albany, for the manufacture of billiard-balls.

In searching for some solution to fill up the pores of this material and qualify it to receive a fine polish, Mr. Hyatt's attention was called to collodion. Alexander Parkes and some others had, at least eighteen years ago, made use of this material, but Mr. Hyatt was not aware of this fact at the time of his first experiments. Those who employed soluble cotton, previous to Mr. Hyatt's experiments, made it into a pasty mass by the use of ether and alcohol. They first made a thin solution like that employed by photographers. Then they gradually reduced it to the consistency of paste by introducing more and more of the cotton; and, finally, they reduced it to the consistency of dough by evaporating off a portion of the solvents. But here difficulties presented themselves, for, if it be attempted to add more of the soluble cotton to a thick paste of collodion, the cotton will not dissolve nor soften. A large percentage of the fibres retain their original condition, and the result is a material not homogeneous and more or less friable. It is as though so much fibre were mixed with the pasty collodion. The reason of this is that the mixture of ether and alcohol only penetrates the particles of the soluble cotton before the solution has reached that point of saturation which much reduces its fluidity. It is also found that in reducing the collodion from a pasty condition to a solid, the bulk of the mixture is decreased three-fourths and sometimes even more, and when the consistency of dough is reached, which is as low as the material can be mixed and have the particles weld, from that point to the point of absolute dryness the decrease in the bulk is more than one-half. It follows that the coatings put on the billiard-balls, which are about a quarter of an inch thick at first, when they become solid and are turned down, are less than a sixteenth of an inch in thickness. Moreover, the quality of the cotton has to be very perfect, or the material will be extremely brittle when prepared by a liquid solvent. Obviously, the material thus prepared is fit for very few uses, except as a coating for billiard-balls, for which it is admirably adapted; it is too expensive, and there are too many difficulties in working it.

In 1868 and 1869, Mr. I. S. Hyatt, a brother of Mr. J. W. Hyatt, interested himself in the problem, and together these gentlemen conceived the idea of employing mechanical means in order to enable them to use the minimum amount of solvents for any proportion of soluble cotton. They first succeeded in this attempt by putting the cotton into a close, strong cylinder, exhausting the atmospheric air, and forcing a mixture of alcohol and ether through the mass instantly, by great pressure, so that it would penetrate through all the particles of the cotton before the solvents had time to act upon it. The essential feature of this process is the rapidity with which the solvents are forced into the cylinder. If they are forced in slowly, a stratum upon the top is converted into a doughy mass, and through this the remaining liquid cannot be forced. While the soluble cotton remains still in a state of fibre, the mixed liquids must be injected suddenly and forcibly and held under pressure, and in two minutes' time the cotton can be removed from the cylinder as solid as oak-wood. This process was patented in 1869.

In the early part of 1870, the Messrs. Hyatt made numerous experiments, the purpose of which was to render more convenient the manipulation of large masses of material, and also to secure desirable qualities which did not exist in the solid collodion obtained by the process patented in 1869 — viz., plasticity when heated, and the reduction of inflammability. Among other substances experimented with, camphor was mixed with the cotton. It had been known previously that a solution of camphor in alcohol was a solvent of soluble cotton. It was reasoned, therefore, that camphor might be mixed with the cotton at any stage of the process, and that upon the addition of alcohol the same result would be obtained as when alcohol is previously mixed with the camphor. In the first experiment of mixing the camphor with the wet pulp, while casually squeezing it with the hand, it was found that it compacted and showed signs of combination, although no alcohol had been added. This important discovery was the origin of the present manufacture of celluloid, for it was immediately found upon repeating the experiment that camphor alone was, under proper conditions, a perfect solvent of soluble cotton. In a very short time after the first experiment, a lump of solid celluloid was produced by heating the material to a temperature less than that necessary to melt solid camphor. It was, moreover, found that a perfect chemical combination of the two substances resulted, and the remarkable material now called celluloid was then produced.

The outline of the process now employed in the production of celluloid is as follows: After the pulp is ground in the beater-engine, and the camphor and whatever coloring material may be desired are thoroughly incorporated with it, the substance being kept meanwhile at the proper temperature, the superfluous water is removed by pressure and absorption, a peculiar porous material made specially for the latter purpose being employed. During the process of drying under pressure and absorption, the material becomes nearly converted, so that it is no longer nitro-cellulose, but imperfect celluloid. In so far as conversion has taken place, its properties have undergone a total change. All that remains to convert it into the various articles referred to is manipulation under heat and pressure, during which process the chemical combination is completed. For some qualities of the material desired to be produced, a small percentage of alcohol is added in the subsequent manipulation. As evidence that there is a perfect chemical combination, and not a mere mechanical mixture of the materials, the fact may be stated that whereas camphor in its uncombined state is an extremely volatile substance when exposed to the air, in its combination with nitro-cellulose it loses this property altogether. An enumeration of the properties of the material which we shall give anon will be further proof of the chemical combination. When the material is properly converted, comparatively no shrinkage takes place. There is no escape of the camphor unless an excess has been employed; and in that case the excess of camphor will escape from the surface of the celluloid, but whatever uncombined camphor remains in the interior is so closely imprisoned by the solid surfaces that it cannot escape. By varying the proportions of the excess of camphor, different degrees of solidity and flexibility are obtained.

The properties of celluloid are as follows. Without the admixture of coloring material, it has a pale amber color. If it is desired to make the material white like ivory, oxide of zinc is used, and for other colors various mineral pigments are incorporated with it, or dyes soluble in alcohol or any of the aniline dyes may be caused to permeate the material to give it any desired color. It is hard and elastic, having a hardness ranging from horn to that of ivory. It is as tough as whalebone. A thin piece like a paper-folder may be wound around the finger without breaking, and it will nearly resume its original shape when released. In fact, elasticity is one of the most prominent characteristics of the material. In this respect, it greatly exceeds ivory. On this account it would be extremely useful in the construction of apparatus for physical laboratories intended to illustrate the impact of elastic bodies. A ball two inches in diameter placed upon an anvil would require perhaps fifty blows from a heavy blacksmith's hammer to fracture it, and if the anvil and the hammer are both polished, not even a scratch or indentation can be found upon the ball previous to its breaking. By the use of the lathe for turning spheres invented by Mr. J. W. Hyatt, and described and illustrated in our last number, balls of this material can be produced with great facility, much cheaper than ivory balls and vastly nearer perfection. Celluloid is also a very fair non-conductor of heat and electricity—not quite as much so as hard-rubber, but approximating the latter very closely in this particular. It would make good insulators for knobs of telegraph instruments, for insulating posts for electrical machines, and for telegraph wires. While it is so good a non-conductor, it is not perceptibly electric. On this account, and on account of its toughness, it is particularly adapted to the manufacture of combs. It does not acquire electricity when passed through the hair, and the teeth are with great difficulty broken. A comb made of this material may have several of its teeth cut out, and the remaining teeth may be bent flat down to the back, twisted and manipulated with the greatest rudeness, without breaking. As a material for combs, it is undoubtedly superior to any other yet used.

But perhaps the most remarkable property of this otherwise very remarkable material is the fact that it becomes plastic at a temperature of from 250° to 300°, and this property enables it to be moulded with facility into a great variety of forms for ornament and utility. Pure celluloid has a specific gravity of about 1 4.

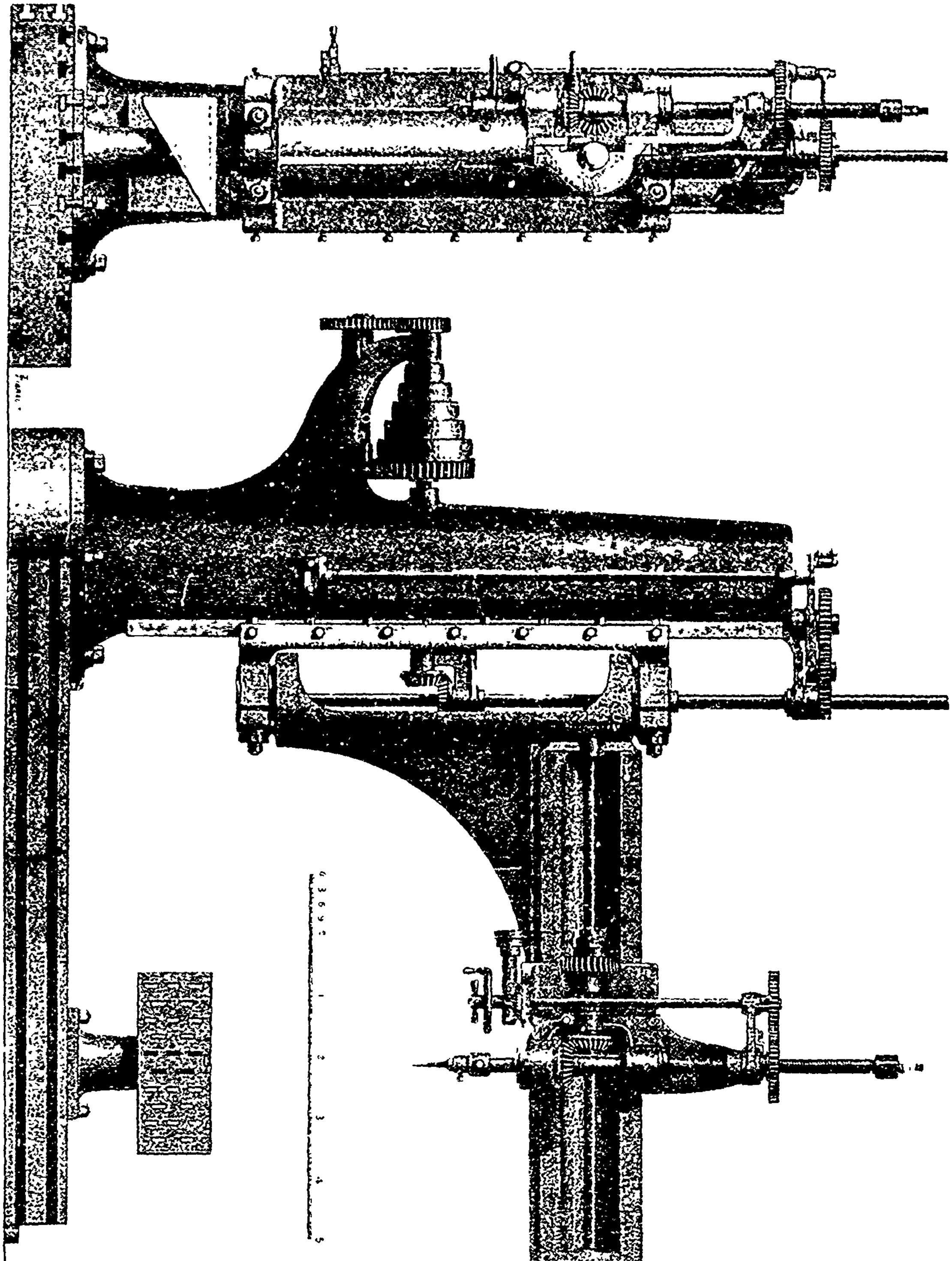
A profitable and successful industry, based upon these properties of celluloid, is the manufacture of dental plates. The material can be made precisely the natural color of the palate and gums. It is much strayer has a perfectly clean surface. It may be manipulated more easily than rubber, as it does not require to be vulcanized. It possesses all the valuable qualities of rubber for dental purposes without its defects. It requires only about one-sixtieth as much vermilion to give the proper color to celluloid as is required to impart the usual color to rubber. The danger of salivation which sometimes occurs in the use of rubber for dental purposes is therefore obviated. The difficulties encountered in the application of celluloid to dental plates have been very great, and many failures were at first experienced, but, with untiring perseverance, the inventors have pursued the subject until, during the last year, they claim to have produced an article possessing all the requirements desired; not a single failure having been experienced through any fault of the material made within a twelve-month past. The editors of the *Dental Cosmos*, the foremost dental journal published in this country, fully corroborate the value of celluloid as a dental base, and many of its correspondents, leading dentists throughout the country, add their valuable testimony in its favor. The material seems adapted to a great many uses to which it has not yet been applied, but its applications are now sufficiently various to render it of great importance in the arts. It is used for handles for table cutlery, for martingale-rings, for coating harness-trimmings in place of leather, rubber, etc , and in these applications is meeting with high favor. The Celluloid Novelty Company is the name of a large concern just starting in Newark for the manufacture of napkin-rings, ladies' necklaces, crosses, lockets, and other ornamental articles. The Celluloid Harness-trimming Company is the name of another extensive concern which has been successfully working for about a year in the same city. The articles produced by this establishment are elegant, and the martingale-rings have double the strength of ivory rings. Another establishment is manufacturing imitation coral and amber jewelry of celluloid. Penfield & Company, of Philadelphia, are manufacturing celluloid truss-pads and truss-springs coated with celluloid. These articles are of a flesh colour, and the coatings are far superior to hard-rubber, being so elastic that the spring may be bent until it breaks before the covering will rupture. As it does not become brittle under extreme cold, like hard-rubber, there is no danger of its cracking when cold. A few samples of beautiful brush-backs have been made from celluloid. It may be run out into tubes of any required diameter and thickness. Watch-cases have been made from it, and are pronounced far superior to those made of hard-rubber. It is a valuable material for the manufacture of the tubes of opera-glasses and folding-telescopes The Celluloid Manufacturing Company—also established at Newark, and with which the inventors are identified—are manufacturing large quantities of this material for the purposes named, and are also engaged in the manufacture of some of the articles enumerated. They are now preparing facilities for the extensive manufacture of combs, a branch of industry which they propose to make a speciality. Gen. Marshal Lefferts, of this city, is the President of the Company. We are promised specimens of celluloid, and articles made from it, which, when received, we shall be happy to show to any of our readers or clients who desire to investigate its character with a view to its employment in any new application. For some delicate parts of models, requiring great strength in proportion to size and weight, it would be excellent.

TEMPERATURE OF THE WATER IN THE ATLANTIC.

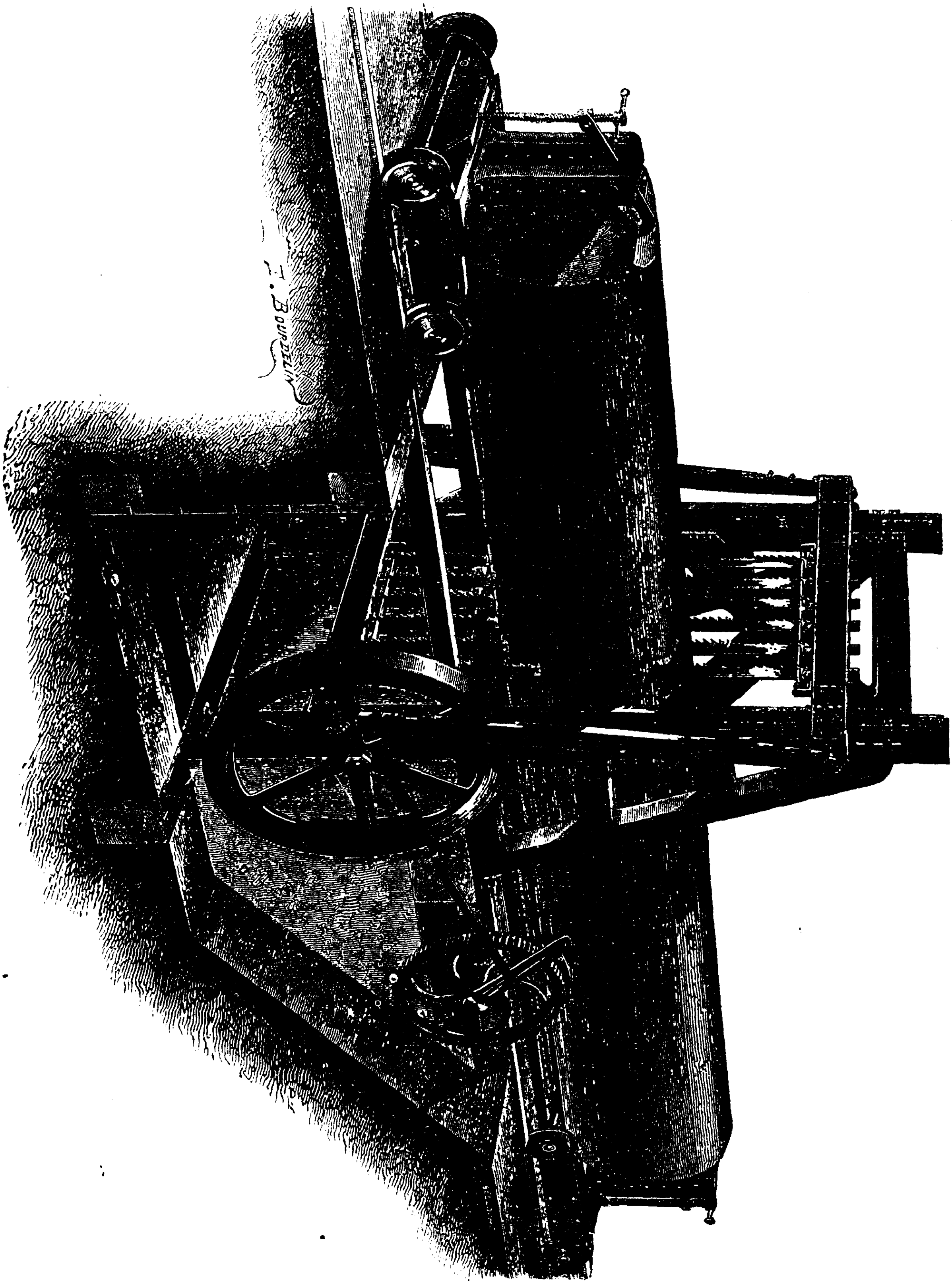
The British Government Scientific Expedition has, amongst other things, proved that on the western side of the Atlantic, at all the stations south of the Bermuda and Azores line, the bottom water is colder than that on the east side, which shows that the Antarctic cold current enters the North Atlantic, runs to the north-westward through the channels between St Paul's rocks and the Brazilian coast and gradually expends itself as it circles round to the north-eastwards, in the same manner as the warm equatorial current does on the surface, considering that current as including the Gulf Stream, which it undoubtedly helps to produce. This cold current entering the North Atlantic is found between 1,700 fathoms and the bottom a total thickness of 700 fathoms. The heat-giving properties of the equatorial and north-east trade current, carrying as they do a continuous body of warmed water towards the Caribbean Sea, can be traced by the rise in temperature of the whole body of water at Sombrero, and afterwards at all the stations in the North Atlantic, but most readily so by the widening of the isotherms about 62 degrees, between America and Azores. Thus is formed an immense reservoir of warmed water 1,000 feet thick, and at least two millions of square miles in extent. This change of temperature or disturbance is greater, and nearer the surface on the western side of the Atlantic, the nearest point to the source of the current, than at the eastern side, where it slowly and gradually expends itself. The most remarkable fall of temperature due to depth has been found at a station 180 miles south of Cape de Verde Islands, at the south edge of the trade wind, the temperature at 50 fathoms being 54.2 degrees, when the surface was 78 degrees, a fall of 24 degrees.

ON WOODS SUITABLE FOR ENGRAVING.

The increasing scarcity of boxwood suitable for the purposes of wood-engraving has induced Mr. Worthington G. Smith to experiment upon other woods which appear to be possessed of the requisite qualities. He has utilised some of the specimens forwarded to him by Mr. Jackson from the collection at Kew, as the raw material for the illustrations to an article on Abnormal Mushrooms in the *Gardeners' Chronicle* of July 26th. So far as he has yet been enabled to experiment, judging from the results exhibited by his engravings, he has not at present alighted on any substitute for Turkey boxwood, which is at once equally serviceable and as cheap, or rather cheaper—that being the great desideratum. He says that he has found none equal to good box, not to speak of the best box, which is alone suitable for the higher class of engravings. The wood of *Elæodendron australe* is only suitable for outline diagrams and posters; for which purpose, however, we have a very serviceable material in the common sycamore, which is not likely to "give out" for some time to come. Another of Mr. Smith's figures is engraved on the common yew (*Taxus baccata*), which though softer and tougher than box, is very close grained; but it "blunts the tools," and that as every workman knows is a s[illegible]s item in the bill. It takes besides "longer to engrave on these woods than box," and the lines are also liable to chip. *Pittosporum undulatum* is soft and tough compared to box, requiring more force to cut it, and greater care owing to the tendency of the lines to chip. *P. bicolor* is better, and so is *Monotoca elliptica*, but the latter has a bad surface and breaks away, the engravings requiring a "great deal of retouching." These defects are fatal, we imagine, although Mr. Smith says it is otherwise a good wood for diagrams, plans, &c. As far as the engraver is concerned, the *Bursaria spinosa* is the best of these woods, being equal to common box, but this "takes the edges and points off the tools." In Mr. Smith's hands it is evident that it is capable of meeting the requirements of the principal part of the wood-engraving done nowadays. The best wood, however, in all respects with which Mr. Smith has yet experimented is that of *Tecoma pentaphylla*, which is equal to good box, but is at present of the same value. It remains to be seen whether this wood can be imported at a cheap rate. In the mean time Mr. Smith will be glad to experiment upon any other hard, close-grained woods which can be sold at a cheap rate, say less than a half-penny per square inch.—*English Mechanic.*



RADIAL DRILLING AND BORING MACHINE



FRENCH GANG SAW.

NEW GANG SAW.

We extract from the *Moniteur Industriel Belge* the annexed engraving of a new gang saw, manufactured by M Arbrey, of Paris. The machine which appears to be of very simple, and doubtless effective, construction, is composed of two heavy standards of cast iron, joined above by a cross piece and bolted below to a heavy bed of stone. Between the standards vertically travels a frame which carries the saw blades, and to which a reciprocating motion is imparted by means of two connecting rods attached to pulleys fast upon an arbor passing through the lower parts of the supports. The pulley at one end receives motion by a belt from the engine, and the other carries eccentrically a second connecting rod, which communicates with a ratchet wheel, by means of which the log is carried against the saws.

The log is dogged to the carriage by the simple contrivance shown on the left of the engraving, the arrangement of which is such that the blades are allowed to traverse the entire length of the work without necessitating the readjustment of the latter. The carriage is provided with traction hooks which, when the former is in any position, engage with an endless chain This chain is actuated by a cog wheel, not shown, connecting with the ratchet wheel, and completes the mechanism for driving the carriage.

Any number of saws may be attached to the frame by the usual means, and so that trunks of the largest diameter may be divided into as many boards as desired, all of which, by suitable adjustment of the spaces between the blades, may be of uniform thickness.

RADIAL DRILLING MACHINE.

We illustrate, on page 40, of the present number, a very fine radial drilling machine lately constructed by Messrs F Berry & Sons, of Sowerby Bridge, for some works in Germany The illustration is from the columns of *Engineering* The machine is fitted on a strong cast-iron bed-plate 13 ft long by 6 ft broad, and 1 ft deep, this bed-plate being planed on the top and on one side, on which surfaces it is provided with bolt slots, as shown. The radial arm—which swings through an angle of 190 deg. — is fitted to a slide which can be raised and lowered by power through a range of 3 ft., 6 in., the raising and lowering gear being thrown into or out of action by a lever situated at the side of the pillar, as shown. The arm has a radius of 8 ft. 6 in., and it will admit under it articles 8 ft in height from the bed-plate.

The spindle is 3¼ in. in diameter, and has a variable feed motion through a range of 2 ft, the feed being either self-acting or controlled by hand at pleasure. The machine is capable of boring up to 18 in. in diameter and 2 ft deep, and a portable table is provided which can be bolted on to the bed-plate, as shown, for carrying small work. The total weight of the machine is 12 tons, and is altogether of very neat as well as thoroughly substantial design.

Mr H. Carrington Bolton, of the School of Mines, Columbia College, has proposed that American chemists should hold a centennial celebration this year, commemorating the year 1774, which was remarkable for great chemical activity and discoveries, and which he thinks, might be almost regarded as the birth-year of modern chemical science. Thus, in 1774, Scheele first isolated (what is now called) chlorine; he also recognized baryta as a peculiar earth, and it took its place among elementary substances; and he published his masterly essay on "Manganese." Lavoisier was engaged in studying the increase of weight of tin when calcined in close vessels, a research which led to most important discoveries. Wiegleb proved alkalies to be true natural constituents of plants. Cadet described an improved method of preparing sulphuric ether, Bergmann showed the presence of CO_2 in lead white; Comus reduced the "calces" of the six metals by means of the electric spark. Priestly discovered oxygen; the immediate results of which were the overthrow of the time-honoured phlogistic theory, and the foundation of chemistry on its present basis.

INDIAN ARCHITECTURE, AND THE MANUFACTURES OF GLASS, TERRA-COTTA AND PORCELAIN.

From a lecture delivered to the Edinburgh Architectural Association, on the 27th of May, by ALEX HUNTER, M D.

A great deal of the earliest architecture and ornament of India is, like that of other countries, rude, coarse, and quaint, but with characters that are due chiefly to the climate and natural features of the country, which give a peculiar nationality and individuality which are purely Oriental.

One of the first impressions that are made on the mind by a careful inspection of these early records of Art in India, is that simplicity of form at first pervaded most of the styles and that there was an inherent love of Nature, and a desire to represent by sculpture scenes or events, and persons who took a part in them, and the circumstances under which they occurred. Marks of gradual improvement are obvious in both the sculptures and figures, until the periods, when complexity, elaboration of detail, and profuseness of ornament, took the place of some of the grand simplicity that characterised the works of the early Buddhist sculptors and architects, who took a just and correct view of the relative value of simplicity, beauty of form, and appropriate ornament, suited to enhance, but not to encumber or distract attention from the story to be told.

Perhaps the oldest and most quaint rock sculptures of India are the underground vaults and cave temples, with roughly-hewn representations of men and animals, recently brought to light by the late Mr. Breeks, Commissioner of the Neilgherries, and the Rev. Mr. Metz, of the German Lutheran Mission, and by Mr. Longley, Collector of Salem, and the Rev. Mr. Phillips. These are not decidedly cave temples, but they bear some resemblance to them in their sculpture and arrangements, as some of the rude sculptures are on the solid rock, while others are on separate slabs, of no great size, placed erect, and in straight lines; and others project at right angles, dividing the cave into partitions. In some localities the whole structure is subterranean, and covered by a huge flat mass of rock from 11 ft. to 13 ft. in length by 8 ft. in breath, and from 8 in. to 10 in in thickness. These sculptures belong evidently to very early periods when the worship of serpents and of the sun and moon were common. Along with the sculptures have been found antique pottery of very quaint forms, consisting of culinary, domestic, and other vessels, cinerary urns, containing bones and teeth of men, women, and horses; gold ornaments of considerable value, bracelets of cornelian, quartz, and felspar, cut, polished, and occasionally inlaid with a very hard enamel; tools and implements of iron and bronze, and some very delicate and tasteful bronze vessels of elegant shapes and of pure forms.

The pottery of the Neilgherries is evidently of older date and of a ruder period than that of Salem and of Coimbatore. Some of the latter is very like the pottery of the Greek of Etruscan periods. Large collections of these antiquities have been sent to the Indian Museum, and other museums at Madras and at the Neilgherries, and steps are being taken by the Madras Government to trace the origin, and to determine, if possible, the dates of these sculptures and antiquities. The quaintness of the head-dresses of the figures, with the hair as a chignon, sometimes on the top, at other times on one side, and occasionally in the form of a horn, point to early periods of history.

We now come to the Buddhist period, when some taste and refinement were introduced, and when snake worship, though still tolerated, was evidently supplanted by a purer form of worship, and by sculpture and architecture of better descriptions. The square, the circle, the pyramid, and the triangle, were the first forms selected for the basis of architecture, and with the early Buddhists each of these forms had a symbolical meaning; thus, the square, from its solidity, was supposed to be typical of the earth; the circle, of water; the pyramid, of air; and the triangle, of fire. To this the followers of Buddha added a fifth element, namely, the winds, as distinct from air, and the symbol which they selected was a crescent. Much of the early architecture of India consisted of cave temples and sculptured rocks, some of them of a gigantic size, and of hard granite or gneiss, a few of magnesian limestone, and others of sandstone. The latter have, in most instances, suffered from the weather, and the forms and outlines have been nearly obliterated, while those in magnesian limestone, potstone, and chlorite, or serpentine rocks, are almost invariably sharp and in good preservation, while the rocks containing magnesia have become harder by exposure, although these rocks are generally soft, tough, and cheesy when first quarried. Some of the granites have become corroded on the surface, from the decay of the felspar and mica. Our architects may learn some useful lessons from the examination of the old cave temples and early Buddhist and Jain temples in India, as many of these have withstood the ravages of time and weather for periods varying from 800 to 2,400 years, while some of the sandstones employed in our cathedrals and public buildings have not lasted for more than two or three centuries. The sandstones of the Oolite period, I believe, have proved to be the worst; but some of those of the Trias, or New Red, and of the Old Red sandstone and Devonian formations, have not proved so durable as those of the true Carboniferous periods. And in this respect Edinburgh, Glasgow, and the Lothians, are, perhaps, more favoured with good durable building-stones than most other counties.

One reason why the buildings are in better preservation than those of Great Britain is, because the climate is drier, and mists and frosts are of rare occurrence. There is one class of rocks, however, that corrodes perhaps more in India than elsewhere, and that is the pure limestone and marbles, which are dissolved slightly on the surface by heavy rains, and become full of pinholes. The Hindoo builders are well aware of this, and of the relative durability of building rocks; this they have learned from an examination of their old buildings, and in describing these we must remember that about 2,600 years ago civilisation had made far greater strides in India, Japan, and China than in Europe, and that even before the times of Phidias and Praxitiles, Callimachus, Scopas, and Callicrates, men had lived, died, and been forgotten in India, but they had left sculptured on the rocks, marks and evidences of thought, that prove that the artists and sculptors were in the habit of studying from nature, and executing with considerable skill and taste, sublime, grand, and simple conceptions, that prove the existence of an elevated and refined taste, even in very remote periods of antiquity. Unfortunately, although some of these sculptures are in good preservation, several of them have suffered from the wanton and ruthless hammer of the conquering or succeeding races, who showed their contempt for the religious beliefs of the Buddhists and Jains, and tried to substitute by force or by fire and sword other forms of religion. Thus in some localities, as Bijanuggur or Humpee, which was the great centre of the Hindoo dynasties of Southern India from the thirteenth century, back to the time of Asoka, 2,400 years ago, and also at Mahavellipooram and Salluvan Coopum, twenty-four to thirty-two miles south of Madras, we see the remains of ruined cities, cave temples, rock-cut temples, monolithic temples of a considerable size, Buddhist baths and monasteries, Brahminical pagodas, and, lastly, Mahomedan tombs and mosques, built out of the *débris*, and with the very pillars and stones of the old Hindoo temples, but finished off with the domes and minarets of the East conquerors. Among the ruins are also to be found inscriptions on rocks and stones in eight different languages, some of which cannot be deciphered,—a strange and startling parody on the mutability of human affairs.

In wandering through some of these old, ruined cities, there is a great deal that reminds us of the times of Solomon, and that carries us back to even earlier dates; for it has been ascertained that both the ground-plan, the measurements and the arrangements of the buildings correspond with those of Solomon's Temple, there being also a Holy of Holies and an oracle, and that the very idolatries that Joshua warned the Israelites to avoid were introduced and encouraged, as the worship of snakes or serpents, the golden calf, and of images of stone and wood, and of the sun and moon; but the most startling of all is the fact that there are numerous stones set up, and pillars and rocks with inscriptions and edicts of Asoka and of others who propagated the Buddhist religion. Now, it is a strange coincidence about this religion, that it is the nearest approach to Christianity; that there were ten commandments; and that the religion was one of toleration, of peace, and good-will, that recommended itself so strongly to the nations of the East that for upwards of 2,000 years there have been more followers of this than of any other religion.

I shall draw your attention to the simplicity and grandeur of some of the architectural details which I have alluded to. The base of these early temples was a square, supposed to be typical of the solidity of the earth. This is well seen in the temples at Mahavellipooram and at Humpee, Wurungul, and Bichookindab. In the latter place the square is surmounted by the triangle, typical of fire. This was afterwards raised into a pyramidal form, in which we see it in the goprums of modern pagodas. The circle was supposed to be typical of the sea or water, and the crescent was supposed to indicate air or the winds.

The sculptures in the cave temples and on the rocks of this period are also very grand and imposing, and some of them tell their story with a remarkable energy and simplicity; one, for instance, that I show you from the seven pagodas of Mahavellipooram, is supposed to be a representation of the spread of the Buddhist religion, of which I gave a description in a lecture which I delivered in Madras about two years ago, shortly after we had made some excavations and discoveries. In the same vicinity is also a very grand sculpture illustrative of a scene described in the "Rig Veda," lately translated and published by Max Muller.

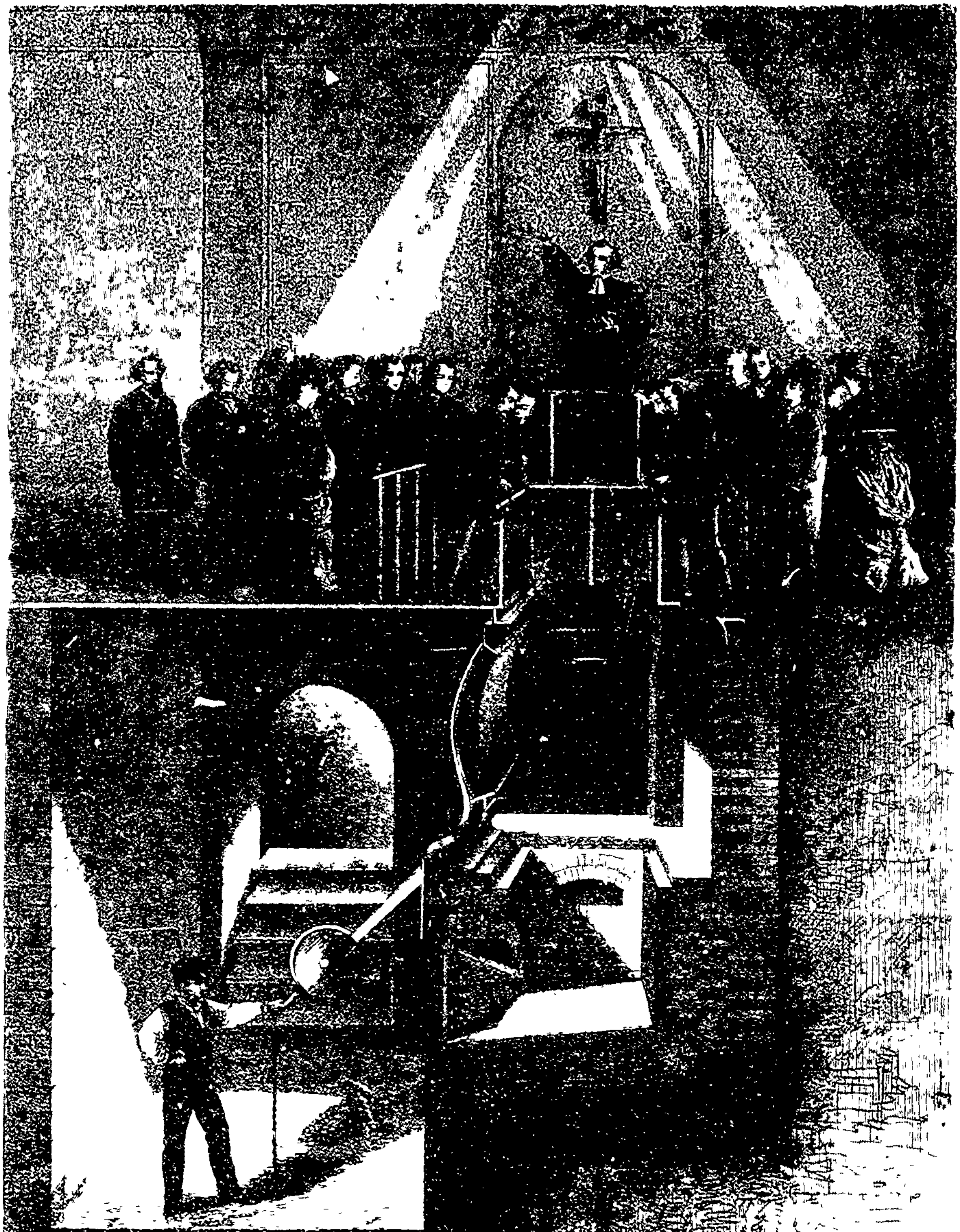
I was in hopes that I should have been able to show you a complete set of photographs of several grand Buddhist sculptures, that we took in India, but they have not arrived by this mail. I may mention that they were taken for the Madras Government; but I can show you some of the ornaments of this and of the succeeding Jain periods, which are very rich and tasteful, and will probably interest you to know that the last two lectures which I delivered in Edinburgh, before the Royal Society of Arts, on wood carving in India, and on works in precious metals, led to my receiving orders for £45, for the purchase of articles similar to those exhibited, and of photographs of antiquities and ornaments. Messrs. W. Marshall & Co., jewellers, 24, Princess-street, were so much pleased with the Indian manufactures in silver, copper, bederware, and brass, that they gave me an order for a good collection of them to be procured from Madras, and Mr. Cadell, the late collector of the Tanjore district, has offered to procure the articles. Messrs. John Millar & Co., 2, South St. Andrew-street, have been so much interested with the beauty of the India patterns of the Buddhist and Jain periods that they have commenced to apply them to the decoration of glass.

THE MAGNETIC METALS.

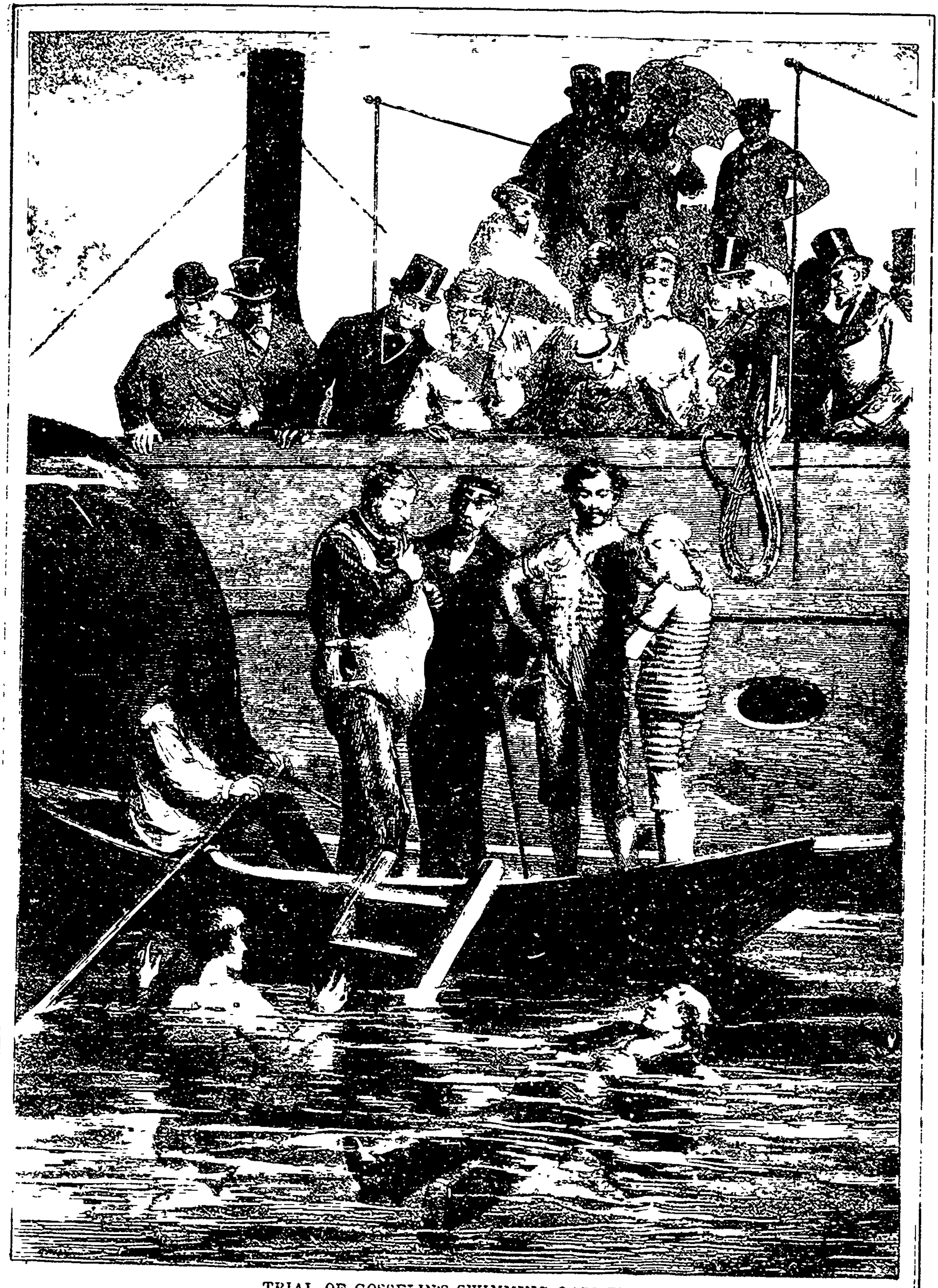
It is well-known that, besides iron, there are a few other metals possessing magnetic properties, viz., nickel and cobalt in a strong degree, manganese and chromium in a feebler one. Mr. W. F. Barrett, in an article in the "Philosophical Magazine," has pointed out the similarity of these metals to each other in their physical and chemical properties.

Thus, as to specific gravity, that of the thirty-eight known metals ranges from lithium 0.59 to platinum 21.5, a difference of nearly 21; whereas those of the three strongly magnetic ones are iron 7.8, nickel 8.3, cobalt, 8.5, where the extreme difference is only 0.7. Their specific heat is nearly identical; their atomic one is the same; so also their conductivity for sound, heat and electricity. Their dilation by caloric, and the amount they lengthen by mechanical strain are also identical. The enormous cohesive power of iron, nickel and cobalt, in the solid state, signalises these substances as the most tenacious of metals, and their melting point is only exceeded by the platinum group of metals. They are not volatile at the temperature of the hottest furnace, but only by the electric spark, when they yield very similar spectra. As to their chemical properties, the combining weight of iron is 56.0, nickel, 58.5; and cobalt the same. Chemists class these three metals in the same group, from the similarity of their chemical behaviour, and also the identity of their combining energy or atomicity.

What has been said concerning the likeness of iron, nickel and cobalt, in many respects holds true of manganese and chromium. The former has latterly been used to replace nickel in the alloy of German silver. The compounds of all these five metals are conspicuous for the brilliancy of their colours. This uniform coincidence suggests the practical inference that nickel and cobalt might be obtained in a malleable and ductile condition when submitted to a process similar to that by which wrought iron is produced.



THE SIEMENS CREMATION PROCESS



TRIAL OF GOSSELIN'S SWIMMING GARMENT.

MECHANICS' MAGAZINE.

MONTREAL, MAY, 1874.

ILLUSTRATIONS:

CONTENTS:

CREMATION IN EUROPE.

In a recent issue we illustrated the method of cremation as proposed by Sir Henry Thompson. The new idea does not seem however to make such progress in England as it does in Germany where cremation societies have been formed and furnaces erected suited to the proper performance of the operation. On page 44, we give a sectional view of the cremation apparatus recently erected at Dresden by the Siemens, at the request of Professor Reclam, on the model of a furnace exhibited by that firm at the Paris Exhibition of 1867. The mode of conducting the operation of cremation by means of this apparatus is thus described by Herr F. Siemens, of Dresden:

The entire apparatus consists of three distinct parts: first, a gas generator for the production of the gas necessary to heat the furnace, outside the building; secondly, the proper furnace with the furnace and cremation room, inside the building; thirdly, the pipe or flue for carrying off the product of the operation. Imagine, then, a large, handsome building, suitably constructed for the purpose for which it is intended; in the middle of which is built a furnace, out of sight of those inside the place. The funeral procession enters the edifice, as it now enters the churchyard, and the coffin is placed on a catafalque. After the usual ceremonies, the remains are lowered (as shown in the illustration) into the vault, the cover of which has been previously raised, and is immediately closed upon the reception of the coffin. The manner of performing the operation of cremation by the means of heated air is then as follows: The gas generator is so contrived that every four or six hours the fuel is replenished (apparently on some self-feeding system). The gas is then carrried off, as fast as produced, through a pipe furnished with a regulator valve, into the "Regenerator," or furnace proper, where a regular current of heated air is kept up, by means of which the gas is converted into flame. This flame fills the furnace, keeping the bricks at a white heat and the receptacle for the remains at a moderate red heat, and finally escapes through a conductor leading to the chimney. As soon as the furnace is in this condition the operation may be commenced. The furnace cover is lifted, as shown in the illustration, by a man whose business it is to attend to the furnace, the coffin is lowered into its receptacle, the cover of which is fastened down, and the remains are exposed to a red heat for a longer or a shorter time, according to the physical condition and constitution of the deceased. When the body has been exposed to the heat for a sufficient length of time the regulator valve is closed and the gas shut off. The heated air streams through the furnace and speedily operates a disselution of the more combustible portions of the now dried up body; while the bones are destroyed by the heat, the carbonic acid passing off through the chimney, and the calcareous matter remaining in the form of a fine powder which is subsequently collected for preservation as the friends of the deceased may wish.

DE GROOF AND HIS FLYING MACHINE.

Another accident to swell the long list that mars the history, of aerial navigation occurred last month at the Cremorne Gardens, near London. The victim was a M. De Groof, a native of Liege, who has spent a large fortune in repeated attempts to construct a flying apparatus on the model of a bird's wings. The unfortunate gentleman having reduced himself to penury by his efforts and experiments, sent lately to London where he gave an exhibition of his plans and machinery, with a view to obtaining pecuniary assistance in continuing his experiments. His first attempt being moderately successful, a second exhibition was advertised when the "Flying Man" and his machine were conveyed aloft by a balloon starting from Cremorne Garden, where an enormous crowd assembled to witness the affair. When M. de Groof had been raised, with his "wings," to the height of 300 feet, he signalled to the aeronaut of the balloon, Mr. Simmons, to cut the rope which held him up. He had gone up in high spirits, dancing to the music of the band in the Garden, and being loudly cheered by the spectators. But this exultation was of very short duration. No sooner had the rope been severed than M. De Groof, whose machine did not seem to offer the slightest resistance to the air, fell to the ground with a heavy crash. He was rescued from his apparatus with the utmost promptitude, and conveyed to the nearest hospital, but, though still breathing, he never recovered consciousness and expired shortly afterwards. His wife had fainted on seeing him fall, and there was a terrible scene when she reached the hospital, only to learn the fatal result. It was at first supposed that the apparatus was out of order, but this can hardly have been the case, as De Groof had carefully examined very part of it before setting out. Mr. Simmons states that I Groof bent forward when the cord was cut, and seemed to give it a push, as though to loosen his apparatus more promptly from his connection with the balloon; he thinks that in this De Groof may have lost his balance, and thus incapacitated himself from managing his apparatus. The latter is said to consist of a little platform for standing on, to which is attached a pair of great wings, in green oiled silk, worked by the arms, and intended to enable the "flyer" to make his way through the blue in emulation of its natural denizens.

On page 56 will be found an illustration of the iron and of the metal works of Cail and Company at Paris on the occasion of a visit made to them lately by Marshal McMahon. The works are well known throughout the world for their vastness and for the enterprize of their conductors. A very interesting fact in connection with these works is, that during the late siege the works were kept fully occupied even while they were exposed to the fire of the Prussian batteries.

The works became, during the siege a vast arsenal turning out immense quantities of that war material by which the siege was prolonged.

Our illustration on page 45, represents a trial of a new life preserver on the Seine at Paris. This life-preserver is the invention of M. Gosselin and it seems to be in some respects superior to any of the kind yet produced. It consists of a garment of double flannel in which is an india rubber tube which may be inflated at will by the wearer. This tube, carrying a self-closing mouth-piece at its upper end, extends from the top of the chest, round the body, down the back to the loins. Here it divides into two tubes one of which is wound round each leg to the knee. From the main tube branches extend round the body, just like the ribs. The whole forms a garment easily put on and which may be worn without the slightest inconvenience under the clothes. The trial is said to have been a success, the life-preserver being easily and quickly inflated and sustaining the body in a natural position in the water.

Not many of our readers are probably aware that there is a considerable business done in the exportation of trout from the Laurentian Lakes to New York and Saratoga. The business is very profitable and is said to be increasing every year. Ice is stored away in the winter, and in the summer months men are occupied in catching the fish with hooks and line, in the legal manner, as some say, or as others insinuate with illegal nets. The demand is, however, as yet greater than the supply and an attempt is being made in Colorado to breed the fish for the Eastern market. The system pursued, which we illustrate on page 43, does not differ in any material detail from other similar establishments. The spawn is deposited in long troughs, slightly inclined, through which runs a constant stream of pure spring water. When the young fish attain a certain growth they are placed in ponds arranged in a series. In the first they remain three or four months, after which they are transferred to a second, and so on from one to another until they have attained their full growth. Trout-raising might be pursued with profit in the Eastern Townships, the country is suitable, the market close at hand and the price paid for the fish is so high as to leave a very large margin in favour of the producer.

The number of people maimed annually by thrashing machines is so very great that it seems strange that makers should go on producing and selling machines which expose the users to such danger. At the recent show at Bedford, Eng., of the Royal Agricultural Society several machines were exhibited with devices for doing away with this danger. Our illustration on page 61, which is from the *Engineering*, represents the plan of Messrs. Ransome, Sims, & Head, of Ipswich, who guarded their drum by a combination of rollers placed in the vertical mouth of a hood. The one is a six-sided wooden roller, and is run at rather high speech by a strap. Above it and parallel runs a fixed shaft, on which are loosely strung a number of heavy wooden discs about 10 in. diameter, covered with leather. A man could not get his hand drawn in between the rollers, because when an obstacle interposes the disc rises, and ceases to revolve. The protection is here perfect.

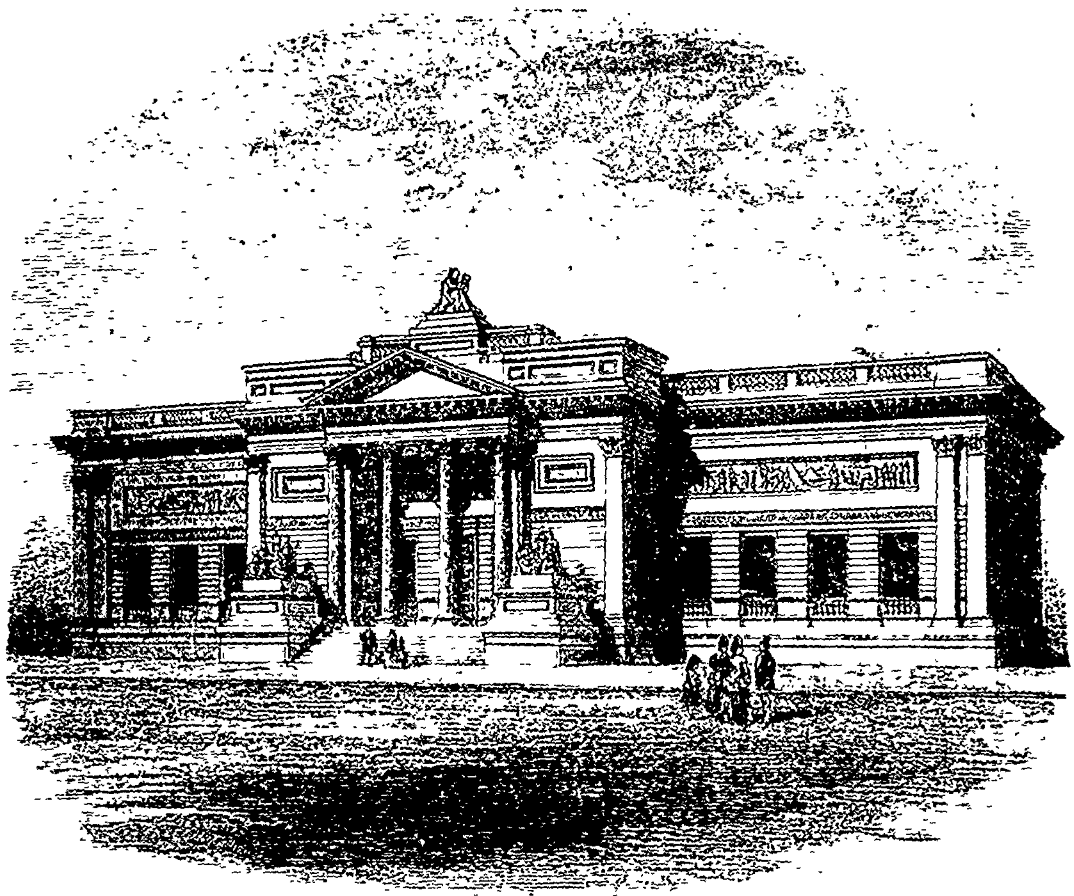
The fountain which we illustrate on page 49, is the centre piece of what may be called a transformation scene in London. Leicester Square has for years past been a by-word for neglect. In consequence of certain vested interests and individual rights it was left to itself until its condition became simply a disgrace to the metropolis of England. In the midst of this difficulty Mr. Grant, M.P., came forward, purchased the various interests in the square, at the cost of £13,000, and made a gift of it to the inhabitants of the metropolis. The square has been laid out and charmingly ornamented. The garden is enclosed by bronzed and gilt railings upon a marble basement, and the grounds are tastefully and artistically displayed. In the midst of the square is the Shakespeare Fountain,—a large marble basin and fountain in the centre, the water proceeding from the mouths of dolphins at the four corners, the whole being surmounted by a statue of Shakespeare. The material of this work is Sicilian marble. The statue, which has been executed by Signor Fontana, is a slightly modified version of the Westminster Abbey statue, which was designed by Kent, the architect, in the reign of George II., and carved by the painstaking Peter Scheemakers, who sold his shirt to pay his last expensess on the road to Rome. The well-known statue of the Abbey was chosen as the traditional Shakespeare of England, which everybody would recognise at a glance without any label.

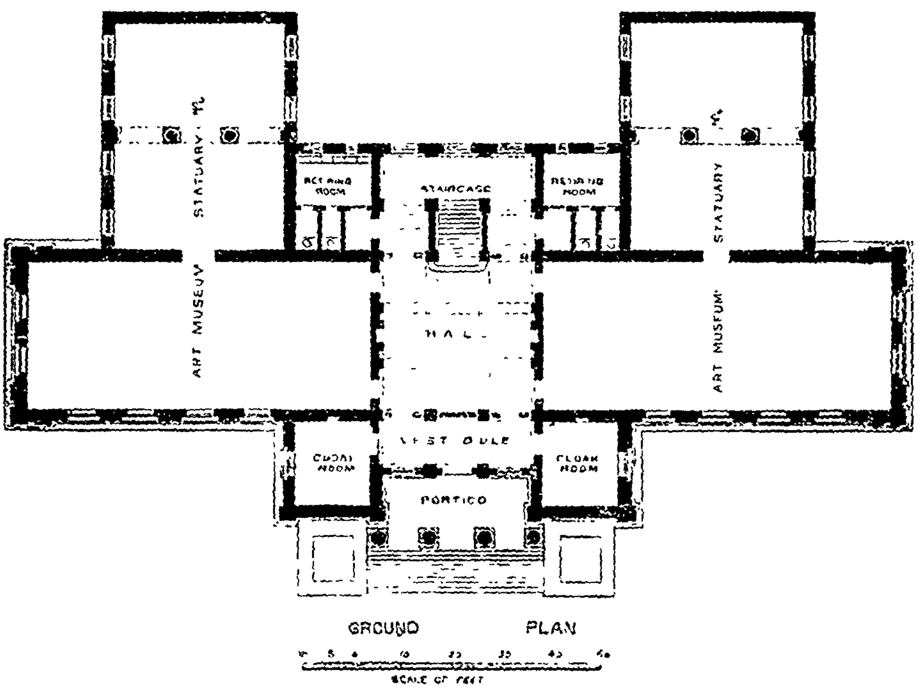
THE WALKER ART GALLERY, LIVERPOOL.

We illustrate, in our present number, the new Art Gallery for Liverpool, which is about to be erected upon the ground adjoining the Free Public Library, at a cost of 20,000*l*., the gift of the present mayor of Liverpool, Mr. Alderman Walker.

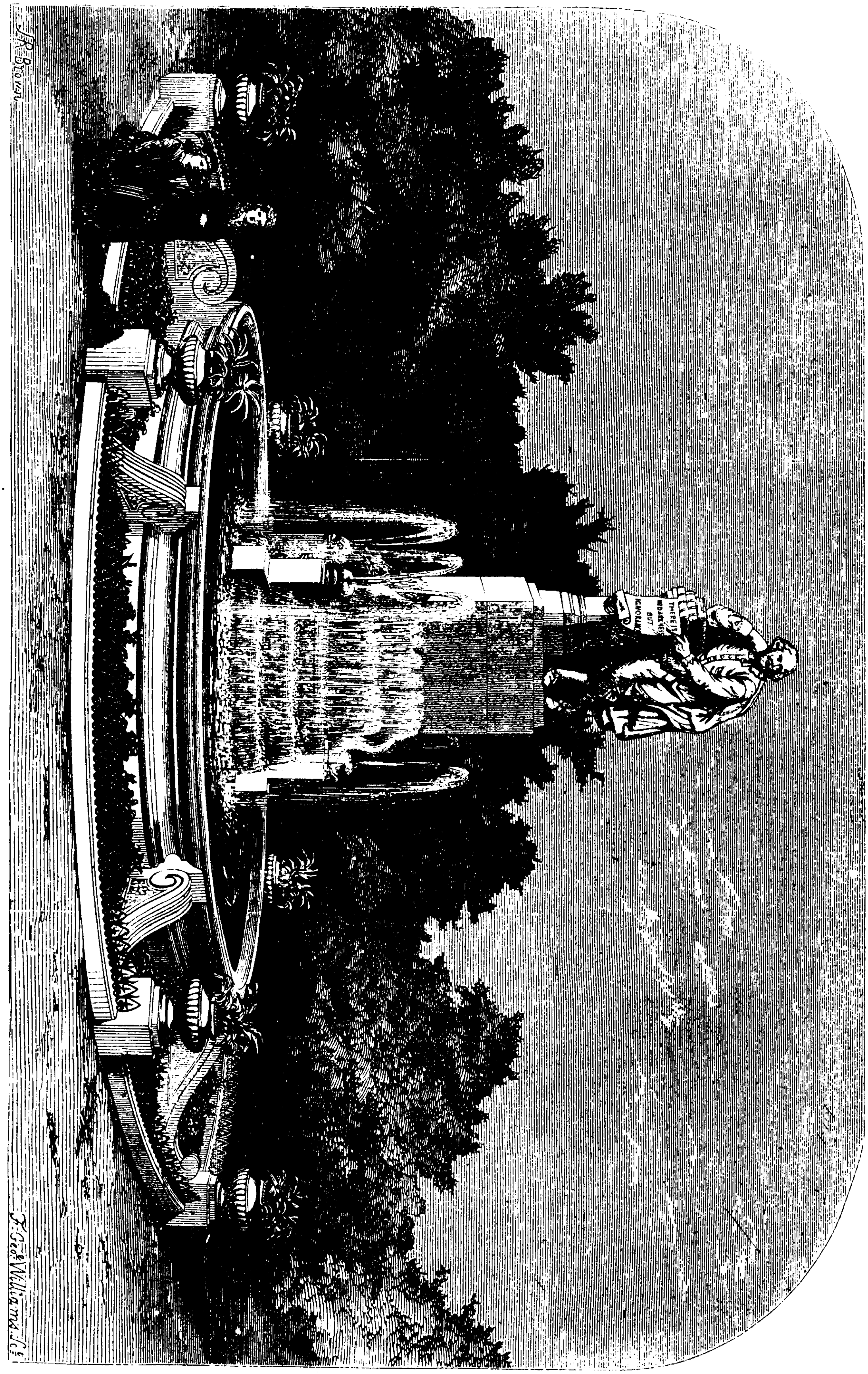
The order of the building,—which will be in accordance with plans prepared by Mr. Cornelius Sherlock, of James-street, and Mr. H. H. Vale, of Central-chambers, South Castle-street,—is Corinthian. In the centre of the front, facing William Brown-street, there is a portico, consisting of four fluted columns with carved capitals, approached by a flight of twelve steps. Above the portico are a pediment and attic, crowned by a figure representing the Arts. On either side of the portico is a group of statuary, representing, we believe, Science and Literature; and above are panels carved in bas relief. To the right and left the façade extends 70 ft., making, with the central portion, a frontage of 180 ft. to William Brown-street. The wings on the right and left of the portico consist of four large windows on the ground floor, with a continuous frieze and cornice above, the frieze over the windows being ornamented with a fret enrichment. Above these openings are long panels, running almost the entire length of the wings, and containing bas reliefs representing subjects having reference to the purposes of the building. The whole of this portion of the façade is surmounted by modillion cornice and open balustrade, the total height being about 50 ft. The extreme ends of the front of the building are finished with coupled pilasters, having Corinthian capitals and bases, standing upon a moulded plinth, continued up to the portico upon each side.

The main doorway is recessed beneath the central portico, and opens into a vestibule lighted by each side of the doorway, the flooring formed of encaustic tiles. Beyond the vestibule is a spacious hall with panelled ceiling at the end of which, facing the grand entrance, is the staircase leading to the picture-galleries. The whole of the ground floor of the building is appropriated to sculpture and museum purposes, lighted by windows at the sides, and consists of two large





THE WALKER ART GALLERY, LIVERPOOL.



THE SHAKSPEARE FOUNTAIN, LEICESTER SQUARE.

galleries, 70 ft. long by 30 ft. wide, and two galleries, 46 ft. long by 35ft. wide. Upon this floor retiring-rooms and other suitable apartments will be provided.

The picture-gallery proper occupies the upper portion of the building, and is approached by the staircase, which leads to a large hall lighted by windows in the roof. Out of this hall open two miniature-rooms and six galleries, of the same dimensions as the sculpture-galleries beneath, but more lofty, and having their light entirely from above. The plans have been prepared with a view to further extension; but, inasmuch as the eight rooms in the upper floor will have upwards of 1,000 lineal feet of hanging space for pictures, any enlargement will perhaps not be necessary for some time.

LOCOMOTIVE ENGINE BUILDING IN THE UNITED STATES.

The following is taken from *Paterson's New York Press.*

"We are very sorry to have to announce that the order for fifty locomotives for the Grand Trunk Railway of Canada, bids for which were advertised for a short time since, and of which high hopes were entertained that the work might be secured for one of our Paterson shops, has gone to a New England establishment, which was able to bid on a lower basis of labour than our locomotive builders ventured to hold. Our Paterson builders made strenuous efforts to secure this order, not because they expected to make any money out of it, but simply to open their shops, employ their machinery, and put their operatives at work. We know as a positive fact, that the locomotive companies of Paterson—and of all other places, too—expecting sharp competition, shaved their figures down to the lowest that they dared venture, and the close agreement amongst most of them shows how closely the thing was figured down. The bids received were as follows:—

Rogers Locomotive & Machine Co., of Paterson	10,250
Danforth Locomotive & Machine Co., "	10,050
Baldwin Locomotive Works, of Philadelphia...	10,575
Schenectady Locomotive Works..............	10,500
Pittsburgh Locomotive Works................	10,650
Kingston (Canada) Locomotive Works (gold).	10,000
Portland Locomotive Works..................	10,000
Hinkley (Boston) Locomotive Works.........	10,510
Manchester Locomotive Works................	9,250
Rhode Island Locomotive Works.............	8,800

"The bid of the Rhode Island (Providence) Works was much the lowest, and, of course, the contract was awarded them. This company have put their figures so low that all their competitors agree that they must lose money. They underbid even the Manchester (N H.) Works, who had twenty locomotives in process of construction which they had expected to sell to the road. We understand that the figuring between these two shops was a regular 'cut-throat' game. Not one of the other builders whose bids are given could see any object whatever in taking the order at less than 10,000 dollars an engine, and most of them came away from the opening of the bids, pleased that their offer was not accepted, as all of them had made their estimates to cover the bare cost, without a dollar of interest on the investment. Added to this is the fact that the conditions of the contract were very exacting, failure to deliver to the day, or any defect in construction of material, entailing heavy damages.

"From the above statement, which our readers may depend upon is true in every particular, our citizens and mechanics may understand the difficulties which lie in the way of our locomotive establishments—the great source of our prosperity, and really the mainstay of our city—getting started again. The main trouble is the labour question. Our mechanics, hard as the lesson is to learn, must make up their minds to face one of two inevitable alternatives: wages will have to be lower, or there will be no work It is literally the choice, so far as locomotive building is concerned, of 'half a loaf or no bread,' employers and employed agreeing to share the ' s between them. When our locomotive builders in good faith make an earnest and determined effort to get a contract, figured for at the actual cost of doing the work, and are underbid by other places, it is clear that the employers have gone as far as they can be expected to go. It is time for the men to inquire what they can do to relieve this miserable "dead-lock."

PRINCIPLES OF SHOP MANIPULATION FOR ENGINEERING APPRENTICES.*

(Continued.)

By. John Richards, M.E.

THE OBJECTS OF MECHANICAL INDUSTRY.

Mechanical engineering, like every other pursuit, is directed to the accumulation of wealth; and, as the attainment of any purpose is more surely achieved by keeping that purpose continually in view there will be no harm, and perhaps no little gain, derived by an apprentice considering at the beginning the main object to which his efforts will be directed after learning his profession or trade.

So far as an abstract principle of motives, it is of course useless to consider this subject in connection with engineering operations or shop manipulation; but the subject of commercial gain has a practical application, to be followed throughout the whole system of industrial pursuits, and is as proper to be considered in connection with machine manufacturing as mechanical principles or the functions and objects of machines.

"Cost" is the element that continually modifies or improves manufacturing processes, determines the success of every establishment, is continually present in making drawings, patterns, forgings, and castings. Machines are constructed because of the difference between what they cost and what they sell for — between the manufacturing cost and their market value when they are completed.

It seems hard to deprive engineering pursuits of the romance that is often attached to the business, and bring it down to a matter of commercial gain; but it is best to deal with facts, especially when such facts have an immediate bearing upon the object in view. There is no intention in these remarks of disparaging the works of many noble men, who have given their means, their time, and sometimes their lives, to the advancement of scientific truths, without hope or desire of any other reward than the satisfaction of having performed a duty. The following propositions will place this subject of aims and objects before the reader in the sense here intended:—

1. The object of engineering pursuits is commercial gain—the profits derived from the planning and construction of machinery.

2 The gain so derived is as the difference between the cost of constructing machinery, and the market value of the machinery produced.

3. The difference between what it costs to plan and construct a machine and what it will sell for, is generally as the engineering knowledge and skill that is brought to bear in producing the machine.

This last sentence brings the matter into a tangible form, and indicates what the subject of gain should have to do with what an apprentice ... to learn of machine construction.

Success in an engineering enterprise may be temporarily achieved by illegitimate means, such as misrepresentation as to the capacity and quality of what is produced, the use of cheap or improper material, or by copying the plans of others to avoid the expense of engineering service, or from want of engineering ability; but, in the end, the permanent success of such a business must rest upon the knowledge and skill that is connected with it.

By examining into the facts, the apprentice will find that all truly successful establishments have been founded and built upon the mechanical abilities of some person or persons, that form the base upon which the business was reared, and that this is the essential element that must in the end lead to permanent success.

The material and the labour which make up the first cost of machines is, taking an average of various classes, nearly equally divided; labour being in excess for the finer class of machinery and the material in excess for the coarser kinds of work.

The material is presumed to be purchased at the same rates by those that are well skilled as by those of inferior skill, so

* This, and the succeeding articles under the same title, were published simultaneously in the Journal of the Franklin Institute, Philadelphia, and in *Engineering*.

that the difference in first or manufacturing cost is determined by skill exclusively. This skill consists in preparing plans, and in various processes for connecting and shaping the material, which will be noticed in their regular order. The amount of labour, and consequently the cost of machinery produced, is as the number of these processes and the time consumed in each.

The business of the mechanical engineer is to reduce the number of these processes or operations, and to shorten the time in which they may be performed.

A careful study of shop processes of operations, including designing, draughting, moulding, forging and fitting, is the secret of success in engineering practice, or in the management of manufactures.

The advantages of an economical design, or the most carefully prepared drawings, are easily neutralised and lost by careless or improper manipulation in the workshop; an incompetent manager may waste more pounds in shop processes than the commercial department can save in buying and selling

This importance of shop processes in machine construction is realised by proprietors, but not generally understood in all of its bearings; yet the apprentice may notice the continual effort that is made to augment production in engineering works, which is the same thing as shortening the processes.

By reasoning in this manner the apprentice will form true standards by which to judge of plans and processes that he is brought in contact with.

A machine may be mechanically perfect, arranged with symmetry, true proportions, and correct movements; but if such a machine has not commercial value, and is not applicable to a useful purpose, it is as much a failure as though it were mechanically inoperative. In fact, this consideration of cost and commercial value must be continually present, and a mechanical education that has not furnished true conceptions of the relations between commercial cost and mechanical excellence, will fall short of achieving the objects for which such an education is undertaken.

ON THE NATURE OF MACHINERY.

Machines may be defined in general as agents for transmitting and applying power, or motion and force, with constitutes power.

By machinery the natural forces are utilised, and directed to the performances of operations where human strength is insufficient, or when natural force is cheaper, and when the rate of movement exceeds what the hands can perform.

The term "agent" applied to machines conveys a true idea of their nature and functions. Machines do not create power or consume power, but only transmit or apply it; and it is only by conceiving of power as a constant element, independent of all kinds of machinery that the learner can have a true conception of the nature of machines. When once there is in the mind a fixed conception of power, dissociated from every kind of mechanism, there is laid a solid foundation on which a knowledge of machines and mechanics may be built up, but without this conception correctly fixed in the mind, it is not only impossible to appreciate the true nature of machines, but difficult to understand even the most simple principles in machanism.

To believe a fact is not to learn it, in the sense that this term may be applied to mechanical knowledge; to believe a proposition is not to have a conviction of its truth, and what is meant by learning mechanical truths is to have them so firmly fixed in the mind that they will involuntarily arise to qualify everything met with that involves mechanical movement.

An apprentice or student that in his younger days has had the misfortune to confound power with machinery for transmitting it, as taught in school-books on mechanical philosophy, will find these impressions remain in his mind for years, even after he has become acquainted with the true principles of mechanism. For this reason the apprentice is urged to start rightly, first acquiring a clear and fixed conception of power, and next of the nature and classification of machines, for without the first he cannot have the second.

I am well aware of the difficulty that must be encountered in attempting to learn the nature and classification of machines without the aid that may be derived from a knowledge of their practical application; but to learn such practical application first is certainly to commence wrong, because of the waste of time and effort that is required by such a course; and, while it may be difficult to form such clear conceptions of machines by studying their nature and general principles in advance of being acquainted with their application, it is by no means impossible to do so.

Machinery is divided into four classes, each constituting a division, that is clearly defined by the functions it performs, as follows:

1. Motive machinery for utilising natural forces.
2. Machinery for transmitting and distributing power.
3. Machinery for applying power.
4. Machinery for transportation.

Or, more briefly stated: Motive machinery, machinery of transmission, machinery of application, and machinery of transportation.

I will now proceed to consider these divisions of machinery with a view to making the classification more clear, and shall revert briefly to the principles of operation in each division; and as this dissertation will form a kind of base upon which the practical part of the treatise will in a measure rest, it is trusted that the reader will not only carefully consider each proposition that is laid down, but will add others from his own deductions as he goes along.

(To be continued.)

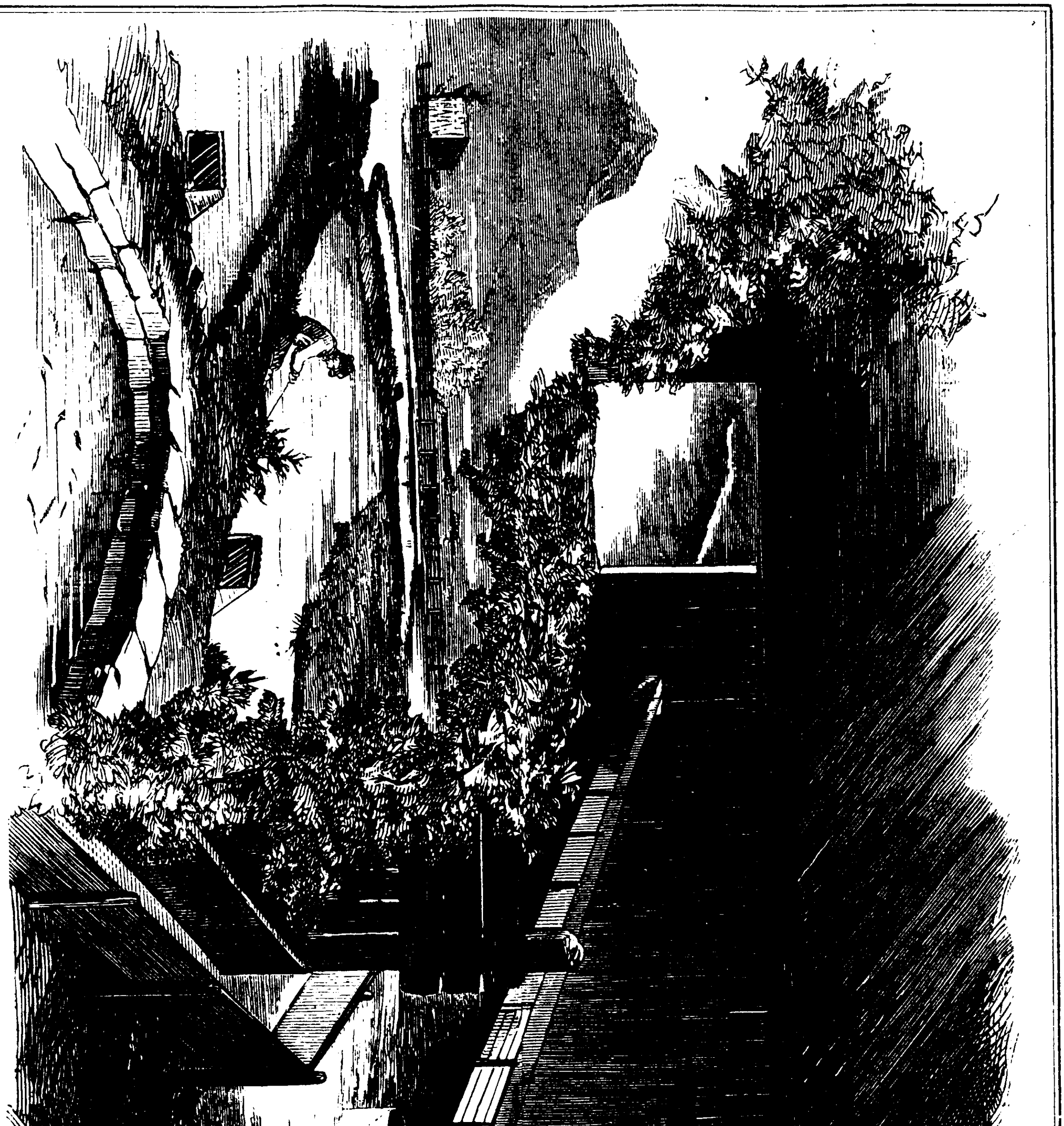
PROGRESS OF WORK ON THE MONTREAL NORTHERN COLONIZATION RAILWAY.

We are happy to know that work on the construction of that portion of the Montreal Northern Colonization Railway between Ste. Scholastique and Chatham (Dobbie's) is now fairly under weigh, and progressing favorably Mr. Murray, sub-contractor, at St. Scholastique, has got out a nice lot of stone for the St. Scholastique bridge, sufficient for one abutment; also a considerable amount of culvert stone, for the large double box culvert, about a mile from that place. Messrs. Dwyer & Anderson, who have the sub-contract from Cote St. Louis to Wilson's Road, have got on well with their earth work, they having graded nearly a mile and a half of the road bed. These contractors would have done much more work, but were prevented by the owners of land refusing possession of their land; but we believe matters of this kind are now all settled in this section, or will be in a few days. Messrs. Doyle & Co., sub-contractors, from Wilson's Road to North River (through Lachute village) are also getting on very well. At Vide Sac they have nearly all the clearing and grubbing done. A large culvert is completed at that place, and nearly one mile of road bed graded. Between Vide Sac Road and the North River (through the Station ground,) nearly one and a half miles (embracing two large cuttings,) and one very heavy bank, is two-thirds graded.

At the North River Bridge, which will have two spans of 150 feet each, the foundation for the eastern abutment is excavated, and the lower course of masonry laid; sufficient stone is on the ground to build the abutment. The stone for this work is of very superior quality, weighing 170 pounds to the cubic foot—it is primary limestone, difficult to distinguish from granite; we are perfectly satisfied this stone will make a handsome structure. Considerable stone is hauled for the West River Bridge, the foundation for which will be shortly commenced. From the West River to Dobbie's homestead over two-thirds of the road bed is nearly complete; this portion has two cuttings, one of which is somewhat heavy, 7,000 cubic yards of earth having to be removed. From West River to Dobbie's the Messrs. Gordon Bros., contractors for this division, build the two bridges at Lachute. Mr. James Gordon, senior partner of the firm, is at present visiting his brother, Mr. Clarke Gordon, in Lachute. The latter gentleman, who has charge of the work here, seems to be on the *qui vive* all the time, to push forward the work. Mr. Croasdale, the engineer in charge of this division, don't seem to have any slack time on his hands.—*Argenteuil Advertiser.*

A cotton factory in Sherbrooke is talked of. Rhode Island capitalists are making an examination of the manufacturing facilities.

DEATH OF DE GROOF, THE FLYING MAN.—(See page 46.)



TROUT HATCHING IN COLORADO.

SCIENTIFIC NEWS.

Music by Telegraph.—At the last meeting of the California Academy of Sciences, the president, Prof. George Davidson, said that Mr. Mumford, of the Telegraph Company, had shown him an instrument for the transmission of musical sounds along a telegraph wire He himself heard distinct musical sounds sent 800 miles. He had asked Mr. Mumford to extend a wire to the Academy's building, so as to show the members this remarkable invention, but a detailed description of the instrument could not be given until patents were obtained.

Cure for Burns —Comte de la Tour du Pin publishes the following for the benefit of the world at large. He says that a pretty strong solution of ammonia in water is an excellent remedy for burns in cases where the skin is not destroyed, and, as "much trouble doth environ those who meddle with hot iron," our readers are peculiarly interested in such remedies. The count says, that having by accident taken hold of a crucible which was nearly red hot, he suffered great pain, plunged his hand into some ammoniacal water, and kept it some hours afterwards covered with a piece of linen soaked in the same; the pain was allayed almost immediately, and no blisters or suppuration occurred.

Welding.—In welding iron, as is well-known, the pieces are heated to whiteness. When iron is to be welded to iron this plan answers well enough; but if iron is to be welded to steel the white heat often destroys the steel completely. To remedy this evil a patent has recently been taken out in America which promises to remove all difficulties. By this process the surface of the metal to be welded is moistened with water, and on the wet surface there is sprinkled a compound consisting of 1 lb. pulverised calcined borax, 1 lb. fine iron filings, and 4 oz. pulverised prussiate of potash intimately mixed. The two surfaces are then wired or otherwise held together, and raised to a red heat, or about 600 deg. to 700 deg. Fah. When subsequently subjected to rolling or hammering the joint is completed, whilst the steel is not sufficiently raised in temperature to be at all injured by the operation.

A New Calculating Machine.—A short time ago (says an American contemporary) we saw in the Reliance Machine Works, Philadelphia, a wonderful little mathematical machine, which was being manufactured in that establishment. There is nothing remarkable in the appearance of the machine, but there is in the result it achieves. It will add, subtract, multiply, divide, and in fact, perform almost any arithmetical operation with perfect accuracy and perfect ease of management. It might be made of special service to politicians in office, for it understands "addition, division, and silence." As an example of rapid computation, recently before the Franklin Institute, the inventor, Mr. F. S. Baldwin, set up a multiplicand, consisting of eight places of figures and a multiplier, also composed of eight places, and performed the multiplication in a minute and-a-half. The operator has simply to turn a crank. For instance, suppose the unit figure in the multiplier to be eight, the operator turns the crank eight times, then moves the multiplying gear one place to the left. The partial product is shown complete at each turn. The machine also proves its work by reversing the operation and turning the crank backwards until the starting point is reached. If correct, the product will then show a row of noughts. The machine has been used by a prominent railroad company for several weeks, and in a number of long computations has not made a single mistake, but has detected several mistakes in their prepared arithmetical tables. This interesting invention will be exhibited at the Franklin Institute Fair, next October.

M. Tresca has called attention to a curious phenomenon observed in hammering of the bar of platinised iridium recently prepared for the International Metric Commission. At each stroke of the hammer there were produced rectilinear luminous flashes (*éclairs*), which crossed each other in the form of an X, extending from one side of the bar to the other, and always in the same manner. No explanation is offered of the fact.

The following process of determining tannin in astringent materials communicated to *Les Mondes* by M. Terreil is founded on the absorption of oxygen by tannin in the presence of alkaline liquors in a special apparatus. The latter consists of a glass tube, 0·6 in. in diameter and 7·8 cubic inches in capacity, suitably graduated The upper portion is closed, and below is a glass cock, between which and the zero of graduation is a space of 1·2 cubic inches, in which the alkaline liquor is introduced. The solution contains one-third, by weight, of caustic potash, and it is known that 1 5 grains of tannin absorb 1·2 cubic inches of oxygen. The astringent material is ground as finely as possible, and from 1·5 to 3 grains are enveloped in unsized paper. The alkaline solution is introduced at the tube by plunging the latter into the liquid and opening the cock below. The material is then dropped in and the apparatus carefully shaken, care being taken to note the temperature and pressure of the atmosphere and also not to warm the air within the tube by the hands. The liquid becomes immediately of a yellowish brown, and the agitation is frequently renewed. The extremity of the tube is plunged in water, and the cock opened. An absorption follows, but the cock is immediately closed, as soon as the coloured liquid appears to descend through the lower opening. After 24 hours, during which the above operation is frequently repeated, the entire apparatus is plunged in water to bring it to the surrounding temperature, and the cock is opened under the surface to detect the final absorption. When this is complete, the cock is closed, and from the graduation of the tube may be read the quantity of oxygen absorbed; and knowing that 1·5 grains of tannin absorb 1 2 cubic inches of oxygen, it is then easy to determine the richness, in tannin, of the material analysed.

Electro-Silicon.—This substance is not a manufactured article, but is pure silica, obtained from a mine in the State of Nevada. It is composed of the minute shells of infusoria, and is both inodorous and insipid. On chemical analysis the percentage of its composition is found to be as follows:—Silica, 83 5 parts, alumina (with trace of oxide of iron), 2 7, water, 13 5; loss, 3 parts. There is nothing of an injurious nature in this silica, and it is of so fine a texture that, as taken from the earth, it feels like velvet. For the purpose of polishing gold, silver, or plated wares, or any other metallic substances of this nature, it has no equal, removing all tarnish and imparting to them a brilliant lustre. It does not scratch the finest surface, and is also more permanent in its character than any other polishing powder.

A curious case of disintegration of a metal under the combined influence of cold and continuous vibrations has lately been described by M. Oudemans. A manufacturing house in Rotterdam despatched, for Moscow, last winter a certain quantity of tin, in the ordinary form of blocks. The metal, conveyed by railway in very cold weather, reached its destination in the form of a powder of large crystalline grains. It had a grey colour, quite different from that generally presented by tin, and which the author compares to that of sulphurised molybdenum Chemical analysis showed that the metal was almost quite pure, containing at the most 0·3 per cent. of foreign substances (lead and iron).

Incombustible Wood for Ship and House Building.—Several attempts have been made at different times to render timber uninflammable. A new and apparently successful method has recently been tested at Plymouth, of which perhaps the most convincing of the first series of experiments was that in which a large heap of the prepared timber, about two feet high and seven or eight feet in circumference, placed on large iron sheets, was saturated with paraffin and set on fire; as soon as the paraffin was consumed the fire spontaneously went out. The timber was then examined, and found to be scarcely injured. The pieces of wood were of various sizes, the majority being about eighteen inches long by two and three inches square. Not only does the process render timber uninflammable, but it has the not less important property of making the softer kinds of timber (such as white and yellow pine) throughout, both in appearance and hardness, like teak or oak. What adds immensely to the value of the discovery is that the system can be applied by a simple method to ships already built, so as to render those containing incipient dry-rot almost as good as new, and absolutely arresting any further damage from these destructive fungi. We understand that the inventor is a clergyman, the Rev. Dr. Jones, Principal of Harewood College, Tavistock, and that the process is very inexpensive.

Les Mondes of 21st May gives an engraving of a curious clock. The instrument has been designed by E. Henri Robert, and consists simply of a transparent glass dial, suspended by two cords from points in its border It carri s the two usual hands, which, however, are quite free, and witho t apparent mechanism. If you move either round a little, then let it go, it returns to its position after a few oscillations. The regular movement of the hands is effected not by electricity (as some thought), but by displacement of their centre of gravity (by mechanism within them). It is remarked that this simple dial will give the hour in two apartments, only the observer on one side would have to accustom himself to interpret the backward movement.

On the 16th and 17th May last P. Secchi took the opportunity of examining with the spectroscope the light of Coggia's comet. He found it to consist of bands, two, especially, were very bright in the green and th green-yellow. These corresponded to the spectral bands of carbonic oxide and carbonic acid. It is remarkable that all the comets observed hitherto have given carbon bands P. Secchi also states that he has lately met with confirmation of the opinion that the line 1474 of the solar spectrum does not belong to iron. Observing a magnificent eruption one morning, he found this line reversed throughout its length, while the two lines of iron near it were reversed only along a very small space hardly perceptible to the eye. If the three lines all belonged to iron, they should all be reversed throughout the same extent.

A curious capillary experiment was devised by M. Lippmann some months since, which the author has recently utilised in a very ingenious way. The original experiment is thus described in the *Journal of the Franklin Institute*. Place in a saucer or in a large watch-glass a globule of mercury an inch or two in diameter, and pour upon it a little water acidulated with sulphuric acid and slightly coloured with potassium bichromate. If now the mercury be touched laterally with the point of a needle, the globule will be observed to contract and withdraw itself from the needle, then to extend again to its primitive position. This brings it again into contact with the needle, the contraction is renewed, and so on indefinitely. When the globule is quite large it executes contorted and grotesque movements which are surprising to those who are not in the secret. The explanation of this phenomenon is found in the fact that under the joint influence of the iron and the bichromate, the mercury is successively oxidised and deoxidised, thereby producing an alteration in its capillary condition and causing the swelling and flattening. This oxidation and deoxidation may also be effected by an electric current. The globule is seen to swell up or to flatten, according as it is connected with the negative and deoxidising or with the positive and oxidising electrode. It is this oscillating motion of the globule of mercury that M. Lippmann has utilised in his motor. It is constructed as follows. In a trough of glass two small cups are placed, full of mercury, in each of these moves a piston formed of a bundle of glass tubes. The trough is filled with acidulated water, and the two masses of mercury are in communication with the electrodes of a battery in such a way that when the one contracts the other flattens. Consequently, when one of the pistons rises the other falls; and by simply transforming this reciprocating motion of the pistons into a rotary one, an electro-capillary engine of some hundredths of a kilogrammetre of power is readily obtained. In the machine actually constructed by M. Lippmann the fly-wheel made a hundred revolutions per minute. The extremely feeble current needed to set this engine in action suggests its use as an indicator of currents too feeble to be detected by the ordinary instruments. Used in this way it would constitute an extremely sensitive electrometer. Indeed it might come in use for the reception of cable dispatches, which, as is well known, are sent by means of very feeble currents. Certain movements of the machine might correspond to certain predetermined characters or sentences, and in this way the dispatch might be easily deciphered. Though scarcely more than curious at present, these experiments of M. Lippmann are exceedingly interesting, and will undoubtedly in the future receive important applications.

The mineral products of Nova Scotia for the past year were 1,051,476 tons of coal; 11,852 ounces of gold; 3,500 tons iron, and 120,000 tons freestone.

FINISHING WOOD WITH CHARCOAL.

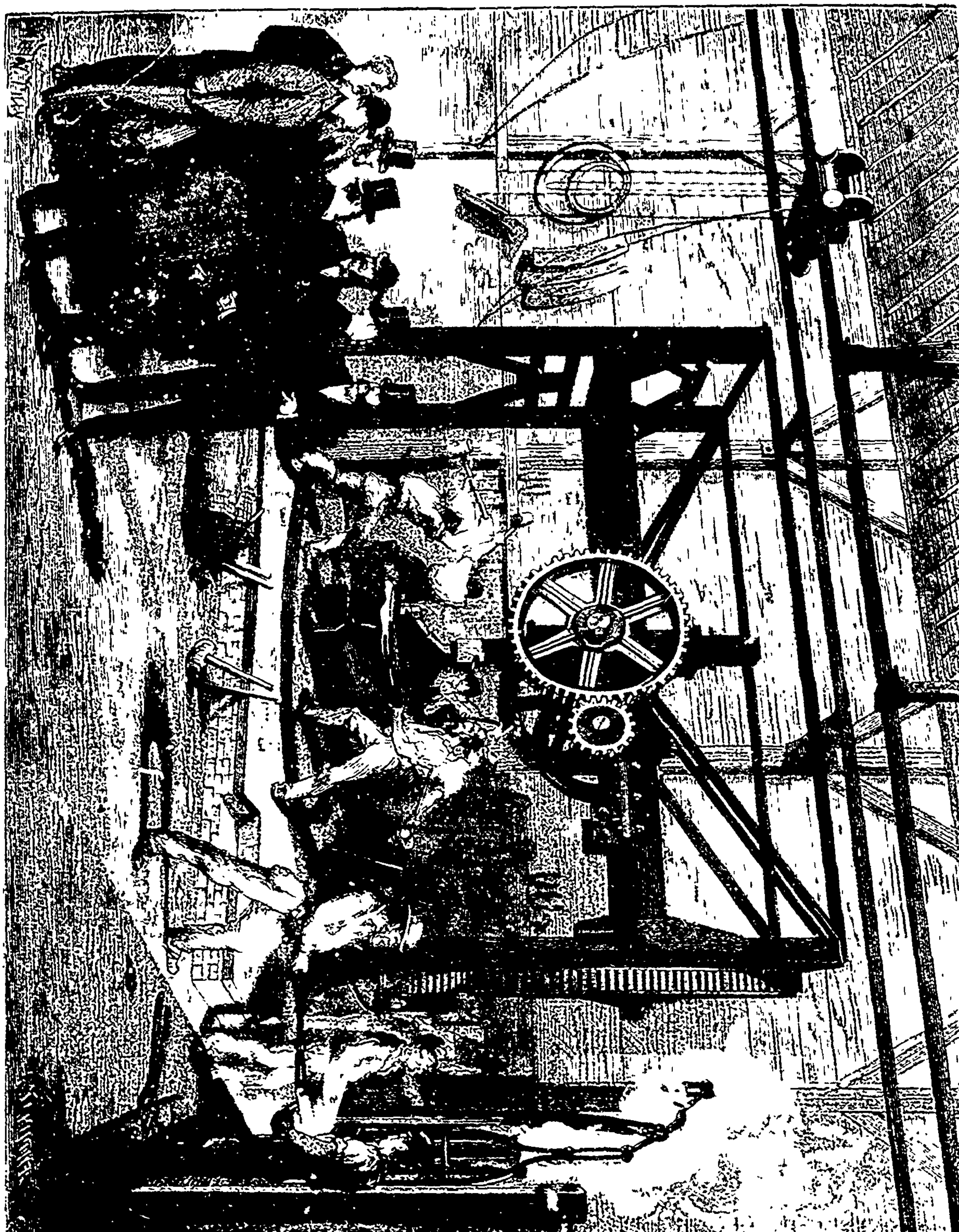
The United States *Cabinet Maker* gives the following brief account of the method adopted by French cabinet-makers of producing a dead black on furniture and other work :—All the world now knows of those articles of furniture of a beautiful dead black colour, with sharp clear-cut edges, and a smooth surface, the wood of which seems to have the density of ebony. Viewing them side by side with furniture rendered black by paint and varnish, the difference is so sensible that the considerable margin of price separating the two kinds explains itself without need of any commentary. The operations are much longer and much more minute in this mode of charcoal polishing, which respects every detail of the carving, while paint and varnish would clog up the holes and widen the ridges. In the first process only carefully selected woods of a close and compact grain are employed, these are covered with a coat of camphor dissolved in water, and almost immediately afterwards with another coat composed chiefly of sulphate of iron and nut-gall. The two compositions in blending penetrate the wood and give it an indelible tinge, and at the same time render it impervious to the attacks of insects.

When these two coats are sufficiently dry, they rub the surface of the wood at first with a very hard brush of Couch-grass, or Dog's-tooth grass, (*Triticum repens*) and then with charcoal of a quality as light and friable as possible, because if a single hard grain remained in the charcoal this alone would scratch the surface, which they wish, on the contrary, to render perfectly smooth. The flat parts are rubbed with natural stick charcoal, the indented portions and crevices with charcoal powder. At once, almost simultaneously, and alternately with the charcoal, the workman also rubs his piece of furniture with flannel soaked in linseed oil and the essence of turpentine. These pouncings, repeated several times, cause the charcoal powder and the oil to penetrate into the wood, giving the article of furniture a beautiful colour and perfect polish, which has none of the flaws of ordinary varnish. Blackwood, polished with charcoal is coming day by day to be in greater demand; it is most serviceable; it does not tarnish like gilding, nor grow yellow like white wood, and in furnishing a drawing-room it agrees very happily with gilt, bronzes, and rich stuffs. In the dining-room, too, it is thoroughly in its place to show off the plate to the greatest advantage, and in the library it supplies a capital frame-work for handsomely bound books.

ELECTRIC PHENOMENA OF THE LEAVES OF THE FLY CATCHER

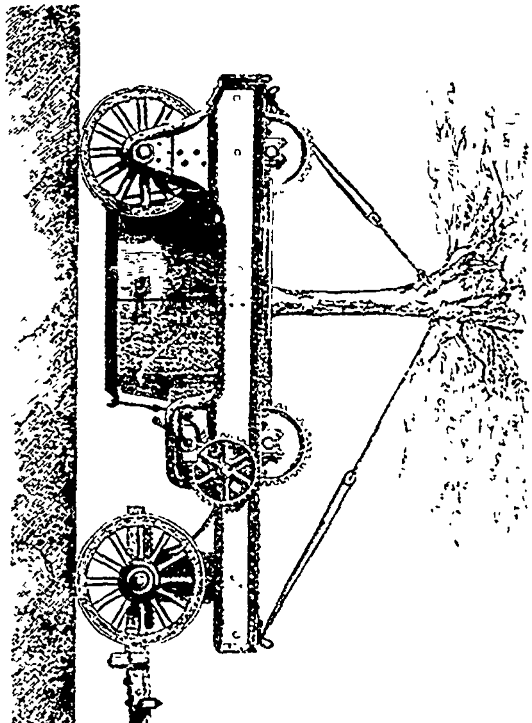
The *dionæa muscipula* or fly catcher is one of the most curious examples known of a vegetable gifted with motion. The leaves of this plant, which are shown in the annexed engraving, for which we are indebted to *La Nature*, are terminated by a limb which carries two concave plates or valves united by a kind of hinge. If an imprudent fly venture to rest upon the inner surface of this trap, the plates, the minute bristles upon which become irritated by the presence of a foreign body, suddenly snap together like the covers of a book quickly closed. If the insect struggles, the portions adhere more closely, holding him prisoner until he dies or until, tired out, he remains motionless. Then the plates slowly open, ready to close again, however, on the least movement of the fly. If this does not take place, the trap allows its victim to fall out and remains set for new prey.

Professor Burdon Sanderson, of the Royal Society, has recently made some interesting investigations into the electric condition of this singular plant, proving that its movements are due almost entirely to electrical circumstances. By connecting sometimes the limb and sometimes the petiole of a living leaf with the circuit of a galvanometer, two permanent currents have been discovered, acting in contrary directions, one passing through the limb from base to apex, and the other directed from the base of the limb to the base of the petiole. The experiments of Professor Sanderson throw considerable light on phenomena heretofore very obscure. The peculiar movements of vegetables, it may be considered as established, result from changes in tension produced in the tissues, either spontaneously or accidentally. The tensions are due to the unequal turgescence of the cellules, the surfaces of which either absorb the water which surrounds them or else



THE CAIL WORKS.—(See page 47.)

THE FLY-CATCHING PLANT



APPARATUS FOR TRANSPLANTING TREES.

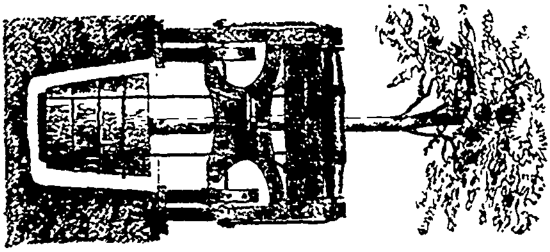


Fig. 1.

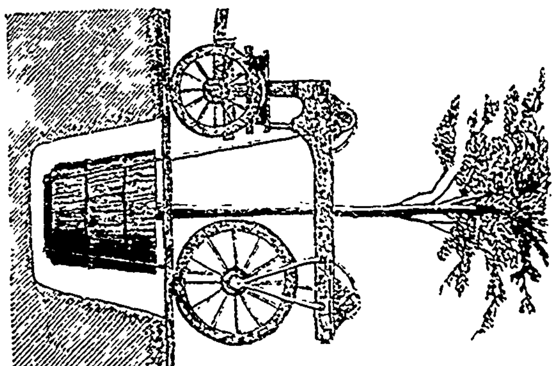


Fig. 2.

abandon it, by virtue of a special property of their substance under the influence of physical forces, such as light, heat, and without doubt electricity. The most recent researches, for example, show that the drooping and the erection of the leaves of the sensitive plant result from a displacement of the water which swells alternately the superior and inferior vessels of the base of the petioles.—*Scientific American.*

APPARATUS FOR TRANSPLANTING TREES.

The transplanting of trees which have attained to certain amount of growth is an expensive and difficult matter, but sometimes it is necessary to be done in the case of public parks and other grounds. In the case of the Bois de Boulogne the great pleasure ground of Paris, which, during the late war, suffered almost total demolition at the ends of the contending forces, it has been necessary to transplant a large number of trees to replace those cut down. This work being found very costly, as well as difficult to perform with existing means, a less expensive method has been devised for its accomplishment, which consists in the use of wagons especially built for transporting the trees bodily from place to place.

Our illustrat ons show two forms of the apparatus, Figs, 1 and 2 giving different views of the small one horse vehicle, and Fig 3 of the largest machine, required the power of several horses. The former is constructed of wood and the latter of iron The mode of operation consists in first digging an annular trench around the tree, so as to leave sufficient earth about the roots of the latter. As the excavation progresses downward, the exterior of the clod is enveloped in branches or with barrel staves encircled by iron hoops held by binding screws. The tree is sustained by guys from falling. When a sufficient depth is reached, the earth under the tree is cut away and planks shoved beneath.

Timbers are next laid on the surface to serve as ways for the vehicle, which is run thereon. The rear crosspiece of its frame is detachable, so that the machine can be placed directly over the hole and surrounding the trunk. Chains are then carried down from the two windlasses and led under the planks beneath the roots. The windlasses being turned, the tree, roots, and clod are lifted bodily up between the wheels, and there remain suspended while the wagon is dragged off to the point at which the tree is to be placed. There, a hole being dug, and its interior well watered, the tree is lowered in and the earth packed around, thus completing the operation. The smaller vehicle is used for moderate sized trees; but with the larger one and its more powerful machinery, trees of considerable magnitude, it is stated, may be readily transported.

DOMINION.

Galt is to have a new sewing machine manufactory. Hamilton, another.

A second attempt is being made to raise the Paris sulphur spring to a height of six feet.

Sherbrooke has formed a Joint Stock Paper Manufacturing Company with a capital of $100,000.

The remaining Grand Trunk broad gauge track on the sections east of Montreal will be changed to the uniform standard on Saturday, the 26th of September next.

Two cargoes of rails have arrived for the Yarmouth Railway, and a locomotive for the line has been contracted for in Portland, Maine, and will be ready in about a month. Twenty freight cars are being manufactured for the line in Yarmouth.

The Perth *Expositor* says :—A project is now being set on foot to build a line of railway from Kemptville on the St. Lawrence and Ottawa Road to connect with the Kingston and Pembroke Railway It is intended that this road shall run through Merrickville, Smith's Falls, and Perth.

Specimen lead pencils are to be seen in Ottawa, made from plumbago of the Buckingham Mines. They are of superior quality, something like No. 2 Faber. Mr. Walker has gone to England for the purpose of forming a joint stock company to manufacture the plumbago at Buckingham, instead of shipping it in a crude state.

A telegram from Hamilton to the London *Free Press* says :—"H. A. Wilkens, of London, informs me that during a tour in the Niagara Peninsula, he discovered a quarry of freestone, covering some four hundred acres, which he immediately bonded. The stone, he asserts, is equal in every respect to the Berea stone, and Mr. Wilkens proposes showing Canadians that the quarry can be worked to pay."

The St John *Telegraph* says a public work of immense value to the commerce of the Bay is about to be undertaken by the Government. Tenders are asked for a break wat er from Negrotown Point to within about a thousand feet of Partridge Island, thus leaving that important channel clear. The effect of this work, which may cost a quarter of a million of dollars, will be to create a vast harbour of refuge for all the shipping of the bay, a harbour of vast extent and as calm as a mill-pond even in great storms.

A Pittsburgh manufacturer has recently been invited to estimate for the requisite "plant" for three rolling mills in different parts of the Dominion. Apropos a paper of that city queries whether the proposed Reciprocity Treaty has anything to do with this awakened activity. For our part we don't know, but we are glad to hear of the rolling mills any way, and hope that at an early day, either with or without reciprocity, local or outside capitalists will avail themselves of the special advantages of this locality to set going a rolling mill here.—*St. Catharines News.*

Narrow Gauge Locomotives. — Owing to the intended change of gauge on the G. T. R East, on the 26th of September next, several of the new locomotives have already arrived. Some of them have been manufactured in Hamilton, Ont., and ten of an improved pattern have been ordered from the Providence, R. I., Locomotive Works. They have three sets of driving wheels, suited to the narrow gauge, and well adapted for the ascending of grades. Some of them have arrived and are intended to run the heavy grades between Richmond and Island Pond immediately after the change of gauge. The Quebec train will be the last to run on the wide gauge track on the evening of the 24th September.

New-Brunswick Shipping.—Almost all the large ships built at St. John's, New Brunswick, go at once to England, and very few of them ever return to St. John's. They are chartered for the East Indies and elsewhere, and run for years without returning home. The first cargo out is lumber, and to give an idea of where both ships and lumber go, we may quote the lumber exports for the last year. Of the timber-laden ships that sailed from St. John's, 140 vessels, carrying 125,940 tons, went to Liverpool; 27 ships of 20,538 tons, to London; 65 ships, of 39,251 tons, to the Bristol Channel; 111 ships, of 47,600 tons, to the Clyde, 27 ships, of 14,410 tons, to other British ports; 3 ships, of 1,257 tons, to France; 177 ships, of 39,912 tons, to the West Indies; 334 ships, of 33,888 tons, to the United States, and 23 small ships to South American and other ports. The grand total is 934 ships of 347,181 tons.

The Largest Ship Yet —Mr. Thomas Forhan, of this city has contracted to make the sails for the large full-rigged ship building at Maitland for Mr. William Lawrence. This ship, which will register about 2,400 tons, will be, when completed, nearly 600 tons larger than any other ever built in the Dominion. The following are some of her dimensions :—Length of keel 244 feet, depth of hold 30 feet, length over all on deck 280 feet, length of masts from keelson to truck—fore 185 feet, main 193 feet, mizzen 160 feet; the lower yards are each 90 feet long, and the skysail yards 36 feet, the jibboom from the knightheads to the extreme is 63 feet long. She will carry three skysails—an unusual thing in ships built in this country —and a spanker-boom 60 feet in length. At the bilge she has a thickness of 2 feet 8 inches solid wood, including her ribs and inner and outer planking. She is diagonally ceiled throughout, is finished in the most complete manner, and will spread when under full sail about 7,000 yards of canvas. She is expected to carry nearly 3,000 tons of freight. The ship will be ready for launching in September next.—*Halifax Recorder.*

RAILWAY MATTERS.

Experiments are being made by an English railroad company to ascertain whether steel tubes can profitably replace those of copper and brass in locomotives.

A company has been formed in England with a capital of £100,000 in £20 shares, to construct a line of road, tramway or railroad, between Shanghai, Woosing, and Paoushur, in China, and to work the same.

The *Iron Trade Review* says that a German engineer, Mr. Hensel, has obtained a concession from the Egyptian Government to construct a railway in Nubia. He will be on his way to Egypt in a few days to make his preparations. Both English and German financiers are interested in the undertaking. It is said that Mr. Hensel has discovered extensive coalfields on the projected line.

The Channel Tunnel Scheme.—A commission, appointed by the French Minister of Public Works, having reported favourably upon the great scheme for connecting England and France by a submarine tunnel, French coal-owners in the north of France are beginning to discuss the probable effect of the work upon their trade, and are afraid that the tunnel would greatly increase the deliveries of English coal upon the northern French markets.

A street car is propelled in San Francisco on the system formerly in use on the London and Blackwall Railway. An endless cable is placed beneath the track and kept in motion by a powerful engine at one end of the journey. The cars are provided with clamps, by means of which they can take hold of the cable and release themselves instantly, the cars run at a much higher rate than the horse cars, but we should imagine the start was rather jerky.

The St. Gothard Tunnel.—The works of the St. Gothard Tunnel are advancing regularly at the Goeschenen end at the rate of 10 ft. per day, but considerable obstacles have been encountered at the Airolo end. Landslips have damaged the water conduits and approaches, and in the tunnel itself exceptionally hard rock makes a rapid advance impossible.

A new pneumatic gas lighting apparatus, now being introduced by Mr. Asahel Wheeler, of Boston, Mass, was recently tested at Providence, R. I, says the *Scientific American*, with satisfactory results. A current of compressed air is transmitted from a central engine to diaphragms at the burners. the moving of which turns on the gas, which is then lit by an electric spark. Forty lights were kindled and extinguished simultaneously. It is stated that by this device all the street lamps in a city may be lit by the movement of a single lever, at any certain point.

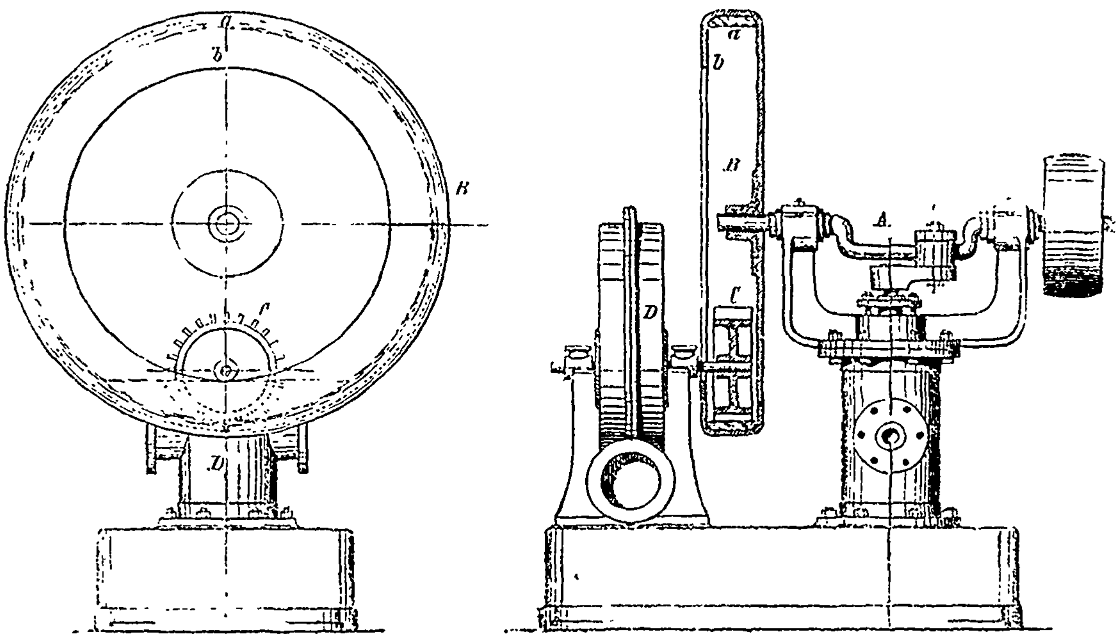
If a partition of porous earth separates two gases of different densities, an unequal diffusion takes place across the dividing body; the current of denser gas is more abundant than the other. M. Dufour has recently investigated the question as to what takes place when two masses of air of the same temperature, but containing unequal quantities of water, are substituted for the gas. He finds that there is still unequal diffusion, and that the most abundant current passes from the dry over to the moist atmosphere. This diffusion depends on the tensions of the aqueous vapour on the two sides of the porous partition.

A correspondent writes to the American *Railroad Gazette* with reference to the narrowest gauge in America. He says, "It is stated the narrowest line is the railroad at Mount Union, which has a width between the rails of 27½ in; but there is one narrower still, viz, the Peakskill Valley Railroad, which is of 24 in gauge, five and a-half miles in operation, and which is said to give great satisfaction. The locomotive employed on this line weighs 8000 lb. There appears to be almost as much variation in gauge in narrow as in the broad lines. For instance, we have in the United States, apart from the standard narrow gauge, of which the Denver and Rio Grande Railroad is a type; the Peakskill Valley of 2 ft. gauge, the Mount Union of 2 ft. 3½ in. gauge, the Pittsburgh and Castle Shannon of 3 ft. 4 in. gauge, the Brownsville and Rio Grande and others of 3 ft. 6 in. gauge."

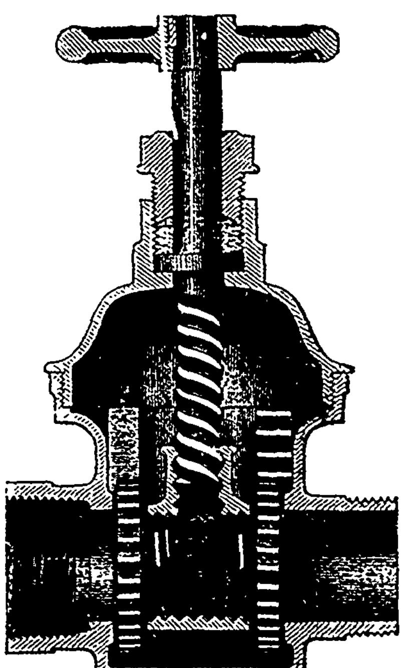
The New Brunswick Railway is to extend from St. Mary's opposite Fredericton, N B, to Edmunston, or Little Falls, on the upper St John River, a distance of 161 miles, with a branch of nine miles long to Woodstock. The road was opened for traffic to Northampton, opposite Woodstock, and 61 miles from St. Mary's, on the 20th of January. A bridge over the St John to carry the road into Woodstock will be commenced this year and may be finished within twelve months. The iron for 17 miles additional is delivered, and the grading for that distance is nearly completed. It is intended to have the road to Tobique, 98 miles, making with the Woodstock branch 107 miles, completed by November 1, and the whole road will be finished in 1875. An extension of some 65 miles from Edmunston to Riviere du Loup on the St. Lawrence is to be undertaken in a short time. At Nashwaak, the deep water terminus opposite Fredericton, large shops have been built and fitted with machinery, and the company has full facilities for turning out all the rolling stock needed except locomotives. A rotary saw and kilns for drying lumber are connected with the shops, and lumber is brought down in the log and worked up in the shops. A large wharf, 250ft deep and 500ft face, has been built on the river, and the company has every facility for shipping lumber and other freight. The gauge of the road is 3ft. 6in. The locomotives are of the Fairly pattern, and are built by the Mason Machine Works, at Taunton, Mass. The snow-ploughs are 9ft. 3in. wide, and have spring trucks with 30in. wheels

By a letter from Zurich, says the *Railway News*, we regret to find that the accounts of the progress making in the St. Gothard tunnel are not so favourable as they might be. On the Airolo side the works are much impeded by a thick bed of quartzite, which resists the boring machinery so effectually that they cannot pierce more than half a metre per day, instead of the calculated two metres, and it is quite uncertain how long this obstacle will last before the normal rock be again reached. At the same time the sanitary condition of the men is much to be deplored; they have not only to work in the dark, but to stand up to their knees in the unpleasantly cold water, with the drops moreover trickling down on their heads from above. This has caused much grumbling among the workmen, some of whom have died, others are in the hospital, and a good many refuse to fulfil their engagement, and have returned to their homes, broken down in body and spirits. At the Goschenen end of the tunnel the work is going on better, as in May 82 metres were perforated, whilst at Airolo the progress of the month was only 36 metres. At the end of May the total piercing at both ends was 865 metres.

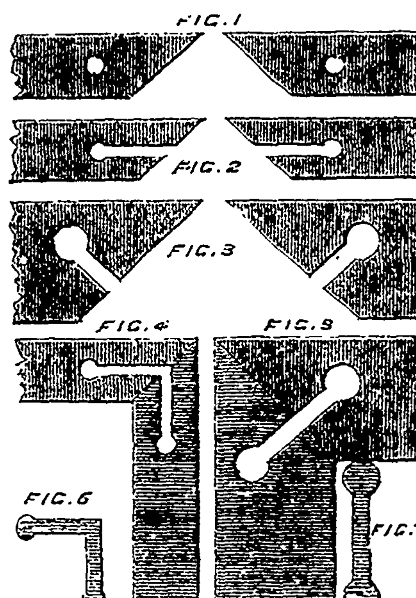
An evident improvement in the direction and appointments of the principal American railways is in progress, an example of which is seen in that portion of the Pennsylvanian Railway between New York and Pittsburgh. The road is provided with 60 lb. steel rails, oak ties, broken stone ballast, and the best splice joints. The bridge work is of the most substantial character, the superstructure is smooth and solid, the cars and locomotives superior in construction, all the latest appliances for safety being likewise supplied, such as Westinghouse air brakes, safety platforms, switches, block telegraph signals, &c. The run of 444 miles from Pittsburgh to New York is made in 11 hours, with only three stops, being an average rate of forty miles an hour, as follows:—Pittsburgh to Altoona, 117 miles, stop 5 minutes; to Harrisburgh, 132 miles, stop 20 minutes; to Philadelphia, 105 miles, stop five minutes; thence to New York, 90 miles. The locomotives dip up water from side troughs at certain station without stoppage. The trains are comprised of magnificent Pullman parlour cars. It would be difficult to name any stretch of railway in the world, of equal length, where passengers can be more expeditiously and luxuriously carried. The railroad mileage of the United States now exceeds the combined mileage of all Europe, although the population of Europe 282,000,000, is seven times greater than that of this country. Every year adds to the improvement as well as the length of American roads. How to make our railways better and safer is the constant study of the legion of engineers, inventors, and managers who are connected with them. The practical results of their labours will be naturally manifested in gradual changes for the better in all branches of railway service.



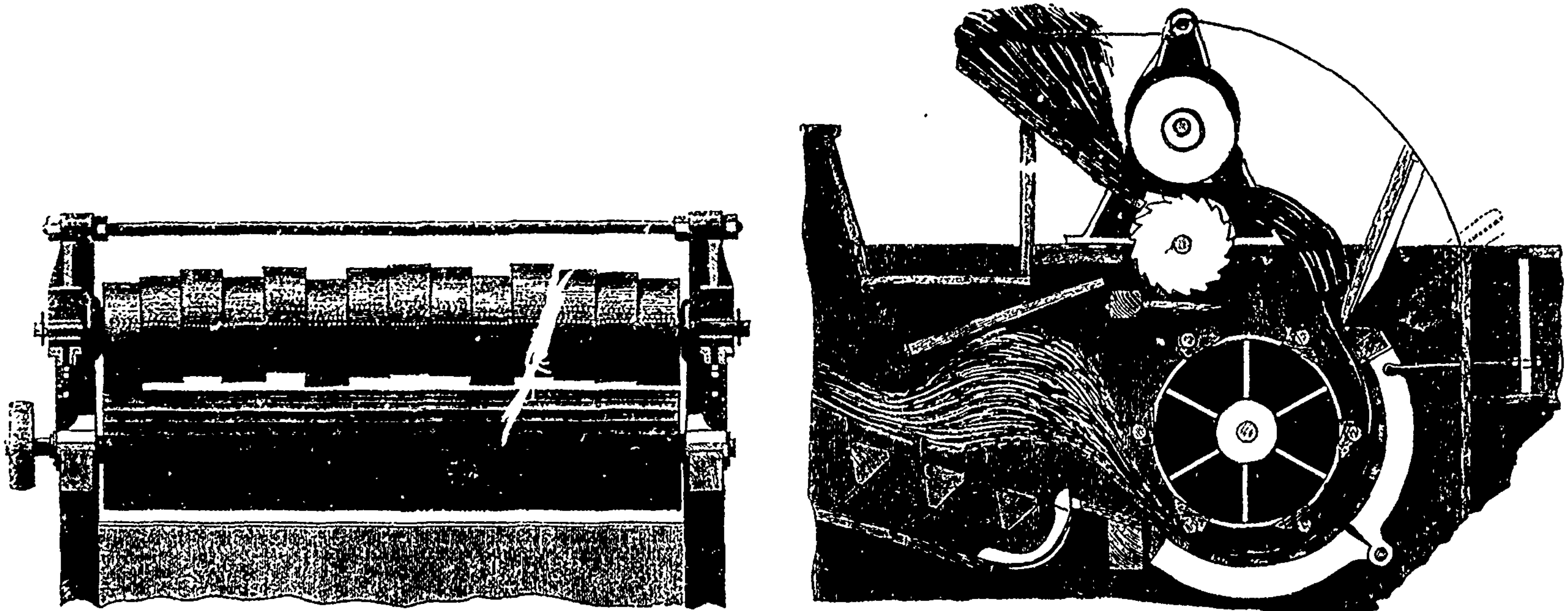
WATER BELT FOR TRANSMITTING MOTION.



DENNIS' STOP VALVE.



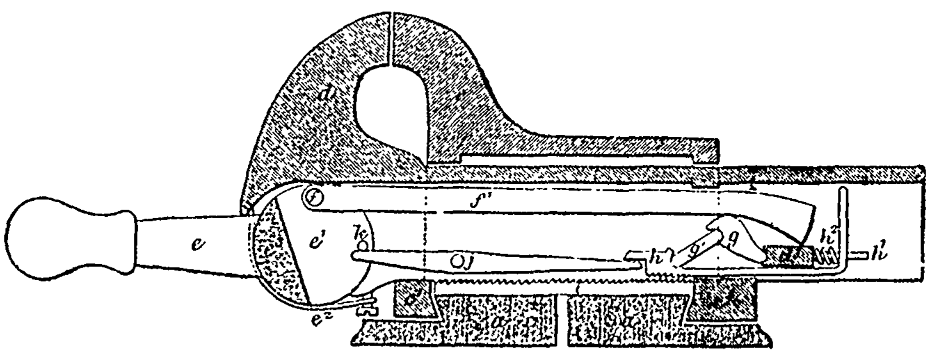
A NEW JOINT.—(See page 62.)



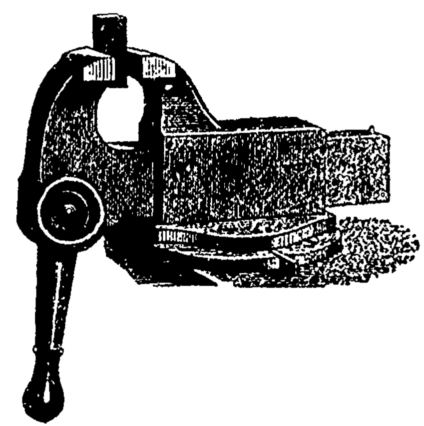
TRANSVERSE SECTION

LONGITUDINAL SECTION

THRASHING MACHINE GUARD.—(See page 47.)



HALL'S LEVER VICE.—(See page 62.)



HALL'S LEVER VICE.—(See page 62.)

DENNIS' PATENT STOP VALVE.

On page 60 we illustrate a stop valve, the invention of Messrs. Dennis, of Chelmsford, which almost explains itself. In the valve-box are fitted two short racks at opposite sides of the box, as well as at opposite ends. The valve consists of a central portion with an internal screw at each end, and of two discs toothed at the edges to take into the teeth of the racks to which we have just referred, and of a screwed boss which enters the central portion of the valve. By raising and lowering the central portion it is obvious that the discs will be caused to rotate, as they approach the bottom they are by this rotation screwed further apart and made to fit tight against the internal faces of the valve-box, so as to be quite tight. The slightest upward motion starts the valves from their seats, and allows the utmost freedom of motion. This appears to be a very ingenious valve, likely to prove exceptionally useful under many conditions in hydraulic work.

A WATER BELT FOR TRANSMITTING MOTION.

A curious mode of transmitting motion by means of a water belt is represented in the engraving on page 60, which we extract from the *Revue Industrielle*. The device is that of an English inventor, Mr J. Robertson, and is said to work with perfect freedom from noise and vibrations. The piston of the engine is connected with the driving shaft A, on one extremity of which is attached a large hollow pulley B. The outer face of the latter is cut away from the center so as to leave only a flange of the width shown at *b*. Through the opening passes the shaft of a fan blower D, on which, and inside the hollow pulley, is a pallet wheel C. The pallets on the latter do not touch the inside of the hollow pulley.

In operation the water *a*, of which a small quantity is placed in the pulley B, is caused, by centrifugal force, to spread itself against the inner periphery, and to be carried around with the wheel. Into this water, as shown in the sectional view on the left, the pallets on wheel C, dip, and are thereby acted upon by the force of the same, causing the wheel C, to rotate. The hollow pulley is of sheet iron, and is revolved at the rate of 500 turns per minute. No water whatever, it is stated, is ejected from the apparatus, and it is only necessary to supply the small amount lost by evaporation to keep the device in working order.

HALL'S VICE.

We publish on the previous page, a perspective view and a section, showing the arrangement of an ingeniously devised vice, designed by Mr. Hall, of New York. With the help of the section the construction of the tool will be clearly understood. The fixed jaw is shown at *c*, and is cast in one piece with the rectangular hollow block, through which the movable jaw and its parts slide, and terminates in a disc, with a dovetailed circular recess, as shown at *c*1 and *c*2. The bedplate of the vice is circular, and dovetailed, to fit the similarly-formed recess in the stock of the fixed jaw. This bedplate is made in two pieces, as shown at *a a*, and a sufficient space between is left in the centre to set them in place easily; they are then tightened up by a slightly tapered steel key, but this is not driven so tightly as to prevent the free movement of the stock *c*1 *c*2 round its dovetail.

The forward end of the movable jaw *d* is provided with a circular block *e*1. This block consists of two discs, connected by a saddle piece *e*3. This is all cast in one piece, and is of such a width as to fit between the parallel sides of the U-shaped sliding piece which forms the continuation of the movable jaw *d*, and the form of which is clearly shown in the perspective sketch. This block is fastened in its place by two straps *e*2, each of them the width of the disc *e*1. The straps are fastened by a screw to the under-side of the sliding block, and at the top they are hooked over a small pin, as shown. A lever is attached to the saddle piece *e*3. By depressing this handle, as in the perspective view, two effects are produced. First, the vice—which, when the lever is horizontal, is free to turn—is locked, and, second, the object put in the vice is firmly gripped. These results are obtained as follows: A small pin *k* extends between the two discs *e*1. Bearing against the underside of this pin is shown one end of a lever *j*, the other end of which engages under a piece *h*, of the form shown in the section. Another pin *f* is also placed between the two discs. To it is attached a long wedge bar *f*1, parallel as far as the small projection, shown inside the top of the sliding block. A strong abutment *d*1, bridges the space between the sides of the sliding block. Outside this is a light spiral spring *h*2, acting always against a tall piece formed on *h*, and of sufficient strength to retain *h* in the position shown, providing there is no opposing effort. Resting on the bedplate *a* is a rack bar *i*, with teeth corresponding to those of *h*. On depressing the lever *e* the pin *f* is drawn back, and pulls the enlarged end of the bar *f*1 along with it. At the same time, as the pin *k* rises it ceases to hold the lever *j*, which then no longer prevents the teeth in the piece *h* from locking in the rack teeth. As the bar *f* is drawn back the enlarged end has to pass between the small projection inside the top of the sliding block and the toggle lever *g g* 1, the effect being to depress the latter, and to set up a powerful locking action on the jaws of the vice. At the same time *h* is pressed down, and, entering the teeth of *i*, seizes the stock *c*2 upon the bedplate, and checks all further movement in this direction. The vice is so arranged that no dirt can enter it, as the tail piece of *h* and the lever *j* are wide enough to fill the space between the cheeks of the sliding block, and the opening under the disc *e*1 may also be closed.

A NEW JOINT.

A method for making joints to unite the sides of boxes and other matters has been recently patented by Mr. W. M. Beaufort in England, France, Belgium, and the United States, through the agency of Messrs. L. de Fontainemoreau & Co. The joint is made with great speed and with little labour.

The two pieces of wood to be fastened together are first mitred in the usual manner, and a hole is then drilled (preferably by a drilling machine) vertically in each piece, from the bottom upwards, at a short distance from the mitred edge as seen in Fig. 1. A channel or groove is then cut by a circular saw or otherwise, from the mitred edge to the drilled hole. This channel is of a less width than the diameter of the hole, and may be cut either parallel to the sides of the piece of wood, as in Fig. 2, or at right angles to the mitre, as in Fig. 3, so that when the two pieces are put together a continuous channel shall be formed between the two holes, as seen in Figs 4 and 5. The two pieces are then held tightly together, and a key is formed by running metal, such as lead or "fusible metal," in the molten state into the channel; by this means, the key, which is to bind the two pieces together, is cast in the place which it is to occupy The key may also be made separately, of solid metal, as seen in Figs. 6 and 7, and driven home into the prepared channel. The invention is likely to be useful.

HOWARD'S SAFETY BOILER.

Among the novelties exhibited at the meeting of the Royal Agricultural Society at Bedford, was a new type of safety boiler by Messrs. J. and H. Howard. We publish, on the present and opposite pages, engravings of this boiler which will enable us to explain its peculiarities fully. As will be seen from the views we give, the boiler is, like the former Howard boiler, composed of wrought-iron tubes 9 in. in diameter externally, these tubes being connected together in groups and being placed at a slight angle to the horizontal, the several tubes of each group lying one over the other. It will be remembered that in the horizontal tube boiler, until lately made by Messrs. Howard, the tubes of each group were connected at but one end only. In the new type, however, connexions are provided at both ends, a decidedly better arrangement. The manner in which the connexions are made we will now proceed to describe.

Referring to the engravings, and particularly to the detail views on page 64, it will be seen that each tube has fixed to it at each end a cast-iron cap or chamber. The manner in which these caps are fixed to the tubes is somewhat peculiar. Around each wrought-iron tube, at each end, is placed a thin wrought-iron hoop, and holes are punched through this hoop and the body of the tube. The tube end, properly cleaned, is then placed in a mould, and the cast-iron cap is cast upon it, the metal running through the punched holes, as shown in Fig. 1, on the present page. To perfect the joint the wrought-iron hoop, which, as shown, projects slightly beyond the casting, is caulked all round the tube. Messrs. Howard assure us that the joints thus made stand well and give no trouble. The mode of attachment is certainly a simple one, and the introduction of the wrought-iron caulking strip is ingenious.

To connect the superimposed pipes forming each section, the end caps or chambers are provided with nozzles turned slightly conical externally, these nozzles entering wrought-iron junction rings bored out conically to receive them. The arrangement is shown clearly in the upper part of Fig. 1, the detail views, from which it will be seen that the nipples on the cast-iron caps take their bearing entirely against the conical surfaces of the junction rings, and do not butt against each other. Messrs. Howard have tested the joint for a considerable period at their own works with satisfactory results.

The series of caps are drawn tightly together by a pair of internal bolts at the end of each section, these bolts, which are of rectangular section lying close to the sides of the caps, and being furnished at their lower ends with T heads, which take hold of the lugs cast inside the lowest caps, as shown in Figs. 1 and 4 of the detail views. These tie bolts are tightered up at the top as shown. The caps are provided with doors opposite the ends of the tubes, so that good facilities are afforded for inspecting the latter. On the outside of the caps are cast square flanges and ribs for holding fire-bricks or tiles for filling up the spaces at the ends between the sections. The arrangement of the setting of the boiler will be readily understood from the general views, from which views it will also be seen that the steam is lead off from the higher end of the sections through curved pipes communicating with a cross pipe or steam drum. The pipes connecting the sections with the steam drum are but 1 in. in diameter, and they might, we think, be made larger with advantage. It will be seen from what we have said, that in the new boiler the screwed joints which gave trouble in many cases in the boilers of the older pattern, have been entirely got rid of, while greatly improved facilities are given for the circulation of the water. Altogether we think that this new type of Howard's boiler is characterised by some material improvements, and we shall watch its performance with much interest. Messrs. Howard have worked hard for some years to perfect their type of boiler and hence they are deserving of every success.—*Engineering.*

GREENWICH TIME SIGNALS.

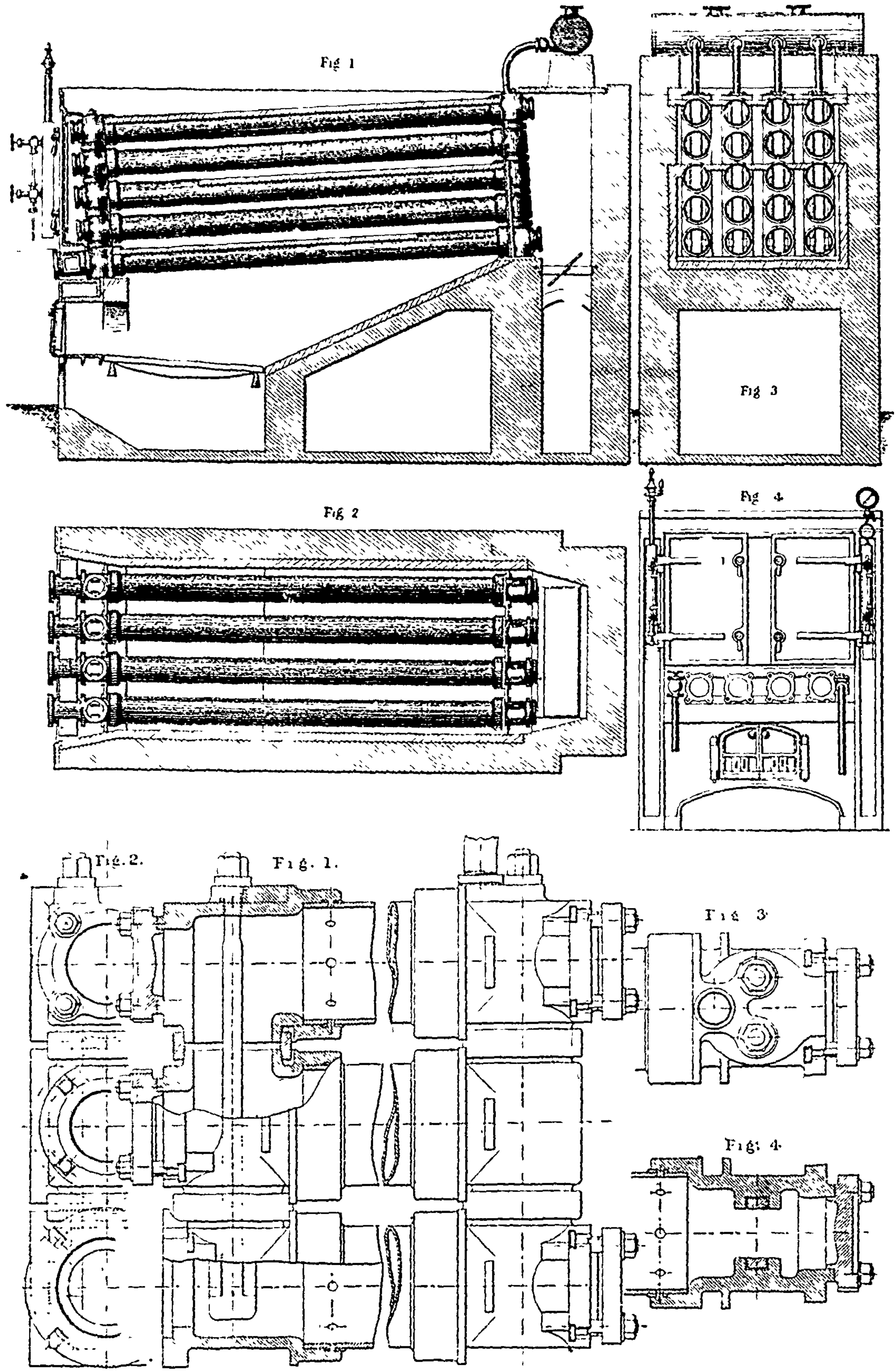
The following facts regarding these signals are taken from the report for the past year of the Royal Observatory, Greenwich, or as the Astronomer-Royal more accurately puts it, for "the period of twelve and a half lunations included between Full Moon of 1873, May 11, and New Moon of 1874, May 15":—

With the exception of eight days, on which the violence of the wind prevented the raising of the ball, and of two days on which accidental failures occurred, the Greenwich time-ball has been regularly dropped every day through the year to which this report refers. The Deal time-ball was not raised on five days on account of high-wind, and was not dropped on five days owing to interruption in the telegraphic communication. On one day, October 10, it was erroneously discharged four seconds before 1h. by a telegraph-signal; on 321 days it was dropped correctly by the current; and on thirty-seven days, principally in rainy weather, the current was too weak to release the trigger without the assistance of the attendant's hand A proposal has been made to me to drop a ball at Portsmouth by direct current from the Royal Observatory, but no further action appears to have been taken in the matter by the Admiralty.

Since the removal of the telegraph department from Telegraph Street, Lothbury, to the new building facing the General Post Office, a new and more elaborote chronopher has been constructed for the signal at 10h a.m., in which provision is made for sending signals in sixty different directions, the old chronopher being still in use for the signal at 1h p.m. Mr. H. Eaton, of the Post Office telegraphs, has kindly furnished me with the following account of the distribution of signals:—"The Greenwich current is received hourly. This hourly current is transmitted to ten subscribers (mostly chronometer-makers) in London. The method of observing the current varies, and is fixed by the subscriber In two cases, time-balls are dropped on the top of the buildings; in some other cases, model time-balls are placed in the windows; and others again use an electric bell; while two or three have a simple galvanometer, and observe from the deflexion of the needle. The Westminster clock records its correctness and errors at Greenwich, as also the clock at the Lombard Street post-office. The 10 a.m. current is most extensively used for the provinces. It is transmitted automatically to twenty-one provincial towns in England (where there are subscribers), to Guernsey, Edinburgh, Glasgow, Dublin, and Belfast. In addition to the automatic sender, a sound-signal is established in the instrument room here; when heard, a current is sent by the clerks to over 600 offices in direct communication with the Central Telegraph Office, including the principal railway termini. Many of these offices re-distribute the time-signal to the offices radiating from them, so that practically from the 10 a.m. current from Greenwich most of the post-office and railway clocks in the kingdom are regulated. The 1 p.m. current is transmitted automatically to nine provincial towns, viz, Newcastle, Sunderland, Middlesborough, Kendal, Hull, Norwich, Stockton, Worcester, and Nottingham. At the first four named, guns are fired; at the others, the current is observed by means of time-balls or galvanometers. With regard to the 10 a.m. current, I should have said that there is no rule as to the method of observing; the subscribers use the form of apparatus most suitable to themselves. At the telegraph office the signal is recorded or observed on the telegraph instrument."

To this account it is proper to add that wire communication has been made, experimentally, from the chronopher to the Royal Observatory, so that, by two Galvanometers, the time of a current leaving Greenwich and the time of its distribution by the chronopher could be immediately compared. No sensible difference could be discovered. It follows that the hourly time-signals, based upon the most accurate determinations of of time that the Observatory can furnish, may be used for accurate determinations of longitude At the Lombard Street post office, the Greenwich current at noon *starts* the clock which had stopped itself were few seconds previously, or at noon of its own time, the clock having a gaining rate. For the guidance of the attendant who regulates the Westminster clock, a signal is received at the clock tower from Greenwich, and a return signal is sent to the Observatory by this clock, as well as by the Lombard Street clock, to give information as to their errors. The errors of the Westminster clock were below 1s. on sixty-seven per cent. of days, below 2s. on twenty-five per cent., and below 3s. on five per cent.; when the error amounts to 4s. it can be corrected by the attendant, by lifting a pallet.

Recently published statistics show that the yield of the mines of the Pacific slope during the last quarter of a century reached the enormous total of $1,588,644,934. Of this immense sum California has produced three-fourths, or $1,094,919,098, nearly all of which was in gold. Nevada has produced $221,402,412 in gold and silver, but chiefly the latter Utah, although known for many years to be rich in precious metals, has only lately been made to produce them, and the yield has been no more than $18,527,537. Montana has added $119,308,147 to the riches of the world, and Idaho has given $57,249,197. Colorado has been only lately developing as a mining region but its yield has already reached about $?0,000,000. Oregon and Washington Territory have together produced $25,504,250. British Columbia has contributed about $9,000,000, and Arizona a small sum, but the latter territory has not been worked to any great extent. The production of the Pacific slope has been steadily increasing year by year. The increase of last year was about 14 per cent., the actual yield being $80,287,436 against $70,236,914 in 1872. The great bulk of this wealth has been exported chiefly to England, China and Japan, but mostly to England, which has had nearly $1,100,000,000, leaving only about $500,000,000 for the rest of the world.



HOWARD'S SAFETY BOILER.