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NOTE AND COMMENT.

IT is with great pleasure that we see the growth of interest in England in trade education. The spread of the movement for superior technical instruction has induced Lord ROSEBERY, Sir JOHN LUBBOCK, M.P., Mr. T. BURT, M.P., Mr. ASHTON DILKE, M.P., and other gentlemen to take the initiative in an attempt to reorganize the Trades' Guild of Learning on a larger basis. In a circular inviting attendance at a public meeting which was to be held on August 8, they propose that the Guild shall undertake, as a regular part of its work, to provide lectures on the history of the higher branches of industry, and the principles of art or science underlying them; and they point to the lectures on House Decoration which Mr. WILLIAM MORRIS delivered for the Guild as an example of the kind of information they desire to impart. Although these objects are of a highly useful character, Lord ROSEBERY and his colleagues do not propose to limit the movement to them. They intend to arrange for the delivery of lectures on subjects of more general interest; to form classes for the systematic instruction of working men; and to invite the co-operation of the trades societies in the educational portion of their work. The Guild, although dependent upon the contributions of a very few public-spirited persons, has not been inactive during the last few years; and indeed its lectures in the winter months have been attended by many thousands of the artisan population of London. If the employers of skilled labour come forward, as they are now invited to do, with more substantial aid than they have yet rendered to the association, there is no reason why the sphere of its operations should not be both largely and beneficially extended. The lesson which is taught by this movement is one which should not be lost upon us upon this side. The demands for special technical instruction in the mechanical trades are taking d stinct form, and before long will call for a movement in the direction of the English one.

THE results of the census as published are sufficiently encouraging, all things considered. The percentage of increase throughout the country has been 18.02 per cent. in the last ten years, as against 15 per cent. in the ten years preceding. Comparison with the rate of increase in the States shows at first sight a large difference between our 18 and their 30 per cent., but the fact is that the increase of our neighbours' population is due in the main to the opening out of vast fields for colonization in the West. Our own great western prairies are only now being made accessible to immigration, and another ten years may show a great difference in that direction. Meanwhile if we compare our increase with that of the New England States, we find that the five older Provinces of Canada are about on a par with these States, 14.55 against 15, while Ontario shows a growth of 3 per cent. more than New England, and scarcely less than that of the Middle States of the Union.

The increase in population in the cities of Canada is as follows:—

	1871.	1881.	Increase.	p. c.
Montreal.................	107,225	140,682	33,457	31
Toronto..................	56,092	86,445	30,353	55½
London...................	15,826	19,763	3,937	25
Ottawa...................	21,545	27,417	5,837	27
Hamilton.................	26,716	35,865	9,241	34
Kingston.................	12,407	14,093	1,686	14
Quebec...................	59,699	62,447	2,748	4½
Halifax..................	29,582	36,102	6,520	22
St. John.................	28,805	26,128	2,677	9

The loss in St. John is, of course, to be attributed to the destruction of so large an area by the conflagration of 1877. Meanwhile Montreal, Toronto, Hamilton show, as might be expected, the largest increase, Montreal the largest in actual numbers, but the western cities a greater growth in proportion to their size. As we have said, considering that, of the ten years included in the census, five were years of great commercial depression, in which the country may be almost said to have stood still, emigration being balanced against exodus, the result is fully as satisfactory as could have been expected; while the close approximation of it to popular expectation is a good guarantee of the accuracy of the figures given.

THE plans for the rebuilding of the Tay bridge have been laid upon the table of the House of Commons. An examination of the foundations of the old bridge convinced Mr. Barlow that it was requisite to make more allowance than had been before done for the scour of the river, and that the safest and best plan would be to put in piers for a double-way bridge entirely independent of the old piers. The erection of the bridge on this slightly altered site will require the construction of two or three short pieces of railway, and from the shore to their junction solid stone piers will be employed. The total length of the new bridge is a little over 10,000 ft. or about two miles. It is similar to the old bridge with regard to the number of large openings. Each pier is opposite a pier of the old bridge. The calculations are made for double the wind-pressure that will ever be brought to bear on the holding-down bolts. In reply to a question very pertinently put by Viscount Folkestone, Mr. Barlow said that the wind-pressure was calculated at 20 lb. per square foot, and that in point of fact, the design allowed for 56 lb. pressure of wind and train. This is close upon the allowance made by American engineers, and is ample, if it be regarded as a probable strain that is not unlikely to come upon the bridge —the breaking strength being at least double. It would not, in our opinion, be safe if the breaking tension is put at less than 120 lb. per square foot of surface on which the wind can lay hold, so as to exert a leverage against the resistance; and no doubt this is what is meant by the evidence. The piers are to be solidly connected with the girders. The parapet will be of wrought iron, as a precaution in case of any vehicle leaving the rails. There are also strong balks of timber placed as fenders outside the rails. It is intended to use some portion of the old girders, after proper testing, in the new structure.

AN accident which recently occurred at the Union Iron and Steel Mart Furnace Works in Chicago, goes far to point our remarks upon the superiority of the new glass roofing to the sheet iron coverings now in vogue. About twelve o'clock on Wednesday, the 20th ult., seven or eight laborers were at work in the casting room when a vivid flash of lightning, immediately followed by a tremendous crash of thunder, and a crashing sound overhead, caused them to look up. They were horrified to behold the roof over their heads swaying and quickly giving way. They were literally paralyzed with terror, and were brought to their senses by the foreman, who was standing near the door, shouting: "Quick. men, for your lives; for God's sake." Simultaneously they all rushed for the door, and the last man had barely reached the threshold when the heavy roof fell in with an awful crash, taking with it, in its fall, about twelve feet of the south wall, the break extending the entire length of the building. The casting room is a large hall standing directly on the ground, and has no floor, but is full of pits dug in the ground, where the pig iron is cast. The wooden roof was completely covered with sheet-iron, which gave way in the general wreck and broke into bits like fractured glass. The damage to the building is estimated at between $4,000 and $5,000, and the company will lose besides about $2,000 by loss of time and labor. Immediately after the storm a gang of men were put to work with pick and barrows to remove the *debris* and the work of building a new roof will commence immediately. This new roof will in all probability be built as before, and may never of course meet a similar accident, but the conductibility of sheet iron will always render it a dangerous roofing in a violent thunderstorm such as that alluded to.

SIR JOSIAH MASON, THE ENGLISH PHILANTHROPIST.

By cable the death is announced of Sir Josiah Mason, the great penmaker and philanthropist. He was the founder of the Mason Scientific College, at Birmingham, England, and will be most widely remembered by that foundation. But he was long before that time an illustrious example of the use of well won fortune for the good of others. He was born at Kidderminster, February 23, 1795, of poor but worthy people. When a boy he worked as a shoemaker, then as a baker, and next as a carpet weaver. At the age of twenty he went to Birmingham and worked hard for ten years as a jeweller and gilt toy maker. At thirty he was connected with the manufacture of steel split rings and key rings, in partnership with Samuel Harrison the inventor, and at his death he succeeded to the business and added to it the manufacture of steel pens. In 1829 a superior steel pen of his making gained an introduction into the market, won a high reputation and enormous sales. He went into the business of electroplating and gilding, then into copper smelting, establishing for this latter industry in 1850 a large manufactory at Pennbury, in Wales, which grew up under his enterprise from an obscure village to a flourishing town. By his numerous manufactories he amassed enormous wealth. His first great work of benevolence was the erection and endowing of almshouses and an orphan asylum for boys and girls at Erdington, near Birmingham. This was done at an expense of $300,000 on the erection of the buildings alone, and he afterward endowed the institution with real estate valued at $1,000,000. Neither race nor religion is allowed to exclude the little ones who need its care. In addition to this noble charity he established and richly endowed a college for the study of practical science, with a distinct application to the industries of the midland district, in which his life had been spent and his fortune made. In recognition of his many benevolent and philanthropic works in 1872 Queen Victoria conferred on him the honor of knighthood. He had passed his eightieth year when he announced the matured and well-considered plan of his science college; and, being still vigorous and active in body and mind, had the satisfaction of seeing its buildings and equipments completed under his own eye, an able faculty selected for it, and of hearing from Professor Huxley an admirable setting forth to the public of its purposes and plans, on the occasion of its opening, on the first of October, 1880. The college is a magnificent Gothic edifice, with a frontage on Edmund street of 148 feet. The buildings cover an area of about two thousand four hundred square yards, but in the course of time, when the orginal plan of the founder is carried out, they will occupy nearly double that area. This institution is also endowed to the extent of $1,000,000. It should be remembered that all departments of the college were thrown open by its founder to both sexes on the same terms; and also that, with the absolute exclusion of party politics, theology and mere literary instruction and education from its curriculum, there is given to its trustees a large freedom of action to secure, with whatever changing condition of the future, a sound, extensive and practical scientific knowledge to all who may need and seek its benefits. Beyond the fact that Sir Josiah's noble gift must become of incalculable value to the great, crowded midland manufacturing district of England lies the wider one of the practical example it gives to other men of wealth the world over, who having, like him, risen "from the ranks," may desire to bestow efficient aid on those who come after.—*New York Herald.*

An Agricultural and Industrial Exhibition is to open on the 14th of September, 1881, at the exhibition grounds, Mile-End, Montreal. The prize list fills a pamphlet of 200 pages. Twenty-five thousand dollars in prizes are to be distributed to exhibitors. It closes on the 23d of the same month.

A tramcar has been driven in Paris by means of Faure's accumulators. It conveyed forty persons at the rate of six miles an hour, the motive-power being 160 Faure batteries, weighing 18lb. each, altogether 2,880lb.—a nice little load. It is naïvely stated that the work could have been done by two horses.

A STUDIOUS INVENTOR.

Ransom Cook, who died in Saratoga last week, was master of twenty-six trades and owner of seventeen patents. Among the latter was one for an improvement in the manufacture of wrought iron and steel cannon. This idea was appropriated by Sir William Armstrong, who made both fame and fortune out of it. Among the other patents were one for a lunch-case, one for a fan-blower, for a hydraulic apparatus for producing a blast, for an improved electro-magnetic ore separator (made by Mr. Cook when 80 years old), an improvement in blast pipes for carrying heated air and gases to furnaces, an improvement in scissors, an improved boring instrument known as the "Cook auger," an improved machine for turning the lips of augers, an improved bit for boring wood, an improvement in ventilating and excluding dust from railway cars, an improved exhaust fan, and an improvement in the mode of straining saws for saw-mills. There were several others of more or less importance. Some of his inventions, particularly the patent auger, were very profitable. He was making a machine and wanted an auger that would bore at an angle with the grain without starting with a gouge. He hit upon the idea of examining the lips of the worm commonly known as the wood-borer with a microscope, and from this model, furnished by nature, he made his augur, which was very successful. His workshop was a curiosity. He made all his own models, and had engines and machinery well adapted to the purpose. He had also accumulated one of the most complete and valuable collections of scientific and mechanical books in the country. His library contains more than 3,000 volumes, some of them very rare. The books are arranged in small cases, piled one on top of the other, from floor to ceiling. The purpose of this arrangement was to have them ready for rapid removal in case of fire.—*Buffalo Express.*

THE SAND BLAST.

Among the wonderful and useful inventions of the times is the common sand blast. Suppose you desire a piece of marble for a grave stone; you cover the stone with a sheet of wax no thicker than a wafer; then you cut in the wax the name, date, etc., leaving the marble exposed. Now pass it under the blast and the sand will cut it away. Remove the wax and you have the cut letters. Taking a piece of French plate glass, say two by six feet, cover it with fine lace and pass it under the blast, and not a thread of the lace will be injured, but the sand will cut deep into the glass wherever it is not covered by the lace. Now remove the lace and you have a delicate and beautiful figure raised upon the glass. In this way beautiful figures of all kinds are cut in glass and at a small expense. The workmen can hold their hands under the blast without harm, even when it is rapidly cutting away the hardest glass, iron, or stone, but they must look out for finger nails, for they will be whittled off right hastily. If they put on steel thimbles to protect the nails, it will do little good, for the sand will soon whittle them away; but if they wrap a piece of soft cotton around them they are safe. You will at once see the philosophy of it. The sand whittles away and destroys any hard substance—even glass—but does not effect substances that are soft and yielding, like wax, cotton, or fine lace, or even the human hand.

STAMP CANCELLING MACHINE.—It is announced that an American inventor, employed by the Post Office Department, Washington, has produced a machine which, worked by hand, will easily cancel 400 stamps a minute, but if worked by power can cancel 1,000 a minute. The mechanism is so managed that the various pieces of mail matter are surely separated from each other, and the postal card as well as the letter is certain to come under the eraser. The rapid increase of mail matter, and the fact that in our largest cities, where important mails close in day time, there are thousands of pieces deposited in the Post Office just before the hour of closing, renders such a machine a very important one. The most experienced man cancelling by hand has a difficult task in such an emergency, and the physical results of the severe strain oftentimes prove injurious.

THE International Geographical Institute of Berne has put forward a project for the establishment of an international school for training travelers. The programme of study is a formidable one, and is divided into two distinct divisions. The first includes instruction in numerous branches of knowledge more or less necessary for a traveler, and the second practical training in the field.

Engineering, Civil & Mechanical.

EXPLOSION OF A PLAIN CYLINDER BOILER IN PHILADELPHIA.

BY S. N. HARTWELL.

The next page cut illustrates the explosion of boiler No. 3 in the dye works of Gafney & Co., in Kensington, Philadelphia, which occurred during the noon hour, on the 1st day of June, 1881, killing three persons and injuring a number of others. The coroner's sensible and pertinent inquires into the cause of death brought out the usual variety of opinions of the cause of the primary rupture from which the explosion arose.

THE CONSTRUCTION OF THE BOILER

was not new or uncommon, nor was the material or work unusually bad. The shell plates, which did not break, were marked at a fair tensile strength, and the head that did break was a fair quality of cast iron where the rupture began. The type and principal dimensions are as follows: A plain cylinder, 30 feet feet long by 36 inches diameter, composed of No. 3 iron plates in nine courses, single riveted; the least observed thickness at the edge of plate was 0·255". The end plates or heads were flat cast iron disks having suitable flanges turned inward, with cored radial holes for the rivets that secured them to the shell plates. Thickness of disks, 1⅞ inches; flanges, 1⅝ inches. The pitch or spacing of the rivets was according to accepted American practice. A man-hole was cut in the centre of the front head, 12¾ by 12½ inches, the form of which appeared to be not an ellipse, but of somewhat larger area. The gasket seat had been planed, but the corresponding seat on the man-hole plate was not planed, though it appeared quite as true as such castings usually are.

The arrangement of the boilers is shown in the engravings, by which it will be seen that two, namely, Nos. 1 and 2, were set over by the same furnace, and No. 3 by itself over an adjoining one. The former, called the old boilers, had been in use two years, and the latter, the new boiler, had been working but two months prior to the explosion. Two pair of safety valves, one pair to each system, were fitted as shown, their connecting pipes coming through the wall of the steam dry house under which the boilers were set. The pair of boilers had a pair of 2½ inch, and the single boiler, No. 3, had a pair of similar 2 inch safety valves. The main steam stop valves, by which communication between the boiler and with the heating and drying systems of pipes was regulated, were also in front of the wall, as shown. The steam and water pipes were so arranged that the single boiler could be used alone.

These boilers were insured by the Hartford Steam Boiler Inspection and Insurance Company, and allowed to carry 70 pounds of steam. The usual working pressure appears to have been from 60 to 65 pounds *by the gauge*, the pressure increasing when the demand for steam was less than the supply, indicating that the safety valves did not fully relieve the boiler The increase of pressure that might have occurred with all the distributing valves closed is therefore unknown.

The new boiler was inspected on or about the 7th of March, and no doubt the hydrostatic test (about 100 pounds) was applied according to law. The builder swears before the coroner that he applied a cold water test of 115 pounds, and found it all tight, etc.

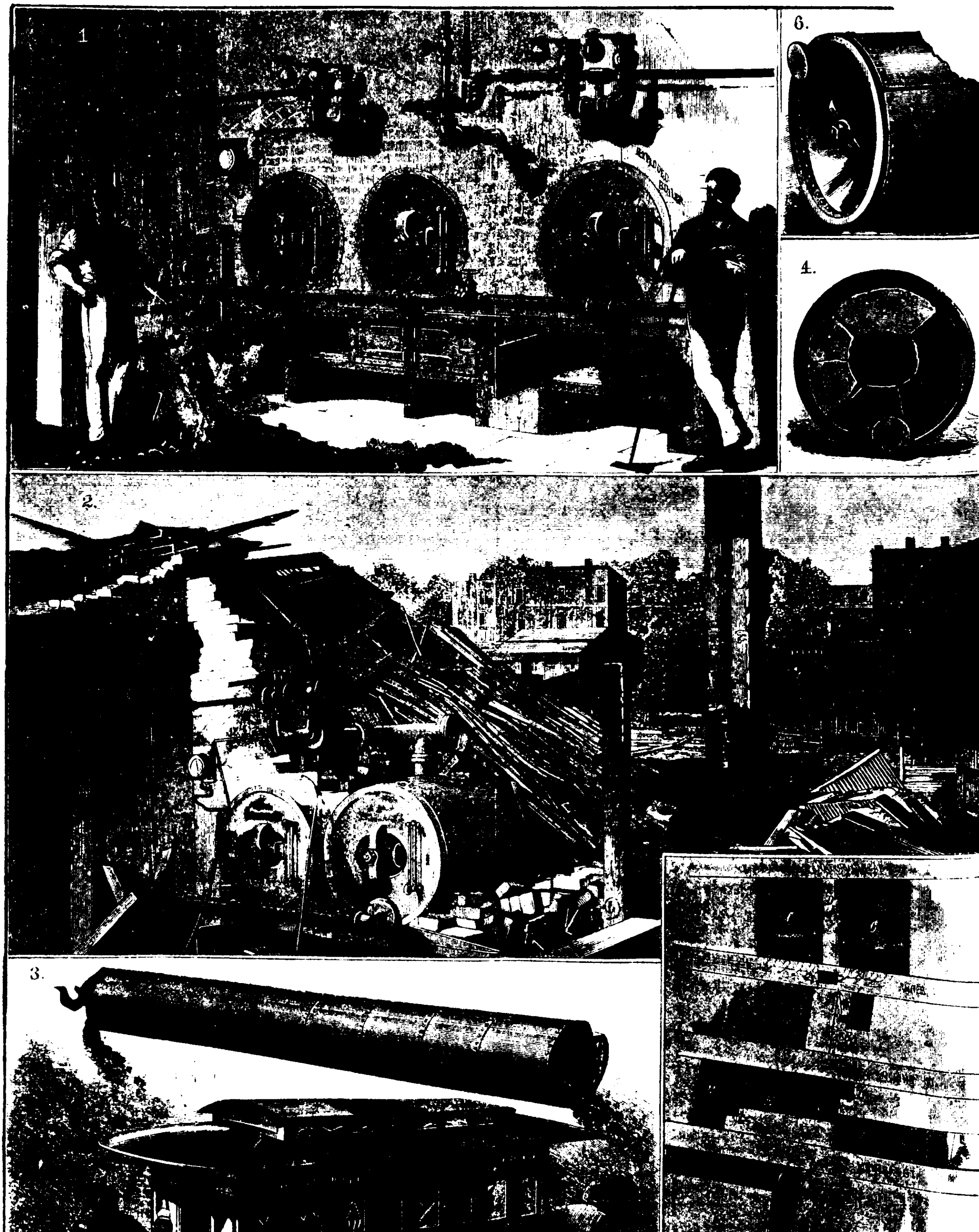
This boiler, No. 3, was fitted with the usual gauges and other attachments, and fed by an injector, either separately or in common with the other two boilers. The steam was used for boiling dye-stuff and for drying.

The observed phenomena indicate unmistakably that

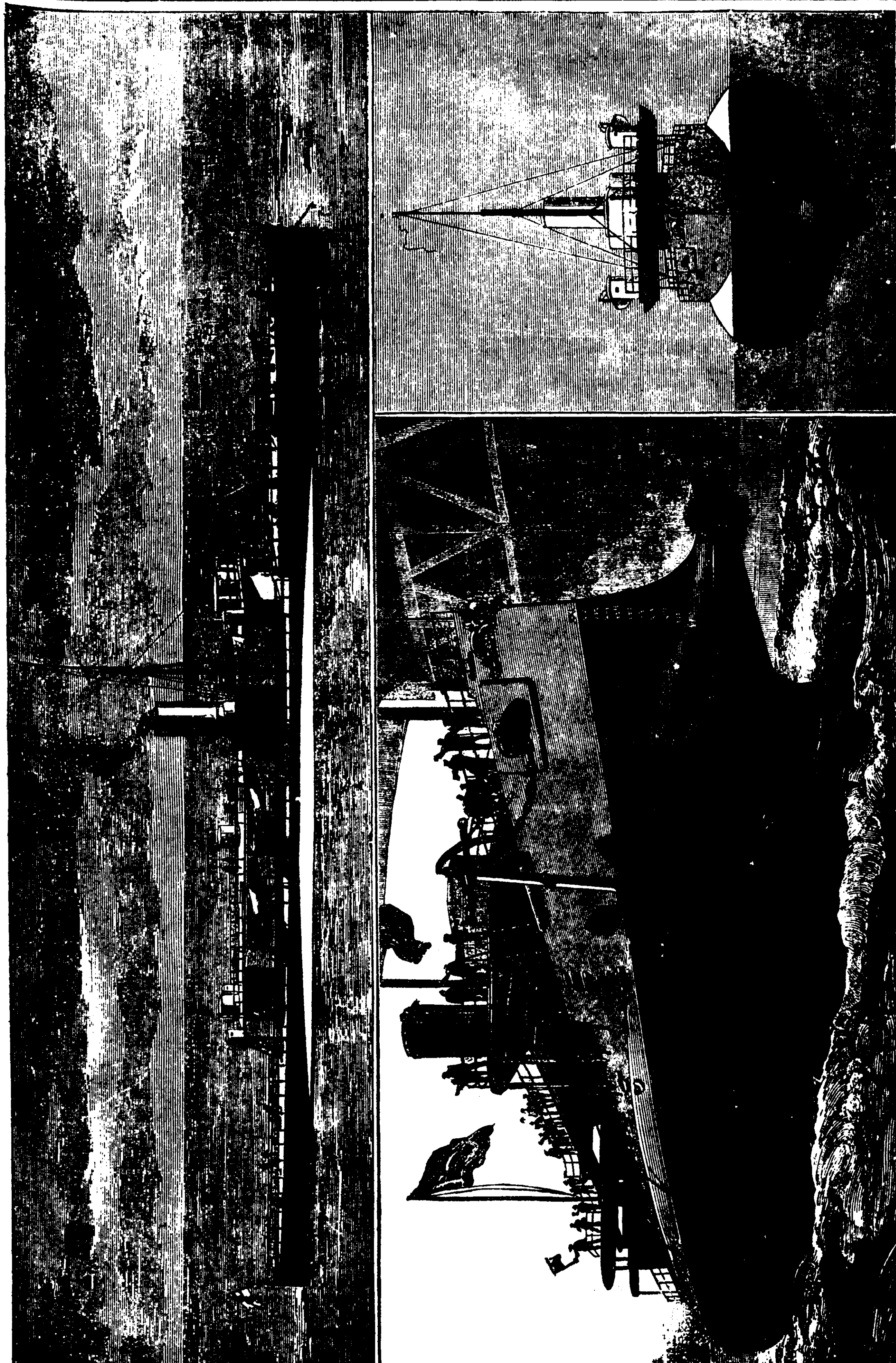
THE EXPLOSION

was due to a pressure a little in excess of the strength of the weakest point of the boiler. The course of the initial ruptures is clearly indicated in the engravings, radiating from the manhole. The cast-iron head was not compensated for the loss of continuity. There was simply a slight chipping spot just raised above the general inner surface, for convenience in finishing a gasket seat upon the planing machine. The removal of the firm and tenacious skin of the iron by the planer reduced its strength. The slight sustaining power of the pinch on the gasket is an indefinite and variable factor, and a great strain falls upon the margin of the man-hole.

So far as the writer knows, there is no well defined and simple rules for determing the strength of the flat disks with man-holes



EXPLOSION OF A PLAIN CYLINDER BOILER IN PHILADELPHIA.—(SEE PAGE 259.)



LAUNCH AT CHATHAM DOCKYARD. H. M. S. *POLYPHEMUS.*—(SEE PAGE 267.) BOW VIEW. SHOWING HULL BELOW WATER LINE.

in them. To make this front head equal in strength to the rear one, omitting now all comparison with the strength of the cylindrical portion of the boiler, it seems evident that a rib is necessary around the man-hole of sufficient depth to fully compensate for the removal of so important a part of the disk.

But without a full line of ultimate experiments on the strength of these forms it would be difficult to specify the depth of the rib.

It may be said, and is strongly maintained by some engineers, that the concave form, shown in figure 6, is stronger than the flat; but how these two forms compare in strength when they have equal inward projections, experiment only can determine.

No respectable guess, therefore, can be made at how much internal pressure was required to break this boiler. Either of its heads had less resisting power than the cylindrical portion, on which form plenty of experiments have been made.

The arguments used against the hydrostatic pressure as a test of the strength of unequally heated and complicated boilers, do not so well apply to this case, for this head was in a fairly uniform condition of temperature throughout, so that unequal tension, except such as might arise from a badly fitted man-hole plate, is hardly admissible. Its strength, if uniformly heated to 350° or 400° Fah., would not differ greatly from its strength when the cold test of 115 pounds was applied. And here are its neighbors, cast from the same pattern apparently, they have held out for two years, while no doubt many of the hundreds of cast iron boiler heads now in use in Philadelphia and elsewhere in America, are no better and have stood longer and heavier strains than those now under consideration.

A defect is noticeable in the circular fracture, as much as 3 or 4 inches long by width of 0 to ½ inch, in the middle of the plate and near the lower part, consisting of confluent blow holes; but it is difficult to conceive how the rupture could start at any point in the circle from which lines of fracture should converge toward the man-hole so as to break the head as shown. The rupture, no doubt, began almost simultaneously at the inner end of the four radial lines, in which case a defect in the circular line would not affect the weakest point at the margin of the hole.

It is not pleasant to think that a boiler which ought to be able to stand five times the working load would be so capricious as to blow up upon slight provocation. Scully, the fireman, stoutly and persistently denies having wet this head with his hose, although it was sought to be proved that he did so, and it was assigned as a sufficient cause of the breaking of the head.

Many of the steam valves were found to be closed when dug out of the *débris*; in fact the writer has not seen one that was open when found, but has seen four that were closed, and under such conditions that no amount of swearing by interested witnesses to the contrary would stand as truth.

The diagram, Fig. 5, is a plan of the neighborhood of the explosion. The buildings occupied by Gafney & Co. are (were) located between Martha and Collins sts., the boilers in the lower story of the three story brick building, A, adjoining the one story dye house, E. To the left is the shed M, on the roof of which the dyed material was sundried in fine weather. The dye tubs, F, were square wooden vats, heated by direct steam, admitted by branch steam pipes, in each of which was a steam stop valve, controlled by each dyer, according to his requirements. G is the small detached office building of the proprietors. H is the location of the two story dwellings, one of which was badly smashed and took fire, but it was soon extinguished. Beds, cooking stoves, and household utensils in the ruins, were painfully suggestive of the horrors that attend a first-class boiler explosion. The stable, L, was also destroyed by the falling of adjacent walls. The boiler gave out by the bursting of the front cast-iron head, which broke into four quarters, the fracture running from the man-hole radially, as shown in drawing; thence the break continued along the circular base of each quarter of the head, leaving the entire rim or flange outside of its junction with the disk attached to the shell plates. This rim was smashed, as shown in the cuts (Fig. 3), by the fall upon the ground at D, or possibly by contact with some solid object in its flight. On leaving its bed the main portion of the boiler took a direct, nearly horizontal, course in the line of its projected axis, and striking the terrace at the corner of the grapery in front of the dwelling, B, it rose and turned to the left, some 15° or 20°, passing over or in front of a passenger street car, at N, which was about to enter the station house of the Second and Third street horse railroad, shown at C, whence the cars depart at the opposite end on Frankford road. In striking the terrace, the rear head, which was foremost in the flight, was demolished, and the adjoining shell sheet torn and turned inward, as seen at Fig. 3.

The four quarters of the front boiler head were found scatter at various points in the foreground, the lower piece, in which was the feed water opening, was found on removal of a large mass of *débris*, about twenty-five feet from, and directly in front of its former site. Here also were found a 2½ inch steam pipe (easily distinguishable from the feed water pipe of same size), in which was a stop valve *closed*; to this pipe were connected several 2 inch branches, and valves, also *closed* when examined by the writer, before they were touched by any person, after the explosion. Mr. Farran, of the Hartford Steam Boiler Inspection and Insurance Company, observed the same thing, and the attention of bystanders was called to this important fact. Mr. Williams, a member of the coroner's jury, was informed, and the valves shown to him before their removal. That gentleman remarked that other steam valves were also closed when found, notably the one in the pipe connecting this boiler with the others. In fact *all steam valves were found closed when taken from the ruins* so far as known.

The man-hole crossbar, a pretty heavy one, with its bolt, which engaged with the plate by means of a pocket in the plate, into which the head of the bolt fitted loosely, was detached when the boiler head was broken and its tension relaxed, and it flew to the front, crossing Martha street, to the second door on the cross street, when it struck the brick door jamb. A man was found dead or fatally injured at this point, marked J on the diagram, having been hit by this piece before it struck the brickwork. It made an indentation of a depth indicating that its force was far from being spent upon the body of the man. The man-hole plate itself flew a greater distance in the same direction, said to have been more than two squares, where it lodged on top of a building. This is the longest distance traversed by any of the pieces. A piece of the rear head bounded from D into Frankford road and landed in front of a boarding saloon where a number of people were taking dinner. This was warm, said to be hot, as well as the main piece of the boiler, which caused steam to arise from the damp manure heap on which it landed. A rumor gained circulation that the boiler flew through the air like a glowing meteor, red hot, but no evidence of an extraordinary temperature was found on any part of the fragments.

Some search was made for the steam gauge that was said to have been attached to this boiler, but its condition could have given no clew to the pressure at the time of the explosion, and it could not have contradicted other phenomena.

The fact that the plate and crossbar of the man-hole of the broken head were shot with violence as from a gun, indicates that the head, weak though it is acknowledged to be, resisted considerable pressure, and at last gave way with a snap. This wreck has been studied from a disinterested standpoint, and the

CONCLUSION IS

that the flow of steam from this boiler was stopped or obstructed by the defective condition of the safety valves, the distributing valves having been incidentally closed at the noon hour, by the several workmen who were in the habit of handling them according to the several demands for steam, and that the pressure gradually increased the fire being active, till the boiler gave way at its weakest point, which was manifestly the front head.

STEAM BOILER NOTES.

We learn from Chief Engineer McDougal's annual report for 1881, that the French decree relating to inspection of stationary steam boilers requires that all new boilers pass a test which consists of subjecting them to hydraulic pressure superior to the working pressure allowed, to be maintained during the examination of every part of the boiler. As a general rule the pressure to be double the working pressure, but never to be less than 7 pounds nor more than 85 pounds above such pressure. There must be two safety valves, so loaded that the steam will escape at maximum limit, which is stamped upon the boiler in a conspicuous place, together with the date of the last test.

The area of each safety valve (two on each boiler) must be sufficient to prevent the pressure exceeding the limit, whatever may be the intensity of the fire.

Every boiler must have a pressure gauge *in good order*, marked plainly to show the point that must not be exceeded by the pressure; a check valve, a steam stop valve on the boiler itself, and two gauges independent of each other, one of which must be a glass gauge, so constructed that the tube may be readily cleaned, and its casing conspicuously marked for the lower water level.

All boiler plates (not in separate superheaters, or small, and so located that they cannot become red hot) exposed to the flame on one side must be in contact with water on the other side.

The registry of all "fixed" boilers must be made before they can be put to work. It must show the origin of the boiler, the place where it is fixed, its shape and heating surface, its official and special number, and the purpose for which it is used.

A table is annexed to the decree that shows the temperature of the water in any given boiler when working at limited pressure, and all boilers are classified by multiplying their capacity in cubic meters by the temperature in excess of the atmospheric boiling point in degrees centigrade. Boilers giving a product greater than 200 are denominated first class; those from 50 to 200, second; and those at or below 50, third class.

Boilers of the first class must be fixed in one story buildings, and if not protected by heavy walls, 50 meters must intervene between them and any dwelling house, but in no case are they to be nearer than 3 meters, except when located with their top line 1 meter or more below the ground line.

Boilers of the second class may be fixed in workshops of any kind if no part of them are dwellings.

Boilers of the third class may be placed in shops or dwellings, provided the furnace is half a meter clear space from neighboring houses.

Portable boilers, or such as do not require special fixing or setting in brick, must, in addition to the above, be provided with an engraved plate, on which plainly appears the owner's boiler number and his business address. The attendant must be able to show a copy of the registry declaration whenever required to do so.

All the regulations, except those specially applicable to stationary, apply also to locomotive boilers, but some special rules relating to the rights of locomotion are provided.

Detached vessels that may be heated by steam to above the atmospheric pressure of a capacity greater than 22 gallons (English) must also be registered and stamped, and the test pressure must be 50 per cent. in excess of the working pressure, but never more than 57 pounds per square inch. They must be provided with safety valves that will, when lifted, prevent the pressure from rising above that indicated on the stamp.

Tanks in which water is confined at high temperatures, serving as storage reservoirs of power or heat, are subject to the same rules as receivers of steam.

Users of steam apparatus must see that they are kept in good working order, and report to the official engineer any important repairs that are made after inspection.

In case of accident, by which injury to any person is caused, the owner or his representative must at once report to the local police and the government inspecting officer, who will proceed as soon as possible to the scene of accident, and report to the *Procureur* of the Republic and the Chief Engineer, who will inform the proper magistrate.

The building must not be repaired nor the fragments of the exploded boiler removed or altered before the engineer makes his official inspection.

In 1878 there were 79,071 land boilers and steam vessels under surveillance in France, of which 32 exploded during that year, or nearly 1 in 2,200, while they were among marine boilers in the same year 1 explosion in every 614 boilers.

J. McM. asks: "Is there any difference between the bursting and explosion of steam boilers?" It may be said in response that by common acceptation among engineers bursting means rupture, while explosion implies rupture, but it is also accompanied by detonation. The terms as applied to bombshells are used indiscriminately by many writers. As applied to steam boilers "bursting" may be considered a rupture from internal pressure, and "explosion" the loud noise and flying to pieces of the boiler after the rupture. This last will always occur with ordinary working pressures of the initial rupture is of sufficient size and suddenness to instantly relieve the contained water of pressure. Every elementary atom of the water then gives up its quota of steam, which causes an expansion of the mass of such suddenness that it may be characterized as explosive.

Another correspondent asks: "Does it take more fuel to run an engine with steam at a given pressure than to keep the same pressure without running the engine?" A. Yes. To maintain a given pressure already existing in a steam boiler no fuel at all would be required when no steam is withdrawn from or condensed within the boiler. Banked fires will usually keep up the pressure even in unprotected boilers when the engine is stopped.

Steel boilers appear to be making slow progress in France, as shown by a paper recently read by M. Jourdain, whose paper discussed the subject of boiler inspection associations, stated, according to *Engineering*, that a certain number of makers were employing steel plates for parts directly exposed to the fire, but that he did not know of any stationary boiler constructed entirely of steel. As M. Jourdain is in a position to be well acquainted with French practice, we conclude that our neighbors are greatly behind us in the use of steel for steam boilers.

A large steam pipe connecting the boilers with the engine at Foster & Merriam's shop in Meriden, Conn., is reported to have recently burst with a noise like the explosion of a cannon. John Leary, who was in the vicinity, was badly scalded, and a boy named Doran was knocked senseless. The engineer is reported as saying that the pipe was too tightly bound in the brickwork, hence the explosion. If he had told us that water had collected in the cast iron pipe and had cooled during the night, so that unequal expansion occurred on opening his valve in the morning, he would have made a reasonable statement. Many a cast iron pipe has done so before.

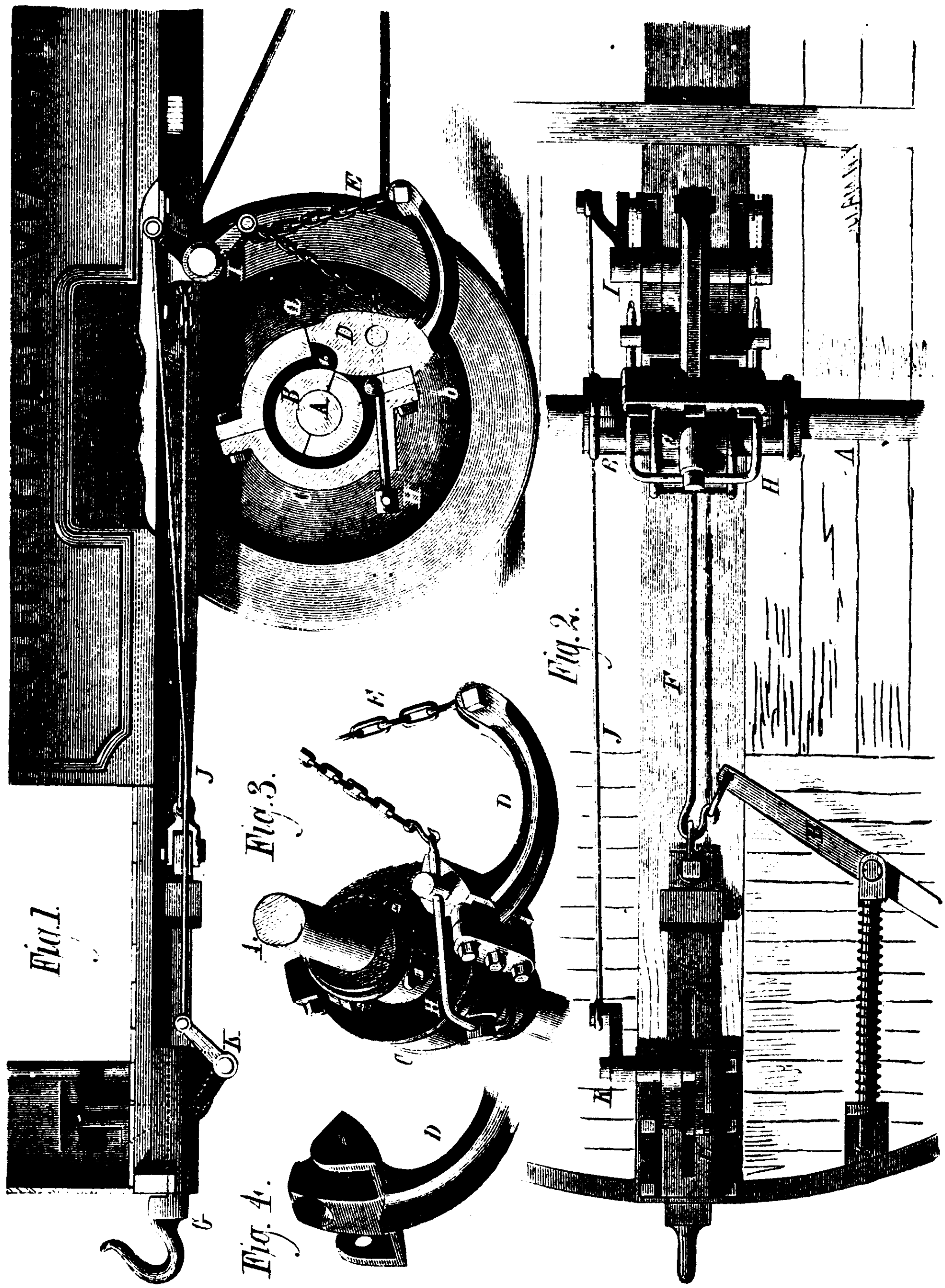
BUTTON-SET RIVETING FOR BOILERS.

"Button-set riveting," which means forming the zone of a globe on the rivet by means of a concave "set" and a sledge, has been generally regarded with disfavor by boiler makers, but it has been long used by oil tank builders, enabling them to erect large tanks with astonishing rapidity and at correspondingly low cost of labor. The fine appearance and general good character of this work led enterprising boiler makers, who were not in condition to warrant the expense of steam riveting machines, to clandestinely try this method on steam boiler shells, and it has at last found favor among reputable makers, who now employ it openly, and they are supported in it by most people who understand the difference, except perhaps professional hand riveters, whose occupation is injured by its adoption.

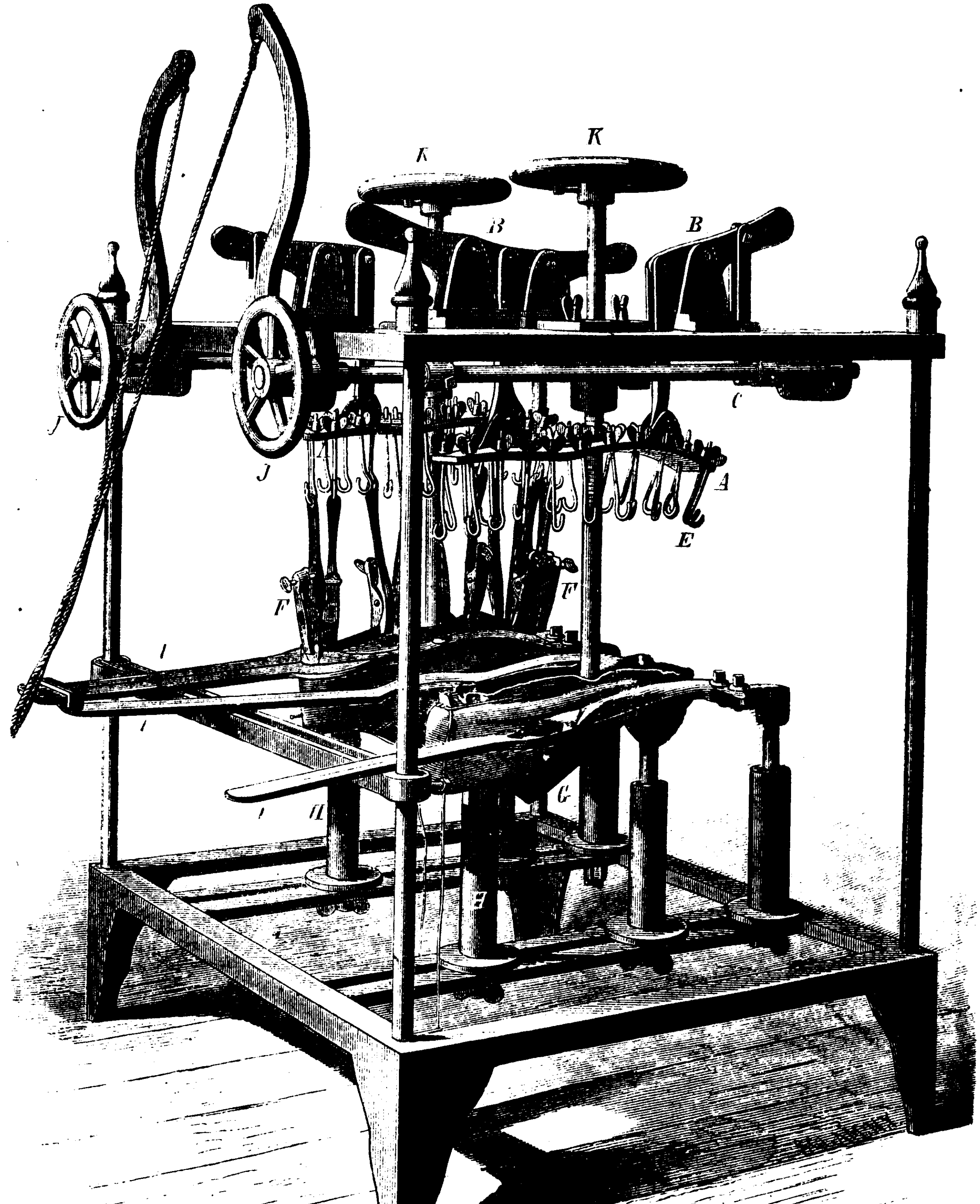
We take the following from an interesting report by Mr. Wells to the recent convention of Railroad Master Mechanics at Providence, on the subject of "set riveting," as compared with "steam" and hand riveting" of locomotive boilers. The plan of "set" riveting consists in placing upon the inserted hot rivet a set, mounted upon a handle, as smiths' sets, flatters, and hot chisels are, and having a cavity of the shape and dimensions of the desired head in its lower end, and "driving" the rivet by strokes from one or more sledges upon the other end of the set,—a heavy holding iron being used to meet by its inertia the force of the sledges. The weight of the set described is 2½ to 3 pounds, of the sledges 9 to 10 pounds, while the holder or anvil placed upon the other end or head of the rivet is about 60 pounds, and held firmly against the work by the short arm of a stiff lever of the first order.

The skill required for this work is readily acquired by laborers of ordinary intelligence, and consists merely in properly placing the holder, holding the set squarely on the rivet, and delivering fair blows upon its upper end. The first blows serve to upset the body of the rivet in the hole more effectually than blows struck with light hammers directly on the rivet point, and 24 blows in all, at the rate of about 80 per minute, finish the "setting" of the rivet, and half a dozen blows upon a "flatter" placed on the lap near the rivet completes one rivet, except a few blows more on the set to give the head a nice finish according to the taste of the workman.

Thus are driven on the shell of a boiler 30 rivets per hour, or an average of 22 on all parts, including changing bolts, drifting holes, and adjusting the work. Hand riveters average about 125 rivets per day of twelve hours and a half, or 10 per hour, under similar conditions. The report shows that the riveting of a locomotive boiler containing 1,722 rivets will occupy 65·85 hours, at a total cost for labor of $44.77, or an average of 2·64 cents each rivet, against which stands 5·84 cents each for rivets driven by hand at the rate of 10 per hour. The difference in favor of set riveting is shown to be 54 per cent in cost and 51 per cent in time. From the drawings exhibited, showing sections of laps riveted by the two methods as well as by steam riveter, it appears that "set" riveting is the most perfect in the matter of the rivet filling the hole. The remarks by members that followed the report indicated that no discussion was possible, since all seemed to think favorably of this method, and the president of the convention thought, that being the case, it ought to be adopted at once.



HILL'S CAR STARTER.



ELLITHORP'S BOOT AND SHOE LASTING MACHINE.

Mechanics.

IMPROVED CAR STARTER.

No subject is more deserving of the attention of inventors than that of starting our heavily laden street cars after they have come to a full stop, and singularly enough no subject has been more bunglingly treated. The two essential qualities of a car starter are simplicity and durability. Complicated and expensive mechanism for this purpose is entirely out of the question, as no class of devices are subjected to greater wear or greater inequalities of strain.

The car starter shown in our engraving happily combines all the essential qualities, and has proved itself by actual and continued use to be adequate to all the requirements of a device of this character. The clutch employed is of novel construction, and the leverage is equal to the radius of the wheels.

In the engraving Fig. 1 is an elevation of a portion of a car, showing the clutch of the starter in section Fig 2 is an inverted plan view. Fig 3 is a perspective view of the clutch and clutch lever, and Fig. 4 shows the inner end of the clutch lever.

The axle, A, with which the apparatus is connected, has attached to it a sleeve, B, and a clutch, C, which may be rotated around the enlarged central portion of the sleeve.

In connection with this clutch there is a lever, D, the central pivoted end of which is pivoted in a slot in the clutch, C, in such a way as to have freedom of motion to a certain extent up and down. Upon the outside of this central portion are winged flanges which embrace the sides of the clutch, C. A pivotal pin, passing through these wings as well as the central portion, and clutch, C, give steadiness to the lever, D, and prevent it from lateral movements. At the extreme inner end of the lever, D, there is a recess, of a semi-globular form, elongated in the direction of the length of the lever. A ball, *a*, having freedom of movement, is placed between this recess and groove, around the central portion of the sleeve, B. This ball, in the movement of the lever at the proper point, is clamped against the groove, and, having freedom of movement in its own recess, presents continually a new wearing surface, and avoids the inconvenience and bad results which would follow if no such ball were employed.

By reason of the longitudinal form of the recess, the ball, in the upward movement of the lever, is brought into engagement in the upper part of its recess with the groove in the sleeve, and therefore the resistance of the ball, being in a slightly angular direction is increased to such an extent that it never slips.

The outer end of the lever, D, is slotted to receive the link of the chain, E, which is held by a bolt, so that if it is necessary to shorten the chain at any time the bolt may be withdrawn, and then replaced through another link of the same chain. The chain, E, passes over a pulley secured to the bottom of the car, is attached to a rod, F, which, in turn, is attached to the draw bar, G, by a pivotal connection. The inner end of the draw bar connects with one end of the lever, D, pivoted to the bottom of the car, and a spring, with this lever between its pivotal point and its free end, presses it back, and draws back the draw bar, and holds it in this position when no force is applied to it.

It will be seen that with any forward motion of the draw bar the lever, D, will be raised, and the power for the moment will be exerted to great advantage, and the car will be started easily without strains or shocks on the horses, harness or car.

To check any retrograde movement of the car upon up grades, an auxiliary ball, *b* is placed in a cavity in the clutch, C. When the car makes the slightest movement backward the ball, *b*, wedges in the cavity and stops the car.

The starter is not intended to supersede the brakes, but to be used as supplementary to them. The main object is to lessen the labor of overcoming the inertia at the initial of the forward movement, and also to equalize the draught after the loaded car has been put in motion.

There is also an attachment by which the driver is enabled to reverse his car by throwing the lever out of gear—and preventing the locking of the wheel—simply by a pressure of the foot.

If by any neglect on his part he should fail to put it in gear again, it acts automatically as soon as he attaches the horses to the draught bar.

The ball of the checking device is thrown out of position to engage the clutch by means of a rod attached to the yoke, and extending into the ball cavity. This yoke is operated by a pedal, L, through the medium of the angled levers, K, I, the rod, J, and a short section of chain connecting the double arm of the lever I, with the yoke, H. By means of this mechanism the checking device may at any time be thrown out by the pressure of the foot on the pedal L, and should it be desirable to keep it out of engagement with the clutch, the catch on the pedal is hooked under a plate in the platform.

NEW LASTING MACHINE.

It would be difficult to name an industry in which mechanical skill and invention have produced such marked effects as in the manufacture of shoes. The cutting of the uppers, soles, and heels, the treeing, pegging, stitching, finishing, and eyeleting, are all done by machinery, and many of the minor operations in the manufacture of shoes are accomplished by improved tools which greatly facilitate the work and cheapen the cost of manufacture. But hitherto lasting has been principally done by hand, making it a comparatively slow operation.

We give an engraving of a machine recently patented by Mr. S. B. Ellithorp, of Rochester, N. Y., for accomplishing this work with rapidity and uniformity. The machine is equally well adapted to boots and shoes, and it is so clearly shown in our engraving that any one familiar with boot and shoe machinery will be able to understand it without reference to the description.

The frame of the machine is made of the base and top pieces, connected by vertical iron rods at the corners. The plates, A, are suspended by connecting rods from levers, B, pivoted at the top of the frame, and the levers are connected with arms on the rockshafts, C, so that when the latter are partly rotated the plates will be raised or lowered more or less.

The plate, A, carries a number of adjustable hooks, E, provided with nippers or clamps, F, which grasp the edges of the uppers surrounding the lasts, G.

The machine shown in the engraving holds two lasts, and is capable of lasting two uppers simulaneously. In the present case the uppers are omitted in the first half of the apparatus to avoid confusion in referring to the different parts. Two levers, II, are provided for each last. They are pivoted to a standard in front, and are elongated at the opposite extremity, forming handles which are brought together and retained by a link after the operation of stretching the uppers has been performed.

The lasts are held down upon their seats by screws, K, passing down through nuts in the top of the frame and bearing upon the center of the lasts.

The standards which support the last seats are made adjustable, so that they may be raised or lowered for different sizes of shoes and for boots.

The devices which hold the last render it adjustable in every direction, so that a last of any size may be used in the machine. The hooks on which the nippers are hung are capable of being adjusted, and the screw that holds the last down may be adjusted so as to press upon any part of the last.

The shafts, C, are provided with hand wheels, J, and with levers, by which they may be turned so as to bring any desired amount of strain upon the leather.

To last a boot or shoe on this machine the upper leather that has been prepared for lasting is turned bottom up and the last inserted therein bottom up, the last having an insole already tacked on the bottom. The last is then placed bottom up in the seat, so that the pin (Fig. 3) enters the corresponding hole in the last, the toe of the last resting in a curved seat, supported by the adjustable standard. The plate, A, is then lowered to the full extent, and the clamps, F, are adjusted so as to grasp the upper leather all around the edge, first grasping at the center at the heel, then at the center at the toe, and then, at proper distances apart, all around the upper. The holding bolt is then forced down upon the last, holding the last firmly down on the seat. The plate, A, is then drawn up by turning the shaft, C, pulling up the clamps, E, and consequently the upper leather, closely to the last at every point alike. The last being firmly held down, all the surplus leather of the upper leather is then above the bottom of the last. The levers, I, are now closed, pressing the upper leather to the shape of the last all around the bottom about the insole.

A gathering cord is then placed about the upper leather and drawn tight. The cord is again pulled and secured, and the boot or shoe is then lasted ready for tacking, which may be done in the machine while the last rests on the seat on opening the levers; or the boot or shoe may be removed and then tacked.

It has been supposed by some that there were mechanical obstacles that rendered it impossible to last boots or shoes by machinery. Such obstacles, if there were any, have been successfully overcome by this invention, by which boots or shoes of all grades of stock may be lasted in a manner far superior to hand work.

This machine is simple and easy to operate ; a girl or boy can operate it and do better work than is usually done by hand.

To produce a handsome boot or shoe and a good fit it must be perfectly lasted ; this every practical man in the trade admits ; and it is equally true that not one pair in ten is properly lasted. Th e inventor says that with this machine it is hardly possible to last a boot or shoe imperfectly. It will do perfect work with all kinds of stock, and it may be operated by hand or power.

Further information in regard to this useful invention may be obtained by addressing the inventor as above.

H. M. S. "POLYPHEMUS."

This novel specimen of naval architecture, which is the subject of three of our illustrations, was launched June 15, 1881, at Chatham Dockyard. It is not exactly a ship, but a "torpedo ram"—that is to say, a vessel designed, with a projecting point at the bows, to pierce or run down the enemy's ships, and also to discharge explosive torpedoes for the purpose of blowing them up. The Admiralty Director of Naval Construction, Mr. Barnaby, C.B., was the designer of the Polyphemus, and the construction of it (or of her, to use the customary female personal pronoun) was begun in September, 1878, by Mr. R. P. Saunders, chief constructor at Chatham Dockyard, and Mr. Penny, senior foreman in charge. The shape of the hull, is a cylinder with tapering ends, the upper side or hull deck being arched, though not so much as to present a circular midship section. Upon this hull is mounted a superstructure of iron and timber, consisting of a main deck running fore and aft, and above it a hurricane deck. At intervals along the sides of the hurricane deck will be placed six turrets—three on either side—which will carry the heaviest class of Nordenfelt guns. Protruding upward throug h this deck are two protected conning towers, one at each end, which form means of ingress and egress to and from the interior. There are also two ventilators and a smoke funnel. The superstructure may all be shot away without injuring the vessel herself or impairing her powers, save only as regards the Nordenfelt guns.

The steam steering apparatus is placed below, over the after boiler-room ; the steering-room is in telegraphic communication with the forward conning tower. The steering apparatus can, however, be actuated from the conning tower by manual gear which is fitted therein. As the Polyphemus carries no canvas, masts are dispensed with, and beyond a flag-staff or two nothing will appear above her decks but the towers, the ventilators, and the funnel. She will be propelled by twin screws, which are carried in framings, one on each side near her stern. These screws are three bladed, 14 ft. in diameter, from 15 ft. to 17 ft. pitch, and with a blade surface in each screw of 45 ft. She is also fitted with two rudders, which are placed under her hull near her bows, and can be lowered for use and raised again into recesses in which they are ordinarily carried. They are intended to be used for special manœuvering purposes. There is an ordinary rudder at the stern. The ram projects some 14 ft. beyond the body of the vessel, and is made hollow for the discharge of Whitehead torpedoes. The port or opening is covered by a solid steel cap, which forms the ram-point, but which, by means of a twisted sliding bar, can be easily pushed forward and turned up to allow of the discharge of the torpedo some 8 ft. below water-level, and is as easily closed afterward. Besides this, there are four other torpedo ports for the discharge of the same class of weapon, two being placed on either side of the vessel near the bows. She will also carry spar or deck torpedoes.

The framing of the Polyphemus is of Landore-Siemens steel, over which is a double layer of half-inch plates of the same material. Upon this, again, is superimposed a plating of Witworth fluid compressed steel, the plates measuring 10 ft. long by 2 ft. 6 in. deep and 1 in. thick. Her outer armor consists of small plates or scales, also of Whitworth compressed steel, measuring 10 in. square by 1 in. thick, running off to ¾ in. at the ends. The plates are fastened on by five screws, one at each corner, which holds three other plates, and one in the center. This plating covers her curved deck, and extends a short distance down below water level. The vessel measures 240 ft. long between perpendiculars, and has an extreme breadth of 40 ft. ; with a depth of hold of 18 ft. 9 in. Her immersed midship section is 625 square feet, and she draws 19 ft. 6 in. of water forward and 20 ft. 6 in. aft, her displacement load being 2640 tons. The hull is divided into a number of water-tight compartments.

The engines, which are by Messrs. Humphrys, Tennant & Co., are of the compound, horizontal, single piston-rod type, having four cylinders, the two high-pressure being 38 inches in diameter, and the two low-pressure 64 inches in diameter, with a 39-inch stroke. Her indicated horse power is 5,500, and her estimated maximum speed seventeen knots. Steam will be supplied from ten boilers of the locomotive type, at a working pressure of 120 lb. per square inch, they having been tested to double that pressure—viz., 240 lb. per square inch. The air-compressing machinery for the torpedoes and the steam steering apparatus are by Mr. Peter Brotherhood. The weight of the machinery, inclusive of the water in the boilers and ten tons of spare gear, is four hundred and ninety tons.

The ceremony of the launch was attended by Admiral Sir George Sartorius, Admiral Sir Houston Stewart, the Secretary to the Admiralty, Mr. G. O. Trevelyan, the Admiral Superintendent of Chatham Dockyard, and other official persons, with several members of parliament. After the usual prayers and benediction, pronounced by the chaplain, with the quaint formality of "christening" by dashing a bottle of wine against the bows, Mrs. G. O. Trevelyan handled a lever which released the "dogshores," and allowed the Polyphemus to glide down into the river Medway. The vessel had all her engines on board. She has been taken into dock, to be made ready for her steaming trials.—*Illustrated London News.*

A VERY NARROW GAUGE.

The most remarkable narrow gauge railway in this country, or perhaps in the world, is the 10-inch gauge road running from North Billerica, Mass., to Bedford, a distance of 8½ miles. The road-bed is well and substantially built. There are eleven bridges on the road, one of them over 100 feet long. The rails weigh 25 pounds to the yard. The cars and engines, though small, are handsomely proportioned. They are supported very low down, to give them stability. The cars have a center aisle, with a seat for one passenger on each side (instead of two.) Each car provides seats for 30 passengers ; they are provided with closets and a water tank, are heated by steam, and furnished with all other customary improvements. They weigh but 4½ tons—an ordinary passenger car weighing about 18 tons. The engines weigh about 8 tons, and, to give greater adhesion, are placed behind the tender. They draw two passenger and two baggage cars, at a speed of 20 miles per hour.

MINING UNDER FIRE AND WATER.

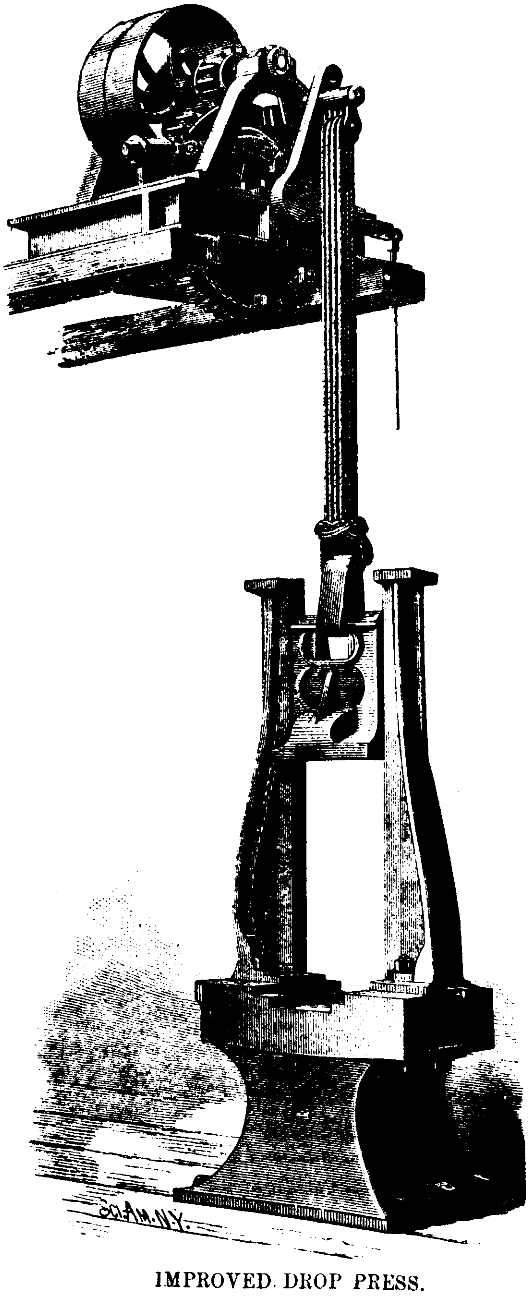
In his annual report for he Eastern District of Luzerne and Carbon Counties, Pennsylvania, Mine Inspector W. S. Jones states that Butler Mine fire, which has been raging at Pittston for nearly five years, is now under control, and he anticipates no further serious consequences from it. The company surrounded the burning area with a wide ditch varying from fifty to one hundred feet in depth, with a view to isolating the fire completely. A peculiar phase of mining is shown in the fact that while the fire raged in the upper vein, the miners worked in the vein directly beneath, and at times the water dripping from above was scalding hot. This has been remedied by a costly system of ventilation. In view of the frequent fires in coal mines, Mr. Jones suggests that a strong continuous pillar of coal be left on the dividing line between collieries, to prevent the spread of the flames from one mine to another. He points out a new source of danger in the fact that many collieries are now working under the beds of the Susquehanna and Lackawanna Rivers, and there is every reason to fear that sooner or later "caves" will occur, in which case the rivers would rush into the mines beneath, with disastrous results, which would be multiplied by the indiscriminate system of working from one mine into another.

Mr. Benjamin Lee Smith has started for the fifth time on a private exploring expedition to the Arctic Regions. The expedition from which he returned last year was very successful, a considerable part of Franz Josef Land, hitherto unknown, having been laid down upon the chart. Mr. Smith intends this year to proceed to Franz Josef Land direct, and on reaching Eira harbour, which he discovered last year, will erect a house, the material for which he carries with him. Should any accident occur, this building will be a place of refuge for the crew, or for any others who may be shipwrecked in that inhospitable region. On leaving Eira harbour the steamer will call at other places in Franz Josef Land, and subsequently an attempt will be made to get as far north as possible. The *Eira*, the steamer which carries the party, some twenty-five all told, is provisioned for fifteen months, but the voyage is only expected to extend over five.

Miscellaneous.

NEW DROP PRESS.

The variety of work that can be welded and forged under a drop press, and the great economy and rapidity with which it can be done, have worked a complete revolution in the production of steel and iron shapes. In no other way can duplicates be made so surely to replace missing or broken parts.



IMPROVED DROP PRESS.

We illustrate a new drop press which is a great improvement over those now in use. The patent connection between the crank pin and hammer is slightly elastic and acts as a cushion. The right tension can be much easier attained and changes can be more readily made than with the strap in common use. Its first cost is less, and when worn out can be quickly replaced at a small expense. We are informed that quite a demand has arisen for this connection to replace old straps on lifters of drop presses of other manufacturers.

Internal steel ratchets—whose teeth are much stronger than those of external ratchets—are used in constructing this press, and the ratchet being attached to the rim of the main driving gear the transmission of the strain through the arms of the gear wheel is avoided. The greatest strain on crank and ratchet drop presses comes when the dog fails to catch a tooth at its furthest rebound, then it falls back to the next tooth. This ratchet contains forty-five teeth, and hence the falling back in this machine is always through a very small distance. This press is manufactured by Williams, White & Co., Moline, Ill.

A LIFE-SAVING LESSON IN PHYSICS.

It is a well-known fact that any person of average structure and lung capacity will float securely in water if care is taken to keep the hands and arms submerged and the lungs full of air. Yet in most cases people who are not swimmers immediately raise their hands above their heads and scream the moment they find themselves in deep water. The folly of such action can be impressively illustrated by means of a half empty bottle and a couple of nails; and the experiment should be repeated in every household until all the members—particularly the women and children—realize that the only chance for safety in deep water lies in keeping the hands under and the mouth shut.

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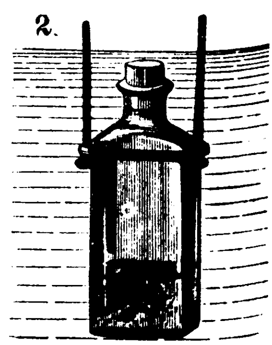
2.



Any short-necked, square-shouldered bottle will answer, and the nails can be easily kept in place by a rubber band or a string. First ballast the bottle with sand, so that it will just float with the nails pointing downward, as shown in Fig. 1; then by turning the arms upward, as shown in Fig. 2, the bottle will be either forced under water at once or will be tipped over so that the water will pour into the open mouth, and down it will go. To children the experiment is a very impressive one and the moral of it is easily understood.

The vital value of this precaution was strikingly illustrated near Accomac C. H., Virginia, a few days ago. A niece of the Hon. John Neely, while bathing, was swept off into the ocean by a strong current and soon disappeared in the high breakers. As she could not swin her companions gave her up for lost. Two young fishermen who were employed some distance away thoughtfully set out with a small boat in search of her, and, when a mile or more from shore, found her floating on the water. She had been drifting nearly an hour and was greatly exhausted, but soon recovered. Unable to swim she had pluckily floated, thereby making her rescue possible.

MOLES—HOW THEY AID AGRICULTURE—HOW THEY CAN BECOME A NUISANCE—HOW THEY MAY BE DESTROYED.

The common ground mole or "meadow mole," as this little animal is often called, is of interest from a zoological point of view, but in this article it is proposed to deal only with the practical side of the subject in its relations to agriculture and horticulture.

The mole is both useful and hurtful. When his services more than counterbalance the injury he commits he should be left unmolested. On the other hand, when he becomes, as he often does, an intolerable nuisance, he may be more or less successfully dealt with in the manner we will proceed to describe.

It is very annoying to see a handsome lawn covered with unsightly ridges plowed by the noses and paws of these little depredators; but the knowledge that they are the natural enemies of the numerous worms and grubs that sometimes make fearful war upon the tender roots of growing young crops, renders it often difficult to decide whether the moles are to be welcomed as allies, or combated with such means as are available.

The mole is a purely carnivorous animal, and never does any damage to plant life except in pursuit of his prey. He may break and disturb the tender roots of young plants, but he does not devour them, and he is often wrongly blamed for injury which has been committed by the insect depredators he has caught and devoured.

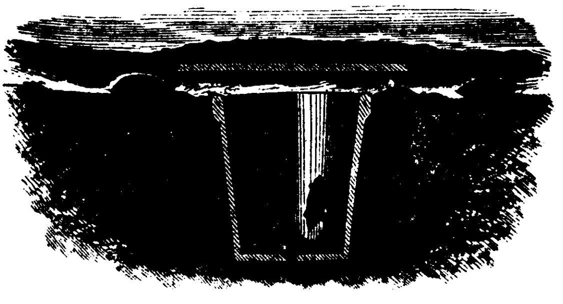


FIG. 1.—MOLE TRAP.

The field mouse, on the contrary, does devour tender succulent roots, and the mole is too often charged with the damage thus sustained by farmers, in addition to that really due to his burrowings.

Experiments performed in France to determine the usefulness of moles as insecticides show that the number of grubs, etc., destroyed by them is enormous. A single mole, in one instance, devoured 432 maggots and 250 grubs in four days. Another ate 872 maggots and 540 grubs in twelve days.

Prof. Weber, a distinguised naturalist of Zurich, Switzerland, performed some interesting experiments with moles to prove their carnivorous character and their destructiveness to larvæ. In the stomachs of fifteen moles captured in different localities, not the slightest trace of vegetable matter could be found. He shut up two moles in a box in which fresh grass was growing, and also inclosed in the same box a case of grubs and earthworms. The moles devoured 341 white worms or grubs, 193 earth worms, 25 caterpillars, and a mouse—bones, skin, and all—in nine days. He next gave them raw meat cut in small pieces and mixed with chopped vegetables. The moles ate the meat but did not touch the vegetables; and when vegetables alone were given them the animals soon died of starvation. It has been computed that a single mole may destroy 20,000 grubs in a single year.

In the face of these experiments it is positively asserted by some that moles will eat wheat grains with avidity, and that poisoned wheat introduced into their burrows through holes punched with a stick is sure death to them. We have tried the latter without impairing the health of the moles, and we have more faith in mole traps, in the use of which we have had considerable experience and with varying results.

We give herewith engravings illustrating two implements of destruction, both quite simple, either of which will be found practically useful.

The simplest form of trap, and one that will prove effectual if skillfully employed, is the jar mole trap shown in Fig. 1. A glass or stoneware jar is sunk into the ground under the runs, as indicated in the engraving. The moles, while running along, fall into the jar, and the vertical slippery sides of the jar prevent their getting out again. Field mice are also frequently caught in these traps, which leads to the suspicion that they are the authors of much of the mischief attributed to moles, whose burrows form convenient avenues for the intruders. Another effective mole trap was described and illustrated in the *Rural New Yorker*, some time ago and not unlike one illustrated in these columns a few numbers back. It is shown in Fig. 2 and is thus described by our contemporary:

The spikes, A, three-quarters of an inch wide and tapering somewhat at the end, are pressed into the ground beside the mole track, as far as possible. so that the trigger, B, which is not yet attached to the lever C, rests upon the surface of the mole track, the prong head, D, meantime, being held in its present position by the ring at the top of the upright square bar, F. Now let it slip from the hand. The force of the spring, E, will drive the prongs, D, into the ground, perhaps half way. Press them entirely down with the foot and raise and lower them several times so as to give firmness to the earth and a free passage to the prongs. Then raise up the prong head to its present position and place the lever, C, in one of the notches of the trigger, B, according as the other end of the latter is more or or less depressed. Now the mole cannot again pass through this track without so pressing upon the earth as to move the trigger at B, which releases the lever, C, and permits the spring, E, to act, sending the prong head into its place with great force, securely pinning (generally killing) the mole.

There are a number of other traps more or less effective, but the two represented in our illustrations exhibit the two diverse ways for catching moles, other appliances in use being simply modifications of the plans represented.—*Ill. Scientific News.*

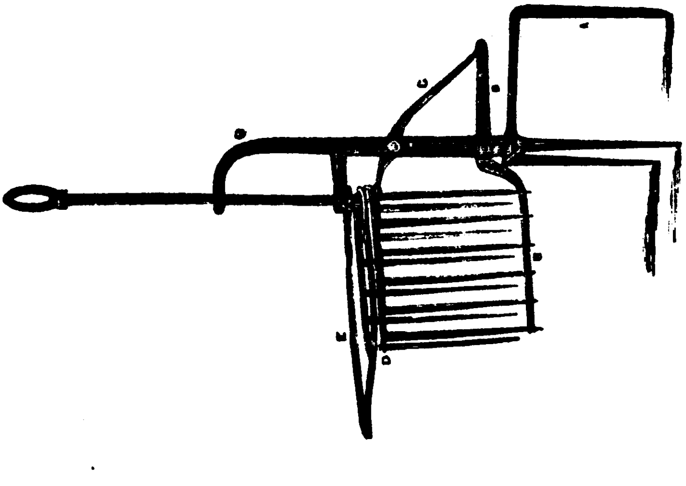


FIG. 2.—MOLE TRAP.

SLEEP AND SOMNAMBULISM.

BY M. REGNARD.

It almost seems as if there were things in science which we should leave undiscussed, subjects which a prudent man never takes upon himself the task of expo ing—dangerous topics, in short, which it never benefits one to meddle. Somnambulism, or animal magnetism, as it is still called by persons who persist in employing an erroneous term, certainly belongs to this category. It is a mystery, inasmuch as it is only known by its effects, and it has always struggled, from remote ages up to the present day, against two classes of people—dupes who believe all that is told them, and charlatans who seek to impose upon the world.

In the short space of time reserved for me, I shall frequently endeavour to the best ability, to teach you what intelligent men accept and profess relative to that singular nervous malady called Somnambulism. Our immortal poet, Molière once said that opium makes us sleep because it possesses soporific properties. This phrase although apparently a bitter criticism upon medical science, is in reality a definite, exact, and complete expresses of a a scientific fact. Opium makes us sleep because it possesses soporific properties. It is impossible for us to say anything further even at the present day. For should we observe that it makes us sleep because it congests the brain, we must add also that this arises from the fact that it possesses the power of causing congestion. This, however, is not a solution of the problem. These things, you may say, however, have nothing to do with somnambulism, but it was necessary to make the foregoing remarks in order that you might fully understand the aim and significance of this lecture. I shall place facts before, show you experiments and, I trust, gain your conviction. I shall prove everything to you, but explain nothing.

Somnambulism is a disease; it is a nervous affection, and one which we are able to combat, treat, and cure. It consists in the alteration of a physiological function in a modification of sleep. We must there begin with sleep, for it is necessary to understand the normal functions before entering upon its modifications. One of the greatest of nature's laws is that repose must succeed action. Our organs are not capable of performing their various functions indefinitely. Even the heart, which apparently beats incessantly, rests a certain time between each pulsation, and instead of reposing a long while, after continued activity like the rest of the body, it relaxes for a brief space after each period of motion. The brain is no exception to the general rule, and requires rest after having worked all day. It then ceases to act, partially at least, leaving other nerve centres, the spinal cord for instance, to govern whatever remains active among the functions of the organism.

As to what becomes of the mind, during that time, I really am unable to say. A certain portion of those who have occupied themselves with the subject, affirm that sleep is our normal condition. Our birth is an awakening, our death merely a return to our primitive state, while life is simply an episode where this eternal slumber is interrupted by a series of vigils and periods of activity. Buffon was less exclusive, and stated that sleep was a form of existence as real and general as any other. "All organised beings which have no sensations exist in this manner," he said. The first manifestation of the state of sleep is relaxation of the muscles. The entire body becomes, as it were, annulled; the arms fall, causing the book they supported to drop; alas! sometimes as most of us know, the head descends abruptly forward, which causes us to wake frequently, and produces anything but an agreeable sensation. After this the senses gradually sleep. Apparently sight is the first to become abolished. The outside world disappears, and a dream begins. Frequently, particularly in children, an astonishing spectacle is presented. When awake we would call it a kaleidoscope, or an exhibition of fireworks represented by various brilliant-hued flames of all shapes, passing before us rapidly, then suddenly fading away. Sleep is not far distant, but it is not fully established, for the sense of hearing is still awake. This sense, indeed, seems to be last to succumb. How many times, when on the point of dropping asleep, have we heard our name suddenly pronounced or a particularly interesting observation uttered; we arouse with a start, exclaiming, "I was just going off; I was already in dreamland." We might say that the sense of hearing, by the very persistence of its activity, contributes to the production of sleep. Does not a monotonous sound often induce the state? When amid the universal silence of Nature we hear the ceaseless lapping of waves along the sea coast, or a soft wind swaying among the trees, do we not become drowsy in listening; In infancy, an analogous mechanism, the singing of our mother or nurse cause our senses to sleep rapidly while our ears are still sensible to the impression of sounds. I could furnish you with innumerable examples. How many times has the monotonous discourse of a rambling and wearisome orator caused your eyelids to close involuntarily. The mind struggles at first and then abandons itself. The words succeed each other like the uniform ticking of a clock; the meaning is gradually lost upon the listener, and only when the speaker finally stops does he awake with a start. I have but little to say of the sleep of smell and taste. They seem to be quickly abolished and, apparently, do not even persist in dreams. A certain man who, although not a *savant*, was nevertheless a very minute and shrewd observer, Brillat-Savarin, calls our attention to the fact that it is excessively rare that we experience either the sense of smell or taste in sleep. When we dream of a beautiful garden or a field of flowers, we see the blossoms without inhaling the perfume. If we imagine ourselves to be present at a bountiful repast, we observe the dishes, and may even partake of them, without tasting them. Touch does not seem to be much behind sight in becoming abolished. But on the other hand a slight impression in this respect is sufficient to drive sleep completely away. It is pretended, you know, that a rose leaf upon the bed was enough to prevent the Sybarites from sleeping. Recognising the possible exaggeration, let us, however, recall some of our travelling experience and think of the hard beds at the different hotels, which in spite of our intense fatigue, keep us awake so long. While we become thus gradually deprived of our faculties, the organic functions continue to perform their work without ceasing; only, nothing is subject to our control, everything occurs automatically. This last word will reappear so frequently throughout this lectuie that I will pause for a moment to explain to you the precise sense in which I employ it. In ordinary life our will never sleeps. It regulates the exercise of our organs and presides over the accomplishment of all out acts. Some of these, however, are so habitual that we execute them, as we say, without thinking. Thus, for example, we expand the chest when we experience a desire to inhale the air. Sometimes we do this voluntarily, but more frequently the act is purely mechanical, and in the same we execute a thousand different motions with the thorax in the course of an hour without being in the least aware that this is the case, without even knowing that the desire to breathe makes itself apparent. This, of course, does not mean that the causes which produce the inclination do not exist. I simply intend to say that their effect does not reach our understanding, It stops *en route* and does not go as far as the brain. It is reflected upon the spinal cord, and gives rise to what is called *reflex action*.

In a normal state, the impressions which are made upon the surface of the body are conveyed directly to the brain; the latter immediately determines the order, so to speak, in which the organs re-act. Suppose, for instance, that you burn your finger. A sensation of pain is transmitted to the brain, and instantaneously your muscles are made to contract, and you draw back your arm. It very often happens, however, that the arm is drawn back before the brain has had time to comprehend the dangerous situation of the finger. This is owing to the fact that the sensation has already made a vivid impression upon the spinal cord *en route*, and this nervous centre causes the arm to be withdrawn, although the mind as yet known nothing of what has occurred. The sensation, therefore, is reflected upon the spinal cord as though the latter were a mirror, and this is what is meant by reflex action. You see how simple it is to understand. I could go on and multiply such examples *ad infinitum*. Sneezing, swallowing, and the motions of the viscera are all reflex actions governed entirely by the spinal cord.

Do you wish for proof? A single experiment will give it to you. Here is a frog whose head you see I have just cut off. It has no longer a brain and consequently no sense of any kind. It can neither feel nor exercise any will power. I now place a drop of acid upon its foot and you see that the latter is violently withdrawn. It makes efforts to remove the acid, This is all due to the spinal cord, which produces a series of combined reflex actions. You are thinking, perhaps, that we are still very far away from somnambulism. On the contrary, we are in its immediate neighborhood, for I will show you presently, that the somnambulist is a being whose brain is temporarily abolished, and who like the decapitated frog, acts in a purely mechanical way. To be brief, the physiological characteristic of sleep is the comatose condition of all the senses combined with voluntary movements produced by reflex action. The latter we find in dreams. When our senses fall asleep, they convey to our understanding, a final impression which results in the last idea that we receive, and *vis-à-vis* to which our conceptive faculty, our intelligence, is, so to speak, completely free. It then happens that this idea produces a more vivid impression, and that with the rapidity of thought it can give rise to a long chain of imaginary ideas which develop and which our still conscious mind (the perception alone being annulled) accepts as real. This chain of ideas is a dream. If the chain is well made the dream will continue methodically; if defective, we have those absurd and ridiculous dreams which sometimes recalled the following day, cause us to smile.

In every case nothing can be more rapid than a dream. It has the precise duration required for a chain of ideas born solely of the imagination, and a dream that we often think has lasted all night, has in reality occupied the brain but a few moments. On how many occasions have you awakened several times successively after you have fallen asleep. In a few moments between each period you had a long dream, and were it not for the clock which informs you of the incontestable fact, you would swear you had been asleep for hours.

Thus many physiologists and psychologists think that a dream is nothing more than the prolongation of ideas proceeding from a final impression produced in the mind by the senses at the moment when sleep overcomes them, or else the result of an impression formed upon the mind while it is yet awake, and the senses asleep. The proof that this is the case is contained in the fact that in certain subjects it is possible to produce dreams and to regulate them at will. With some chlorotic young girls, for instance, the sounds produced in the arteries reach the ear and are conveyed to the brain during sleep—dreams result which are always the same. The young girl from the city will dream of a ball or concert; another, whose religious tendencies are more developed, will imagine she hears the singing of angels and the hymns of saints, while a country girl will dream of wind stealing through the foliage, of rain pattering against the window panes, the gentle murmur of a brook, or the soft twittering of birds. The senses furnishes the first idea, the imagination does the rest. I told you it was possible to regulate dreams at will. With certain persons subject to nightmare, a sudden exclamation, an unusual sound can change the whole course of a dream, awaken a portion of the brain, and cause the sleeper to reply to a question put to him, which proves that his dream has conformed itself to the suggestion of whoever speaks. This is the normal state. Exaggerate it and you are in the presence of that nervous malady called Somnambulism. Sleep, abolishing perception, but not conception; a dream that another person may modify according to suggestion; automatic action, consequent upon the lethargy of a portion of the brain and the predominance of the spinal cord. This is the conception of that famous affection which appears to be so incomprehensible, when we do not take the trouble to analyse it, or else when we investigate it superficially. You see I did not deceive you when I said it would be necessary to study sleep in order that we might comprehend the maladies arising from it.

AN IMPROVED PIPE FOR SMOKING TOBACCO.

The objects of the invention are to prevent any waste of tobacco by causing the whole of the charge in the pipe, including the portion which is known as the "dottle," and which is usually thrown away, to be consumed; to keep the pipe at all times cool and sweet, and to effect a saving and avoid the need of the matches. To effect this, the pipe is formed with both top and bottom open; the latter is, however, closed with a removable plug, which also fits the top, so that when the pipe is once alight and it is desired to refill it, the plug is removed from the bottom and inserted into the top, and fresh tobacco put into the bottom, so pushing up the dottle to the top of the pipe; the plug is then removed from the top and fixed in the bottom, and the smoker can continue to smoke without relighting. This method of refilling is also much cleaner than the usual way of filling at the top, so saving soiling and often burning the fingers.—*London Tobacco.*

Scientific.

OPENING OF THE PARIS ELECTRIC EXHIBITION.

The International Exhibition of Electricity at Paris was officially opened August 10. Much work remained to be done to put all the exhibits in proper position. The delinquents were mainly in the British and Amerian sections. The French, German and Belgian sections were more forward. The electric railway was not completed. The Tissandier balloon was ready and attracted much attention. President Grévy, the ministers, and a few other privileged persons were treated to a telephonic musical entertainment. Four wires had been placed in communication with the opera, and the voices of the opera chorus were heard with perfect distinctness.

STORAGE OF ELECTRICITY.

Professor Tyndall writes as follows to the *Times*:—Would you permit me to say a word or two on a subject of great public interest and of considerable public perplexity, I refer to the so-called "storage of electricity?" The usual condition for the production of a voltaic current is known to be the immersion of two different metals in a liquid called an electrolyte. When two pieces of metal thus immersed are connected with a galvanometer, the existence of a current is declared by the deflection of the needle of that instrument. Substituting for the two metals two clean plates of platinum and connecting them with the galvanometer, the needle remains unmoved. The platinum plates being homogeneous, there is no reason why a current should start from one of them through the electrolyte rather than from the other. If such currents started they would be equal and opposite, and would, therefore, neutralize each other. In other words, with the two homogeneous plates of platinum we have no current. But let the wires connected with these platinum plates be detached from the galvanometer and joined, even for a moment, to a voltaic battery, the current which passes will destroy the homogeneity of the plates. If the electrolyte, for example, be acidulated water, that liquid will be decomposed, a film of hydrogen covering one plate of platinum, and a film of oxygen covering the other. These two films play the part of two different metals in the ordinary voltaic battery; and if the plates of platinum thus coated be connected with the galvanometer, the current produced will be strong enough to dash the needle violently aside. The experiment may be varied in fifty or five hundred ways, and when, instead of the films of gas, solid layers are deposited electrolytically on one or the other of the homogeneous plates, the duration of the current is prolonged. Several cells thus rendered active, through the agency of an extraneous current, constitute what is known as a "secondary battery." The discoverer of this battery was a man who, without pecuniary reward, or even the hope of such reward, almost sacrificed his senses to the investigation which resulted in the discovery. The name of this man was Ritter, a native of the small German village of Liegnitz. He died, as Dove remarks, exhausted by restless labor, poverty and disorderly living. I think his name and services ought not to be ignored at the present time. Other men labored and we have entered into their labors. Employing homogeneous plates of lead and rendering them non-homogeneous—converting them, in fact, virtually into different plates—by the action of an extraneous current, M. Planté greatly intensified the effects obtained by Ritter. M. Faure has followed and improved upon M. Planté. Covering the plates of lead with minium, with the aid of the currents now obtainable at a small expense, he has, it appears, produced a secondary battery of great power and of considerable promise from a practical point of view. But I think scientific men have a right to demur to the phraseology in which M. Faure's extension of the discovery of Ritter has been introduced. It has been severely criticised in the *Revue Scientifique*. Numbers of people in this country have been thrown into perplexity by the first letter on this subject published in the *Times*. With regard, for example, to the "box of electricity," if such language be tolerated, we may call a common packing-case containing a voltaic battery a box of electricity; but I am not sure that science will profit by a terminology which bewilders the public mind.

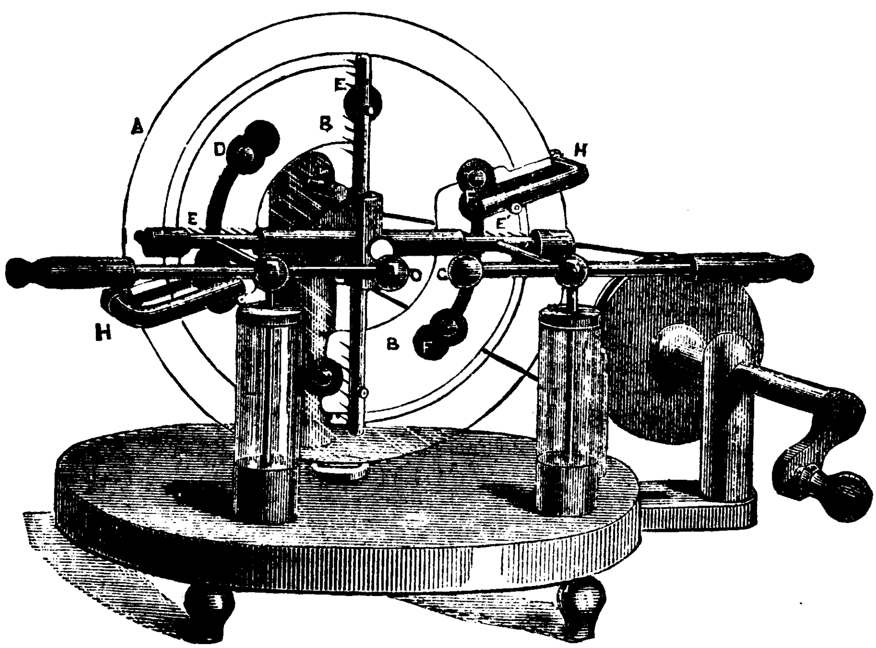
THE DIVISION OF THE COMET DOUBTED.

Owing to the persistent bad weather and the rapid retreat of the comet into space it is to be feared that the question of the comet's spontaneous division on the night of July 6, as reported by Professors Stone and Wilson, at Cincinnati, will not be satisfactorily settled. The astronomers of the observatory at Washington, saw a great disturbance in the coma about the nucleus of the comet the same night, and a partial separation, which might appear as a complete division in the less powerful glass employed at Cincinnati. Other astronomers are confident that no division of the nucleus occured.

Unfortunately, as already noticed, the atmosphere has since been very unfavorable for such observations, and the question threatens to go undecided until the comet comes back again—if it ever returns.

VOSS'S INDUCTION ELECTRICAL MACHINE.

The modified Holtz machine, by Voss, possesses certain features rendering it of special value in this country, the most important of which is its independence of atmospheric conditions, as noted by the querist. The following particulars and drawing are taken from *Engineering*. The machine, in the fact that it is self-charging, requiring neither friction nor any outside initial charge to start it into action, nor is it necessary to bring the discharge terminals into contact, as in the Holtz machine, before commencing to work it, is perhaps the best in existence. On reference to the illustration it will be seen that the apparatus consists, like the Holtz machine, of two glass disks, unequal in diameter, of which the larger, A, is held in a fixed position, while the other is mounted upon a horizontal axis, and can, by means of multiplying gear, be rotated at a high velocity. To the front face of the larger plate are attached two pairs of tin foil disks, F F, F^1 F^1, each pair being connected together by a strip of tin concentric with it, is attached a metallic button of the form of a plano-convex lens, and these buttons, in the revolution of the plate, pass under and are lightly touched by the metallic brushes, F F, which are held by the bent arms, H H^1, the brushes being so adjusted as only to touch the buttons and not to come in contact with the glass of the rotating plate to which they are attached. E' and E' are two horizontal collecting combs, insulated from one another by being attached to a horizontal bar of ebonite, but connected respectively to the two discharge terminals, C and G, in the front of the instrument by the horizontal bars shown in the figure, and the distance between these terminals can be varied at pleasure by sliding them through the balls which are attached to the inner coatings of the two cylindrical Leyden jars by which the charge is accumulated and the discharge intensified. E^1 is a vertical bar of brass carrying at each end a comb, directed toward the rotating plate, as well as a pair of metallic brushes, similar to F and F, and

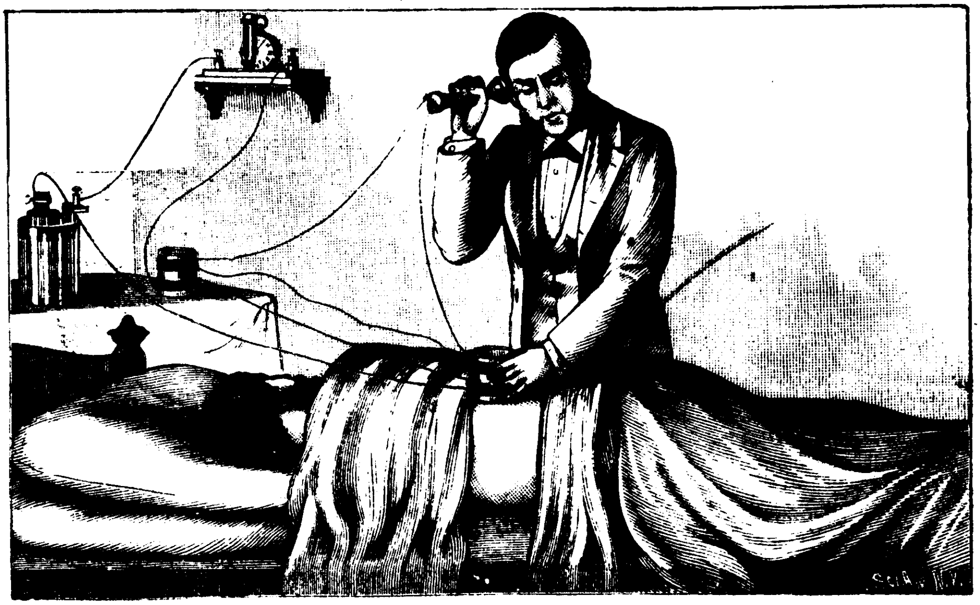


THE VOSS-HOLTZ ELECTRICAL MACHINE.

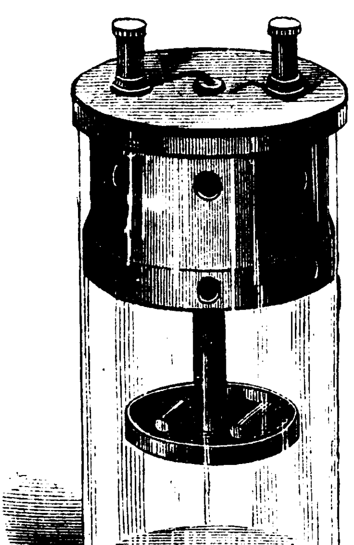
foil, and by a second strip to one of the two bent arms, H and H^1, by which they are connected to a light metallic brush directed toward the front face of the rotating plate. At the back of the fixed plate are pasted two paper coatings which correspond to what used to be called the paper "armatures" in the Holtz machine. To the face of the rotating plate are attached, at equal angular distances apart of 60°, and at a short distance from the circumference, six disks of tin foil (one of which is marked D in the figure), about an inch in diameter, corresponding in position and size with the tin foil disks upon the fixed plate, that is to say, if the disks, D, were numbered in rotation 1, 2, 3, 4, 5, and 6, those numbered 1 and 2 would, in a certain position of the rotating plate, correspond and be opposite to one connected pair of disks of the fixed plate; Nos. 4 and 5 would similarly correspond to the other pair, and Nos. 3 and 6 would have no disks on the fixed plate opposite to them. To each of the little tin foil disks, on the rotating plate and which also, in their turn, make momentary contact with the metallic buttons as they pass beneath them, and at a moment when they are not under the inductive influence of the metal disks of the fixed plate.

Italian Poison Antidote.

M. Bellini, of Florence, advocates the use of iodide of starch as an antidote for poisons in general, and, as it has no disagreeable taste and is free from the irritant properties of iodine, it can be administered in large doses; also, without fear in all cases where the poison is unknown. It will be found very efficacious in poisoning by sulphureted hydrogen gas, the alkaloids and alkaline sulphides, ammonia, and especially by alkalies, with which iodine forms insoluble compounds; and it aids in the elimination of salts of lead and mercury. In cases of acute poisoning an emetic is to be given before the antidote is administered.



THE BULLET FINDER.



A NEW USE FOR THE INDUCTION BALANCE.

The form of induction balance desised by Professor Hughes, of London, already has several interesting and useful applications, and a new use for it is now suggested by the recent tragedy at Washington. It seems essential to locate the bullet in the body of the President.

The induction balance is a most delicate electrical instrument for detecting the presence of metals, and a modified form of it could be easily applied to this purpose with a reasonable expectation of success. This instrument consists of two short glass cylinders, around each of which are wound two parallel coils of

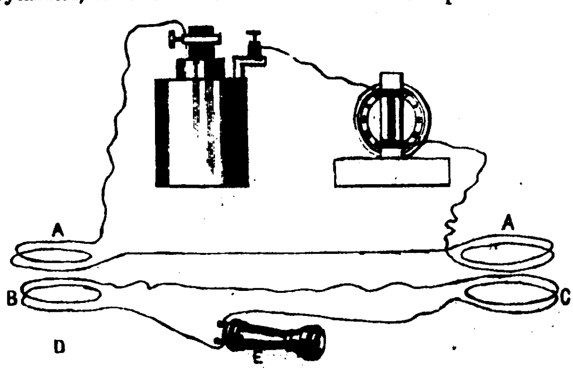


Fig. 2.—Diagram showing circuits of the induction balance.

fine insulated copper wire. One coil of each pair is included in a battery circuit in which there is a clock microphone. The other pair is placed in a closed circuit with a receiving telephone. The two glass cylinders, with their encircling coils, may be widely separated. The induction set up in the secondary or telephone circuit is balanced by the reversal of one of the secondary coils and so adjusted that the induction in one of the secondary coils exactly balances or neutralizes the induction in the other, so that when the ear is applied to the receiving telephone no sound is heard.

Now by placing ever so small a piece of metal in one of the glass cylinders the electrical balance is disturbed and the clock on the microphone is heard to tick loudly, thus indicating the presence of metal—and the same is true if the coil be placed in the vicinity of a piece of metal.

It occurred to me to try the effect of a lead bullet upon the instrument, placing it at different distances and separating it from the coil by insulating material, but I found that the ordinary microphone with carbon electrodes was entirely useless, inasmuch as a very strong current is required to get results from lead, which of all metals, unfortunately, produces the least effect on the instrument. As a strong current burned the carbon of the microphone, I devised a current interrupter operated by a clock which interrupted the current at regular intervals and insured uniform results. With this current breaker the result exceeded my anticipations, as with a set of coils that were by no means sensitive I was able to locate the bullet with the coils raised a vertical distance of nearly two inches. I suggested to Mr. J. Stanley Brown, the President's private secretary, that, by passing a pair of coils over the President's back and abdomen, the bullet might be located, and that by making comparative tests the depth of the bullet might be ascertained.

At the request of the secretary my apparatus was sent to Washington, but nothing can be said at present in regard to the success of the experiment.

If the missile were of iron or steel no difficulty would be experienced in locating it at a depth of four to five inches, but being lead, it is questionable whether it will disturb the electrical balance at a greater depth than two inches.

The diagram shows the arrangement of battery, microphone, and primary and secondary circuit wires.

The battery and microphone are in a closed circuit with the coils, A, A, and the coils, B, C, are in a closed circuit with the telephone receiver, E One of the secondary coils, B, C, is reversed, so that the electrical pulsations induced in one secondary coil by one of the primary coils, A, is exactly counterbalanced or neutralized by the opposing current induced in the other secondary coil by its primary, A. Now, by placing a piece, D, of any metal in or near one of these pairs of coils the electrical balance is destroyed, and the preponderating current produces audible effects in the telephone.—*Scientific American.*

THE ILLUMINATION OF RAILROADS.

Railroad men have recently been considering the feasibility of using the electric light for headlights to their engines and for the purpose of generally illuminating trains. The difficulty in the way seems to be that the jar of the locomotive and coaches is liable to cause uncertainty in the continuity of the light. But there is one method that does not appear to have been discussed to which this objection will not apply. This is, utilizing the existing telegraph poles and wires for the purpose of making a continuous illumination along the railroad tracks. There are 30 telegraph poles to the mile, and if on every other one of these were hung an electric lamp the entire track could be made as light as day. This would do away entirely with the need of of the expensive and cumbrous headlights, and, to some extent, with the necessity for using oil lamps in the train. It would also obviate all the dangers to railroad traffic that are now incident to the darkness. Accidents resulting from washouts, or fallen trees, or land slides, would be things of the past. Obstructions placed by malicious persons on the tracks would be seen at once, or, were the malefactors to take the precaution of cutting wires before attempting to wreck the train, that would at once extinguish all the lights within the circuit and give warning to the train officers that danger was ahead. Moreover, suppose the case of a train dispatched on mistaken orders ; as soon as the case was discovered, the operator at the battery could, by a simple movement of the hand, extinguish the lights, which would be a signal for the train within his circuit to come to a stand and wait for orders. It may be urged against the suggestion that some of the lamps might get out of order and remain so, unless a close and expensive system of supervision were maintained. This difficulty can be met with the further suggestion that, by a simple system of lettering and numbering the lamps, the engineers of passing trains could report to the next station what particular lamp or lamps might happen to be out of order. At any rate the plan, which has been suggested by a practical railroad man of great experience, presents so many points of apparent advantage that it must be worth examination. To the public at large it would certainly give a greater feeling of security than is possible under the present system ; and, if the economical questions connected with it can be satisfactorily adjusted it would undoubtedly be considered a large step in advance.—*St. Louis Globe-Democrat.*

SWAN ELECTRC LAMP AT PLEASLEY COLLIERY.

The Royal Commissioners upon Accidents in Mines, including Prof. Abel, Mr. Warington Smyth, Prof. Tyndall, and others, have made an examination of the experiments on the application of electric lighting to coal mines, which are being carried out at the Pleasley Colliery, near Mansfield. The pits are about 1,600 ft. deep, and the workings are very extensive, but in the present instance the light was applied to three workings only, situated at a distance of about one-third of a mile from the bottom of the pits. The Swan system was adopted, and the arrangement, were carried out by Messrs. R. E. Crompton and Co. The lamps themselves were enclosed in lanterns of a very ingenious construction, designed and made by Messrs. Crompton which enabled the very fragile glass bulbs to be carried about without fear of accident, and at the same time rendered it impossible that the fracture of the lamp within could cause an explosion inasmuch as the air inside the lantern would suffice for the instantaneous combustion of the carbon filaments before the flame could be communicated to the external air. In working the coal, the men undercut the face to the depth of some five or six feet, and the superincumbent mass is then brought down by wedges or blasting. It is said that the new lamp was found to be admirably suited for the requirements of the workers, since it not only gave a light many times as intense as the lights it replaced, but it was equally brilliant in whatever position it was placed, and it required absolutely no attention. In addition to the lamps which were used in the actual workings of the pit, the pit bottom was lighted up with similar lamps. The number of lights employed was 94 in all, which were worked by the current of an ordinary Gramme machine driven by a portable engine placed near the top of the upcast shaft.

MAICHE'S BATTERY.

The inventor of this entirely original form of battery, of which we give an illustration, has endeavored to fulfill all the conditions necessary to make his battery work for an indefinite period, and this ideal result is obtained—thanks to the means of depolarization which he employs.

A porous vase, pierced with large holes, is fixed to an ebonite cover, which closes an earthenware vase filled with retort carbon, broken in pieces and platinized. The porous vase is traversed by an ebonite tube supporting a small porcelain cup, in which is placed a small quantity of mercury and two small pieces of zinc. A platinum wire, connected to a terminal fixed on the cover, dips into the mercury, and establishes a good contact with the zinc.

Another platinum wire connects a second terminal with the carbon fragments placed in the porous vase. The contacts are thus completely assured. The zinc is not attacked, except when the circuit of the battery is closed ; it is plunged entirely in the liquid, consequently it is entirely used up without any loss.

Under the influence of the platinized carbon the hydrogen of the water, which tends to polarize the carbon, combines with the oxygen of the air. That this novel effect, sought for in vain for a long time, can take place, the carbon should only be partially immersed in the water; the rest becomes wetted by capillary action, and presents a considerable surface to the air.

The water produced by the combination of the hydrogen and the oxygen contributes, to a certain degree, to replace that which passes off by evaporation, and which the cover keeps from being lost.

The electromotive force of this battery is about 1.250 volts ; but it is necessary to work it through an external resistance of about 3 kilometers of ordinary telegraph wire in order that it may work well. The exciting liquid may be water saturated with sal-ammoniac, or acidulated by sulphuric acid, or the bisulphate of soda, in the proportion of 10 to 1.

An element working a bell about 100 times a day would not require to be looked after for a very long time, and, in this case, it would only be the zinc that would require replacing, as the platinized carbon preserves indefinitely its catalytic properties.

The Maiche battery is particularly well adapted for electric bells. Maintenance not being required, its fitness and the care taken in its whole construction make it the most perfect bit of apparatus of its kind.—*L'Electricité.*

THE ANTECEDENTS OF THE BELL TELEPHONE.

BY GEO. M. HOPKINS.

Should the recent decision of the U. S. Circuit Court, at Boston, in reference to the Bell telephone patent, be sustained by the higher, court it will prove calamitous not only to inventors who have succceeded Bell in telephonic inventions, but to the public at large, who will be at the mercy of a powerful monopoly, so far as telephonic communication is concerned. Already the workings of this power are beginning to manifest themselves in increased and apparently exorbitant rents, with no corresponding increase in the efficiency of the instrument or in the perfection of the service.

This being the condition of things, it behooves telephone inventors and telephone users to inquire as to the scope of Bell's patent, and to acquire a knowledge of the status of the art of telephony prior to the invention of Bell.

Should it be fouud that articulate speech had been transmitted from one point to another by means of electricity before Bell thought of the telephone, or should it be proved that instruments as old as the telegraph, without any alterations or additions whatever, could be made to transmit and receive articulate speech through the agency of electricity, that it might be very properly questioned whether the broad claim for the "new art of transmitting speech by electricity" could be sustained, even though Bell's results were secured by improved devices.

In regard to the early transmission of speech, it is certain that Reis, in 1861, transmitted vocal sounds by means of electricity, and it is authoritatively stated that he transmitted words. It is certain that Reis's instrument *can* be used to transmit articulate speech; but now this instrument is claimed to be crude and imperfect. The ordinary Western Union telegraph key and sounder, as elements of a telephonic system, are even more crude and imperfect, and yet with a common telegraph key, used as a transmitter, I have transmitted articulate speech, which has been received by means of a common telegraph sounder, and this without modifying either key or sounder in the least. It is simply a matter of adjustment. Now, could a broad claim for talking to a telegraph key and listening to a telegraph sounder be sustained? Can a broad claim for a "*new* art of transmitting speech by electricity," by old and well-known instrumentalities, be sustained, when the new results are secured by mechanical skill, exercised in adjustment merely?

Clearly, if Reis transmitted vocal sounds, or signals, or words, and if Bell has done the same thing through the agency of the same force, but in a more perfect manner, it should signify nothing, since degrees of perfection are not patentable. As a writer of this journal very aptly said a short time since: "If Reis's instrument was crude and imperfect, the same may be said of Bell's, for when it is constructed and operated according to his patent, and used independently of subsequent inventions, it proves inadequate for commercial purposes under the usual conditions of use." The original principle of the Bell telephone has really been replaced by Reis's invention, as will presently appear. That is, the Bell telephone has reached its present usefulness and popularity through the adoption of the Blake or some other form of transmitter substantially like the original Reis transmitter.

It is claimed by the advocates of the Bell system of telephony that the lack of efficiency in the Reis transmitter was due to the fact that intermittent currents of electricity were employed instead of an "undulatory" current, which Bell holds as essential; but it can be proved that in all contact telephone instruments the currrent is intermittent, and this is especially noticeable in the class having small contact surfaces like the Blake and Reis instruments.

If the language of the learned judge who rendered the decision above referred to is applicable to Bell's invention, it should also apply to that of Morse or Reis. The judge says: "There is some evidence that Bell's experiments with the instrument described in Fig. 7, before he took out his patent, were not entirely successful; *but this is now immaterial; for it is proved that the instrument will do the work, whether the inventor knew it or not, and in the mode pointed out by the specification.*"

It is equally just to say that the telegraph key and sounder are operative for the transmission of speech, "and that it is immaterial whether Morse and other telegraph inventors knew it or not, "*for it is proved that the instrument will do the work.*" and as the invention of the telegraph now belongs to the public, every function of the telegraph instrument belongs to the public also.

It is even more just to say the same of Reis's invention. It makes no difference whether Reis knew it or not (though he did know it), the transmission of articulate speech by means of his instrument is an undeniable fact.

From the foregoing it will be seen that it is at least question able whether *any one* is now entitled to a broad claim for transmitting speech by electricity.

Many of the claims of Bell as to the particular method and means employed by him for the transmission of telegraphic and other signals are manifestly too broad and cover some of the oldest inventions in telegraphy.

For example, the first and second claims in his patent of March 7, 1876, read thus:

"1. A system of telegraphy in which the receiver is set in vibration by the employment of undulatory currents of electricity.

"2. The combination of a permanent magnet or other body capable of inductive action with a closed circuit," etc.

These claims are anticipated by the invention of Oersted in 1820 (Fig. 2). His apparatus consisted of a compound bar-magnet, H, mounted in a standard, I, and surrounded near its upper end with a coil, J. This coil was in a closed circuit with a distant coil, K, containing a vibratory magnetic needle. By moving the coil, J, up and down on the magnet, H, "undulatory" currents were produced, which vibrated the needle, giving intelligible telegraphic signals.

The more recent magneto-induction key of Siemens and Halske (Fig. 3) operates in substantially the same way.

Between the poles of the magnet, L, is placed a Siemens armature, M, which, being vibrated by means of the lever, produces "undulatory currents in the circuit in which it is included. This system antedates Bell's.

The first Bell telephone is shown in Fig. 4. The armature *c* is fastened loosely by one extremity to the uncovered leg of the electro-magnet *b*, and its other extremity is attached to the centre of a stretched membrane *a*. When a sound is uttered in the larger cone A the membrane attached to it is set in vibration, and the armature connected with the membrane is forced to partake of the motion, and thus electrical undulations are created upon the circuit which influences the electro-magnet *f* at the opposite end of the line, so that the motions of the armature *h* and membrane *i* are the same as in the same members of the transmitting instrument.

Fig. 5. represents the later Bell telephone. The form is simplified, but the principle upon which it operates is the same as that of the first instrument.

It will be observed that the transmitter and receiver are alike, that the instruments are upon a continuously closed circuit, and it seems to be questionable whether Bell's invention covers more than this specific arrangement.

But this arrangement is not the one so largely employed at present by our telephone exchanges. The instruments used at opposite ends of the telephone wires are incapable of being used interchangeably as transmitter and receiver. In the present system of telephony an instrument similar to that shown in Figs. 4 and 5 is used as a receiver, but employed in this way it is difficult to see how it differs materially from Reis's receiver, invented, used, and published twenty years ago.

The Reis receiver, shown in Fig. 6, is familiar to all students of telephony, but the lack of patentable difference between it and the Bell instrument may not be apparent at first. In this instrument there are all of the essential elements of the Bell telephone —the magnet, the sounding board or diaphragm, and the armature, "capable of inductive action"—and while it can be used in its orignal form, as shown in Fig. 6, it may be simplified, whereupon the identical character of the instruments of Bell and Reis will at once appear.

The original Reis instrument (Fig. 6), consisted of an electromagnet A, mounted on a sounding board or diaphragm, B, and was provided with an armature, C, sustained by an arm, D, attached to the diaphragm. By dispensing with the adjusting screws and spring support of the armature (cutting them off on the dotted line in Fig. 6), and by attaching the armature directly to the angled arm, D, as in Fig. 7, an operative instrument is formed, which, although simpler than the original instrument, possesses no patentable features.

By straightening the angled arm, D, so that the diaphragm may be placed directly in front of the poles of the magnet, as in Fig. 8, the form of the instrument is further changed, but it is substantially the same as the original. Leaving out the arm, D, and attaching the armature, C, directly to the diaphragm, B, is not an invention, and the instrument is still the Reis receiver.

Suppose the armature, C, to be flattened or rolled out so as to be capable of replacing the diaphragm, B, the instrument would then appear with but two of the original elements (Fig. 10) viz:

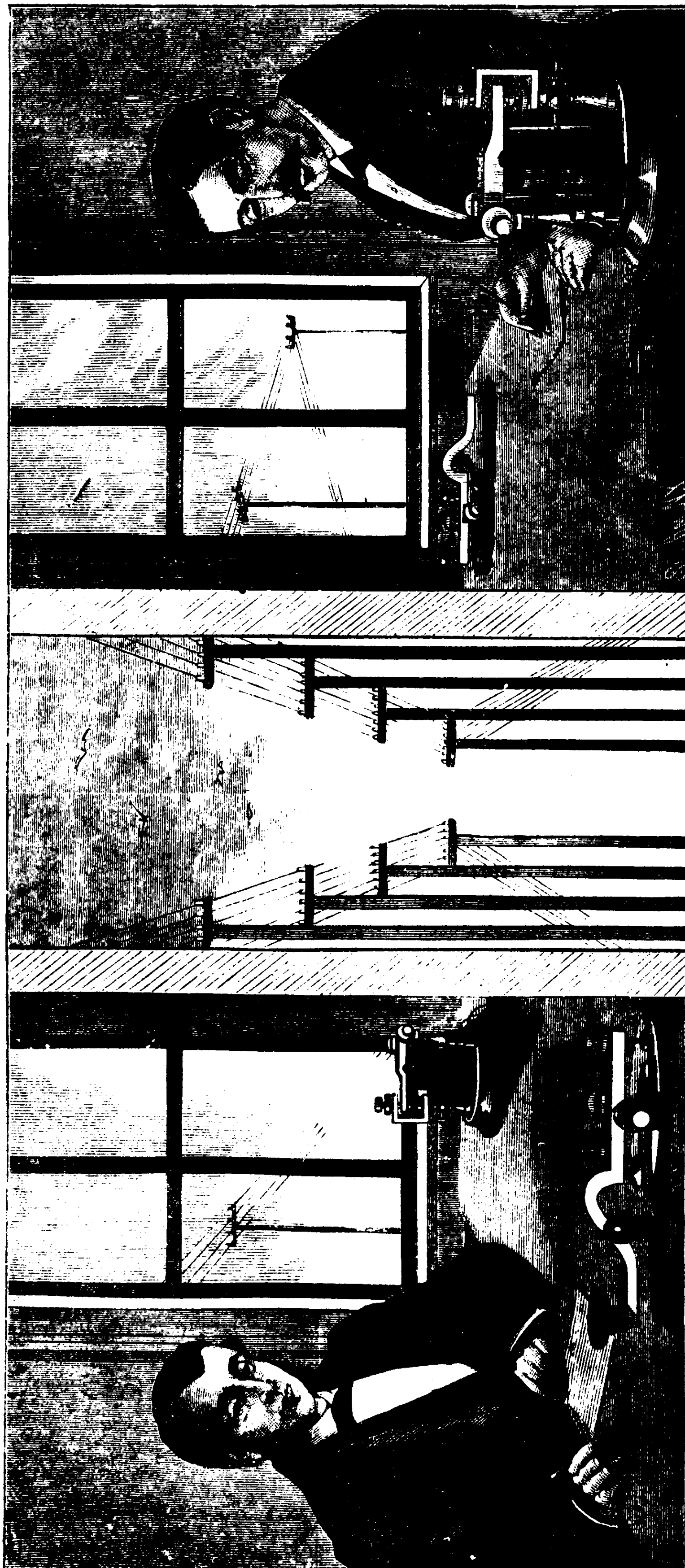


Fig. 1.—ORDINARY TELEGRAM KEY AND SUNDER EMPLOYED IN THE TRANSMISSION OF ARTICULTURE SPEECH.

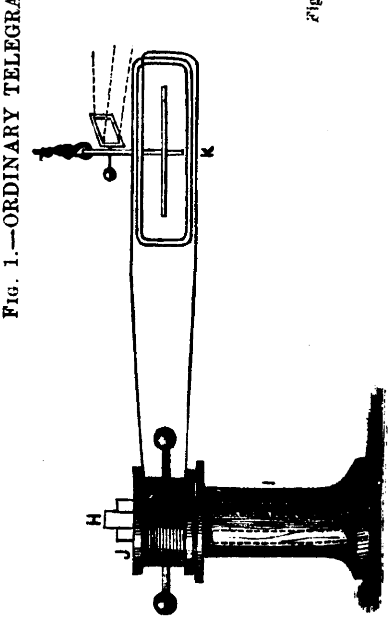


Fig. 2.—Oersted's Induction Apparatus.

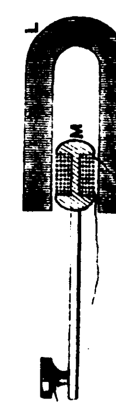


Fig. 3.—Siemens and Ha'ske's Magneto-Induction Key.

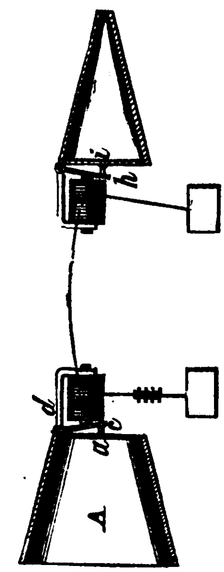


Fig. 4.—Bell's First Telephone.

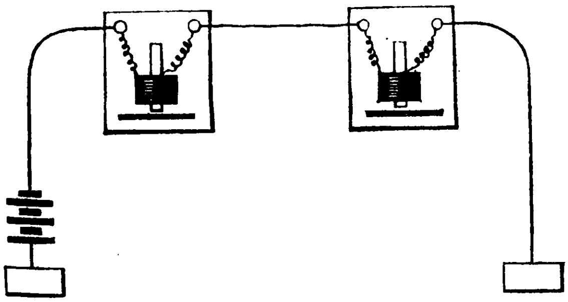


Fig. 5.—Bell's Later Telephone.

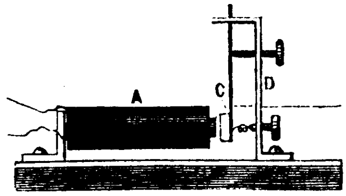


Fig. 6.—Reis's Receiver.

the magnet, A, and the armature diaphragm, C: it is still essentially the Reis receiver. Is it supposable that a valid patent can be obtained by omitting a few non-essential elements from the original instrument?

Reis's receiver was used in connection with a transmitter of his own invention, which was totally different from his receiver. The transmitter, (Fig. 11) consisted of a box provided with a mouthpiece, and covered by a membrane, E, carrying a platinum contact surface, F, which is touched lightly by a platinum point carried by the arm, G, one end of the latter resting in the mercury cup to make a perfect yet frictionless electrical connection. The platinum, F, and arm, G, are in the circuit with the battery and receiver, and the interruptions of the current take place between the platinum point on the arm, G, and the platinum, F, carried by the diaphragm.

Fig. 12 shows the essential members of the Blake transmitter, which is now used almost exclusively. It is hardly necessary to point out the similarity between this instrument and the one just described. The diaphragm, E′, platinum contact, F′, and spring arm, G′, are substantially the same as the elements E, F, and G of the Reis instrument, the only difference being the substitution of a piece of carbon in the end of the arm, G′, for the platinum in the end of the arm, G.

From what has been said it will be seen that the system of telephonic communication in use to-day is more Reis's than Bell's.—*Scientific American.*

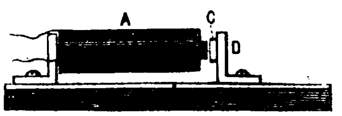


Fig. 7.

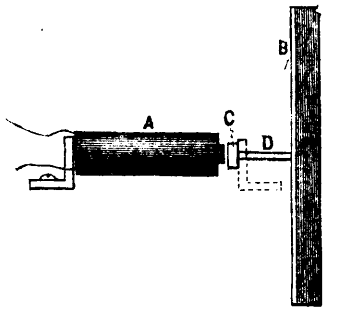


Fig. 8.

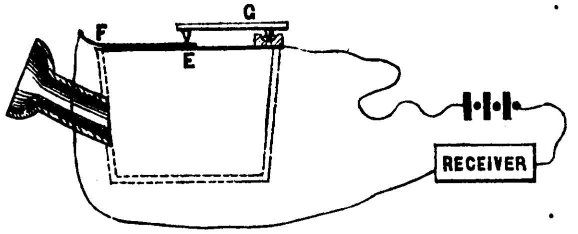


Fig. 11.—Reis's Transmitter.

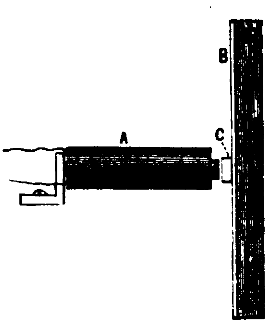


Fig. 9.

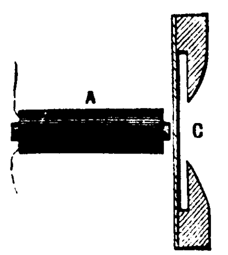


Fig. 10.

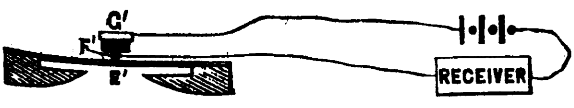


Fig. 12.—Blake Transmitter.

Chemistry, Physics, Technology.

A REMARKABLE INSTANCE OF RETENTION OF HEAT BY THE EARTH.

BY H. C. HOVEY.

Every one knows that heat may be retained for a long time in a bed of ashes, but it is seldom that the period has been known to be so protracted as in the case now to be described.

My attention, a year ago, was called by Mr. Hudson, the manager of the Albion Mines, in Pictou County, Nova Scotia, to a peculiar area including about two acres of ground, where the snow never lies long without melting, and the frost never penetrates far, even in severe winters. All over this space are scattered fused masses of clay and ironstone, resting on the outcrops of what are locally known as the "main" and the "deep" seams of bituminous coal, which at this point are about 450 feet apart. The outcrops of other seams are also partially affected.

On inquiring as to the probable date of the fire that had left this recrement of scoriæ and ashes, I was told that this portion of Nova Scotia was visited early in the seventeenth century by French explorers, and that an account of the harbor called Pictou was given in 1672 by the Governor of the Gulf of the St. Lawrence.

The name—Pictou—is derived from a Micmac word, signifying *fire ;* and the traditions of the Indians still point to this locality as having been a long time ago the scene of a fierce and long-continued fire, which made them avoid the place as being visited with the anger of the gods.

The coal measures of Pictou were discovered in 1798, at the very point now described ; and the discoverers represented the spot as covered with ashes over which grew large hemlock trees. Some twenty years ago, while a drain was being cut in this locality, a tree was felled that showed 230 rings of annual growth ; and three feet below the root of this tree, a large piece of wood was found that had been fashioned by some sort of axe.

In Mr. Harrison's opinion, at least 300 years must have passed since the fire at this point was extinguished. How it was caused and how long it burned are wholly matters of conjecture. The ignition may have been effected by chemical action, such as often causes what is called "spontaneous combustion," in heaps of slack about coal mines ; or it may have followed a stroke of lightning ; or the blaze of a camp-fire may have communicated to one of the "springs" or "feeders" of inflammable gas that issue along the outcrops of the unusually thick seams for which the Pictou area is celebrated.

Last spring it was found necessary to sink a small pit at the outcrop of the deep seam on this area, in doing which, a bed of hot ashes was reached. I am indebted to Mr. Edwin Gilpin, Government Inspector of Mines, for the facts, and to some extent, for the terms in which these facts are presented. Mr. Gilpin prepared for me a comparative view of sections of the same strata made only a short distance apart, the design being to exhibit the changes made by igneous action.

Present Section.	ft	in	Original Section.	ft	in
Surface of burned clay	22	0	Black, argillaceous shale, with bands of ironstone 1 to 2 inches thick. Total thickness, 144 feet 6 in.	2	6
Band of hard scoriæ	4	0	Brown carbonaceous shale	1	10
			Bad coal	0	2
Reddish ashes	3	0	Good coal	3	7
Hardened Shale	2	0	Black shale with ironstone bands	1	2
Good coal, etc. (being upper part of the deep seam)		X	Good and coarse coal in alternate strata	18	1
Depth of pit	32	X	Total thickness of deep seam	22	10

The present section is taken at the new pit sunk by the Albion Mines Company on the burnt area ; and what is termed the original section is one given by Sir William Logan ("Geological Survey of Canada," 1869, p. 69).

The surface cover consists of clay with bowlders of sandstone and layers of gravel. The small portion of the 144 feet of black argillaceous shale filled with ironstone balls passed through by the shaft has been converted into an almost continuous mass of scoriæ, very hard and compact, and difficult to drill through.

The next layer represents the upper portion of the deep seam, which has been completely burned away, leaving a *compact, laminated, reddish ash.* And it was in this ancient bank of ashes, *known to be more than 300 years old,* that the retention of heat was observed, which it is my object by this communication to place on record.

Immediately on opening the pit, the heat of the ashes, at a point 30 feet below the surface, was tested by a reliable thermometer, and was found to be 80° Fah., at a time when the surface temperature varied from a minimum of 45° to a maximum of 65° Fah. Soon after an opening had been made through the pit to the workings in the mine, the air currents caused the temperature to fall rapidly to the normal point.

The consideration of the gradual radiation of the heat of the earth, suggests the idea that abnormal increases in the temperature of deep mines may be due in some cases to the presence, at comparatively short distances, of masses of heated matter, which are, geologically speaking, modern, although they may be historically ancient.

SOLAR HEAT, AND ITS UTILITY IN THE ARTS AND DOMESTIC LIFE.

Solar heat has of late years been the subject of much scientific research, and the calorimeter has shown it to be a source of great power. Captain Ericsson has made some very useful applications of this source of heat. The utilization of solar heat for culinary purposes has been the subject of many experiments, by the use of lenses and concave mirrors. These radiate the heat, or rather reflect it upon the object-vessel to be heated, by concentrating the rays to their focal point. When the concave mirror is used, there is less absorbtion and more power imparted to the heat-rays reflected. The parabolical form of mirror receives the incident rays that are parallel to its axis, and after reflecting, converge to a focus of the mirror. The hollow side of a sheet of polished metal, inclined to the direct rays of the sun, concentrates its rays at a point near the circumference. Now, if a cylindrical tin vessel, with a black surface, be placed at the foci of the solar rays, it will be readily heated—or anything it may contain. Thus a set of domestic ustensils adapted to this service, with the necessary reflectors, would be a novel equipment for an exploring party. The use of mirrors as reflectors was known to the great Archimedes, who, it is said, set fire to the Roman ships in the harbor of Syracuse by their use. There is a modern invention by Prof. Balestrieri, of Naples, which he calls the "*collecteur photo-thermique armillaire,*" (the photo-thermic hollow sphere collector) which seems to have the advantage of multiplying the calorific intensity capable of reducing even the most refractory substances. Now, it is possible that inventive genius may so apply these apparatuses for conveying heat-rays, that it will be a source of great economy in the arts and sciences. The old alchemists have used devices somewhat similar for the preparation of elixirs and tinctures, distilling them entirely by the use of reflectors. The actual heat of the sun's rays is an unsettled question of science. It has been demonstrated that the rays of heat were greater than those of molten steel. Of all the sources of heat, that of the sun is the most abundant ; and yet, owing to the great distance of the earth from the sun, and its meagre size, it can receive only a microscopic portion of the heat which the sun disseminates in the surrounding space. We are thankful for these genial rays, and would, in the same kind feeling, suggest to inventive genius the want of a small machine of portable character that will be useful to the shipwrecked mariners on the Pacific Ocean. The ship's boats are inadequate to carry all the necessary provisions, and especially that of water, and soon resource is had to rations, and the allowances become so small that in the end, after great suffering, many die of thirst. Now, what is wanted is some form of still for distilling sea water, so simple in its construction that the reflection of solar heat will evaporate into a condenser sufficient cool fresh water for the use of the castways on the great desert of waters. This apparatus could be partly or wholly on an adjustable shelf at the stern, with a condenser partly submerged. The Pacific waters would render this instrument more serviceable—or a friendly island—but the relief must be sought wherever, on the trackless ocean, the elements may strand us.

There have been inventions for ship use, one of which was described in Ure, volume 1, page 661. A less perfect machine in its parts would answer than is described by Ure, for this is to meet a special emergency. The simple mode suggested by Dr. Irving consisted in adapting a tin tube to the ship's kettle, and condensing the steam in a hogshead, which serves as a receiver. By this method a supply of twenty-five gallons of fresh water per hour could be obtained on board of a man-of-war. There is another mode of obtaining fresh water from the sea, and that is by freezing, which excludes or precipitates the saline particles In this connection, I would suggest to ship-owners that they would confer upon seamen a great favor, by providing a rubber water-tank with air-tight supports or floats. This water-tank is to be filled with water, when abandoning a wreck, and thrown into the sea and held in tow of the boats, thus providing a good supply of water without any great detriment to the progress of the boat. The application of solar heat to the domestic circle is in the near future; genius, when once directed to this line of thought, will develop forms of reflectors capable of concentrating heat rays so intense that any and all ordinary cooking could be done with despatch. The ustensils to be used must be prepared with a rough surface; absorbers of heat, and of such a nature to retain all its power to do the work rapidly. In localities where the climate in the summer months would allow of open windows, the perfected instruments could be set over night, so that the early morning sun could be at work on the coffee urn, and by the time the indolent sleeper wakes, the aroma of fragrant Java, borne upon a zephyr, would be wafted to his awakened senses, inviting him to solace his parched lips with a draught of this delicious nectar.—*Cal. Architect.*

A NEW SILVER STEEL.

In seeking for an inoxidizable alloy, Mr. Peter de Villiers, M.D., of Silver Hill, St. Leonard's-on-the-Sea, England, has discovered that certain metals will not unite in certain proportions, and he has utilized this discovery to coat steel so perfectly that even the cutting edge of a knife blade is not blunted, or, rather, that the silvery surface remains uninjured when the knife is sharpened. In the first place, he makes an alloy of tin, 80; lead, 18; silver, 2=100 parts; or of tin, 90; lead, 9; silver, 1=100 parts. The tin is first melted, and when a brilliant whiteness of the surface of the metal indicates its thorough fusion the lead is added in a granular state, and the mixture is gradually stirred, preferably with a rod of very dry fir-wood. The silver, separately melted, is then added to and mixed in like manner with the compound. At this moment the fire under the melting pot or crucible containing the alloy must be quickly increased, till the surface of the metal has a slightly yellow tinge. It is then rapidly stirred, and run into moulds to form ingots. When he has the choice between iron and steel for the manufacture of any article to be coated he takes the purest steel used for manufacturing purposes. The blade of a knife, for example, is immersed in a bath of a solution of muriatic or sulphuric acid—1 to 10 parts acid to 100 parts distilled water or filtered rain water, or weak aquafortis. When the blade is withdrawn from the bath it must immediately be plunged into pure water to be quickly and completely washed, and then it is wiped and dried as rapidly as possible with a piece of old linen, soft leather, or a very dry sponge. It is then subjected for about five minutes to a dry heat in a furnace or oven heated to 70° or 80° C.; it is then withdrawn and again wiped. The preceding operations have for their object the preparation of the iron or steel for impregnation with the alloy, the result being that the said iron or steel is perforated with a multitude of holes almost infinitesimally small. In iron, unless this metal is of excellent quality, the size of these holes is extremely variable, and sometimes there are defective parts which make the subsequent operations very difficult. In steel the difference of diameter of these holes is almost imperceptible, so that the subsequent operations are performed without difficulty. This is the chief reason of his preference for steel.

The knife-blade or other article, after its preparation as above described, is immersed in a metallic bath composed of the alloy made according to one or the other of the formulas hereinbefore given. The ingots are melted in a crucible of plumbago or refractory clay, and not in an iron vessel, as particles of the iron woul mix with the alloy and render the same liable to oxidize in the open air, thus impairing the appearance of the impregnated knife-blade or other article. The iron or steel, previous to immersion in the metallic bath or alloy must be heated to a temperature of 50° or 60° Centigrade; the bath must be perfectly liquid, and stirred with a dry rod of fir-wood or poplar, and the surface f the molten alloy must present a fine, silver-white color, which is obtained by slow fusion and by stirring only when the whole of the mass is liquefied. If these precautions are observed the impregnation of the iron or steel will proceed rapidly, and the alloy will enter the artificially produced holes and the pores of the metal, which are slightly dilated by the previous heating of the said metal. For a knife-blade or similarly thin object an immersion in the alloy of a few seconds will suffice. A period of from two to five minutes will be required for pieces or articles of greater thickness, such as horses bits, stable chains and the like.

When withdrawn from the metallic bath, the blade or other article of iron or steel is at once immersed in cold water, or is otherwise properly treated to harden or temper it, or to restore its temper as required. If left in the cold water for too long a time, the metal sometimes becomes brittle, but carefulness on the part of the operator will prevent any difficulty of this kind. The blade or other article having been wiped and dried without the application of heat, is polished in any suitable manner. It will then have the whiteness and luster of silver, and will have a ring or sound analogous to that of the latter metal, and may be considered unoxidizable under ordinary atmospheric conditions. But to obtain a more complete result, he gives it a second bath in an amalgam composed of mercury, 60; tin, 39; silver 1 = 100 parts. It is then either placed in hot molten silver, or has silver deposited thereon cold by means of electro-deposition, so as to obtain a new covering or coating to form part of the impregnating metal, as the latter forms part of the steel or iron.

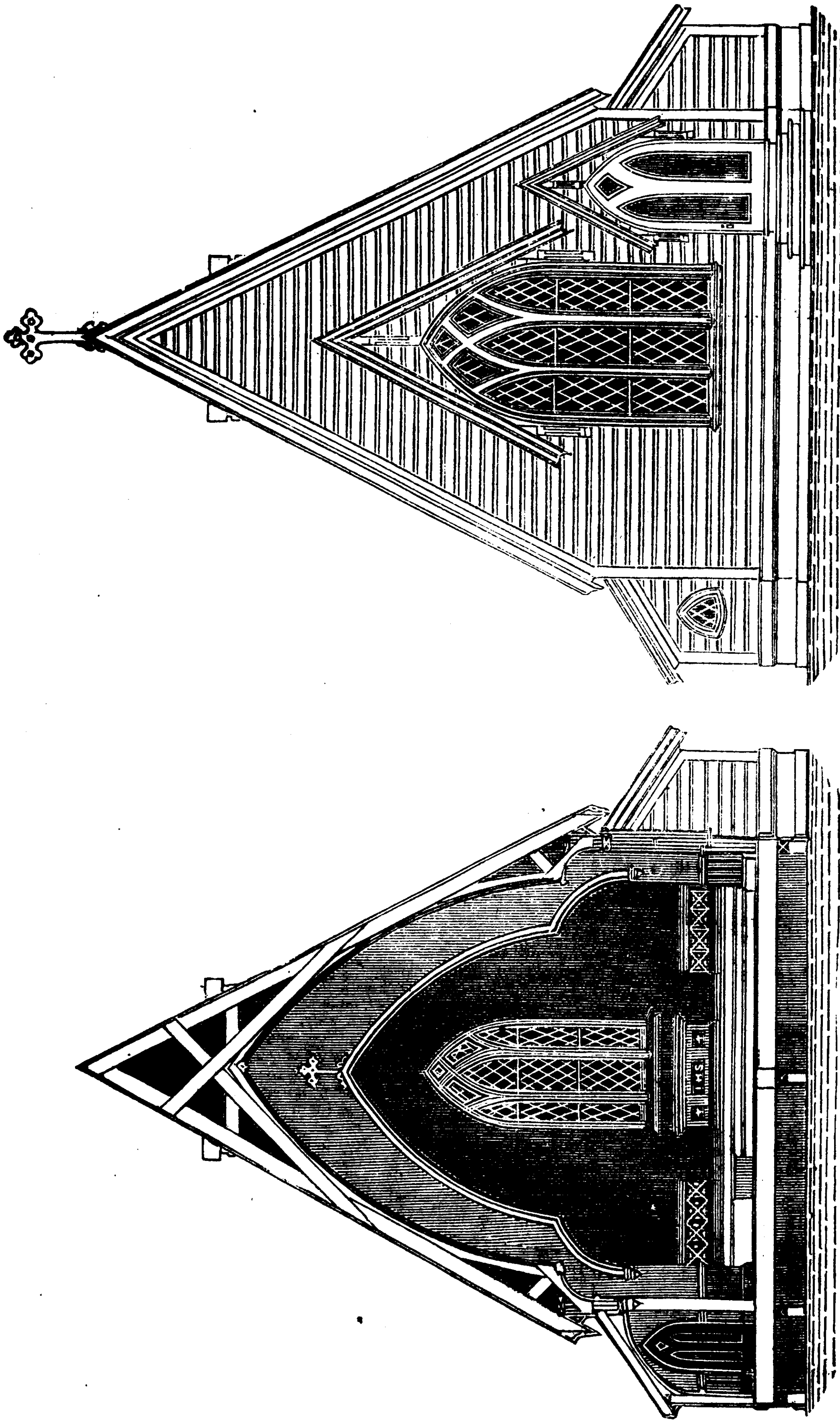
The final operation consists in polishing the articles by rotating apparatus, suitable to the form of the blade or other articles treated, but the objects which are impregnated by means of the hot bath of molten silver are tempered again when taken out of said bath, and before they are definitely polished. The articles so prepared, whether originally made of steel, iron, bronze, German silver, or any other metal or composition capable of bearing the heat to which they will have to be exposed, according to this invention became remarkably hard and sonorous, these qualities resulting from the impregnation above described. He has described the process with respect to knife blades as an example, but desires to be understood that other articles or objects of many kinds may be treated thereby with great advantage; for instance the process may be applied with great advantage to many utensils in which inoxidizability is a valuable quality, and may also be applied for many industrial or manufacturing purposes. The process is not costly, and the difference in the price of articles so made, and that of well finished goods manufactured in the ordinary manner, is amply compensated for by the saving in time and wear in cleaning. Thus, a knife-blade made as above described only requires to be cleaned by means of soft linen or wash-leather to preserve its appearance and silver polish. It can, moreover, be sharpened, and will keep its edge for as long a time as a steel knife would do.—*Mining and Scientific Press.*

HANDKERCHIEF EXTRACTS.

The American perfuming industry, although yet in its infancy, is nevertheless a demonstrated success, and has already succeeded the importation of French and English handkerchief extracts to a degree which a few years ago would have seemed impossible. During the period of this rapid growth the imports of French pomade have risen correspondingly; but these imports have about reached their highest point, and may soon be expected to decline. There are various sections of the United States where the culture of flowers could probably be carried on as successfully as anywhere else in the world, and the industry is a delightful as well as a profitable one. We are informed that already at San José, California, a flower plantation of six hundred acres has been successfully started, and that this acreage can be indefinitely extended when necessary.

The method of obtaining flower odors as practised in France is quite simple. Upon a marble slab perhaps twenty feet long by four feet wide, is first spread a layer of wild goat's fat about an eight of an inch in thickness. This is evenly covered with the leaves of some flower, which in turn receive another layer of fat, and so on in regular alternation, until a depth of eighteen inches is reached. A heavy pressure is then brought to bear upon the whole mass, and it is allowed to remain for forty eight hours. At the end of this treatment the non odorous fat is melted to separate it from the leaves, and being drawn off into twelve-pound cans, is sold to the perfumers under the name of pomade. To describe the process by which the extracts themselves are made from this pomade would be a more difficult task. No art is more closely guarded by its possessors than the perfumers; and each expert therein has certain professional secrets of his own, the application of which, in many instances, his own employers are debarred from witnessing. It is sufficient for the trade that our American extracts are fine in quality and variety, are attractively put up, and are daily growing in favor and demand.—*Oil and Drug News.*

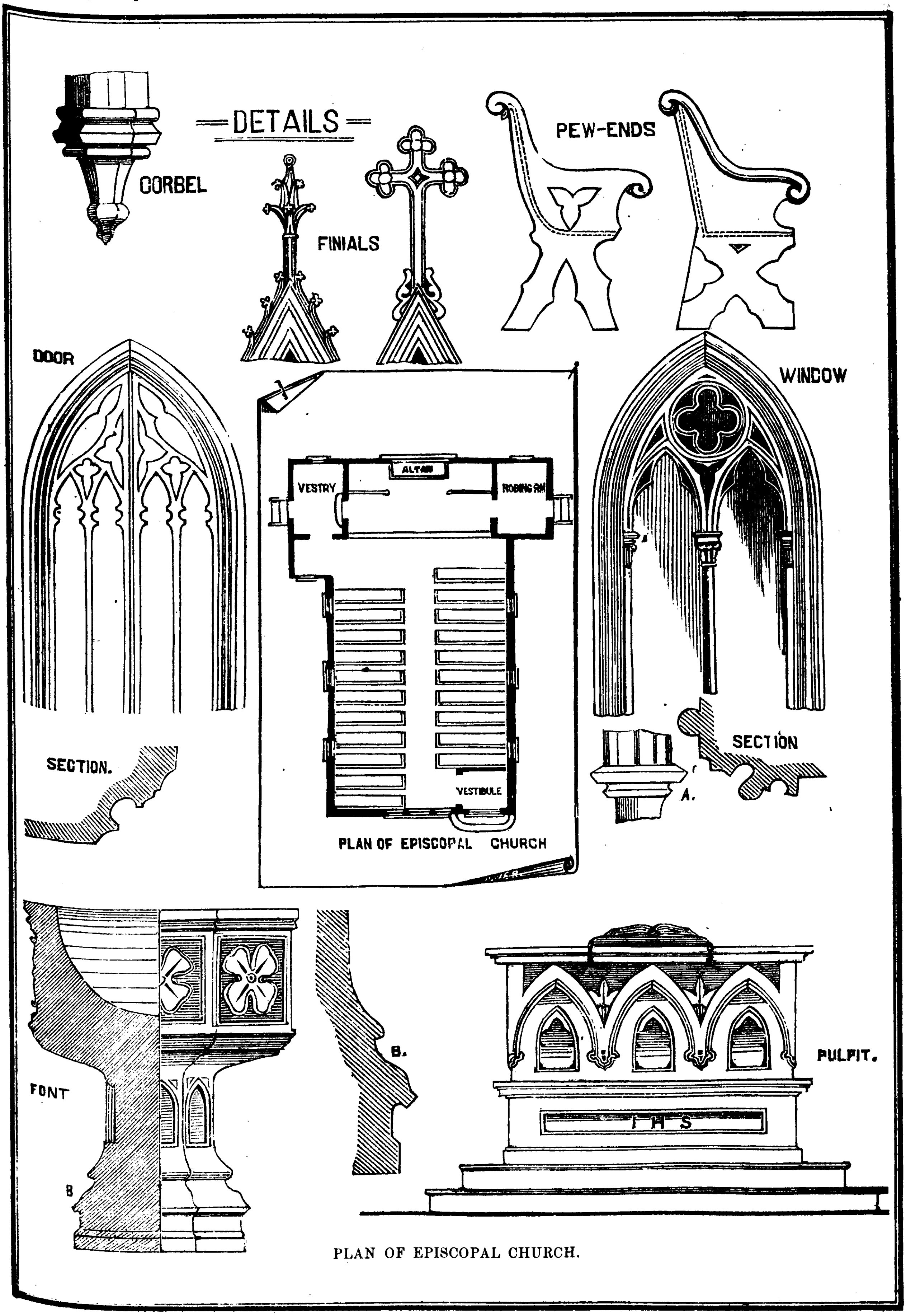
THE *Liverpool Journal of Commerce*, as an illustration of the great activity displayed in the shipbuilding trade of the mother country, mentions that there are now in course of construction nearly 1,000 tons of shipping.



FRONT ELEVATION.

TRANSVERSE SECTION.

EPISCOPAL CHURCH.



PLAN OF EPISCOPAL CHURCH.

Architecture, etc.

BUILDING CHEAPLY.

A decidedly erroneous impression of presumed facts, in a majority of cases, enters into the first cogitations in connection with the erection of buildings. The first being that of cost, the rule is to first fix the amount to be expended, and then to work up a plan such as will meet the wants and wishes of the parties designing to build, with but little regard to the cash limits established. The inconsistency of this proposition should be self-evident to every intelligent mind; yet architects have to meet this issue in most cases. It is common for clients to begin with: "I want to build a five, ten or twenty room house, with certain dimensions, but I won't expend more than one, five, or twenty thousand dollars," as the case may be; while the amount named may not exceed 75 or 80 per cent. of actual value. But the architect is expected to work out the impossible result of securing the erection of just the building desired for the sum named, and at the same time produce a substantial, well-built and finished edifice. It only sometime occurs that an owner first finds and determines the size, character and appointments wished for, and then shapes the matter of cost accordingly; the general presumption being, that by fierce competition, or skilful manipulations, some contractor will be found who will agree to give him one hundred dollars of labor and material for every seventy-five, eighty, or perhaps ninety dollars of cost paid by the owner. This is often done, but it cannot be claimed as fair dealing; for while it is legally right for every one to obtain that which he desires at as little cost as possible, it must be apparent to all, that securing things for less than cost of production, works an injury in some direction, and advantages thus obtained, must be at the expense of others, to the amount of all undervaluation and cost. It is astonishing how persistently the greater number of owners will contend for and adhere to an amount once named to cover the expense of building, without any disposition to abate or modify plans and requirements. Usual business rules, which recognize actual values in merchandise and commercial transactions, are rejected in house-building; and the theory accepted that, if one man will not undertake by contract to build and complete a house for a specified sum, another will; the real value being a subservient consideration to that of what may be accomplished through strong competition. And it is too often the case that men can be found who, for the sake of securing a contract, will risk the result of unwise figuring, and having nothing to lose personally, care but little that their creditors sustain loss. And when full payment of all demands is not possible of enforcement under the provisions of a mechanics' lien law, those who obtain buildings for less than actual cost, all parties to the transaction considered, have the satisfaction of knowing that they have secured an improvement in their real estate property—cheaply. The statement is unquestionably correct, that the amount of money paid by owners for the erection of tenements and residence buildings in San Francisco will not aggregate actual cost, by from ten to twenty per cent; the contract price in the greater number of cases being less than sufficient to pay the cost of erection, without considering any profits to the contractor. And contractors who involve themselves in unprofitable engagements, realizing that a loss is inevitable, generally draw from the respective payments as much as possible for personal uses and purposes, leaving those who may hold claims to material or labor, to share in the increase of loss created by such use of a portion of the contract money. All of which is injurious all around. Owners should be careful to select good and honest men to build their houses, and pay them a sum sufficient to cover all costs and expenses; and contractors should exercise and practice sufficient good judgment to keep them clear of all "ruinous" or losing engagements. This, sensible men will do, and allow the silly kind to practice their losing operations; and material men who suffer losses by trusting such men to reap what they may gather, whether whirlwinds or golden sheaves.—*Cal. Architect.*

THE plan of Church Edifice is one of a style and class most favored by the Episcopal denomination, and is not expensive in construction, conveniences and appearance considered. The plan is susceptible of modifications or elaborations. The various features of special interest—plan, doors, windows, altar, font, finials, pew ends, etc.—are also shown.

Two great bells have been cast at West Croydon, in England, for the tower of the new Eddystone Lighthouse. Each has a weight of about 42 cwt. and a diameter at the mouth of 5 feet 1¼ inches.

COMPOSITE PORTRAITS.

At the last meeting of the Photographic Society of Great Britain, Mr. Francis Galton, F.R.S., read a paper on "Composite Portraiture," in which he stated that his attention was first directed to the subject some years ago, when he found that by taking two or more portraits of different individuals under exactly the same conditions, and superimposing them, the features, if not absolutely dissimilar, blended together and formed an idealized portrait which could be well seen when the image was thrown upon a magic-lantern screen. The register he adopted, so that the features should be identically superimposed, was by drawing a horizontal line through the eyes, another parallel to this through the mouth, and a third perpendicular to and bisecting these horizontal lines through the nose. The point of bisection between the eyes was that which he was especially careful to maintain in the same position in each portrait. Mr. Galton's first method of producing composite portraits was by means of a copying camera, paper positives being used. He now, however, used transparencies, and he exhibited and described the apparatus which he had adopted for the purpose. One purpose for which he believed composite portraits would be valuable was that of producing a standard physiognomy of disease. With this object he had taken the portraits of a number of consumptive persons, male and female, and had combined them; and it was remarkable how a certain average of faces was found to be almost identical. Mr. Galton also exhibited a number of what he called typical portraits. One was the face of an idealized criminal, formed from a combination of seven portraits of criminals; others were the faces of consumptive patients, and a third series was that of the portraits of officers and men of the Royal Engineers. In one case he had combined the portraits of twelve officers, in another the portraits of eleven privates, and in a third he had combined the portraits of officers and privates. In each instance Mr. Galton said the individualty marking each class was strongly brought out and idealized. He also pointed out how, in every case, the idealized portrait was better looking than the faces from which it was made.

In conclusion, Mr. Galton referred to the use which photographers might make of composite portraits. He thought the process could be turned to a most interesting account in the production of family likenesses. Artistic excellence was of no consequence in the negatives, and all that was necessary was that the portraits should be taken under the same aspect, either as a perfect profile or a perfect full face, and under the same conditions of light and shade. The result of the combination of a number of faces of the same family was often very curious, not the least singular point being the circumstance that there was often a difference of opinion as to whom the idealized portrait was most like. Mr. Warnerke said, that when Mr. Galton first described his method, some years ago, he had tried the production of composite portraits and found the results exceedingly interesting. Captain Abney expressed surprise at the result of an experiment which Mr. Galton had made to show that repeated exposures on the same plate made no difference in the result. Had not Mr. Galton proved that he was right, he should have expected some difference. After a remark from Col. Wortley, Mr. Galton observed that one curious result he had noticed was in the case of a combination portrait of two criminal boys. This portrait was given to an artist to copy, and, singularly enough, although the artist had never seen either of the boys, the picture he drew was a portrait of one of them rather than a copy of the composite.

LIVING ANIMALS LIT UP FROM WITHIN.

At a recent soiree in the Paris Observatory, M. Trouvé showed a live fish with its body lit up from within by his electric polyscope, a minute form of which, with conducting wires passing to the hands of the operator, the animal had been caused to swallow (comfortably, let us hope.) The whole body became transparent in the dark, so that the vertebræ could be counted and all details examined. This instrument promises to have many uses. Among others, it has already been applied, *La Nature* says, to showing students the texture of the rectum and bladder; to facilitate extraction of a projectile at the back of the nose, to examine the stomach of a bull (in which a gastric fistula was formed), to lighting the interior of shells and cannon for examination, also to lighting powder magazines, in which case the reflector is inclosed in a triple envelope of glass.

During the last fiscal year over twelve millions of dollars' worth of gold and silver were used in the arts and manufactures in the United States.

DR. GRISCOM'S FAST.

At noon, July 12, Dr. John A. Griscom completed at Chicago, a self-imposed fast of forty-five days. During the fast he drank 1,433 ounces of water, or about two pounds a day. When he began he was in fine physical condition and weighed 197½ pounds. At the close of the fast he weighed 147½ pounds; his pulse was 66, respiration 15, temperature 98° Fah. On the first day of his fast his pulse was 84, and his temperature 100°. He suffered but little during the fast, and his strength held out wonderfully. To the last his muscular power exceeded that of most men, and his mind was perfectly clear.

The faster was watched by a number of reputable physicians, and a scientific record of his condition was kept from day to day. The official summary of the record, it is promised, will add materially to the physiology of fasting, while certain of the results are said to be fatal to some of the accepted theories of medical men.

It will be observed that—if the evidence of Dr. Griscom's case holds generally—a man in good physical condition, subsisting upon water and his own store of flesh, consumes about one pound of solid food a day when leading a fairly active life. This closely coincides with the figures given by physiologists. For an average man at ordinary labor, Dr. Letheby estimates, on the experiments and observations of a large number of investigations, a daily requirement of 5,688 grains of carbon and 307 grains of nitrogen, or nearly six-sevenths of a pound; while, for active labor, the carbon and nitrogen required weigh together about one and one-fifth pounds. Dr. Dalton's observations indicate a more liberal diet as necessary for a man in full health taking free exercise, his quantities being equivalent to 16 oz. meat, 19 oz. bread, 3½ oz. butter—or nearly 2½ pounds of mixed food, and about three pints of water.

It would seem from these figures that the absorption of food from one's own bodily store of flesh costs considerably less energy than the digestion and assimilation of food in the usual way. In any case, a man in good health, with fifty pounds of surplus flesh, can safely reckon on nearly as many days of life, in case of enforced abstinence, or for voluntary abstinence, as for the cure of disease.

The purpose of Dr. Griscom's fast, he says, was to impress people with the utility of fasting and the possibility of long-continued fasting without severe pain. He believes that much of the sickness and physical distress men suffer from may be attributed to the overcrowding of the system with food and food products, and that very many maladies may be cured simply by abstaining from food for a longer or shorter period. The daily observations upon the blood of Dr. Griscom are said to prove the important fact that the relative number of blood corpuscles is not materially diminished by fasting, and there is reason to expect that, when the details of the physicians' observations are digested and published, the sanitary value of fasting—and of eating less, habitually—will be scientifically established. As a remedy for obesity, fasting—partial or complete—would seem to be both safe and efficient; but it must be persisted in for longer periods than have heretofore been thought prudent. Curiously the distress of hunger seems to vanish after a few days' abstinence.

FLOWERS AT EIGHT TIMES THEIR WEIGHT IN GOLD.

The cut-flower business, another phase of horticulture, is perhaps greater in the United States than in any other part of the world. Certainly the use of cut flowers in New York, for bouquets, baskets, and other designs, is far greater than in either London or Paris, and the taste shown in their arrangement here is vastly superior. It is estimated that three millions of dollars were paid for cut flowers in New York in 1880, one-third of which was for rose buds. Immense glass structures are erected in the suburbs for the special purpose of growing cut flowers to supply the bouquet-makers of the city. Not less than twenty acres of glass surface is devoted to the purpose of forcing roses alone, during the winter months. At some seasons the prices paid for these forced rose buds are perfectly astounding. One grower, of Madison, New Jersey, took into New York three hundred buds of the crimson rose known as "General Jacqueminot," for which he received, at wholesale, three hundred dollars, and which, no doubt, were retailed at a dollar and fifty cents to two dollars each. A flower-dealer in Fourteenth street, a few days before Christmas, received the only four of this same variety of rose that were offered in the city, and found a customer for them at sixty dollars, or fifteen dollars apiece, or eight times the value of their weight in gold.—*Scribner*.

CARBON IN STEEL.

Professor Leeds has found that the amount of carbon in a piece of steel which has been purposely burned was the same as in a similar piece which had not been burned; the burning, however, was of the steel itself, which contained a large amount of the oxide of iron; that is, the metal, instead of the carbon, burned. The heat, he says, does not harm steel or iron, and consequently they may be heated and cooled an unlimited number of times, provided they are not brought in contact with the air and so take up oxygen. In heating a piece of steel, the amount of blast has more to do with the burning than the heat; and if the extra amount of oxygen which a burnt piece of steel has taken up is taken out of it, it can be made to work just as well as it did before. The proof that the heat does not harm the steel is found in the fact that if the steel is put in a closed box, and luted up so as to keep out the air, it can be heated and cooled an unlimited number of times without injury.

A SITTING SNAKE.

One of the Indian pythons (*Python molurus*) in the Zoological Society's reptile house, which has been until lately in company with a male of the same species, deposited a quantity of eggs last week, and immediately commenced the duty of incubation, which as it would now appear, is as carefully performed in these highly organized reptiles as in the case of the superior class of birds. The "pythoness" is an excellent mother, and has not deserted her post day or night up to the present time. The eggs, which are believed to be about twenty in number, are completely covered by her coils, and the mother herself by her blanket, so that she cannot be seen by the casual spectator. In 1862 a large West African python in the Zoological's Society's collection laid a quantity of eggs, and sat on them nearly ten weeks, after which, as there appeared to be no reasonable prospect of her hatching the eggs, they were removed. But upon subsequent examination several of the eggs were found to have the embryo partly developed. It is hoped, therefore, that a successful result may be obtained on the present occasion.—*London Times.*

THE LOWER CLASS.

Who are they? The toiling millions, the laboring man and woman, the farmer, the mechanic, the artisan, the inventor, the producer? Far from it. These are nature's nobility. No matter if they are high or low in station, rich or poor in pelf, conspicuous or humble in position, they are surely upper circles in the order of Nature, whatever the factitious distinctions of society, fashionable or unfashionable, decree. It is not low, it is the highest duty, privilege and pleasure for the great man and high-souled woman to earn what they possess, to work their own way through life, to be the architects of their own fortunes. Some may rank the classes we have alluded to as only relatively low, and, in fact, the middling classes. We insist they are absolutely the very highest. If there be a class of human beings on earth who may be properly denominated low, it is that class who spend without earning, who consume without producing, who dissipate on the earnings of their fathers and relatives, without being anything in and of themselves.—*The Mechanic.*

THE BRAY OF THE MEXICAN DONKEY.

The New Orleans *Democrat* recounts the many good qualities of the Mexican burro that has lately been introduced into that city as a child's horse, who, it seems, can banquet on splinters and scraps, carry immense loads, and is faithful, uncomplaining, docile, and tireless; but "we regret to say," continues the *Democrat*, "the burro brays. Amazing as is his strength, his stamina, his amiability, his courage, these things are as nothing compared to his bray. That such a tremendous and far-reaching sound should emanate from so small a source constitutes the eighth wonder of the world. Men start up with the sweat of terror on their furrowed brows, children fall down in fits, the sick believe they have heard Gabriel's horn, and the very atmosphere shudders like a human creature. Burros don't often bray, because they haven't much time for braying; but they bray sometimes, and that is what keeps them so low in the scale of animated nature. Without his bray the burro would be little short of an angel. As he is, however, he is an animal to be admired at a distance and in the abstract."

HOME OF THE AMERICAN OSPREY.

BY DAN. C. BEARD.

Within half a day's journey of New York city lies an almost desert island, whose barren wildness is interrupted — marred, I had almost said — only by a single habitation. A stone lighthouse perched upon the bluff at the end of the island seems a natural accessory to this lonesome symphony of rock, sand, water, and sky. The inhospitable coast of this island offers no safe port or harbor but the treacherous sandy beach is ragged and broken with huge bowlders and rocks against whose flinty sides the angry impetus of the storm wave is dashed and splintered into foam and spray. The occasional fragments of wrecks strewn upon the beach or forming appropriate monuments to the graves of drowned mariners, testifying to the danger of the coast, and add a solemn tone to the sea-song of this desert isle. A marsh or swamp occupies the centre of the island, about which grow trees of some height, being in a measure protected from the winds by the surrounding hills or mounds, whose sandy baldness is scarcely covered by a thin growth if wiry grass. At the foot of the hills, stretching to the water's edge are sandy flats, dotted here and there with trees, gnarled knotted, mishapen and dwarfed by exposure to tempest and lack of nourishing soil.

Each summer's vacation, as our yacht has passed this island, my curiosity has been excited by the great number of birds which make it their home. It was partly to satisfy this curiosity and party to try the black fishing, which is excellent in the dangerous eddies of the tide, that induced the writer, with two companions, to land upon this island one quiet Sunday morning. As our little sail boat approached the lighthouse we saw a couple of great northern divers swimming unconcernedly about, or ever and anon disappearing beneath the smooth waters. After landing, we walked over the sandy flats, disturbing by our footsteps scores of night-hawks (*Chordeiles popetue*). These mysterious birds filled the air overhead, and darted down past our ears with a loud whirring noise, while they all kept up a constant repetition of their peculiar cry. Numerous as these birds were we only succeeded in finding one egg. Nests they have none; but so closely does the egg resemble the lichens, dry grass, or moss, that although the mother bird may rise from beneath your feet, it will require a careful search and sharp eye to detect the little roundish-shaped eggs.

In the low bushes or high grass along the edges of the swamp, we found numerous nests of the swamp blackbird (*Agelaius phœniceus*). Some meadow larks had their nests upon the grass plat in front of the lighthouse door, on top of the bluff. The sandy face of the bluff was perforated with innumerable burrows of the industrious bank swallow (*Cotyle riparia*).

On any part of the island, turn whichever way we would, the large nest of the fish-hawk formed a prominent feature of the landscape, and from sunrise to sunset the American Osprey sailed around overhead in graceful curves, protesting with shrill cries against the invasion of their territory by strangers.

Baird says that the American osprey or fish-hawk nests almost in the tops of tall trees. He gives as exceptions to this rule a nest upon a small pine tree in Maine, and one upon a cliff upon the Hudson River. Audubon, I believe found two fish-hawks' nests upon the ground. With these facts in my mind, I was somewhat surprised to find ospreys' nests scattered around promiscuously upon the sand dunes piles of driftwood, tops of bowlders and small trees. The nests are all of them rather nicely built, the foundations consisting of quite large sticks, and in some instances pieces of plank weighing fully as much or more than the bird; over this foundation a layer, composed of seaweeds, sponges, and other odd material cast up by the waves, the nest itself being a shallow dish-like hollow, of fine soft seaweeds and grasses. Those I found upon the ground stood about two feet high, but some of them in the trees would measure from foundation stick to summit, fully five feet. Such nests are eagerly seized upon by the purple grakle or crow blackbird (*Quiscalus purpureus*), and all the interstices between the sticks forming the hawks' nests are often filled with the nests of blackbirds. I counted six blackbirds' nests in the portion of an osprey's nest within sight; there were three eggs in the hawk's nest, and most of the blackbirds' nests contained young birds just out of the egg. Some ospreys' eggs that I took from a nest in a tree were prettily marked with dark purplish or wine-colored markings upon a cream-white ground. I noticed, however, that in four or five different nests upon the ground the eggs were all of a dirty-brown color, harmonizing so perfectly with the dry seaweed lining of the nest as to require a quick eye to detect the egg in the nest when the observer stands only a few feet away.

After making some sketches, collecting some eggs, and catching about sixty pounds of blackfish, our party bade farewell to the island, and were rowed out to a passing steamer, which slowed up and took us aboard. A few hours after we were back in the hot dusty streets of the great metropolis, with only our sun-burnt faces to remind us of the island-home of the American Osprey.

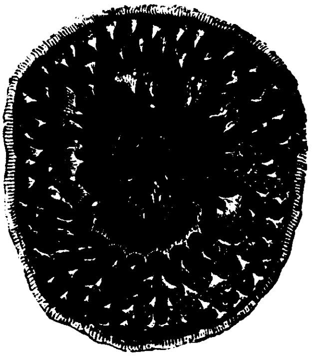
THE SEA LAMPREY.

The lampreys form a small group of hardly more than a dozen varieties, and are the most imperfectly developed, and occupy the lowest grade of all fishes, with the exception of the Lancelet. Their skeleton consists entirely of cartillaginous material. They are destitute of ribs, shoulder girdle, real jaws, and scales, and are possessed of only one nostril, and their gills have the form of fixed sacs. In their habit of feeding and attaching themselves to the bodies of other fish, from which they rasp off the flesh and suck the juices, they become very suggestive of the leech.

The body of the sea lamprey is olive-green, mottled with dark brown. Length from two to three feet; numerous rows of mucous ducts on the head and body. The mouth, when not attached to any object, forms a longitudinal fissure; when attached it is circular in form. The teeth are of various kinds, generally disposed in concentric circles. In the throat and partially closing it, is a group of three large teeth. (See illustration.) Lips fleshy, with a distinct and slightly fimbriated membrane, and beneath a deep triangular fossa, having a fold on each side.

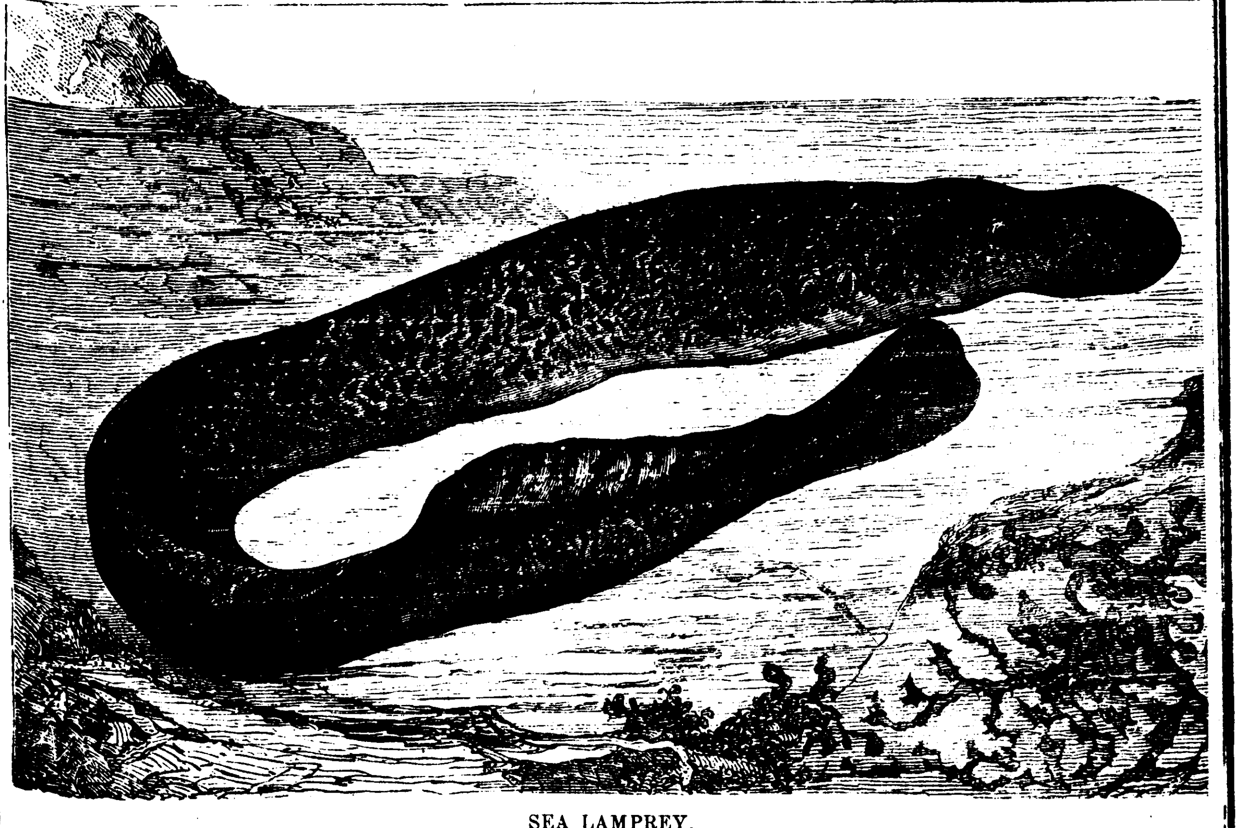
Lampreys are frequently found attached to sturgeon from which they suck the slime and mucus exuded in abundance through the pores of the sturgeon. All the skate family provide favorite food for the lampreys, in whose bodies they rasp out deep wounds which often produce ulcerations. The young pass through several changes before becoming perfect lampreys. At first the young are destitute of teeth and have only rudimentary eyes.

With the Italians and French the lamprey is considered a great delicacy, whereas in England only the poorer classes eat it. In this country it is valued only by a few epicures, and is rarely seen on the fish stands. Sothern, the actor, considered it a great luxury, and was known to pay very high prices to obtain it, being of the opinion that it contained more brain food than any other fish.



MOUTH AND TEETH OF SEA LAMPREY.

It is related of the Roman emperors that, so great was their valuation of the lamprey, both as a luxury and stimulating food, artificial ponds were constructed in which to fatten the lampreys, the principal food used being well fattened living slaves, on whose bodies the eels would fasten and feed, affording an enjoyable pastime to the noble Roman.



SEA LAMPREY.

The only place in New York city where the lamprey is served up is at the Grand Union Hotel.

At the next dinner of the Ichthyophagous Club, the sea lamprey will receive special attention from the French cooks, and is to be served in every known style.

The negroes of the South have great respect for the lamprey eel on account of its supposed medicinal qualities, the skins being in great demand as infallible cures for rheumatism and kindred ailments. The skins are bound about the ankles, wrists, and neck of the patient while fresh from the body of the eel, and are worn for long periods of time, in fact often till they drop off.

In the months of March and April, the lampreys begin ascending our fresh water rivers and streams that empty into salt water. Here they construct what might be called a nest, composed of stones piled up in a heap. These stones are carried from a distance by means of their sucking mouth. In these conical heaps of stone they deposit their spawn.

A NEW EXHILARATING SUBSTANCE.

Dr. Luton, of Rheims, calls attention in a French medical paper to the exhilarating properties of the tincture of ergot of rye when associated with phosphate of soda. The circumstances of the discovery were as follows: A woman of 62, at the infirmary of the *Maison de Retraite*, in Rheims, was receiving tincture of ergot of rye for disease in the knee. Fearing an unfavorable turn, the doctor thought to strengthen the action of that medicament with phosphate of soda, and accordingly combined a little of the two substances in a quarter of a glass of sweetened water. The patient, about three-quarters of an hour after taking this, surprised the inmates by bursting into loud laughter, without obvious reason, and this continued for more than an hour, with brief intervals. The laughter seemed to be associated with merry ideas, and to indicate a kind of intoxication. For some time after it died down the woman was in great spirits and good humor. Dr. Luton had not witnessed the scene, but the consequences to the patient being good, he administered the substance again, and a third time, observing the same effect. The experiments were further repeated on seven or eight women and girls with like results. In the case of men the action of the substance is less marked: it appears only in coloring of the face, giddiness, and slight headache. The effects in question have probably a common origin, it is thought, with those from eating rye bread when, in rainy years, the cereal contains as much as five per cent. of ergot. A sort of intoxication is produced which the consumers by no means despise.

PRESERVATION OF INDIA-RUBBER TUBING UNDER WATER.

Mr. Mareck relates his experience of having met with serious annual losses, in consequence of certain kinds of India-rubber tubing soon becoming brittle on exposure. After many experiments, he has adopted the plan of preserving them under water, which he renews from time to time. He found that even the thickest kind of tubing will thus remain soft and pliable without losing elasticity; nor has he found any other drawback by adopting this plan, except this, that they undergo a change in appearance. Red or brown tubing gradually fades, and becomes brownish or grayish-yellow; gray tubing becomes darker and browner externally. A section of tubing reveals the fact that about one-half of the thickness of the rubber, from the outside toward the middle, appears bleached and fatty; but the change is one which is rather of benefit for their practical use. The author adds that very thin rubber bands, with which other goods were tied, became so soft that they could be rubbed to small crumbs with the fingers.—*Dingler's Polyt. Jour.*, 239, 325.

A MAGNETIC CURIOSITY.

M. Obalski describes a pretty magnetic curiosity to the Academie des Sciences. Two magnetic needles are hung vertically by fine threads, their unlike poles being opposite to one another. Below them is a vessel containing water, its surface not quite touching the needles. They are hung so far apart as not to move towards one another. The level of the water is now quietly raised by letting a further quantity flow in from below. As soon as the waters covers the lower ends of the needles they begin to approach one another, and when they are nearly immersed they rush together. The effect appears to be due to the fact that when the gravitation force downwards is partly counteracted by the upward hydrostatic force due to immersion, the magnetic force, being relatively greater, is able to assert itself.

THE ELECTRIC EXHIBITION.

Such has been the progress made during the past few days in preparing for the International Exhibition of Electricity that it is now possible to render account of very interesting novelties and some valuable scientic applications. One gains, also, as the preparations proceed, a more exact perception of the extraordinary extent of the illumination which will be put forth. The form of the Great Hall of the Palace is rectangular, the open central space being about two hundred and fifty metres long and one hundred metres broad. Tke walls are of masonry. The interior is constructed of lofty iron pillars sustaining a semicircular arched roof glazed throughout. These iron pillars, about eight metres apart, carry galleries every side, under which are receding spaces about thirty metres deep. In one of these underspaces on the river side, the boilers, engines, and dynamo-electrical machines are placed; the boilers to the rear, the engines in line, and the host of electrical generators in front. This space will be railed off for the protection of spectators. The French Syndicate supply power to all who require, and will be remunerated by thirty-three per cent. of the night recipes, the charge of admission being one franc during the day, and one and a half from eight to eleven p.m. They have a set of four enormous Belleville boilers, of which the French think a great deal because they burn coal dust and there is a superabundance of it in the country. They are good boilers, and the four furnish sixteen thousand pounds of steam per hour, equal to eight hundred horse power nominal. Beyond this they have two hundred horse power in gas engines upon the Otto principle. Nevertheless, M. Fonteine is at his wit's ends to meet the ever increasing demands upon his resources.

The Brush Light Company is the only one of the English Exhibitors that has any prospect of being ready for the inauguration. Their motive power is supplied by seven fine Robey engines, respectively of forty, twenty-five, twenty, sixteen, fourteen, twelve, and ten horse-power nominal in all. Concrete foundations have been laid for seventeen machines, sixteen light-giving and one electro-plating. The arc-light generators consist of one Brush dynamo-electric machine, sustaining forty lights, and one of sixteen lights, all of two thousand candle power each: one, of the same pattern as the forty light above, but differently wound, producing a single light of one hundred and fifty thousand candles—three times the power of the first-class lighthouse contributed by the French Minister of Public Works; one machine of six lights of six thousand, and one of the six lights of three thousand candles each; a one light machine of fifty thousand candles, resembling the above sixteen-light one but differently wound; and a one-light machine of fifteen hundred candles.

The French Syndicate serves a hundred magneto-electric machines of various systems—Gramme, Siemens, Meritens, Lontin, &c.; and they have supplied the Gramme pendant lamps arranged around the roof of the Central Hall, to the illumination of which they contribute over two hundred thousand candle power. These new lamps are remarkable for the artistic change the common engineer's lamp has undergone by the merest touch of French natural taste in ornamental design. To the tall brass cylinder there has been merely added a crown of metal leaves and a ring of coloured fringe, and to the opal globe a pendant of like material. The effect is simple and pretty. The hall of the grand side entrance Porte IV., is being furnished with electro-plated lamps of exquisite elegance of design and admirable workmanship by the Paris firm of Siemens Brothers. The numerous bronze statues—especially two full-size figures carrying Jablochkoff lights near this entrance, and the various ornamental stands find holders in the extensive suite of reception rooms, boudoirs, and picture galleries, and happily give proof that the necessities of putting out of sight and of protecting the conducting wires impose upon artistic designers no greater restrictions in their conceptions than those of mastering the unsightleness of gas pipes. Both the London and Paris firms of Siemens Brothers, make further contributions to the general illumination of the interior.

The Edison exhibit will be one of very great interest, and the two *salons* which contain it will prove very attractive. They are fitted up as picture galleries, and will contain a complete illustration of his system of district lighting in competition with gas, as well as representations of all his inventions and discoveries during the past thirteen years, For the present the five hundred small incandescent lights in these rooms will have to be maintained by four small Edison dynamo-electric machines, driven by a hired engine of thirty-five horse-power.

The Siemens electrical tramway is fast becoming a verity. The over-head conductor is erected for the whole distance between the Place de la Concord, where there is a neat Swiss chalet sort of station, into the eastern entrance of the Palace. It consists of a C-shaped copper tube supported on posts. Within the tube there will be a moveable copper disc, from which a connecting wire will be attached to an ordinary tramway carriage and connected with a Siemens small dynamo machine within it, and by which the wheels of the tram-car will be driven. The current is supplied by a fixed Siemens generator of larger dimensions. The purpose of this arrangement is for the working of ordinary street tramways and cars, as they exist, by the addition of eletrical appliances.—*Standard.*

DR. ANDREW CLARK ON ALCOHOL.

Dr. Andrew Clark lately delivered an evening address on alcohol, in the Great Portland Street School-rooms, London, to a crowded and deeply interested audience. He said he purposed offering a few informal remarks upon the influence of alcoholic drinks upon health, upon work, upon disease and upon the succeeding generation. This question of alcohol was of the first importance to us as a nation and as individuals, and hence a great responsibility rested upon those who professed to speak upon it with authority. He ventured to say that he knew something about this question. For twenty-five years he had been physician to one of the largest hospitals in this country (the London Hospital), and there, as elsewhere, it had been a part of his business in life to ascertain the influence which alcoholic drinks exercised upon health, and he had with deep interest and attention striven to get at the truth of the matter. In the first place let him distinctly say that alcohol was a poison, as were also strychnine, arsenic, and opium ; but in certain small doses strychnine, arsenic, and opium were useful in special circumstances, and in very minute doses alcohol could also be used without any obvious prejudicial effect upon health. He was not going to discuss what these minute doses were, save to say that they were very minute. A perfect state of health (and it was rarely to be found) could not be benefited by alcohol in any degree, and in nine times out of ten it was injured by it. He said this not as a total abstainer, though he earnestly hoped that all the rising generation would be. Instead of the ideal state of health which might be enjoyed save for the nature of our surroundings, the sins of our parents, and our own sins, there was a sort of secondary health possessed by most of us, and what did alcohol do for this ?

He had two answers to give—that this sort of health bore apparently with alcohol better than the other, and sometimes seemed as if benefited by it; and this was exactly the sort of health that formed the great debating ground of different people with respect to the use of alcohol. Secondly, there were some nervous people always ailing, yet never ill, for whom he had a profound sympathy, who seemed to derive great comfort from alcohol, and to these he had sometimes said, "Take a little beer or wine, but take great care never to go beyond the minute dose." He did not defend this, but simply stated it to show what he thought. As to the influence of alcohol upon work, Dr. Clark went on to encourage his hearers to try the experiment of total abstinence, and observe the result in regard to work. Let them, however, try it fairly, and not allow themselves to be deterred from it by the evil prognostications of friends. He was certain that if this experiment were tried each individual present would come to the conclusion that alcohol was not a helper of work, but, on the contrary, a hinderer.

Now as to the effect of alcohol upon disease. He went through the wards of his hospital to-day, and asked himself how many cases there were due to natural and unavoidable causes and how many to drink, and he came, after careful thought, to the conclusion that seven out of ten owed their ill-health to alcohol. He did not say that these were excessive drinkers or drunkards—in fact, it was not the drunkards who suffered most from alcohol, but the moderate drinkers who exceeded the physiological quantity. The drunkard very often was an abstainer for months together after a period of intemperance, but the moderate drinker went steadily to work undermining his constitution, and preparing himself for premature decay and death. He had no means of finding out how many victims alcohol claimed each year, but certainly more than three-fourths of the disorders of fashionable life arose from the drug of which he was speaking. Finally, Dr. Clark dwelt upon the heredity of the alcoholic taint, and closed by saying that sometimes when he thought of all this conglomeration of evils, he was disposed to rush to the opposite extreme—to give up his profession, to give up everything, and to enter upon a holy crusade preaching to all men everywhere to beware of this enemy of the race.

GAS FROM CASTOR OIL.

At the gas works of Jeypore, India, illuminating gas is made chiefly from castor oil, poppy, til, or rape seed being used when the supply of castor beans is short. One maund (82 pounds) of castor oil produces about 750 cubic feet of 26½ candle gas, or 1,000 cubic feet of 18½ candle gas. The process of extracting the oil for carbonizing is as follows : First the castor seed is passed through the crusher, when the shells only are broken off. The shells are then picked out by hand, and the seed is again introduced into the crusher, where it is ground to a paste. It is then passed into the heating pan, and, after being well heated, it is packed into horsehair bags and filled up hot into the press immediately. After about twenty minutes' pressing, the exuding oil being meanwhile collected, the cake is removed and ground over again. It is subsequently heated and pressed a second time until about 33 or 40 per cent. of oil is obtained from the seed. The labor of preparing and pressing the castor seed costs two shillings (about fifty cents), per maund of oil. The total cost of the oil is somewhat over $5 per maund.

For generating gas, the oil is used as it comes from the press. Formerly, at other places, when the oil-bearing seeds were carbonized for gas without previous treatment as above described, the product was overloaded with carbonic acid from the woody part of the seeds, and correspondingly heavy cost for purification was incurred.

For out of town consumers, the Jeypore gas works supply gas compressed to about three atmospheres by means of a pump driven by a bullock. The compressed gas is then delivered in a wrought-iron receiver to the point of consumption, where it is either transferred into fixed receivers and burnt by the aid of suitable regulators, or is delivered into small portable or service gasholders, and burnt in the usual way. A *ghat*, or landing stage, two miles distant, is thus supplied with 400 cubic feet of gas every day, which is consumed by 30 jets, each burning 1½ cubic feet per hour for nine hours. There have not been any accidents from the distribution of gas in the portable reservoirs or otherwise. As railroad carriages are also supplied with compressed gas, it is evident that the introduction of this branch of service has widely extended the utility of the establishment. Another peculiarity of the Jeypore undertaking is the necessity that exists for the manager to unite the attributes of a farmer to his other acquirements, for the purpose of securing a constant and chief supply of raw material for gas making. Last year, the manager, Mr. Tellery, personally superintended the sowing of 300 acres with the castor plant (*Ricinus vulgaris*).

BELLS FOR SHEEP.

Mr. James S. Grinnell, writing in the Springfield *Republican* of bells on sheep as a protection against dogs, gives this illustrative experience :

"A good farmer in Leyden, who keeps about a dozen excellent Southdown ewes, always belled, was grieved and surprised one morning to find that dogs had raided his flock, killed two, mangled others, and scattered the rest. On collecting his little flock into the yard after a day's search he found that the tongue was lost from the bell. This was replaced, and never since have his sheep been worried. The experiment is so simple and cheap that it is worth trying."

TOUGHENED GLASS.

From the results of a large number of experiments it is found that the elasticity of toughened glass is more than double that of ordinary glass, and that toughened sheets bend much more readily than ordinary sheets. Single toughened glass has a resistance 2·5 times, and demi-double toughened glass a resistance 3·1 times that of ordinary double glass. Polished toughened sheets, of thickness varying from 0·006 meter to 0·013 meter, have a resistance 3·67 times as great as that of ordinary sheets of the same thickness, and the resistance of rough toughened sheets is 5·33 times that of ordinary rough sheets.—*De la Bastie.*

INCREASED OCCUPATION FOR WOMEN.

Mrs. Mary A. Livermore says that one evening twenty years ago a few ladies, interested in the welfare of women, discussed the employments open to women. They counted eleven and could think of no more. Recently the same ladies repeated the enumeration, and were able to point out 287 employments which women could engage in.

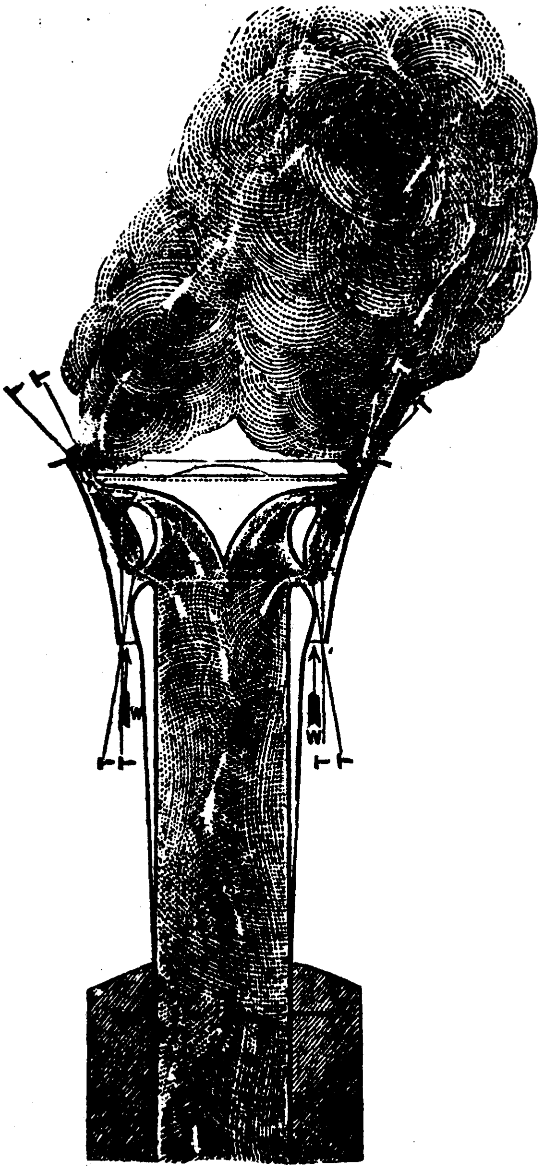


Fig. 1.—Section Through Chimney showing Course of Smoke when Wind Blows so as to Cause an Upward Draft.

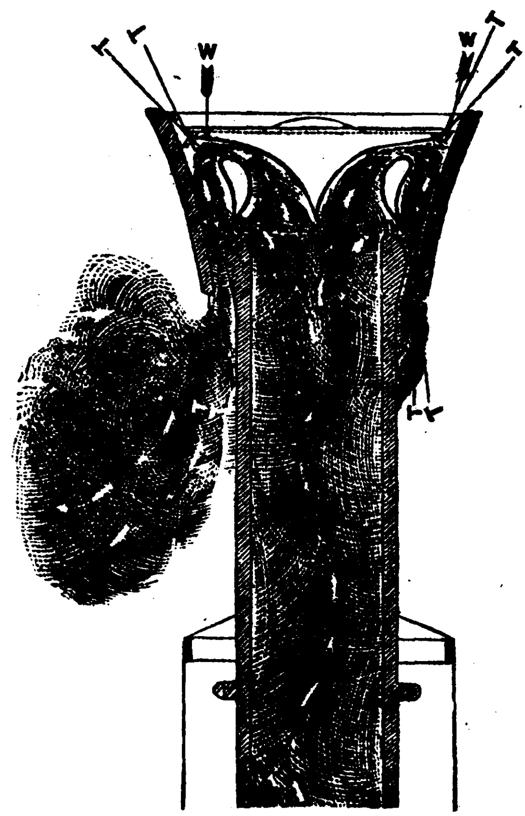


Fig. 2.—Section Through Chimney showing Course of Smoke when Wind Blows so as to Cause a Downward Draft.

IMPROVEMENT IN CHIMNEY TOPS.

The accompanying engravings represent the operation of an improvement in chimney tops recently brought out in Germany. The invention is by M. Born, and the articles are being manufactured by M. Sanfteben, of Magdeburg. The account which reaches us of this invention is quite brief, and the description is confined to generalities. The top of the chimney, as will be seen by reference to Figs. 1 and 2, is, in a measure, stopped by an inverted cone-shaped member. An annular opening around the chimney is provided below the cap, corresponding with the opening between the top of the chimney and the inverted cone section just mentionned. The theory of the invention is that wind entering the top of the chimney in the direction of the arrows shown in Fig. 2 will force the smoke downward, thereby making the outlet of the flue through the annular opening below the cap. On the other hand, if the direction of the wind is upward, the outlet of the smoke will be from the top, as indicated by the arrows in Fig. 1. In the specification the assertion is made that the space occupied by smoke and gas passing from the chimney must be aqual in area to the section of the flue in the main body. From this it is to be understood that the inventor proposes to make the area of the annular openings below and above the chimney can equal to that of the body of the flue.

This improvement is intended to be applied alike to chimneys upon dwelling houses and business blocks, and also upon the stacks in connection with manufacturing establishments. The form of chimney cap or ventilator here presented is novel in many of its features and will, no doubt, be of interest to our readers.—*Metal Worker.*