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NOTE AND COMMENT.

IN another page we record what seems likely to prove one of the greatest advances in electrical science yet given to the world. The difficulties in the way of storing electricity in any permanent form so as to permit of its being used at a distance from the generating machine have hitherto baffled all attempts in that direction, and though Plante pointed out the method to be adopted, it has been reserved for M. Camille Faure, to transmit from Paris to Glasgow a box of a cubic foot in capacity, containing nearly one million feet of compressed electrical energy. The experiments since made by Sir William Thompson have resulted in most unmistakable evidences of the enormous power contained in the little box, and the scientific world are agape at the future which this discovery opens out. In truth, the possibilities which suggest themselves are so vast, that speculation loses itself in the endeavor to trace them. If we may be allowed to indulge our prophetic instinct so far, there is one branch of science which has been for years almost at a standstill waiting for some such discovery to give it a fresh impetus. Aëronauts have been hitherto baffled in their attempts to control their unstable machines in the upper air, and much as has been done in every other direction, no practical method of aërial locomotion has been suggested which is not entirely, or in the main, dependant upon uncertain winds and irresponssible air currents. The difficulty in the way of providing balloons with any of the known methods of propulsion has lain in the inability of the lifting power to carry sufficient weight in proportion to its resisting surface. The largest steam engine, for example, that can be raised into the air by a balloon of any given size is not of sufficient power to overcome the resistance of the air and drive the machine against the wind. This difficulty the new discovery seems likely to do away with. When we can pack a million feet of energy in our portmanteau before starting on a journey, we can afford to laugh at currents, and despise the winds. Nevertheless it will probably be some little time before such results are realized, and we must wait at least for the particulars of M. Faure's discovery to be made public.

THE *Scientific American* devotes considerable space in its items of June 18th to the discussion of "Luckhardt's Process of Photo-engraving" so called, as described by the discoverer (?) in the *Photographische Correspondenz.* The discovery claimed consists simply in the production of a line negative for photo-engraving purposes by working with a point upon an ordinary negative coated with varnish. That this should be regarded as new and a discovery of his own by Mr. Fritz Luckhardt is sufficiently remarkable, but that the *Scientific American* should endorse the opinion is indeed surprising. For the benefit of those who have this view, it may be well to state that the process as described there has been in use here for some 14 years, in connection with the CANADIAN ILLUSTRATED NEWS and other publications of the Burland Lithographic Company and its predecessors, and we believe is by no means confined even to them. Our process is more perfect in every respect than that described in the correspondence in question. The varnish used will keep a considerable time without drying, moreover prints can be made upon chrome or citrate of iron paper, thus avoiding the expense of the silver paper used by Mr. Lockhardt, and finally it is applicable to all processes of photo-engraving, photo-lithography or photo-zincography. This is however by the way; the only point worthy of notice is that the system is at least 15 years old, and not in any sense a new discovery. It may be interesting in this connection to note that some years before the introduction of the process into Canada, a Mr. Cotton, who held some office under the Canadian Government tried the experiment of engraving upon the silvered back of a mirror, afterwards using the plate so engraved as a negative for printing from, and to this idea may possibly be traced the origin of the present system, which whatever its merits, has no claim at least to novelty.

TIN is one of the most necessary metals, and at the same time one of those whose production is most limited; it enters into the preparation of bronze, hence it was contemporary with the age of bronze. Ten parts tin and ninety of copper, compose bronze. The trade in tin ought to date from the highest antiquity; yet in neither Assyria nor Egypt, the presumed cradles of civilization, where bronze instruments were generally employed, does tin exist in a mineral state. The Egyptians had copper mines between the Nile and the Red Sea; bronze was their favorite metal; it formed the woodman's axe, the laborer's pick, and the implements of the artizan. From whence did the Egyptians import tin, as the name of such a metal is never mentioned in the several lists of tributes engraved on the palace of Thebes? The nearest mines were in the Caucusas and Central Asia, and it is presumed to have entered Egypt under the name of lapis, so called after the traders who trafficked largely in general merchandise under that appelation—the contraction of lapis lazuli. As bronze existed, so must tin have been known long before the discovery of the mines of Cornwall, to which Herodotus alludes in terms characteristic of their richness. When the Phœnicians established themselves on the coast of Syria, they became the chief furnishers of tin to the Egyptians; they first settled in Spain and worked the tin mines of that country—for the mines of Spain and Portugal were formerly very rich, though in 1870 they produced but 27 tons; then they coasted round Spain and France, passing from America to Cornwall. But the tin mines of the latter country were known to the Celts before the epoch of the Phœnicians, and the knowledge of that metal, how to work it and where to find it, was derived from the original Celts in their migration from Central Asia. Further, the Celtic terms for tin are analagous with those found in Sanskrit. There is only one of the combinations of tin that interests the metallurgist, the binoxide, sometimes called stannic acid, and which contains 21 p.c. of oxygen and 78 of tin. Wherever kaolin exists, binoxide of tin may be expected to be found. Apart from Cornwall, where the supply of tin is limited, the chief production of that metal comes from the Peninsula of Malacca and the neighboring islands. At Banca the ore is found at a depth of 8 or 10 yards, and 30,000 Chinese constantly work in the mines; were the inhabitants of these regions more active, the mines of tin are so rich that the production would surpass the demand. In America tin has not yet been worked on a large scale, and Australia does not deliver notable quantities to industry. The best bronze contains ten per cent. of tin; the proportions can, however, change, yet in the age of bronze the ratio was uniform. The ancients knew how to produce the brassy character, but their aim was to soften the metal, the better to manipulate it; they were ignorant how to harden it. When heated copper is plunged into water, the result is exactly the opposite to what takes place in the case of steel, it becomes more flexible and softer, taking any form desired, but in proportion as the metal is hammered, it cakes and its hardness augments.

THE distinguished chemist, M. Müntz, has devoted four years to demonstrate the existence of alcohol everywhere in nature, and as common place as stones on the highways. There is alcohol in the air, in the cultivated soil, between paving stones, in the sewers, in rivers, in the sea, in the kennels—only pure spring water is free from the spirit. Having been made aware of these facts, reflection shows that nothing is more natural. Fermentation is universal, and the products of fermentation are carbonic acid and alcohol; decomposing organic matter is everywhere, and the diffusion of alcohol is a necessary corollary. The process employed by M. Müntz to detect the presence of alcohol, is so delicate, that the existence of one-millionth part can be revealed. And that process is as simple as it is certain. In presence of iodine and carbonate of soda, alcohol assumes the idoform state, that is, in tiny, yellow, shaped crystals of six rays, in appearance like crystalline snow that has fallen during a calm. The quantity of alcohol of course varies; cold rain and snow are richer in that spirit than luke-warm rain, while in sewage water the quantity is still higher. Appreciable quantities can be extracted from vegetable soil. Perhaps it would not be too much to say that it is in the decomposition of organic matters in the soil that is to be found the generating source of alcohol in the air and rain water. A cubic yard of water —220 gallons—contains, however, only the thirtieth part of an ounce; the dose is too homœpathic to affect either the interests of health or industry.

PHOTOGRAPHIC PHOTOMETRY.

A promising application of photography to precise measurement of phenomena of light has been recently tried by M. Janssen. The method is advantageous in that photography reveals the action of the extremely weak luminous and the ultra-violet rays; but the chief advantage lies in the permanence of the results as against the fugitive nature of ordinary photometric comparisons, which, too, require the simultaneous presence of the two light sources. The various amounts of metallic deposit on the photographic plate cannot well be weighed, so M. Janssen measures by the degree of opacity produced. His photometer consists of a frame with sensitised plate, before which is passed at a known rate of uniform motion a shutter having a slit. If this slit were rectangular, a uniform shade would be produced on the plate; but by making it triangular he obtains a variation of shade, decreasing from the side corresponding to the base of the triangle to that corresponding to the apex. It is further proved that the photographic deposit does not increase as rapidly as the luminous intensity. Now, to compare the sensibility of two plates differently prepared, they have merely to be exposed successively in the frame under like conditions, and the points where they show the same opacity being compared to the points of the triangular slit corresponding to them, the ratio of the apertures at those points expresses the ratio of sensibility. Thus the new gelatino-bromide of silver plates are proved to be twenty times as sensitive as the collection plates prepared by the wet process. Again, to compare two luminous sources, they are made to act successively on two similar plates in the photometer, and the points of equal shade in the plates indicate, as before, the relation sought. M. Janssen has compared the light of the sun and some stars on these principles, preparing from the former "solar scales" (with uniform degradation of shade), under exactly-determined conditions to sensitive layer, time of solar action, height of the sun, &c. Circular images of stars are obtained by placing a photographic plate a little out of focus in the telescope, and a series of these, got with different times of exposure, are compared with scales obtained from sunlight. M. Janssen will shortly make known some of the results.

THE TELEPHONE IN CHINA.—The Chinese language is so peculiar that there is great difficulty in devising any practicable system for conveying telegraphic messages. The telephone, therefore, is received with peculiar favor by the Chinese Government, which has at length decided to establish a complete system of telephones throughout the country, commencing north of the Yang Tse Kiang. The work will be conducted under the charge of J. A. Betts, the American telegraphist, under whose superintendence the telegraphic line was built from Tientsin to Taku.—*L'Ingèn. Universal.*

Engineering, Civil & Mechanical.

PROGRESS OF THE GREAT SUSPENSION BRIDGE BETWEEN NEW YORK AND BROOKLYN.

The present appearance of the work on the East River Bridge is shown in the accompanying engravings so clearly that any description, except of details, is quite unnecessary.

The point of view chosen by our artist is (for the larger engraving) on the high ground northeastward of the Brooklyn tower, so as to show not only the progress of the work, but the graceful structure of the tower, which from its great height appears to be very slender, notwithstanding its massive thickness and breadth of base.

Beneath the bridge is seen the harbor, looking southward, with Governor's Island and Castle William in the middle distance. Beyond is the lower bay, and beyond that the ocean. Only the southern point of New York is seen on the right. Across the mouth of the Hudson, which looks like a pointed bay, lie the Jersey shores and Staten Island. Across the bay, on the left, is the Long Island shore, with Bay Ridge and Brooklyn.

The smaller cut shows the underside of the bridge, without the timber flooring, as seen from the deck of a ferryboat passing beneath. The work of suspending the floor beams progresses with practical uniformity at both towers and on both sides of each tower, the design being to keep the strains on the masonry as equally balanced as possible. At this writing about twenty-five beams are placed on each side of the two towers, or something near a hundred in all. Suspender ropes are in place for more than twice as many additional beams, there being four suspenders to each beam.

From below the suspenders look like spider lines; they are, however, stout ropes of steel wire, from 1$\frac{5}{8}$ to 1$\frac{3}{4}$ inches in diameter, and able to sustain a weight of 50 tons or more each, or five times the heaviest load likely ever to fall upon them. The bands by which the suspenders are attached to the cables above are of wrought iron, five-eights inch thick by 5 inches wide. They were put on when the cables were being wound, and fit closely to the cables. On the outer side the ends of the bands terminate in two lugs, seven-eighths inch thick. An iron screw bolt, 1$\frac{3}{4}$ inches in diameter, passes through the lugs to hold the suspender socket and to tighten the band around the cable. The bands were put on by the winders, who heated the backs of the bands in little forges until they could be opened far enough to let them go over the cable. The two ends of the band were then drawn together, a thin plate of iron being slipped between the cable and the hot band so as to protect the galvanizing of the wire of the wrapping until the band was cool. To these bands the suspender ropes are attached by means of wrought iron closed sockets. On the lower end of each suspender is a cast iron socket for the reception of the stirrup rods which hold the floor beam. The stirrup rods have long screw threads, by means of which the beam can be raised or lowered to regulate the floor grade, it being impossible to cut and fasten the suspenders to the exact length required.

The floor beams are made in halves at the steel works; are landed at the foot of the towers; are hoisted to the level of the bridge floor and run out upon a tramway to the point of suspension; and after being attached to the suspenders are securely riveted together, making a continuous beam the entire breadth of the bridge, or 85 feet. These beams are unlike any ever before used on a suspension bridge. They are 32 inches deep, 9$\frac{3}{8}$ inches wide, and weigh four tons. Each beam has two top and two bottom chords tied and braced together in the form of a triangular lattice girder. The chords are of steel channel bars. The main beams are suspended 7 feet 6 inches from centers, and between each pair of principal beams a lighter I beam is placed, resting on the truss chords, so that the floor planking will be supported and fastened every 3 feet 9 inches from centers. Wooden bridging will be inserted between the beams to resist the strain of the over-floor stays. The longitudinal trusses are six in number, dividing the bridge floor into five sections. The two outside sections, 18 feet 6 inches in width, are for vehicles. A tramway will also be laid down in each, in case it may be desirable to run street cars across the bridge. Inside the carriageways will be two railways for cars to be propelled by an endless iron rope, operated by a stationary engine. Between the rail ways, and elevated 12 feet above them, will be a footwalk, 15 feet wide. This promenade will be the first part of the structure completed, since it will be needed for the workman upon other parts of the superstructure. On both sides of the river the masonry of the approaches to the bridge is substantially finished.

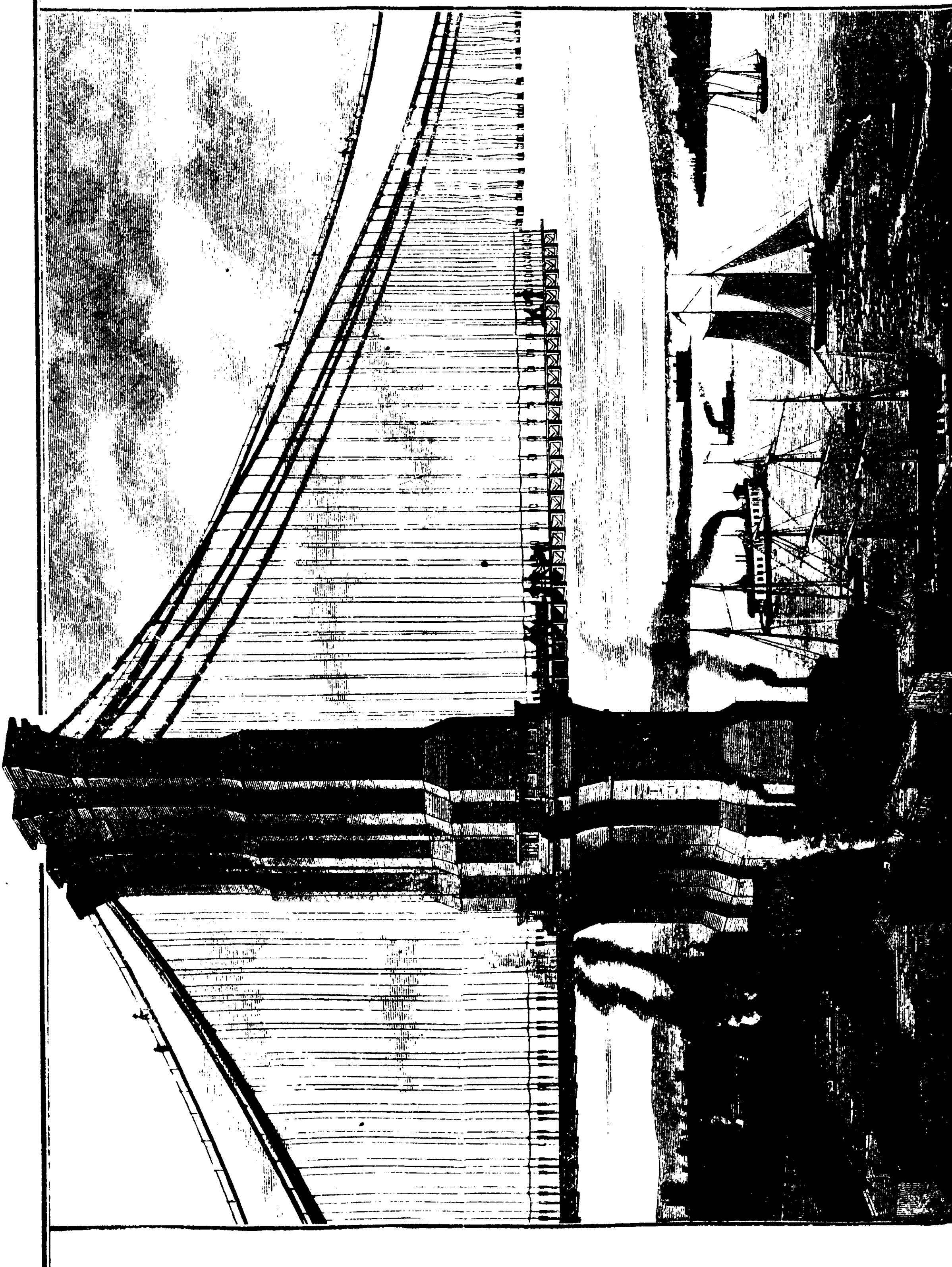
An idea of the magnitude of the work already accomplished may be had from the following figures, which are furnished by Mr. E. E. Farrington, master mechanic of the bridge:

Length of the main span	1,595$\frac{1}{2}$	feet.
" " land spans, 930 ft. ea., total	1,860	"
" " New York approach	1,562$\frac{1}{2}$	"
" " Brooklyn approach	971	"
Height of main span above water	135$\frac{1}{2}$	"
Depth of N. Y. foundation below high water	78$\frac{1}{2}$	"
Depth of Brooklyn foundation below high water	44$\frac{1}{2}$	"
Size of N. Y. caisson (for foundation)	172x102	"
" " Brooklyn "	168x102	"
Cubic yards of masonry N. Y. tower	46,945	
" " " " Brooklyn tower	38,214	
Size of towers at high water mark	140x59	feet.
" " " " top	136x53	"
Total height of tower above high water	271$\frac{1}{2}$	"
Height of roadway at towers	119	"
" " arches above roadway	117	"
" " towers " "	159	"
Width of openings through towers	33$\frac{3}{4}$	"
Size of anchorages at base	129x119	"
" " " " top	117x104	"
Height in front	85	"
" " rear	80	"
Width of flooring	85	"
Grade of roadway	3$\frac{1}{4}$ ft. in 100	"
Number of cables	4	
Diameter of cables	15$\frac{3}{4}$	in.
Length of each cable	3,578$\frac{1}{2}$	feet.
Wrapping wire on each cable	243 miles 943	"
Number of wires in each cable	5,434	
Total length of wire in each cable	3,515	miles.
Number of suspenders—		
Each cable, main span, 208; in all.. 832		
" " each land span, 86; in all. 688		
Total	1,520	
Number of post bands—each land span, each cable, 35; in all	280	
Number of double floor beams supported by cables	450	
Strength of each suspender	140,000	lbs.
Sustaining power of each cable	12,000	tons.
Greatest weight on a single suspender	20,000	lbs.
" " " " cable	3,000	tons.

—*Scientific American.*

THE FIRE RISK OF STEAM HEATING.—The Fire Marshal of Pittsburgh has pronounced the opera-house in that city dangerous, on account of its liability to take fire from steam pipes, and quotes from several authorities to support his position, among them the opinion of the vice-president of the Continental Fire Insurance Company, of New York. He says: "Steam pipes have been known to set fire to wood at a distance of 300 feet from the boiler. Pipes should not pass through a side wall or roof or enter chimneys in unused rooms, where joints may become loosened. It has become a serious question whether stoves—because of their admitted danger and consequent care in their management—are not safer than steam pipes." He cites fifteen fires known to have occurred from a contact of wood and steam pipes, such as the Fire Marshal describes at the opera house.

"It is useless," says the Marshal, "to spin theories upon this question, because the dangerous character of steam pipes in contact with wood has been fully proven in this city, and at the expense of the insurance companies. It will trouble no reader to recollect the burning of Stoner & McClure's planing mill, in the Twelfth Ward, in the latter days of 1879. The fire was not susceptible of explanation on any other theory than from the steam pipes. This the firm refused to believe, and rebuilt in the same manner. The result was a second fire, which satisfied them, and they tore out the apparatus. On the 23rd day of May, 1870, there was a day-light fire at the American Iron Works of Jones & Laughlins. There was no dispute about what caused that burning, as it was observed, and the records of the payment for damages are upon the books of the local underwriters. It was a steam pipe. Wm. G. Johnston, president of the Citizens' Insurance Company, could not believe that hot air would set a board on fire until after suffering a loss from that cause and collecting $300 from his own company to repair it."—*Metal Worker.*



SUSPENDING THE FLOOR BEAMS OF THE EAST RIVER BRIDGE.

FOR FURTHER ILLUSTRATION SEE PAGE 208.

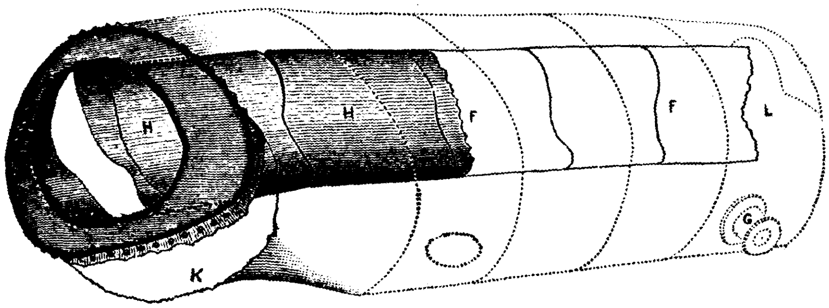


Fig. 1.

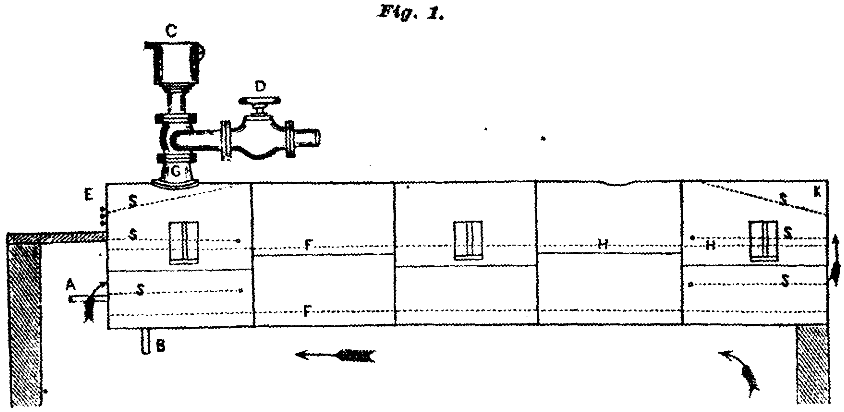


Fig. 2.

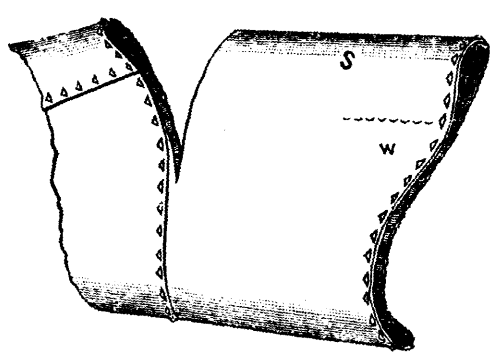


Fig 3

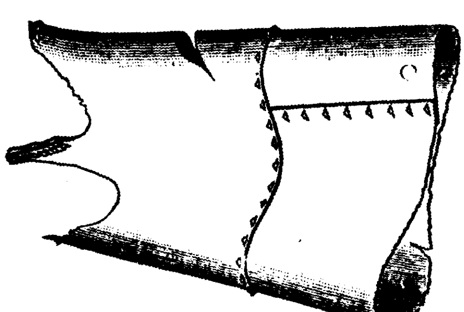


Fig. 4.

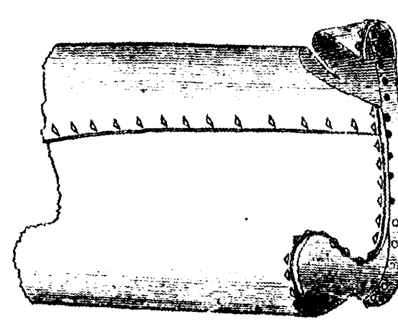


Fig. 5.

EXPLOSION OF A FLUE BOILER

EXPLOSION OF A FLUE BOILER.

The following criticism and analysis of the destructive explosion of a rolling-mill boiler, by the collapse of a large flue, which occured some months ago, will be found interesting and instructive. The case is presented in the monthly bulletin of the Hartford Steam Boiler Inspection and Insurance Company.

The boiler that exploded was a cylindrical, horizontal, single-flue, built about 1870, and was 20 feet long, 4 feet diameter, made throughout of iron not less ⅜ of an inch thick. The flue was 22 inches diameter, and extended from end to end. The boiler was placed over a re-heating furnace, and heated by the waste gases, which entered the chamber below the boiler at the rear end, as indicated by the arrows in Fig. 2, passed the whole length of the boiler in contact with its lower half, and returned by way of the flue to the chimney. The boiler was supported at a height of 10 or 12 feet above the ground by three pairs of cast-iron brackets, which were riveted to the shell and rested upon the side walls. The boiler had flat wrought-iron heads flanged to the shell and flue, and stayed by 12 braces about 4 feet long, part of which were fastened to T-iron placed horizontally above the flue, one on each head, and the inner ends of the braces were attached to the ring of shell plates that joined each head, as shown by the dotted lines S, S, etc., Fig. 2. This boiler was one of a system of ten which were similarly set and heated, all connected to two or more main steam pipes, and each provided with a steam stop-valve, a safety valve, and three gauge cocks, but each did not have a steam gauge. This particular boiler being without a steam gauge, there was no means of ascertaining the pressure when the stop-valve D was closed, except by such indications as the 2-inch patent lock-up safety valve afforded. This boiler was supplied with water (the temperature of which is not known, but probably variable) at intervals through the pipe A, Fig. 2, as often as it got low, and no doubt as rapidly as could be done with the pump or large injector. The blow-off pipe B was located at the bottom, and afforded means of completely emptying the boiler.

About 5 o'clock in the morning, the steam stop-valve D had been closed for an hour or so to repair a steam pipe, and the 2-inch lock-up safety valve C (which had neither cover nor lock), had been blocked open by means of a bit of wood placed inside the case, to relieve the boiler while the repairs were going on. The repairs done, the attendant let down the safety valve, and was about to open, or had partly opened, the steam stop-valve, when the explosion occured. The engravings have been prepared from photographs and sketches, and the case has been made up as well as could be from them and the published evidence given to the coroner's jury The boiler shell, Fig. 1, containing 3½ lengths of the flue, flew through the roof of the mill, taking a direction so that it landed nearly in a line with its projected axis, at a distance of 130 yards from its working site, striking and demolishing a large area of the mill roof and a brick chimney in its flight. It struck the ground several yards short of where it stopped, and plowed a deep furrow in the ground, in which it lay partly embedded, the same end foremost that it had in the mill, by which operation the foremost head K was partly broken from the shell and the shell distorted something as shown in Fig. 1, in which the dotted lines represented the unbroken part of the shell; the shaded portion at the left shows the foremost parts of the shell broken by the fall; the shaded portion of the flue remained in the shell, and that portion in flue outlined was blown out with the missing portion of the head at the right. Of the parts of the flue that went with the boiler shell, that shown in Fig. 3 was dropped out in its flight at about one-third the distance made by the shell, while the other two, Figs. 4 and 5, remained in the shell, but entirely broken apart and from the head. The sides of the piece, Fig. 3, of the flue were shut together with such force as to emboss the forms of the heads inside upon the exterior surface opposite W, Fig. 3, and the two inner surfaces were in perfect contact, as though the iron had been soft as wax when the parts came together; but there was also visible at S, the very summit of the flue when in its place, a dark shiny, thin scale, which is often seen inside of boilers using a particular kind of water, which had not lost its glossy appearance or changed in color, indicating that it had not been hotter than usual since the scale was deposited there. Samples of iron having on them this kind of deposit have since been exposed to heat, and it is found that a heat sufficient to change a brightened spot on the iron to a blue color—say about 550° or 600° Fah.—is sufficient to blister a deposit and destroy its lustre.

The experts who testified before the coroner differ as to the cause of the collapse, and it is probable from the nature of the subject that they will always differ in such cases. Experts from the scientific schools and from the learned professions are seldom in perfect accord when giving testimony, and often their opinions differ so widely that it is necessary to appeal to common sense.

It is the object of the present writing to offer an unbiased technical discussion of this case in the light of this company's experience, and for the good of all whom it may concern.

This boiler was a fair sample of a one-flue boiler, both as to material and workmanship, capable of bearing safely, when sound, a working pressure of 70 pounds, which was about one-third of the collapsing pressure of the flue if it was round and sound. It was run as boilers usually are in works of this kind. A man of good habits was in attendance, who believed in plenty of water as a sure preventive of boiler explosions, and his practice was in perfect accord with his faith. He was on hand and attending to his duty, which was first, last and exclusively to see that ten boilers were fully supplied with water. He did not help repair the broken pipe; his attention was therefore not distracted by that event. The feed valve was open, the steam pump was in motion while the men were at work on the pipe. So swears the engineer who repaired the broken pipe. Other witnesses swear that the boiler attendant was about there trying the gauge cocks; that he was seen trying gauges a few minutes before the explosion. The master mechanic swears that he, the boiler attendant, was directed to fill up as soon as the water fell below the upper cock; that he saw no indications of low water in the exploded boiler. Thus much, and no doubt more, evidence might be quoted relating to the probability that water was or was not low in the exploded boiler; all of which would be of no account if the theory of low water was confirmed by the testimony of the flue itself and by the general character of the explosion. Is it so confirmed? The records shows that boilers which explode with no water in them, are not shot through the air like a rocket, and those containing small quantities go short distances. The records also show that large horizontal flues that collapse on account of being softened by heat, invariably cave in from the top only, and that lateral collapse is due to distortion of form or weakness at the side longitudinal seams from grooving or from thinning of the plate by corrosion. Two witnesses swear that grooving was observed, but as its location was not indicated little can be said about it. The parts not shown in the illustrations were cut to pieces and worked up, and no sketches or description of them were obtained. It must have been on those parts, if there was grooving, as none was found on the parts sketched.

Finally, to satisfactorily account for all the phenomena that attended this explosion, we have only to show that the safety valve was jammed so that it did not prevent the rise of the pressure, and that the stop-valve was closed, or just being rapidly opened, at the instant when the limit of endurance had been reached by the boiler; and as every circumstance and all the testimony confirm the latter requisite, we have only to imagine that this small valve, with its compound levers and disk weights huddled into a case of 8 or 10 inches diameter, and of less depth, which had been blocked open by means of a bit of wood placed against one of the levers when full relief to the boiler by its means was desired, was accidentally jammed when it was let down. The propositions below will not appear absurd to those who realize that over 3,000 cases of defective condition of safety valves, most of them originally correct and proper, had been detected by this company's inspectors during the first twelve years of its experience, out of which number 1,400 were reported as dangerous, and that thousands of defects have been reported that were dangerous only in the event of an accidental over-pressure.

The following proposition seems to account for all the phenomena of this explosion while the theory of low water does not: The hypothesis is, an accidental sealing of the boiler after the broken steam pipe was repaired, the stop-valve D being still closed (or in the process of being rapidly opened), and the safety valve jammed, the generating surfaces of the boiler in full action, the pressure rapidly rising, the flue—at the best only about half as strong as the shell—had acquired (from the sudden thermal changes, due perhaps to the influence of the cold feed-water among other abuses of its ten years' night and day work) an obscure weakness, flattening, thinning or grooving at a longitudinal seam, and the limit of its resisting power was soon reached at no *very* high pressure, and it collapsed near the middle of its length. The head L, being the weaker, for obvious reasons, of the two, gave way instantly when the shock of the collapse was added to its now extraordinary steam load, and it, with nearly half of the flue, fell inside the mill, and the expanding water began to issue from the open end of the boiler (the free steam from the steam space having left in one puff), while the boiler shell, with the remaining parts of the flue, started in the opposite direction, precisely as a rocket would do similarly placed after the compound was ignited, and in a similar manner it continued its flight until the explosive force was exhausted. Hence it will be seen that with so large an opening there must have been considerable contained water to send it so far.

THE STRENGTH OF WROUGHT IRON AND STEEL.

There is something very interesting, but not altogether as yet understood, in the behavior and strength of iron and steel when loaded.

It is all very well to institute certain tests to find the number of pounds it requires to break a piece having a sectional area of one square inch, and from this pronounce what is the strength of the iron; because with our present knowledge and appliances, it is all we can do, and a test of some kind is of course imperative. It is a curious fact, however, that the strength of a piece of iron or steel varies according to the manner in which the load is applied. If the metal receives its load suddenly, it will break under a less weight than if the load comes on slowly and gradually increases; and the difference is not a minute one either, for it is as great as 20 per cent. under the two extremes of conditions. At the recent meeting of the Society of Mechanical Engineers at Hartford, Conn., one of the most eminent constructing engineers in this country stated, in reply to a question, that he would make as much as 20 per cent. difference in the strength of two beams to receive the same load, one to have the load suddenly, and the other to have it gradually applied. From this it is a fair and reasonable deduction that if the load when applied caused vibration, the beam would require still greater dimensions to be of equal strength, because vibrations are simply minute movements and, in the case of horizontal beams, on moving downward increase the pressure of the load.

A short time since some experiments were made to ascertain the strength of iron and steel wire, two specimens of each size of wire being used, one just as the iron came from the mill and the other an annealed specimen.

The wires were suspended vertically, and a certain weight as say 10 lbs., was hung on them. Then in some cases a ½lb. weight per day was added, in others 1 lb. per day, in yet others the weights were increased as fast as they could be put on, and in every instance it was found that the breaking strain increased according as the time between the increases of weight was made longer the amount varying from 10 to 20 per cent. The recent failure of the boiler plates of the English steamship Livadia has elicited some interesting facts and strange opinions upon the behavior of low-grade steel, and we present the most important to our readers. The boiler was 14′ 3″ diameter by 16′ long. The plates were ⅝″ thick, lap-jointed and treble riveted. The plates were all punched, then slightly heated and bent to shape; afterwards put together, and the rivet holes reamed out to size. While under this treatment one of the plates fell out of the slings on to an iron plate and was cracked right across the rivet holes. Naturally this gave some anxiety, but after the plates were all in the boiler itself, they cracked across the rivet holes in nearly all directions; that is, many of them did,

Investigation was immediately set up, chemically and mechanically, when it appeared, as nearly as could be ascertained, that although the stock was good of which the plates were made, it had not been thoroughly worked under the hammer before rolling.

Dr. Siemens, the inventor of the process which bears his name, surprised many of his audience by stating that annealing plates, either before or after working (punching), was of no advantage; tending if anything to injure rather than benefit the materials. This position was vigorously combated by the practical men present who were unanimous in condemning it!

DESCRIPTION OF E. HAUGH'S STEAM-BALANCED SLIDE VALVE.

The main principle in this device is that a bearing plate of the same size and form as the Valve seat of the steam-cylinder rests steam tight on the back or top of the Valve. Said bearing plate forms the bottom part of a cylindrical chamber, having in its bottom surface cavities, corresponding in size and form exactly with the inlet and exhaust ports of the steam-cylinder. The Slide-valve itself is in consequence of said arrangement symmetrically shaped, in as much as its top face is of the same form, size and area, as its bottom wearing face.

The mentioned cavities being located exactly vertically above their corresponding ports of the cylinder, become filled with steam at the same moment as said ports, thus the pressure of the steam against the bottom face of the slide-valve, when the latter has cut off, is counteracted. A number of vertical openings in the Valve are made for the purpose of equalizing the pressure of steam below and above the Valve, as soon as expansion takes place behind the piston of the cylinder. In order to make up for the wear automatically, there are on the upper hedge of the upper edge of the mentioned cylindrical chamber some inclined planes, to which are fitted other inclined planes, being on the bottom edge of a ring. Inside of this is fastened one end of a coiled spring; the other end of this spring is attached to a shaft, which goes vertically through it and enters in a hub, being located in the centre of the cylindrical chamber. Outside of the chamber, on the upper end of the shaft is fastened a ratchet; a dog prevents this ratchet, or rather the spring, when strained, from unwinding itself.

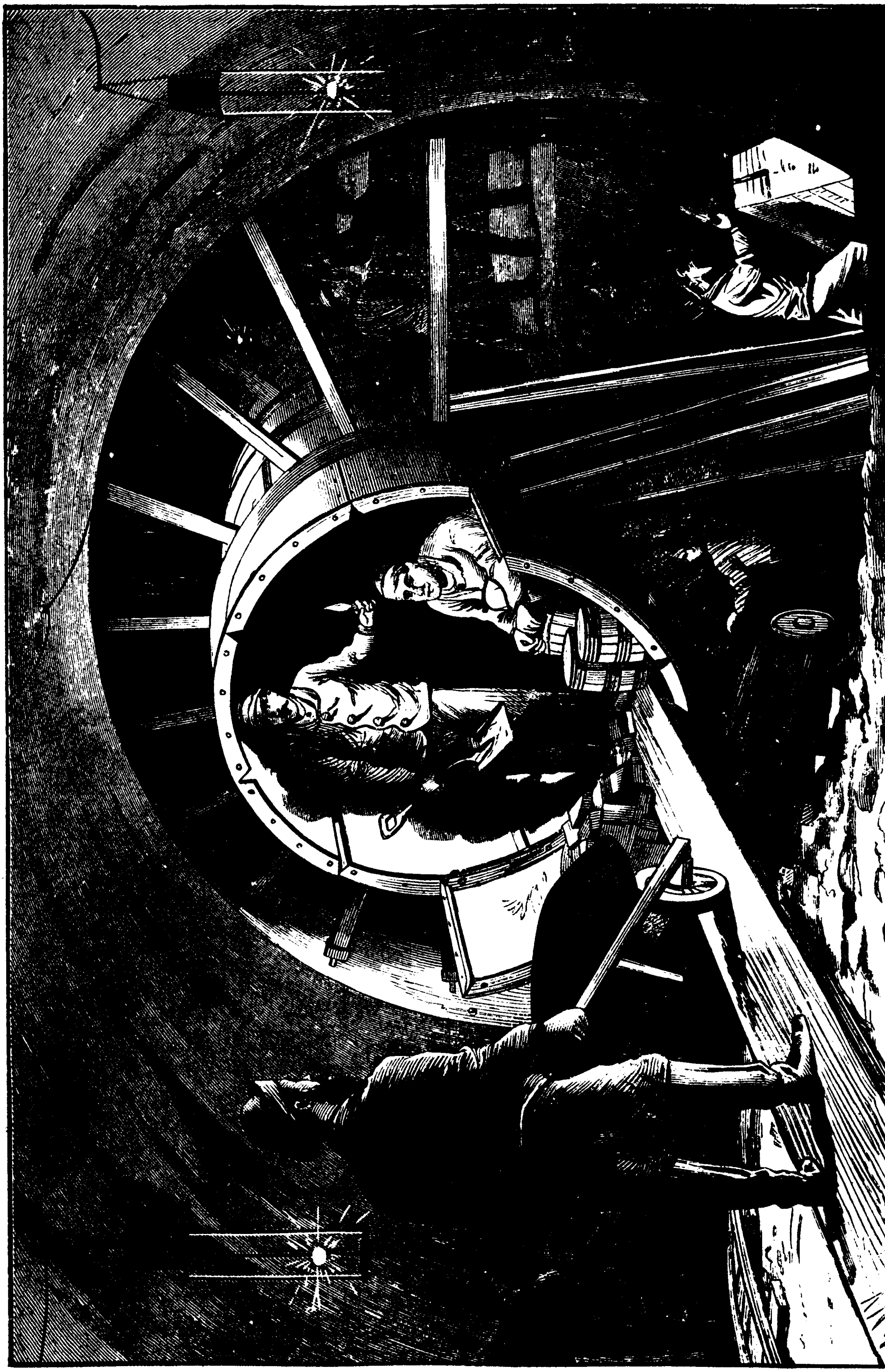
The purpose of this arrangement is to exert just as much pressure or strain of the spring, as is necessary to overcome the friction of the ring to turn, and by means of the inclined planes, instantly take up any or the least amount of space caused by wear of the valve. It may be seen clearly that this slide-valve can be considered a perfectly balanced one, and will run a considerable length of time without getting out of order, as the strain of the spring can be adjusted accurately from the outside of the steam chest without disarranging or moving a single part of the whole arrangement.

Since the above described invention was patented, a small but very important improvement, especially for locomotives, has been added to it, which consists in an also automatic arrangement to lift the top valve seat viz. cylindrical chamber from the back or top of the valve to the amount of about 1-50 of an inch, as soon as steam is shut off, for instance, when running down grade, or before reaching stations. As soon as steam is admitted again, said top valve-seat is brought back to its former and proper place. The object of this arrangement is to prevent only undue friction resp., cutting of the wearing surfaces. Another advantage of this device will be, that the lubricating oil will, by means of the suction, readily and rapidly spread over the whole surface of the valve, as well, as it will easily run down the holes and openings of, or through the valve and thus lubricate the surface of the cylinder valve seat equally as well.

E. HAUG, *Whistler, Ala.*

USE OF GLASS FOR ENGINEERING CONSTRUCTION.

A revolution in the common use of materials is promised by Mr. F. Siemens, who is at the present time making arrangements for the production in this country, on a large scale, says the London *Journal of Gas Lighting*, of his special make of toughened glass. This material has for some time been manufactured in Germany, and with the most satisfactory results; but it is believed that in England even greater facilities exist for its establishment as a regular industry. The glass is made from materials found naturally in great quantities in the neighborhood of Barrow-in-Furness, and other localities, where fuel and labor are also to be obtained on favorable terms. The method of manufacture is as simple as the reduction of ironstone, and the annealing process, instead of being a separate and costly addition to the ordinary routine, as with the system of M. De la Bastie, is as strikingly direct and economical as it is efficacious. The finished material may be made of any degree of fineness, and colored or enameled like ordinary glass, from which it differs chiefly in being practically unbreakable. Gas lamps glazed with Siemens' glass cannot be broken by the most violent storms, and pebbles thrown with force against panes will rebound harmlessly. It is said that the lamps along a promenade in Hamburg were regularly broken every winter by storms of sleet, until the tough glass was used, whereupon this destruction was no longer experienced. Other qualities of material are used for rail and water main pipes. These articles are much stronger than iron castings and imperishable and incorrodible. It is said that common castings, which are now procurable at prices which do not return the iron founder more than the barest profit or none at all, can be produced in Siemens' glass at about twice the figure, giving ample profit to the manufacturer. As the specific gravity of glass is only about one-third that of cast iron, the purchaser will be able to obtain glass articles at about 33 per cent. cheaper than similar goods in cast iron, as he will get, say, three pipes for the weight of one cast iron piece of main. It should be remarked that the Siemens' glass does not crumble to powder or break explosively when it is crushed, but cracks in precisely the same manner as cast iron.—*Industrial News.*



THE HUDSON RIVER TUNNEL.—SHOWING PILOT TUNNEL AND BRACING.

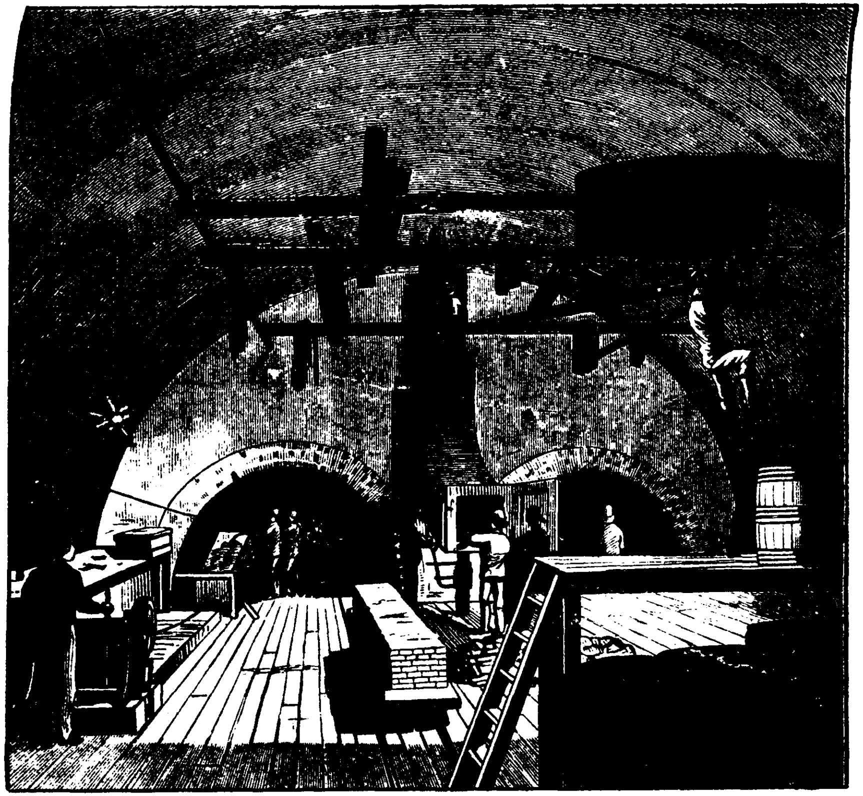


Fig. 3.—SHORE END OF TUNNEL.

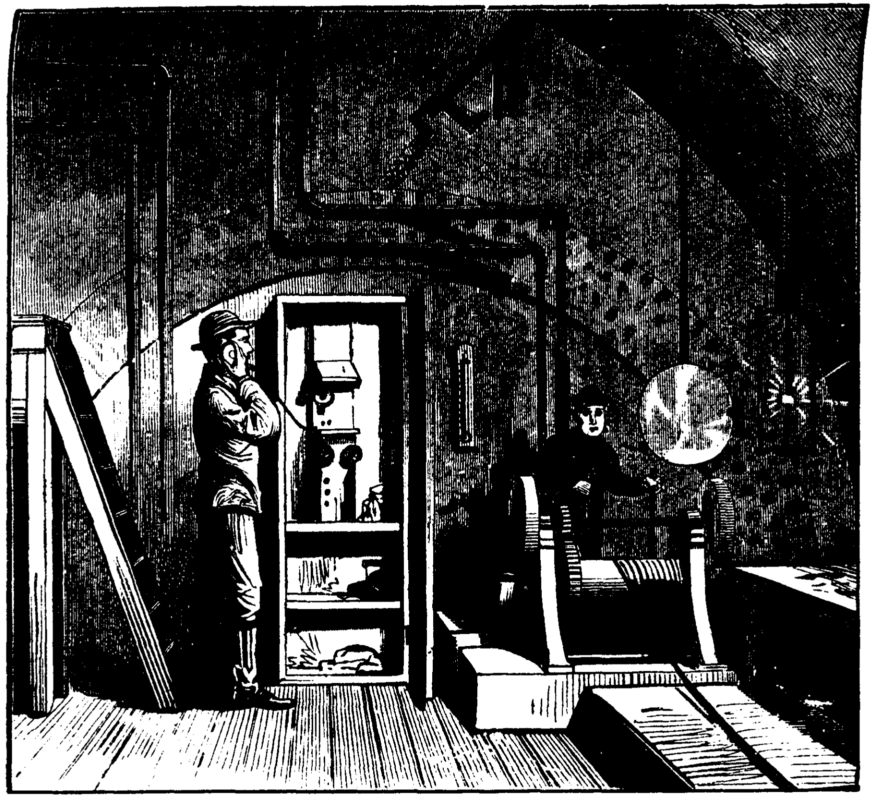
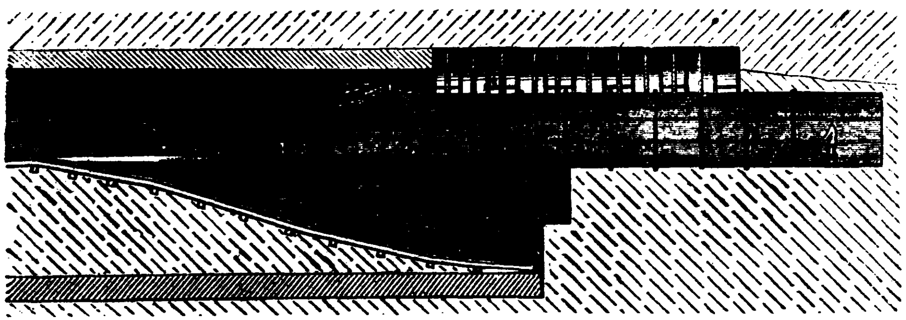


Fig. 4. TELEPHONE AND WINDLASS IN CAISSON.



SECTION OF END OF TUNNEL AND PILOT TUNNEL.

PROGRESS OF THE HUDSON RIVER TUNNEL.

The larger of the three engraved illustrations on this page shows very clearly the manner in which the work of excavation and construction is carried on in each of the two parallel drifts of the double tunnel under the Hudson River between Jersey City and New York. The smaller cut on page 356 shows a section of the same working for about 80 feet of the advanced end of a tunnel, including the entire length of the pilot tunnel. Fig. 3, is a view of the shore ends of the tunnels from the working chamber of the caisson, looking toward the river. On the right is the entrance to the upper air lock, reached by a safety shaft extending to above the level of the river. The lower air lock, communicating with the bottom of the open shaft, is at the side of the caisson near the foot of the ladder leading to the upper air lock. In the middle, between the tunnel openings, is shown the lower curved end of the chute for passing in bricks and other small materials, and which, in emergency, might serve as an additional way out for workmen. Fig. 4 represents the opposite side of the working chamber, with the telephone closet, compressed air pipes, electric lamp, windlass for operating the cable roads to the breast of the tunnel, etc. The tram cars laden with clay from the forward workings, are hauled to the shore end of the tunnel, where they are automatically dumped (as shown in Fig. 3) into the puddle underneath the floor of the working chamber. Here the clay is worked up with water to the consistency of cream and forced, by the air pressure in the tunnel (from 19 to 21 pounds according to the state of the tide) up through the blow-out pipe to the surface, where it is used for filling in low ground.

From the working chamber the visitor may enter either of the tunnels and follow the tramway to the breast, now between 450 and 500 feet distant, and advancing from 3½ to 4 feet a day. As he approaches the working end of the tunnel the roadway suddenly dips downward and the tunnel becomes a full cylinder. The guide explains the purpose of keeping the tunnel half full of clay to be two-fold—to partly relieve the strain upon the brickwork while the cement is hardening, and to furnish a broader passageway for men and materials. By this plan the full diameter of the tunnel is available for roadway.

The method of advancing the work can be described in few words when so much has been shown by the artist. The material to be removed is an extremely compact blue clay, which thus far has proved to be encouragingly free from softer streaks, seams, or other breaks, by which water can enter or compressed air escape in serious quantity. The advance is made cautiously, though, as already noted, with considerable rapidity.

First the quality and consistency of the material ahead are approximately determined by driving in slender rods of iron from the forward end of the pilot tunnel, which is 6½ feet in diameter. The breast of the pilot tunnel is kept from 15 to 20 feet in advance of the forward working of the tunnel proper. In this way any possible change in the character of the ground must be discovered before it can be a source of imminent peril to the main work. Besides, the pilot tunnel furnishes a substantial support for the braces which hold in place the advancing iron plates of the main tunnel until the successive rings are completed and the brickwork built up. The pilot tunnel is composed of ten segments or rings of stout iron plates, each 4 feet long, the whole securely bolted together and braced within by beams of wood (not shown in the engraving), to counteract the thrust of the exterior braces. This pilot tunnel is continually built up at the forward end as the clay is removed, the plates for the advancing segments being taken from the rear end, which has been passed by the advancing brickwork.

The main excavation follows the pilot in six or eight terraces or steps, and the iron shell of the tunnel is advanced section by section as the clay is removed, the construction of the rings going on from the top around the sides until each ring is completed. When four rings (or ten feet of the shell) have been completed and securely joined, the circle is bricked up and finished with a coating of Portland cement.

The visitor cannot but be favorably impressed by the excellent character of the work now being done, and by the increased care taken to reduce to the smallest the inevitable hazards of a work of this nature. Two new features in the prosecution of the work will command especial approbation. These are the introduction of solid bulkheads with double air locks near the working ends of the tunnels, and the construction of an air-light diaphragm filling the upper half of each tunnel, at a point still closer to the men engaged in excavating, plate laying, and brick laying. By means of these precautions the danger to the workmen from any possible inrush of water will be materially reduced. Work upon the bulkhead for the south tunnel is now going on, and at the time of our visit (May 17) the air locks were being put together for testing. The bulkhead will be placed at a point near where Fig. 2 begins ; and the intention is to have one of the air locks always open as a refuge for the workmen. The diaphragm will be placed near the rear end of the pilot tunnel. Its office will be to prevent the outflow of air from the upper half of the tunnel between the diaphragm and the bulkhead, should a break occur at the breast of the working, thus insuring the safe retreat of the workmen to the air lock in case of such an accident. The doors of the air locks are made uncommonly large and strong, both for the safety of the workmen and their convenience in passing through materials. By the use of these bulkheads, as will be readily perceived, the workmen in the other tunnel and at the shore ends of both tunnels are relieved of risk in case an accident occurs at the working end of either tunnel. These bulkheads and diaphragms will be carried forward from time to time as the work proceeds.

The direction and immediate supervision of this important enterprise has lately been undertaken by the favorably known engineers, Wm. Sooy Smith & Son. An early beginning on the New York end of the tunnel is anticipated.

Full particulars as to the location, purpose, magnitude, and history of this great work will be found in the volumes of the *Scientific American* for 1880. For the convenience of readers, who have not the back numbers at hand, the following facts may be recapitulated :

The tunnel is intended for railway use, to obviate the expense of transferring freight and passengers for New York arriving at Jersey City from the South and West, and also to escape the delays incident to fog and ice on the river. The Hudson at the point of crossing is one mile wide. The tunnel proper (under the river) from the foot of Fifteenth Street, Jersey City, to the foot of Morton street, New York, will be 5,550 feet in length. The Jersey City approach will probably add about half a mile to the length of the excavation. On the New York side it is not decided what the course will be—whether to a terminus somewhere on Broadway or into a contemplated system of underground roads for rapid transit throughout the city.

The work comprises, as already stated, two parallel, almost cylindrical, tunnels, each 16 feet in horizontal and 18 feet vertical diameter inside. Outside the measurements are respectively about 4 feet more, the brick wall being 2 feet thick, and the outer shell of boiler iron, one-quarter inch thick. The plates of the shell are 2 feet 6 inches wide, with 2½ inch flanges on each side, through which the plates are bolted together. The brickwork is laid with carefully tested cement. The methods of constructing the shell and laying the brick have been noticed above. In its deepest part, about 1,000 feet from the New York shore, the river is 60 feet deep. The top of the tunnel will be kept about 30 feet below the surface of the river bed. Near the New York side some rock and sand will be encountered. The rest of the way the excavation will be through the stiff clay already described.—*Scientific American.*

THE BOWER FURNACE.

In our last issue we presented illustrations and a description of the most approved form of the Barff furnace for casting iron and steel. We now present a similar series of cuts having reference to the Bower furnace. An understanding of these improved processes is of the greatest importance to stove manufacturers, and all others engaged in making ironwork, whether cast or wrought. While it is probable that the methods here described have not yet progressed beyond the experimental stage, enough has been accomplished to warrant the expectation that they will prove important elements in the manufacturing process of the future.

The Bower furnace is somewhat more complicated than the Barff, as will be seen from the cuts. The articles are first submitted to the action of the gases of combustion, mixed with a large quantity of air, and then to the action of carbonic oxide, so that an oxidation, and later a reduction, takes place. The muffle k, is made of refractory brick. Gas is made in a producer of ordinary construction, a, Figs. 2, and 4, into a series of chambers g, Fig. 2, under the muffle, from which it passes through the flues i and l into the muffle k, Fig. 1. The gases of combustion are then conducted through m, Fig. 3, into a sort of regenerator, from which they issue into the chimney flue s. The tubes in the regenerator are made of refractory material. Into the lower tier the cold air, coming from v, Fig. 2, enters, and flowing through them goes through the upper tier in the opposite direction, being heated by the waste heat of the gases of combustion. This hot air ascending through f, Fig. 2, mixes with the gases from the generator in the chambers g.

The articles, after being cleaned, are charged into the muffle, and are brought to a cherry-red heat with the aid of a slightly reducing flame, obtained by allowing less air than is required for the combustion of the gases from the producer to flow into the tubes through v. This heating period may last from a few minutes to an hour, according to the thickness of the articles. Then an excess of air is given by opening v full, and the interior of the muffle becomes clear and only small flames issue from l. This is the oxidizing period, lasting half an hour, during which a coating of magnetic oxide is formed, and below it a layer of sesqui-oxide of iron. The air valves v are now closed, and the carbonic oxide from the producers transforms this lower layer, the existence of which is fatal to success, into magnetic oxide. This method of first oxidizing and then partially reducing may be repeated until a layer of the required thickness is obtained, and it is stated that with steel very good results are obtained by a repetition at intervals of half an hour for a period of six hours.

The Bower method possesses some important advantages over the Barff in its application to cast iron, and from present information we are inclined to believe it specially promising as an adjunct in stove making. The color imparted to pieces of cast iron treated by this method is exceedingly pleasing to the eye. It is a gray or neutral tint of varying depth, that is to say, ranging between a light and a dark shade. Some of the samples that we have examined possess a very delicate color, and one which renders further ornamentation by means of subsequent treatment unnecessary. Notwithstanding the delicacy of the tint, we are informed that exposure to the influences of atmosphere and weather and the application of severe tests have no detrimental effect upon it.

THE MESSINGER BOILER FEEDER.

We show in the accompanying illustrations a boiler feeder manufactured by the Messinger Boiler Feeder Co., of Boston, Mass., which combines certain novel features of construction which are claimed to give it decided advantages over other machines of its class. We have witnessed the operation of the device, and find the claims of the manufacturers, in respect to its performance and special features, to be fully justified by the test of actual practice.

Machines of the class to which the Messinger boiler feeder belongs, and which are popularly known as injectors, inspirators, etc., are deservedly held in high estimation by steam users, and have come into very general use for feeding locomotive, stationary and marine boilers. The Messinger feeder, however, differs from others of its class in possessing certain peculiarities of construction by which its capacity, range of duty and reliability are substantially increased, and by which certain difficulties hitherto supposed to be inseparably connected with this class of machines, are obviated. These peculiar features will appear from the following description. The machines heretofore manufactured have but one inlet for the water supply, so that all the water drafted is required to be cold enough to condense the steam, otherwise the apparatus ceases to operate. The utility of this class of apparatus is, therefore, limited by reason of their inability to draft hot water, and by their liability to become heated, in which latter case they refuse to operate until cooled off, giving rise to frequent annoyance and delays.

The Messinger feeder (Fig. 1) is bored perfectly straight, and by disconnecting the apparatus and removing the spindle and cap, and turning on the steam, it can be blown out perfectly clean in a moment's time, thus avoiding the serious delays which occasionally occur with machines of complex construction whenever anything is drawn into them with the water to clog them. Again, the apparatus is not affected by a variation of 25 pounds in the steam pressure. It is furnished with a pump in the supply pipe, with which the feeder can be instantly filled with cold water should it become too hot to condense the steam, thereby doing away with all delays with a heated injector. It will draft one-third of its water boiling hot through its auxiliary draft, which does not depend upon the condensation of steam for its action, and at the same time draft two-thirds of its supply as hot as will allow of the condensation of the steam. By another attachment, the feeder will draft from two or more tanks at different levels, or draft from a depth of 25 feet and take water under a head, both at the same time; and will deliver water at different levels and against widely different back pressures, both at the same time; and will feed two boilers at the same time, whether the pressure upon them varies or not, and it is asserted to be the only machine of its class which has the double delivery, or that will accomplish these results.

The water from the overflow is not wasted, but is taken up by the auxiliary drafts, so that no water is wasted by the apparatus. The Messinger feeder will lift water from a depth of 25 feet below the level of the machine, and deliver it to the boiler and to tanks above the level of the machine, both at the same time, or to one or the other as may be desired. This feeder is not dependent on the steam pressure to lift its supply of water, as all other machines are that will draft at all from below their own level. A few strokes of the pump, which is part of and peculiar to this apparatus, will lift the water to the feeder, when it will draft from a depth of 25 feet with 10 pounds pressure of steam.

The specially meritorious features of this apparatus will be appreciated when it is remembered that other machines of its class have but one inlet for water, and on this account must draft all the water cold enough to condense the steam, and are capable of but one delivery at a time.

Fig. 2 shows the Messinger feeder piped for all the uses of which it is capable, and will be understood from the following description: A, B and C are draft pipes. A is the main suction, and through this pipe the machine will draft water from a well or tanks 25 feet below its level, or take water under a head. B is the auxiliary draft pipe, through which the machine will draft water either cold or boiling hot, as may be desired, adding one-third to the capacity of the machine, and will also draft from a depth of 25 feet. This draft may be used or not, as desired. C is a connection in the auxiliary draft pipe B, under which a pail may be set in the boiler-room, and through which the machine will draft any liquid to be put into the boiler for the purpose of cleaning, where lime or impurities exist in the water used, or for the purpose of injecting oil to stop foaming. D is a pipe attached to a drip-cup, through which all the water from the overflow is carried back to the well, or where water is taken under a head, to the tank with which the auxiliary draft B connects, so that no water need be wasted under any circumstances. E is the auxiliary delivery, through which water may be forced to a second boiler while the machine is delivering water to another boiler through its main delivery F. G is a delivery pipe which will deliver hot water to tanks in the upper stories of a building while the machine is delivering water through its main delivery F. All the water may be delivered through either E or G, or these pipes may be used without stopping the delivery through the pipe F. H is the steam pipe for supply of steam to the machine, and through which steam may be taken from boiler No. 1 at K, boiler No. 2 at I, or from both at once. M is a pump, by which the machine may be instantly started, when any condition exists which would make other machines of this class inoperative for forcing cold water into the machine when it becomes heated, cooling the machine instantly, and is claimed to be a sure means of starting the machine to draft from a depth of 25 feet under low pressure, 10 pounds only being needed, even with the water at this great depth, to set the machine in operation.

The makers of this apparatus claim for it the following qualities and advantages: They warrant it to be absolutely reliable under all circumstances and conditions; that it is the only boiler feeder of its class that is not dependent upon the steam pressure to lift its water supply at starting, or that can be started and draft from a depth of 25 feet with 10 pounds of steam pressure; that it is the only boiler feeder that has an auxiliary attachment for drafting boiling hot water, and for increasing the capacity of the apparatus at will; that it is the only boiler feeder avoiding a heated suction pipe, and that does not waste water; that can be instantly started under all conditions, and that will feed two boilers at the same time.

Among those interested in this company, we notice the names of a number of men prominently identified with important manufacturing interests, amongst whom we find the name of Wm. P. Hunt, President of the South Boston Iron Co., and the Boston Machine Co.; and Chas. Carr, General Superintendent of the Boston Machine Co., both of whom are widely and favorably known throughout New England. The Treasurer of the company is Mr. Amos L. Wood, one of the leading representatives of the mechanical arts, and who represented the State of Massachusetts in the capacity of Associate Commissioner at the Vienna Exposition in 1873.

The office of the Messinger Boiler Feeder Co. is located at 370 Atlantic avenue, Boston, Mass.

AN ELECTRIC HAMMER.

The Siemens "electric furnace" described in this number has been supplemented by an electric hammer, the invention of Messrs. Siemens and Halske, Berlin. The device consists of three hollow coils of insulated wire having a movable core or rod of soft iron which is free to move up and down under the axial attraction of the coils when a current circulates in them. The central coil is traversed by a constant current, which magnetizes the rod or hammer, and the two extreme coils are traversed by alternating currents from a dynamo-electric machine in such a manner that they alternately attract and repel the magnetic rod up and down so as to make it beat like a hammer. The range of blow is limited on one side by a spiral spring placed within an elastic cushion. Of course a very great rapidity of action can be given to the hammer, while the arrangement is apparently applicable to working a rock-drill.—*Engineering.*

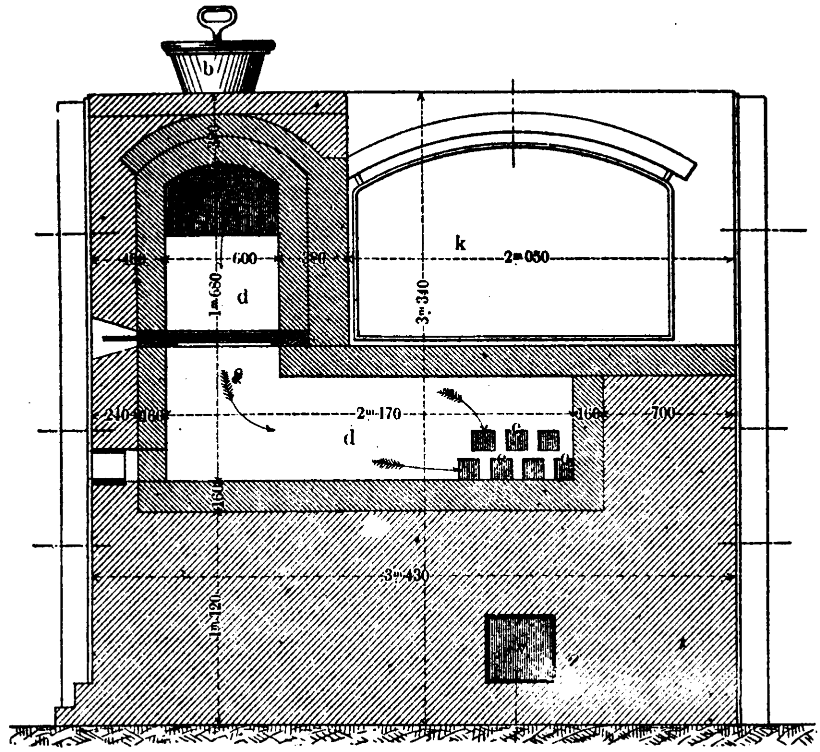


Fig. 1.—Vertical Cross Section near End.—Shown by C D in Fig. 4.

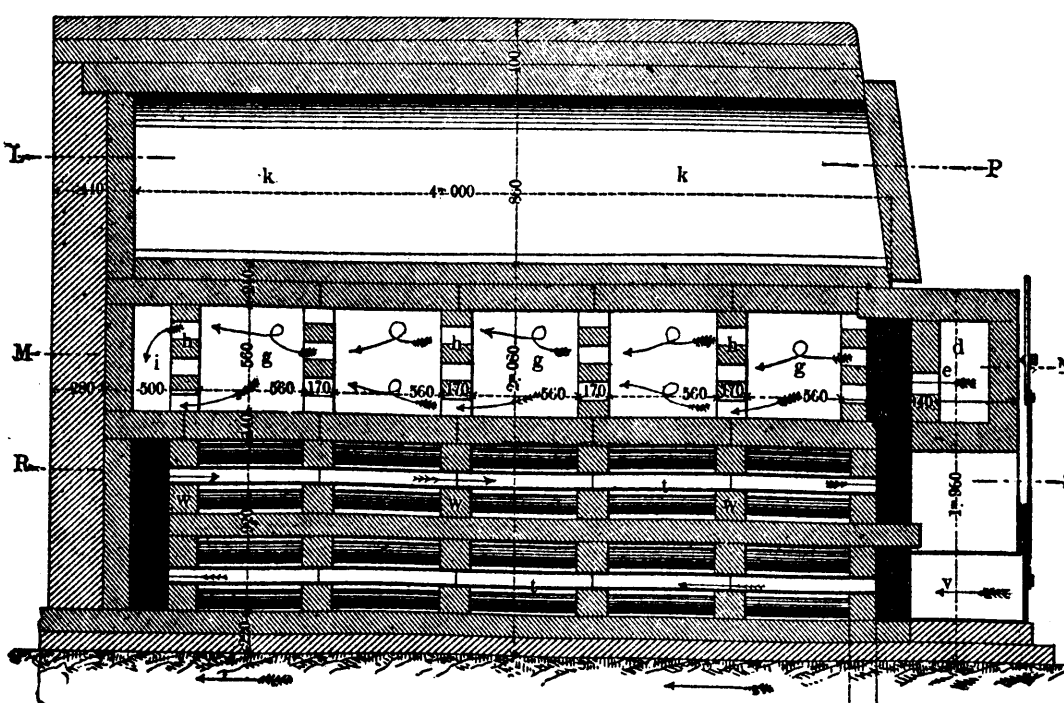
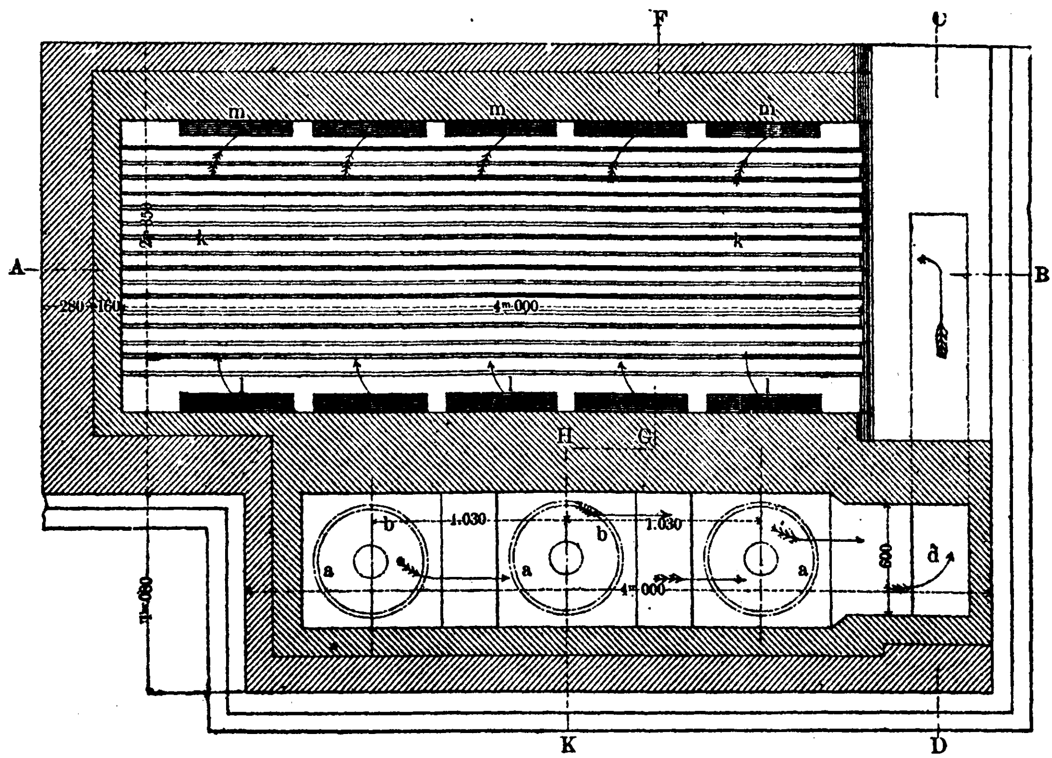


Fig. 2.—Longitudinal Section through Muffle.—Shown by A B, Fig. 4.

THE BOWER FURNACE.



Bower Furnace for Coating Iron and Steel.—Fig. 4.—Horizontal Section through Muffle, shown by L P in Fig. 2.

THE BOWER FURNACE.

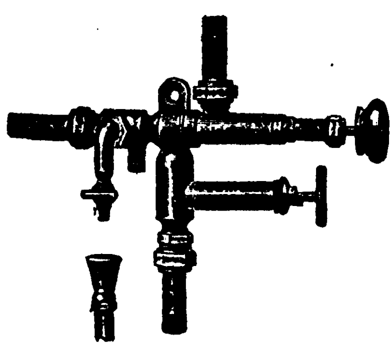


Fig. 1.—The Messinger Boiler Feeder.

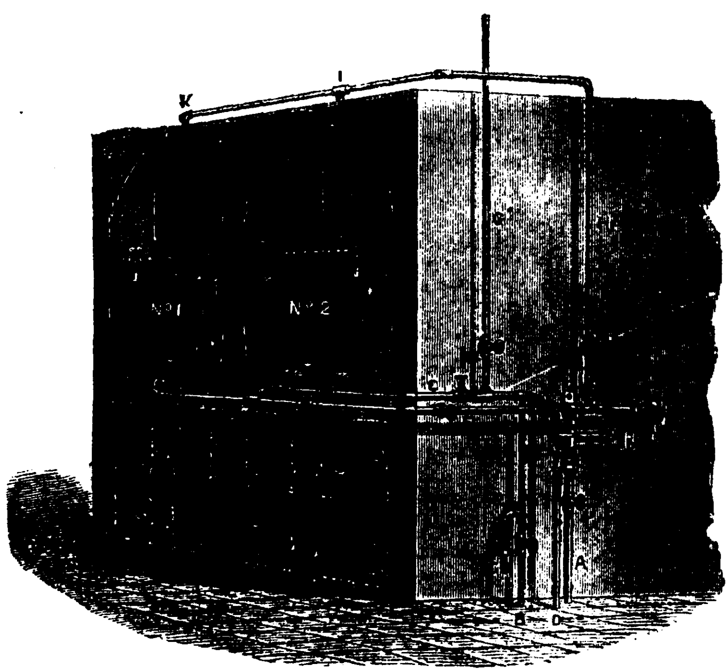


Fig. 2.—Messinger Boiler Feeder and Attachments.

Miscellaneous.

HINT TO BREWERS.

Scale in Boilers.

The number of anti-incrustation mixtures for use in boilers is so very large, and their value in most cases problematical, that every one who has had any experience with such compounds—and what steam user has not—is naturally suspicious when a new material is introduced. This, says our contemporary, *Engineering* was very much our own feeling on the subject, when about a year ago a compound called the Disincrustant Marseillais was brought under our notice. It was, however, so well recommended by responsible people, that we determined to give it a trial, and having satisfied ourselves by some laboratory experiments that it appeared at least harmless, the only acids in it being tannic and gallic acid, and the compound as such being quite neutral, we commenced using it in two cornish multitubular boilers, where New River water is evaporated. The result has been so far, after about eight months' use, entirely satisfactory. Since the Disincrustant Marseillais has been used in these boilers there has absolutely been no scale formed, all the deposit being in the shape of a fine black powder, most ofwhich leaves the boiler through the blow off, which is opened for a few seconds regularly at suitable intervals while working. Previous to employing the Disincrustant Marseillais, soda had been used in these boilers, and some of the scale then formed, particularly on the top of furnace plates, was, though thin, very hard, and had not been all removed. This the new compound has almost entirely dissolved or loosened from the plates, and although one of the boilers has been carefully examined, no signs of any injury to the plates has been discovered. The Disincrustant Marseillais has certainly, as far our experience goes, done its work well, and we understand that it is giving excellent results at sea, the makers, whose factory is at the Knowsley Works, Cheetham, Manchester, informing us that they are doing an extensive business with a number of large shipping companies, and that the compound is used also on numerous stationary boiler plants. The makers claim for their composition that after all scale has been removed from the boiler plates, a protective surface is formed, consisting of tannate of iron, which preserves the plates, and does not allow any deposit to collect on them. Of this quality we cannot as yet speak from experience. One point, however, is well worth mentioning—the compound does not appear to in any way affect the boiler fittings, while when soda is being used, particularly in excess, trouble is often experienced with leaky fittings, cocks, valves, etc. The composition is extensively used, and is exceedingly well adapted for printing works, dye works, etc., and, in fact, in every place where pure steam is of importance.

Treatment of New Casks.

New wood yields an extractive matter which imparts an unpleasant flavor to beer, and it is therefore advisable to submit new casks to some kind of "sweetening" treatment. For this purpose many substances have been recommended, but as the extractive matter is no doubt of an astringent nature, and possesses slightly acid properties, an alkaline liquid is the proper remedy. E. Bibra, in the *Journal fur practische Chemie*, recommends the following method: One pound of soda crystals is used for every 10 gallons of the capacity of the cask, and this is dissolved in a small quantity of soft water; the cask is two-thirds filled with soft water, and then the requisite quantity of soda solution is added; after thorough agitation, the cask is completely filled with water and bunged down; after standing for ten or twelve days the alkaline liquid is run away, and the casks rinsed several times with water. The author found that by this treatment the staves were completely exhausted of all extractive matter to a depth of about a quarter of an inch, and beer or wine might at once be placed in such casks without fear of being contaminated with any objectionable flavor.—*County Brewers' Gazette, (London).*

FILTERING CAPACITY OF SOILS.

The National Board of Health has just published, in the form of Supplement No. 13 to its Bulletin, a very interesting report on the relation of soils to health, and more especially on the filtering capacity of soils, prepared by Prof. Pumpelly, of Newport, assisted by Dr. George A. Smyth. The first part of the report relates to the effects of various soils and substances as filters to remove low vegetal organisms from air, the substances tried being sand of various degrees of fineness, asbestos and charcoal, and the conclusions are as follows:

"I. All the substances operated on are excellent filters in eliminating germs from *infected air* passed through them, except when they are of a coarse grain, 10° to 20°, when the interstitial cavities become probably much less labyrinthine. All these filters withstood the tests of currents having many thousand times the maximum velocity attained in the soil.

"II. All natural substances tried thus far, except the finest animal charcoal, and, perhaps, tightly-packed asbestos, failed to eliminate wholly the germs from liquids.

"In the only natural soils tried, the sand, loess and kaolin, we find in the sand an absolute absence of filtering power as regards germs in water, which would probably be as evident in columns of 10,000 feet as of 100 feet. In the loess, and in the much more compact kaolin on the other hand, there is evidence of a greater filtering power. In these cases it is not unlikely that we shall find that somewhat longer columns will eliminate the germs from the first water passing through; and that with them the filtering capacity is merely a question of the relation of length of column to the amount of water.

"At this point in our work, it seems as though the filtering capacity were wholly dependent on the size and interstitial cavities; and that in dry air filters there is a critical limiting point, beyond which there is no filtering.

"And the same remarks seem to be true in different degrees with regard to the filtration of liquids. Here far greater fineness and compactness of grain and intricacy of passage are needed than are requisite for air filtration. While sand of 20° is an excellent air filter, sand of 100° in long columns is worthless for water, and the critical limiting point below which soils begin to exercise any filtering action probably verges on the size of grain in an impalpable powder.

"*From these results it appears very clearly sand interposes absolutely no barrier between wells and the bacterial infection from cesspools, cemeteries, etc., lying, even at great distances, in the lower wet stratum of sand. And it appears probable that a* DRY GRAVEL, *or possbily a* DRY, VERY COARSE SAND, *interposes no barrier to the free entrance into houses built upon them, of these organisms which swarm in the ground-air around leaching cesspools, leaky drains, etc., or in the filthy made ground of cities.*

"And from the results obtained from the two series of experiments, viz., in filtering air and in filtering water, we can now draw one very important practical conclusion, which cannot be too strongly emphasized: *That a house may be built on a thoroughly dry body of sand or gravel, and its cellar may be far above the level of the ground water at all times, and it may yet be in danger of having the air of its rooms contaminated by the germs from leaching cesspools and vaults; for, if the drift of the leaching be towards the cellar, very wet seasons may extend the polluted moisture to the cellar walls, whence, after evaporation, the germs will pass into the atmospheric circulation of the house.*"

The italics are given thus in the original. The report is illustrated with drawings of the apparatus employed. We shall probably have occasion to refer hereafter to that part of it which relates to the filtration of fluids; at present we will only note that it confirms the results announced by Carmichael and Werenickle, of the effect of traps upon the organisms in sewer gases. *Sanitary Engineer.*

Are They not Artists?—A correspondent of the Germantown *Telegraph*, after alluding to the grand painting, superior sculptures, etc., results of the genius of our highest artists, asks: "Are there not others, also, whom we may call artists? When," continues the writer, "I stand among a lot of common stone masons and see one man walk around among the stones, picking one out here and there, dressing one here and there, just as though he were playing, and then suddenly begin to set them up as fast as he can handle them and the mortar, making a handsome wall, I call him an artist. If we look at a man hewing a log straight and smooth, alike in thickness the whole length, and not leaving a mark of the juggling axe, he too seems to me is entitled to the above name. Or a man, who cannot even write his name, bracing himself aside of a huge tree, and sending his axe into it with the precision of a rifle shot, making every stroke tell, and never missing the mark, and when cut in one side changes hands on the axe and cut the other, and throw the tree just where he wishes it to fall—he, too, is not devoid of artistic skill. And many a common blacksmith, who will forge out a piece of iron or steel as round as if it had passed through the turner's hands, or as square as if ran through the planing machine—I count him among the artists. Yet none of these men are ever classed with those of the higher arts."

Astronomy and Geology.

COMET TELEGRAPHY.

In a special circular issued by the *Science Observer* the announcement is made of the receipt by cable of the elements and ephemeris of Swift's comet (*a* 1881), as computed by Drs. Copeland and Lohse at the Observatory of Dun Echt, in Scotland. The experience with Swift's periodical comet of last year, which was not seen at all in Europe for nearly a month after its discovery, owing to the moonlight and a total inability to determine its position after the moon had gone, was useful. It was an experience which involved the loss of many observations before perihelion passage, and caused the Boston Scientific Society to adapt a code to the telegraphic transmission of astronomical intelligence, and the first test of this code has just been made. The *Science Observer*, published by the society, has for the past three years issued special circulars by mail to American astronomers and observers, containing the elements and ephemeris of each new comet when the date could be obtained, and Lord Crawford has made a similar distribution of circulars by mail from his observatory at Dun Echt to the English astronomers. It was, therefore, agreed that as a test of the code, the elements and ephemeris computed at each place should be cabled to the other; the Boston data to Dun Echt, and *vice versa*.

The elements from Boston were sent across a few days ago, and those computed at Dun Echt have just been received at Boston, and form the subject of a special circular of the *Science Observer*. As a proof of the adaptability and utility of this astronomical code, both the original message and its translation are given. By the same code the announcement of a comet, which now requires a message of sixteen words, with a liability to error, can be condensed into seven words, five of which are necessary and two of which serve as check words to correct any possible error that might occur in the other five.

The elements and ephemeris computed at Dun Echt, on Monday, May 9, were transmitted by cable to Boston in the following message: Decimosexto erective contextual bewitchery anticly demonstrative courageously sputter arithmancy stomachical auriferous suety bayou synecdochically bissextile eminently." The translation of this message is h rewith given.

ELEMENTS OF SWIFT'S COMET, 1881 (*a*).

Per. Passage. 1881, May 20, 67, Greenwich Mean Time.

	°	′	
Long. Perihelion....................	300	2	Eq. 1881.0.
Long. Node..........................	124	54	
$w=n-O$.............................	175	8	
Inclination..........................	78	48	
Log. $q=9.7674$.................... $q=5854$.			

Motion direct.

EPHEMERIS.

Greenwich, midnight.	A.R.	Decl.	Brightness.
	h. m. s.	° ′	
May 10,	0 38 32	+26 46	1·69
14,	56 48	21 35	
18,	1 17 32	15 54	
22,	40 48	9 55	2·32

Computed by Dr. R. Copeland and J. G. Lohse, from observations made at Dun Echt Observatory. The light at discovery is taken as unity.

To astronomical people the translation will, of course, be of scientific value and interest; but a friend at our elbow says he is willing to wager a hat that the majority of readers will understand the telegraph message better and regard it with a deeper interest than the translation.

PHENOMENON PRESENTED BY VORTEX-RINGS.

Our readers are all familiar with the peculiar appearance of vortex-rings, as they frequently result from the discharge of cannon or from the sudden discharge of steam through an open top locomotive stack. Professor A. E. Dolbear, of Tuft's college, Mass., has been making a careful study of the peculiar phenomenon, connected with these rings, and to facilitate his study has improvised a very simple apparatus for their production, which may easily be constructed by any person who may be interested in this curious study. We copy from *Science*:

1. If one vortex-ring strikes another vortex-ring upon the edge the two rings will bound away from each other as though they were solid elastic bodies, each one vibrating as it recedes.

2. If one vortex-ring overtakes another ring, both moving in the same straight line, and both are of the same size, then the forward one will expand in diameter, and the latter will contract in diameter and will go through the forward one, when each will return to its original dimension. At the same time the forward one will have its velocity retarded while the other will have its velocity increased, and it may overtake the forward one and go through it.

3. If a vortex-ring passes near any light object, as, for instance, a silk thread suspended, or better still a small cloud of smoke or ammonium chloride dust, the latter will be seen to be apparently repelled from the front of it, but attracted and drawn into the ring from the rear.

4. If a vortex-ring be projected parallel with any surface, and at not too great a distance from the surface, the ring will move in a curved path towards it and strike it.

5. If two vortex-rings are projected so as to start in parallel lines near to each other, they will approach each other until they touch, when they may be either broken or else bound away from each other as in the first case above.

6. If two vortex-rings having the same rate of rotation be started in lines parallel to each other, and at not too great a distance apart, they will not only approach each other, but *they will combine to form one ring*, which continues to move in the same direction.

7. The combination is effected by the breaking of each at the point of contact, and the welding of the opposite parts of each ring to form one ring with twice the diameter. 8. These rings may in like manner be combined into one.

9. The structure of the vortex-ring is concentric, that is, a cross section of a ring generally shows a series of several concentric circles, with a hollow center. The middle of the ring appears to be a cylindrical unoccupied space.

As experimental work with such rings is very entertaining, as well as suggestive of the behavior of the real atoms of matter, it may be well to give the simple instructions necessary to perfect success.

Provide a cubical box with dimensions about a foot each way, having a swinging back frame, over which is stretched a piece of stout cotton cloth. On the opposite side, two or more inch-holes may be bored two inches apart. Pour some strong hydrochloric acid into one saucer, and some strong ammonia water into another. Set the two into the box, and shut down the door. The box will at once be filled with the white fumes, and a tap with the finger upon the cloth back, will send out well formed rings.

The phenomena one to five, can best be seen by employing only one of the holes, so as to form but a single ring. By striking the cloth a little harder the second time than the first, the second ring may be made to overtake the first, and if it is desirable to exhibit the rings to a room full of people, there should be but a single hole in front, and that one about three inches in diameter; the rings can then be projected with force enough to make them go 10 or 15 ft. from the box.

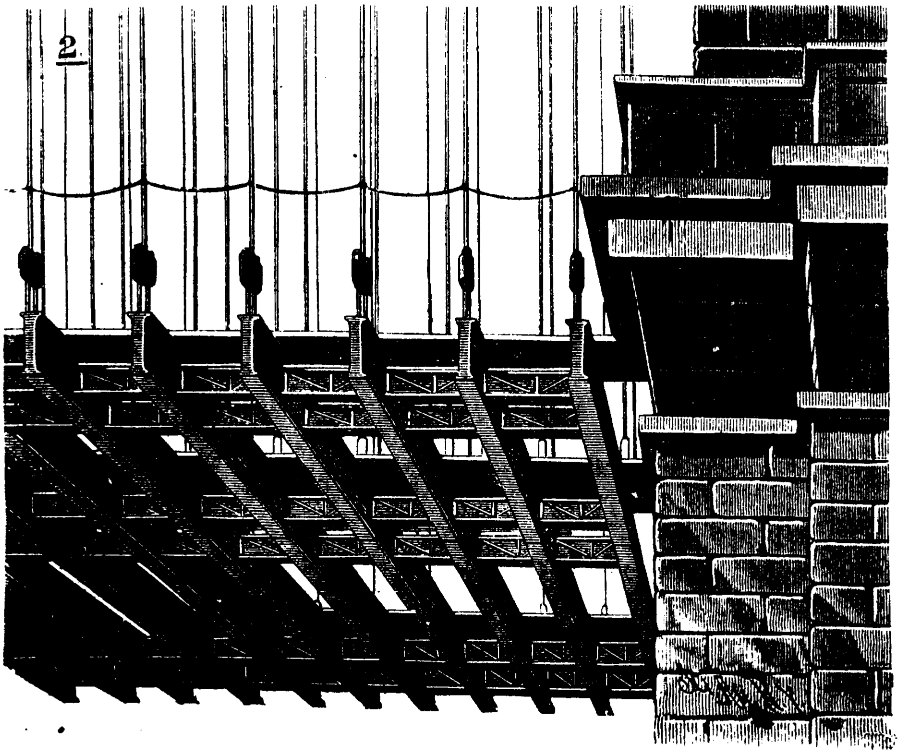
The other phenomena can best be studied by using only small holes, and tapping gently. The rings will come together within a few inches of the box. It seems to be essential that the two rings that combine, should have the same *rate of rotation*, a matter easily secured by forming the two at once in the above described way, but well nigh impossible, if one is formed after the other.

It is sufficient now to remark that the new phenomena described above, stimulate in a very striking way, what we call gravitation and chemism.

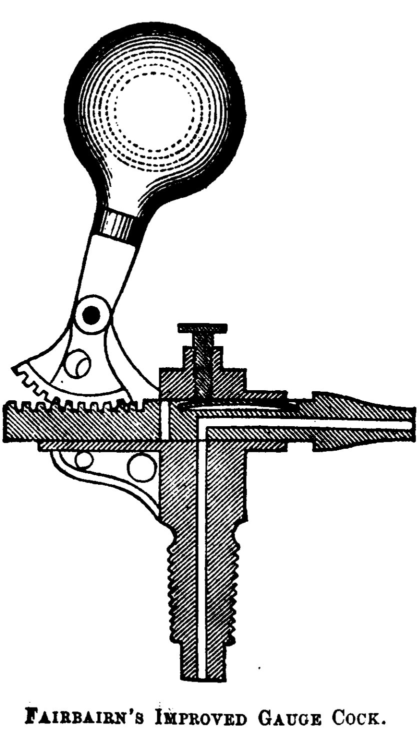
DISCOLOURED BRICK WALLS.

The white saline substance that "comes out" upon brick walls and which has been a source of annoyance to a great many, may, according to the *American Architect*, be remedied. In reply to a query on the subject, it says: The "saltpetring" of brickwork can generally be prevented by adding oil to the mortar, at the rate of a gallon to the cask of lime. If cement is used in the mortar, an additional gallon of oil must be allowed for each cask of cement. Linseed oil is generally employed, but any kind which does not contain salt will answer. The incrustation once formed, can be removed with hot water, or by the muriatic acid generally used for cleaning down brickwork, but it will reappear again by exudation from the interior of the wall, and usually leaves a permanent black or brown stain.

M. Philippart has written to M. Berger offering to place a large sum at his disposal for the best system of transmitting electric force to a distance shown at the forthcoming exhibition in Paris.



THE BROOKLYN SUSPENSION BRIDGE.—THE FLOOR BEAMS FROM BELOW.—(SEE PAGE 196.)



FAIRBAIRN'S IMPROVED GAUGE COCK.

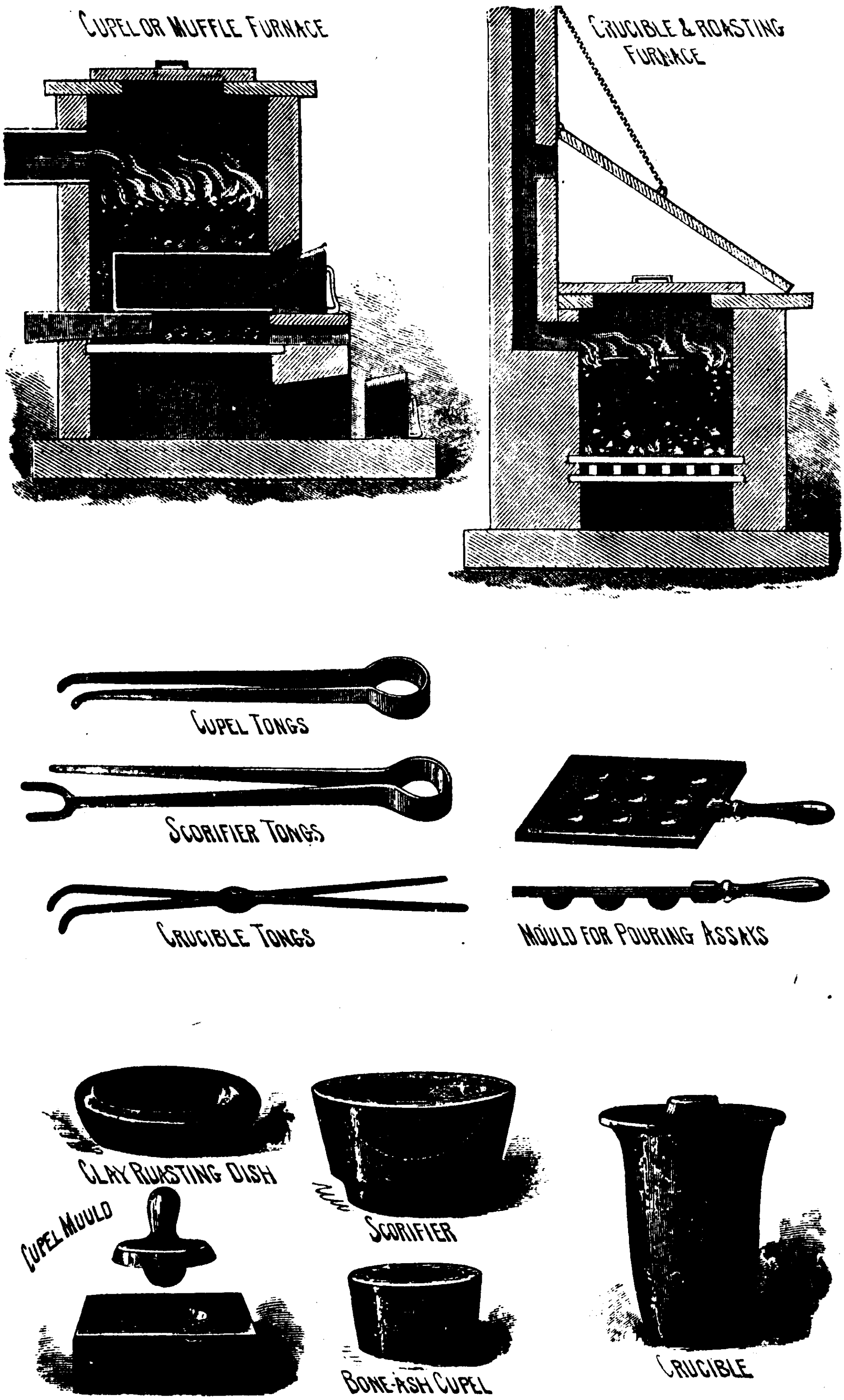
THE FAIRBAIRN GAUGE COCK.

The gauge cock for steam boilers shown in half section in the annexed engraving, is a very simple and practical device, embodying certain radical changes in its construction which give it special merits worthy the attention of steam users. It is readily opened, and is self-closing; no packing is required about it anywhere, and it can be cleaned out while steam is in the boiler, without burning the hands or face. This last feature is a very important one, as there is nearly always more or less deposit or sediment in the water used in steam boilers, and the gauge cocks are very liable to get stopped up, thereby cutting off the means of ascertaining the height of the water in the boiler, and, in fact, becoming a source of danger.

In the Fairbain gauge cock the danger from this source is overcome by a very simple and effective process. All that is necessary to be done in such an emergency is to give the little thumb-screw three or four turns, releasing the spring, which allows the handle to be raised high enough to bring the upper hole in the piston down opposite the connection to the boiler and even with the thumb-screw, which has a hole through it, thus making a direct connection to the boiler. A wire can then be pushed clear through into the boiler, and after the passage is cleared the handle can be dropped down, cutting of all escape of steam, the screw-thumb can be turned up, and all is perfect again.

The construction of the apparatus is shown very well by the cut. The ball seen on the right is of cast-iron, and may be placed directly in front or at the side, as may be preferred. The body of the gauge and the piston are made of brass or bronze, to avoid abrasion. The piston slides up or down by a movement of the ball, and except the latter is lifted by the hand, the cock is positively closed. Lifting the ball throws the pipe down and connects directly with the water in the boiler, allowing it to discharge at the bottom, and the water cannot fly out all about it in the face of the operator. The illustration shows the ball partially raised, and the connection with the water in the boiler is open. This gauge has been in use several years on both stationary and marine boilers, with entire satisfaction.

Parties wishing further information respecting this device are invited to communicate with the manufacturers, the New England Gauge Co., 13 Doane street, Boston, Mass.



APPARATUS FOR ASSAYING.

Mining, Metallurgy, Mineralogy

ASSAYING

THE ASSAYING OF GOLD AND SILVER ORES.

A ton of rocks containing one thirty thousandth its weight of gold, or one fifteen hundredth its weight of silver, can in many instances be worked profitably; this is something like one fiftieth of a grain of gold or four grains of silver per pound of rock or ore. A quantity so small, even if in the metallic or free state when diffused through the rock is difficult to detect with any degree of certainty by any physical examination or blowpipe test. Chemical analysis by the wet way is in this connection too slow and expensive, and without the greatest care and most expert manipulation the quantitive results in the case of poor ores are apt to be uncertain. The fire assay is by far the most expeditious, certain and inexpensive method of testing such ores, as well as of quantitatively determining their value.

The apparatus and materials requisite in assaying are as follows:

A balance for weighing ores and fluxes, sensitive to a grain, with a weight of three ounces on each pan, with box of weights.

A finer balance, sensitive to one tenth milligramme, with a weight of one gramme on each pan, with box of weights.

A small crucible or melting furnace, with hood to carry off the fumes produced in roasting ore.

A cupel or muffle furnace.

Crucible, scorifier, and cupel tongs, muffle cleaner, poker, and shovel, and stone hammar.

Brass moulds for making cupels.

Large iron mortar and pestle for breaking and grinding ores. Fine work with very hard ores also requires an agate mortar and pestle.

Brass wire gauze sieves—80, 100, and 120 mesh. Small spatulas, camels hair brush, and glazed paper.

Iron pans for roasting.

Tin samplers.

Moulds for pouring scorified charges.

Crucibles, scorifiers, annealing cups, parting flasks, and test tubes.

Silver foil, lead foil, granulated lead, litharge, floured charcoal, argol, niter, borax glass, boracic acid, bicarbonate of soda, salt, carbonate of ammonia, fine bone ash, and white silicious sand (silica), nitric acid (pure).

The first requisite in any assay is that the whole of the ore or rock to be tested be reduced to a uniformly fine powder or flour and separated from metallic scales or particles, if there be any. This is usually accomplished by breaking with the hammar, and then completing the reduction in the mortar or beneath a muller. The sample in process of reduction is from time to time thrown on the sieve to separate the finer portions and avoid the inconvenience and loss by dust. If any of the metallic particles or scales remain on the sieve these must be weighed and assayed separately, the results first proportioned to the weight of sample of ore taken being added to the results from the powdered ore assay.

The powdered ore should be well mixed together and weighed, then sampled. A handy sampler is made of three or four semi-cylindrical tin troughs cast six or eight inches long, about three-fourths of an inch in width, and one inch deep, placed parallel at a distance equal to their width, and soldered at the ends to a tin or wire frame or support. When powdered ore is sifted over this half falls through the openings, the other half being retained in the troughs, and the portion caught may in like manner be further divided, so that a large sample is reduced to one of suitable size for assay, the small sample correctly representing the large.*

The method of assaying depends much upon the character of the ore and gangue. If the ore contains any considerable quantity of sulphides, arsenic, or antimony it should be roasted. This is usually performed by spreading the weighed sample of ore on an iron pan, previously coated with oxide or iron or chalk, and gradually heated under a hood to low redness until all fumes cease. Carbonate of ammonia and powdered glass or sand is sometimes added to hasten or complete the action and prevent fusing or agglutination.

The scorification method is preferable in most cases where it can be applied, but owing to the limited quantity of ore that can be conveniently operated upon in this way its use is restricted to comparatively rich ores. Poor or presumably poor ores are best treated in the crucible which permits the working large samples.

*All assays should be made in duplicate to check any error.

With regard to fluxes, litharge (the yellow oxide of lead), carbonate of soda, and borax are the most important. Charcoal and argol as reducing agents, and niter as an oxidizing agent, are used in connection with them. Salt is used as a cover or wash in the crucible. Lead or its oxide, which is a powerful flux, plays a very important part in the gold and silver cupellation assay. In the crucible assay the oxide (litharge) is always used. The ore or the reducing agents mixed with the fluxes react upon it in such a manner that a portion of it is reduced to metallic lead, which, as the contents of the crucible becomes liquefied by heat falls by reason of its greater gravity to the bottom of the vessel, washing down and alloying with the liberated particles of precious metal, so that when the crucible has been cooled aud broken a button of lead is found at the bottom, and this button, if the assay has been properly conducted, contains all the precious metals.

In the scorification the metallic lead exposed to a current of highly heated air is partially converted into litharge, which, acting as a flux, liquefies the ore, the liberated gold or silver alloying themselves with the unchanged portion of lead at the bottom of the scorifier.

In the crucible assay the following proportions of flux will be found to work well with most quartzose ores:

Ores	1 A. T.
Litharge	2 "
Bicarbonate of soda	1 "
Argol	2½ grammes

Too much argol will produce too large a button of lead, and too small a quantity the reverse, or none at all. The ore itself acts as an oxidizing or reducing agent in many cases. The use of oxidizers, such as niter, in the crucible are objectionable, and careful attention to the preparatory treatment or roasting will, in most cases, dispense with the necessity of their use. Experience alone enables the assayer to judge of the oxidizing or reducing powers of the ores and the proper proportion of reducing material. Charcoal or flour or mixtures of these may be employed instead of the argol. These reducing agents should be in the finest state of division, and free from lumps and thoroughly dry. This applies equally to all the fluxes. Ores containing much limestone require a considerable addition of borax silica or borax acid (anhydrous); a similar addition to the charge is necessary if the ore be argillaceous—that is, slaty or earthy.

The ore and fluxes having been weighed out they are thoroughly mixed together and put into a dry and warm sand crucible, and covered with about one-quarter inch of dry salt loosely packed down. The crucible is then put into the melting furnace and covered with a good fire. Twenty minutes to half an honr is usually sufficient to accomplish the thorough decomposition and fusion of the ore, and the crucible is removed as soon as its contents are found to be in a state of complete fusion. It is allowed to cool thoroughly, then broken, and the button of lead at the bottom removed and cleaned by hammering it on an anvil. The appearance of the slag will indicate whether or not the decomposition and fusion were properly completed. The button of lead is put aside for cupellation (or scorification if necessary).

For the scorification assay the following charge will in most cases suffice:

Ore	3-10 A. T.
Granulated lead	3 "
Borax	q. s.

Two or three pieces the size of peas are usually sufficient. The ore is mixed with part of the lead in the bottom of the scorifier, the rest of the lead being poured over the top and the fragments of borax placed on top. The scorifier must be large enough to admit the charge without filling it. When placed in the muffle, properly heated, the lead and borax melt, the surface of the former by contact with the air becoming converted into liquid litharge, which with the aid of the borax fluxes the ore, forming a ring of liquid slag, which finally covers the whole surface of the lead. As soon as this takes place the vessel is removed from the muffle and its contents dexterously poured into the iron mould, where it quickly chills, and the lead button is removed and cleaned by hammering. If the buttons are too large to be admitted to the cupel (which should weigh at least as much as the button) they must be scorified down; that is, placed in a scorifying dish and exposed in the open muffle. The hot air oxidizes and slags off the lead, and on pouring and cooling this may be separated from the reduced button by pounding as before; in many cases it separates itself.

When the button is of proper size it is dropped into the bone ash cupel, thoroughly dried and heated to bright redness, where it melts, and as the hot air converts the lead by degrees into liquid litharge, and this latter is absorbed into the porous cupel, the button decreases in size until the last of the lead is slagged off and there remains in the bottom of the cupel only the fused bright button of gold or silver or any alloy of these. By too high a heat or overlong exposure in the crucible there is apt to be a loss of silver through volatilization. If too low a heat the litharge is imperfectly absorbed by the dish and the button solidifies ("freezes").*

Gold is nearly always found associated in ores with silver, and the button or bead obtained from an assay usually requires "parting;" that is, the separation of these metals. The button having been carefully weighed is treated with pure nitric acid diluted with half its volume of water, and heated to boiling in a test tube or small parting flask. If the proportion of silver is not less than three to one of gold all the silver dissolves in the hot acid, the gold remaining as a dark spongy mass. If less than this proportion of silver is present the gold protects it from the proper action of the acid, and the silver dissolves out slowly, or not at all. In this case—and a little experience enables the assayer to judge from the color of the button whether enough silver is present or not—silver must be added. Enough silver is cut from the silver foil, wrapped about the button, and this in turn placed in a small cornet of lead foil and placed in a clean hot cupel, where it melts and alloys; the lead soon slags out and the button is ready for the parting in acid as described.

The gold sponge or particles of gold powder obtained in parting is washed by decantation with hot water in a test tube. While the tube is filled with water a small annealing cup or porcelain crucible is placed with its mouth over the tube or flask, which is then quickly inverted, so that the fine gold falls to the bottom of the cup or crucible. By immersing this and the mouth of the flask the latter may be removed without disturbing the gold, which after decanting as much of the water as possible is dried at a gentle heat, then heated to redness to give it coherence, cooled and weighed.

The greatest care is necessary in weighing assay beads of gold and silver, as, owing to the value of the substances weighed, a very small error may make a great difference in the results.

The decimal or French system of weights are commonly employed in assaying. The *assay ton* is intended to simplify and facilitate the final calculations; the ratio which an A. T. bears to a milligramme is the same as that between a ton (2,000 lb. avoir.) and a troy ounce, so that if one A. T. sample of ore is assayed and found to contain one milligramme of gold or silver it is known at once that a ton of rocks contains just thirty ounces of the metal.

The weight of gold found as above deducted from the weight of the bead before parting (or adding silver) corresponds to the weight of silver.

One ounce of pure gold has a value of twenty dollars and sixty-seven cents. The ounce of silver is worth about one dollar and fifteen cents; it varies with the market.

As nearly all commercial samples of lead and litharge contain traces of silver, those intended for use in assay should be carefully sampled and assayed, due allowance being made for silver found in calculating results.

SUSPENSION BY SUBDIVISION.

The fact that substances which are quick to obey the universal law of gravitation when in a mass, are apparently lighter when in a state of fine division, will doubtless strike most persons as singular when they consider that the relative amount of air displaced by each part of a substance must be the same whether the part be large or small; while to make a body really alter its weight compared to air, it is necessary that the relation between its weight and bulk should be changed. Its specific weight has clearly not altered. How then is the suspension of finely divided substances to be accounted for, if the same subdivisions be collected into a mass, they will rapidly fall; and also in view of the fact that the force of gravitation acts upon each particle without regard to its neighbors, and will exert its powers whether the particles are separate or aggregate?

It is easy to understand, for example, why a sphere of wood will fall more slowly than a sphere of lead of the same size, the wooden one presenting such a relatively greater resisting surface to the air compared with its weight than the one of lead.

Let us see, therefore, whether the mere act of dividing a substance can alter the relations of weight and resistance surface so as to permit an explanation of this phenomenon.

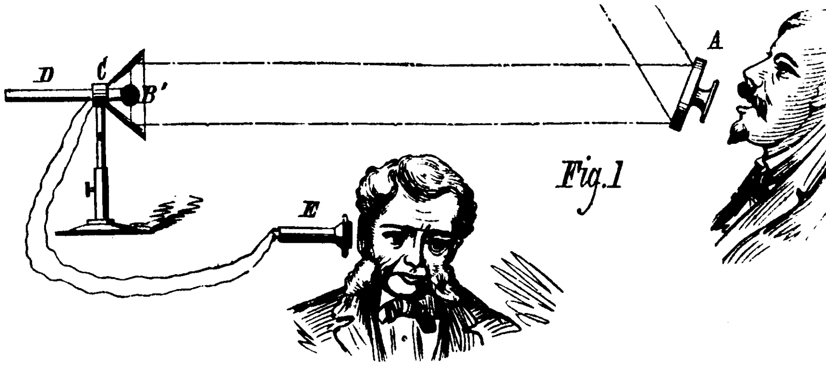
If two spheres of lead or other homogenous substance, having the respective diameters of one and ten, be weighed, it will be found that their weights are related to each other as the *cubes* of their diameters, or as one to one thousand, while the relation between the areas of their great circles or surfaces of resistance are as one to one hundred, or as the *squares* of their diameters, thus making the resistance of the air relatively greater in the case of the smaller body.

Now, although only liquids resolve themselves into spheres when divided, yet this reasoning may be regarded as approximately true of the irregular subdivisions of solid bodies, while the levity of fog and clouds will be more comprehensible. This principle is, of course, applicable to solids immersed in liquids, and also to the ascension of bodies of less specific weight than the fluids in which they are immersed. As the text books do not explain this common phenomenon, I thought that the above might prove interesting. WM. B. COOPER.

THE ROMAN VILLA NEAR BRADING.

The work of exploring the Roman villa near Brading, in the Isle of Wight, is now proceeding with undiminished interest and spirit. The measures taken for protecting the remains from the severe frosts of last winter have been entirely and almost unexpectedly successful. No pains or expense were spared by the explorers (Mr. John E. Price, F.S.A., Mr. F. G. Hilton Price, F.S.A., and Mr. Brabrook, F.S.A.) in covering in effectually the buildings exposed to frost, and the result is that nothing whatever has been injured. With regard to the development of the ground plan of these extensive buildings, the following further discoveries have been made. The angle of wall erected a few feet to the east of the semi-circular structure between the principal room and the hypocaust has been determined to be an external wall of the building, as it is met by the undisturbed soil. The furnace in the wall of the hypocaust has been found in excellent preservation, being an arched passage formed of large tiles with layers of mortar. Several additional rooms, making now altogether 25 in number, have been traced, and the walls excavated. The central space has been determined to have been uncovered by buildings forming a garden of considerable extent. One of the new chambers excavated has at its south-west corner an apse of 6 ft. diameter, and at its north-eastern end a deep pit or well. This seems to have been formed without steining out of the hard sandstone, is about 4 ft. in diameter, and has been excavated to a depth of 25 ft. At a depth of 14 ft. the skeleton of a young person was discovered, which presented in several bones the appearance of severe injury during life. The bones have not yet been submitted to anthropological examination, but peculiarities in them, such as the size of the supraciliary prominence, seem to afford ground for interesting speculation. The teeth of one jaw were perfect, beautifully white and pearly, showing no sign of decay. And beneath an immense semi-circular stone, 5 ft. 6 in. by 3 ft. 9 in., had forced its way down the well, showing on the hard sandstone the path it had scooped out for itself. The raising of this stone was a matter of some difficulty on account of its great weight—over 5 cwt,—but it was successfully carried through by Jackson and the other highly intelligent workmen who are employed on the excavations. The same well or pit yielded a large number of tiles in perfectly unbroken condition of various sizes from 8 in. to 22 in. square. These had probably formed part of the flooring of the room. Many are marked with designs formed by drawing a comb along the surface of the tile when soft or by the fingers of the operators. One tile, 17 in. square, after having been elaborately ornamented by a comb along the sides and diagonally across, and then with a circle round the centre, was turned by the workman while still soft on to his right hand, and bears deeply impressed over the elaborate pattern a cast of that hand. Another, one of the 22 in. size, was walked over by the naked feet of one workman and the hobnailed sandals of others, and in like manner bears a cast of both feet from the ball of the great toe to that of the heel. Whether the practised anthropologists who are engaged on this work will be able (*ex peda Herculem*) to build up the whole mass from these slight indications remains to be seen; but it is sufficiently curious to find such living traces of a man who must have joined the majority 1,600 years ago. The series of coins from Severus (A.D. 222) to Constans (A.D. 350) has been rendered complete by the discovery of one of Magnentius (A.D. 250), who was the only missing emperor of the series. These conclusively fix the approximate dates of the erection and occupation of the buildings.

* Large silver buttons must be removed with care from the muffle to avoid loss through spatting, occasioned by the escape of absorbed oxygen from the silver at the moment of solidification.



MAGNETIC THERMOPHONE WITH REFLECTING DIAPHRAGM TRANSMITTER.

THERMOPHONES.

BY G. R. CAREY.

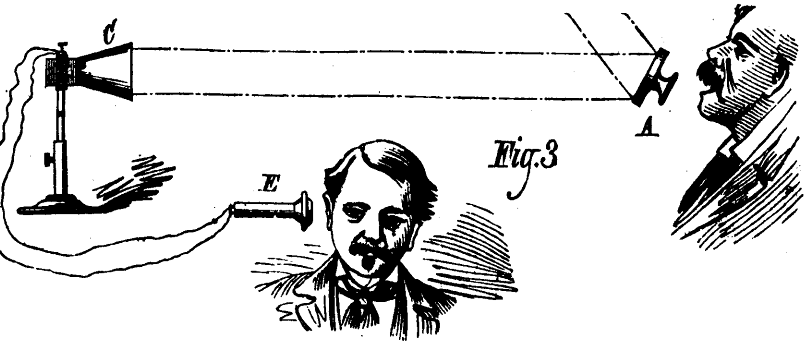
Fig. 1 and 2 represent magneto-thermophones. In Fig. 1, A is the transmitter, which consists of a highly polished thin mirror, similar to Prof. Bell's photophone transmitter, B' is a hollow iron ball which forms the pole of the magnet, D. This ball should be made very thin and covered with lampblack in order that it may absorb and radiate its acquired heat rapidly. C is an insulated helix of copper wire placed around the pole of magnet D, and having in its circuit the receiving telephone E. Sound waves of any kind generated before transmitter A, will cause the reflected heat and light waves to undulate in unison with the sound waves; these undulatory heat and light rays will strike the pole B², of magnet D, producing corresponding variations in its strength, thereby generating magneto-electric currents in coil C. These magneto-electric currents will correspond in time and strength with the sound waves made before transmitter A and will reproduce by means of telephone E, any sound made before transmitter A.

MAGNETIC THERMOPHONE WITH MANOMETRIC FLAME TRANSMITTER.

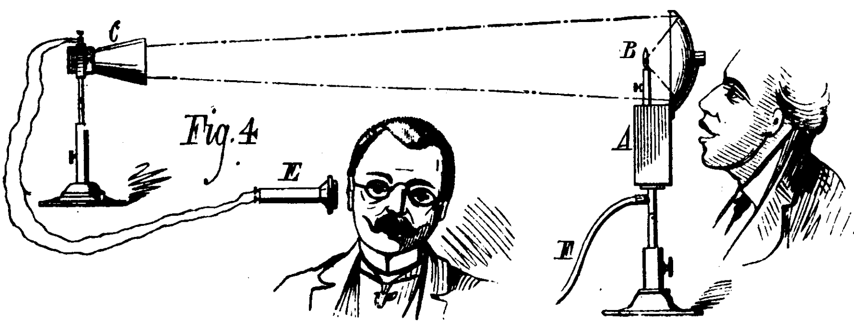
The operation of instruments shown in Fig. 2 is similar to that just described; the difference is mainly in the transmitter, which consists of a manometric flame apparatus, A, of the usual construction, the light and heat of the flame B, being projected by the mirror M to the magnet of the receiver.

In Fig. 3 the receiver is a thermopile connected with a receiving telephone. The heat and light thrown by the reflecting transmitter A, generate an undulating electric current in the thermopile C, which produces audible effects in the telephone E.

In Fig. 4. the chamber A of transmitter is supplied with gas by the tube F. Speaking against the chamber A will produce undulations in the inclosed gas corresponding in time and strength with the sound waves generated before it, thereby vibrating the flame B, and its emitted heat and light rays. These modified heat and light rays will generate electric currents in the thermo-electric pile C, against which they strike, and these thermo-electric currents corresponding in time and strength with the sound waves at the transmitter, the magneto-telephone C being in the circuit of the thermopile, C will reproduce any sound made before chamber A of the transmitter.



THERMOPHONE WITH THERMO-ELECTRIC RECEIVER AND REFLECTING DIAPHRAGM TRANSMITTER.



THERMOPHONE WITH THERMO-ELECTRIC RECEIVER AND MANOMETRIC FLAME TRANSMITTER.

Scientific.

AN ELECTRIC RAILWAY IN LONDON.

One of the novelties at the Crystal Palace on Easter Monday was the opening of an electrical railway, constructed by the Société Anonyme d'Electricité, of Brussels, on the Siemens system. On the upper terrace of the Palace grounds, overlooking the charming scenery of Sydenham, a miniature circular line of railway, consisting of three lines of metals, has been laid down, surrounding one of the ornamental ponds, and a small wooden hut erected besides it as a passenger station. On this railway, which is about 300 meters in length, and has a guage of about 50 centimeters, or 19 inches between the outer rails, stands the electrical locomotive. Its length is about four feet, its breadth about a meter, its height about as much, and its weight some three-quarters of a ton. It is, in fact, a Siemens dynamo-electric machine, neatly boxed in, and mounted on a truck with four metal wheels, and provided with a brake and alarm bell for its control by the man in charge. A stationary engine of about eight horse power nominal, in a shed about thirty yards from the railway line, drives a stationary dynamo-electric machine, from which the electro-motive current is primarily obtained. Two wires are connected with this fixed dynamo machine. By one of them the current flowing out is conveyed to the mid-rail of the railway, to which it is attached by an iron plate bolted on. The second or return wire is attached to the exterior rail of the railway. The mid-rail is supported upon wood blocks, and is thus in a certain degree insulated.

Beneath the electrical locomotive a brush of iron wires sweeps the mid-rail, and the electrical current is thus taken up into the locomotive, where it passes through the mounted Siemens machine within it, the large bobbin of which is thereby caused to revolve, and the current passing away by the wheels of the truck to the exterior rails of the road, is conveyed back to the stationary dynamo-machine. As the current thus circulates, and the bobbin of the mounted machine revolves, it drives the four wheels of the truck as the locomotive moves on, hauling after it a load of nearly three tons with ease at the speed we have named. The electrical locomotive is easily managed; by applying the brake the electro-motive current is cut off as a driving power, while the wheels are at the same time mechanically skidded. By reversing the current the locomotive can be driven in either direction, as desired. The circulation of the electro-motive current from the stationary dynamo-machine to the mid-rail, and from the mid-rail to the locomotive, from it again to the outside rail, and from it back to the fixed machine, depends entirely upon the superior conductivity of the metallic wires and rails over the conductivity of the earth; and this mode of driving the electrical locomotive seems to make such a system open to difficulties upon railroad lines of any considerable length.

On his Fourth Hundred.—Mr. Edison took out his 301st patent on the 12th of March.

AN ELECTRIC DISCOVERY.

London, May, 17.—Sir William Thomson has received from Camille Faure, a Paris discoverer, a box of electric energy. A gentleman writes to the *Times* this morning as follows:—"On Monday last in Paris a Faure battery or *pile secondaire* was charged with electric fluid direct from an ordinary Grove battery, in my presence. The receptacle consisted of four Faure batteries, each about five inches in diameter and ten inches high, forming a cylindrical leaden vessel, and containing alternate sheets of metallic lead and aluminum wrapped in felt and rolled into spirals wetted with acidulated water, and the whole placed in a square wooden box measuring about a cubic foot, and weighing some seventy-five pounds. This was protected by a loose wooden cover, through which electrodes were introduced, and were flattened down for convenience of transportation. This box of electric energy was handed me by Faure, with the object of submitting it to examination and measurement at the hands of Sir William Thomson. In about 72 hours from the time of charging the jar in Paris I had the satisfaction of presenting Faure's rare offering of a box of electricity intact. This is potent compression within a small space of one cubic foot of power equivalent to nearly a million feet. The wonderful box is now deposited in the laboratory of Glasgow University, and being submitted to a series of tests and measurements. The results of some of these made Sir William exclaim, 'Why, it is a little giant.' The advantage to science and humanity which this discovery, or rather perfection of Plante's discovery, is destined to afford are of such transcendent importance that we cannot for the present form any correct estimate of its magnitude. Whatever may be the practical results obtained, I have the satisfaction of recording for the first time to my knowledge in the history of the universe that a box of electric energy nearly equivalent to a million feet, contained within less than a cubic foot of space intact and potential, has been transported from France or elsewhere to Great Britain."

THE POLARISATION OF SOUND.

A novel hypothesis as to the polarisation of sound—perhaps it should be dignified by the title of a theory—has been promulgated by Prof. S. W. Robinson, of the Ohio State University, and as it opposes the teaching of the text-books, it may be as well that we should briefly recount the arguments of the American professor. According to the accepted theories the explanations of the phenomena of light and sound run very much on the same lines, and it is often stated that the dark bands produced by the interference of light resemble exactly in their explanation that of the formation of nodes and loops. But it is distinctly stated that the vibrations producing sound so far differ from those producing light, that while the former take place in the direction of propagation, the latter are transversal to the direction of propagation. It is also stated that this assumption —it is nothing more—as to the direction of the vibration of the particles of ether producing light is rendered necessary and is justified by the phenomena of polarisation. If we understand him correctly, it is this theory, hypothesis, or assumption, which Prof. Robinson combats, and he does the work in an able manner in a paper contributed to the March number of the *Journal* of the Franklin Institute.

He says definitely that the phenomena of polarisation of light, heretofore supposed due to transversal vibrations, can be explained on the basis of longitudinal vibrations alone, and he proceeds to show by hypothesis and experiment, that longitudinal vibrations, such as in sound-waves, can be polarised, and furthermore, that it is irrational and improbable to suppose that vibrations in extended media generally can be primarily otherwise than longitudinal. In other words, he attacks the transversal theory of light, and shows good reason for further inquiry. Light, it is well known, can be radiated, reflected, refracted, diffracted, and diffused, can be made to interfere, and can be polarised. With one exception, we can do the same with sound, but if Prof. Robinson is to be credited with a discovery, we can also polarise sound. In short, it is only necessary to polarise sound to make the theory of longitudinal vibrations universal—to make the theories of sound and light analogous on all points. Assent, says Prof. Robinson, will be the more readily given after noticing that in polarised light it is not necessary to suppose the vibrations transversal until after passing the polariser, and that the latter imparts an effect equivalent to a lateral impulse, as due to its one-sided action upon the ray transmitted, thus giving cause for rays which are more or less transversal. He points out that it is not to be assumed impossible for transversal vibrations to occur when sufficient cause exists; but it is assumed that the cause is insufficient when a material particle is made to vibrate from the action of a disturbance at a remote centre transmitted to the particle considered the centre—the transmission and the particle being supposed to belong to a homogeneous medium of indefinite extent. As regards the nature of the vibratory movements of particles of luminiferous ether, Prof. Robinson says, may we not justly ask that, if we can go through such a range of density as from platinum to hydrogen without a change, where, as we rise through the scale of ethereal tenuity, shall longitudinal vibrations end and transversal begin? Why should the luminiferous ether be supposed to have a peculiar form of vibration; and if ether undulations can be polarised, why not undulations generally? He thinks that if polarised light had never been discovered, probably the idea of transversal vibrations would never have been suggested, and he quotes M. Jamin as expressing a denial of any necessity for transversal vibration to account for the observed phenomena, except as regards polarisation, and even in that case raising the question as to the direction of vibration. From a consideration of the points involved, Professor Robinson arrives at the conclusion that transversal vibrations, at a considerable distance from a radiant, seem impossible, and he asks if light can be polarised, why not undulations generally? After some eight years' cogitation he has put the question to the test of experiment, and has obtained satisfactory results from his point of view. The method adopted for polarising the undulations of sound was the same in principle as that for polarising light by reflection. When the undulations representing sound pass from one medium into another whose velocity for sound differs, the sound is refracted; and recent investigations by Tyndall, Henry, and others have indicated that when the sound-waves encounter a change of density of medium, there is a reflection of sound, *e.g*, as when passing from a clear atmosphere into a wall of fog. Altogether, says Professor Robinson, there seems no doubt but that sound acts like light in these respects, that is, on meeting a change of refractive power, it is both reflected and refracted, as light is at the surface of water or glass. The reflected light being polarised, the sound is supposed to be. Practically any two media whatever may be selected for the experiment; two gases, such as hydrogen and atmospheric air, two liquids, two solids, or a solid and a gas; but for convenience the experiments were made with coal gas and air. The respective velocities of sound propagation in those media are respectively 1,420 and 1,125, and applying the laws of Fresnel and Brewster we find that the index of refraction being equal to the ratio of the velocities of the waves in the media, it is for the case of air and coal-gas $n = 1{\cdot}26$, while the polarising angle of incidence comes out as tangent $i = n = 1{\cdot}26$, or $i = 51^{\circ}\ 45'$. To realize this incidence upon a surface of separation between the gas and air, the coal-gas was placed in L-shaped tubes, in which the two arms were not quite at right angles, but each arm made an angle of $51\frac{3}{4}^{\circ}$ with a normal to the elbow, which was cut away for about half the thickness of the tubes, and the hole closed with a delicate membrane. The tubes may, in short, be described as of very broad V-shape, with the point cut off, and the aperture closed by a membrane. They were 1 inch in diameter by three inches long, and were made of tin-plate, one end being slightly larger than another, so that any number could be joined together stove-pipe fashion. Being cylindrical, the plane of any one piece could be placed at any angle with the plane of the preceding piece. The ends of the combined tubes were capped with membrane, and the whole filled with coal-gas. It will be understood that the portions of the tube fitting easily to one another, any portion could be shifted so as to form almost any angle with the other portions. The actual construction employed for the experiments consisting of a varying number of L-pieces, as they are called, with larger pieces at one end and the centre, thus forming a simple zig-zag tube from end to end, so arranged that the polarising portion of the tube could be readily turned from cross to parallel, etc. The coal-gas was admitted at one end, and allowed to escape by a jet burner at the other, the length of the flame serving as a pressure indicator. A small mirror was attached to the membrane at one end of the tube, and an organ pipe was blown close against that at the other end, but subsequently pendulums consisting of small ivory balls and hollow glass beads were employed. These, suspended by a thread, were allowed to just touch the membrane when at rest, and when the ivory ball was allowed to swing against the membrane at one end, the glass head was impelled through a certain arc, measured on an adjacent scale. It is impossible, in the space at our disposal, to give the results of the very many experiments made, nor is it necessary in the present state of the hypothesis; suffice it to say that, when the tubes were filled with air instead of gas, there was little, if any, reflection, showing that the results obtained with gas in the tube were due to the surfaces of separation of gases differing in density. In repeated reflection from such surfaces the intensity of the final component varies with the relative positions of those surfaces, the same following the laws of polarisation in light, from which Professor Robinson onoludes that longitudinal undulations can be polarised. The conclusions deduced from his investigations are thus stated:—1. Vibrations in extended media, produced from the action of a remote single centre of disturbance, can only be longitudinal, even in light. 2. Vibration will be to some extent transversal when due to two or more centres of disturbance not in the same line, as when two or more independent co-existent systems of undulations combine into one, or when a simple system is modified by such lateral disturbance as a reflection or refraction. 3. That undulations, to be in a condition called polarised, must consist of vibrations which are transversal, and that no necessity exists for assuming vibrations transversal in front of a polariser. These experiments of Professor Robinson will doubtless be repeated in other forms by other experimenters, and another link in the chain which binds together light, heat, and sound will be forged. The new discovery, it will be seen, adds one more proof to the truth of the undulatory theory.

DR. SIEMENS' ELECTRICAL FURNACE.

At a recent meeting of the Society of Telegraphic Engineers, in London, Dr. Siemens gave the following description of his electrical furnace:

Among the means at our disposal for effecting the fusion of highly refractory metals, and other substances, none has been more fully recognized than the oxy-hydrogen blast. The ingenious modification of the same by M. H. Ste Claire Deville, known as the Deville furnace, has been developed and applied for the fusion of platinum in considerable quantities by Mr. George Matthey, F.R.S.

The Regenerative Gas Furnace furnishes, however, another means of attaining extremely high degrees of heat, and this furnace is now largely used in the arts—among other purposes, for the production of mild steel. By the application of the open hearth process, 10 to 15 tons of malleable iron, containing only traces of carbon or other substances alloyed with it, may be seen in a perfectly fluid condition upon the open hearth of the furnace, at a temperature probably not inferior to the melting-point of platinum. It may be here remarked that the only building material capable of resisting such heats is a brick composed of 9·85 per cent. of silica, and only 1·5 per cent. of alumina, iron and lime, to bind the silica together.

In the Deville furnace an extreme degree of heat is attained by the union of pure oxygen with a rich gaseous fuel under the influence of a blast, whereas in the Siemens' furnace it is due to slow combustion of a poor gas, potentiated, so to speak, by a process of accumulation through heat stores or regenerators.

The temperature attainable in both furnaces is limited by the point of complete disassociation of carbonic acid and aqueous vapor, which, according to Ste-Claire Deville and Bunsen, may be estimated at from 2500° to 2800° C. But long before this extreme point has been reached, combustion becomes so sluggish that the losses of heat by radiation balance the production by combustion, and thus prevent further increase of temperature.

It is to the electric arc, therefore, that we must look for the attainment of a temperature exceeding the point of disassociation of products of combustion, and indeed evidence is not wanting to prove the early application of the electric arc to produce effects due to extreme elevation of temperature. As early as the year 1807, Sir Humphrey Davy succeeded in decomposing potash by means of an electric current from a Wollaston battery of 400 elements, and in 1810 the same philosopher surprised the members of the Royal Institution by the brilliancy of the electric arc produced between carbon points through the same agency.

Magneto-electric and dynamo-electric currents enable us to produce the electric arc more readily and economically than was the case at the time of Sir Humphrey Davy, and this comparatively new method has been taken advantage of by Messrs. Huggins, Lockyer and other physicians, to advance astronomical and chemical research with the aid of spectrum analyses. Professor Dewar, quite recently, in experimenting with the dynamo-electric current, has shown that in his lime tube or crucible several of the metals assume the gaseous condition, as demonstrated by the reversal of the lines in his spectrum, thus proving that the temperature attained was not much inferior to that of the sun.

My present object is to show that the electric arc is not only capable of producing a very high temperature within a focus or extremely contracted space, but also such large effects, with comparatively moderate expenditure of energy, as will render it useful in the arts for fusing platinum, iridium, steel or iron, or for affecting such reactions or decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from such disturbing influences as are inseparable from a furnace worked by the combustion of carbonaceous material.

The apparatus which I employ consists of an ordinary crucible of plumbago or other highly refractory material, placed in a metallic jacket or outer casing, the intervening space being filled up with pounded charcoal or other bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum or dense carbon, such as is used in electric illumination. The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively large dimensions. At one end of a beam supported at its centre is suspended the negative electrode by means of a strip of copper, or other good conductor of electricity, the other end of the beam being attached to a hollow cylinder of soft iron free to move vertically within a solenoid coil of wire, presenting a total resistance of about 50 units or ohms. By means of a sliding weight, the preponderance of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. One end of the solenoid coil is connected with the positive, and the other with the negative pole of the electric arc, and, being a coil of high resistance, the attractive force on the iron cylinder is proportioned to the electromotive force between the two electrodes, or, in other words, to the electric resistance of the arc itself.

The resistance of the arc was determined and fixed at will within the limits of the source of power, by sliding the weight upon the beam. If the resistance of the arc should increase from any cause, the current passing through the solenoid would gain in strength, and the magnetic force overcoming the counteracting weight, would cause the negative electrode to descend deeper into the crucible; whereas, if the resistance of the arc should fall below the desired limit, the weight would drive back the iron cylinder within the coils, and the length of the arc would increase, until the balance between the forces engaged had been re-established.

The automatic adjustment of the arc is of great importance to the attainment of advantageous results in the process of electric fusion; without it the resistance of the arc would rapidly diminish with increase of temperature of the heated atmosphere within the crucible, and heat would be developed in the dynamo-electric machine to the prejudice of the electric furnace. The sudden sinking or change in electrical resistance of the material undergoing fusion would, on the other hand, cause sudden increase in the resistance of the arc, with a likelihood of its extinction, if such self-adjusting action did not take place.

Another important element of success in electric fusion consists in constituting the material to be fused the positive pole of the electric arc. It is well known that it is at the positive pole that the heat is principally developed, and fusion of the material constituting the positive pole takes place even before the crucible itself is heated up to the same degree. This principle of action is of course applicable only to the melting of metals and other electrical conductors, such as metallic oxides, which constitute the materials generally operated upon in metallurgical processes. In operating upon non-conductive earth, or upon gases it becomes necessary to provide a non-destructive positive pole, such as platinum, or iridium, which may, however, undergo fusion, and form a little pool at the bottom of the crucible.

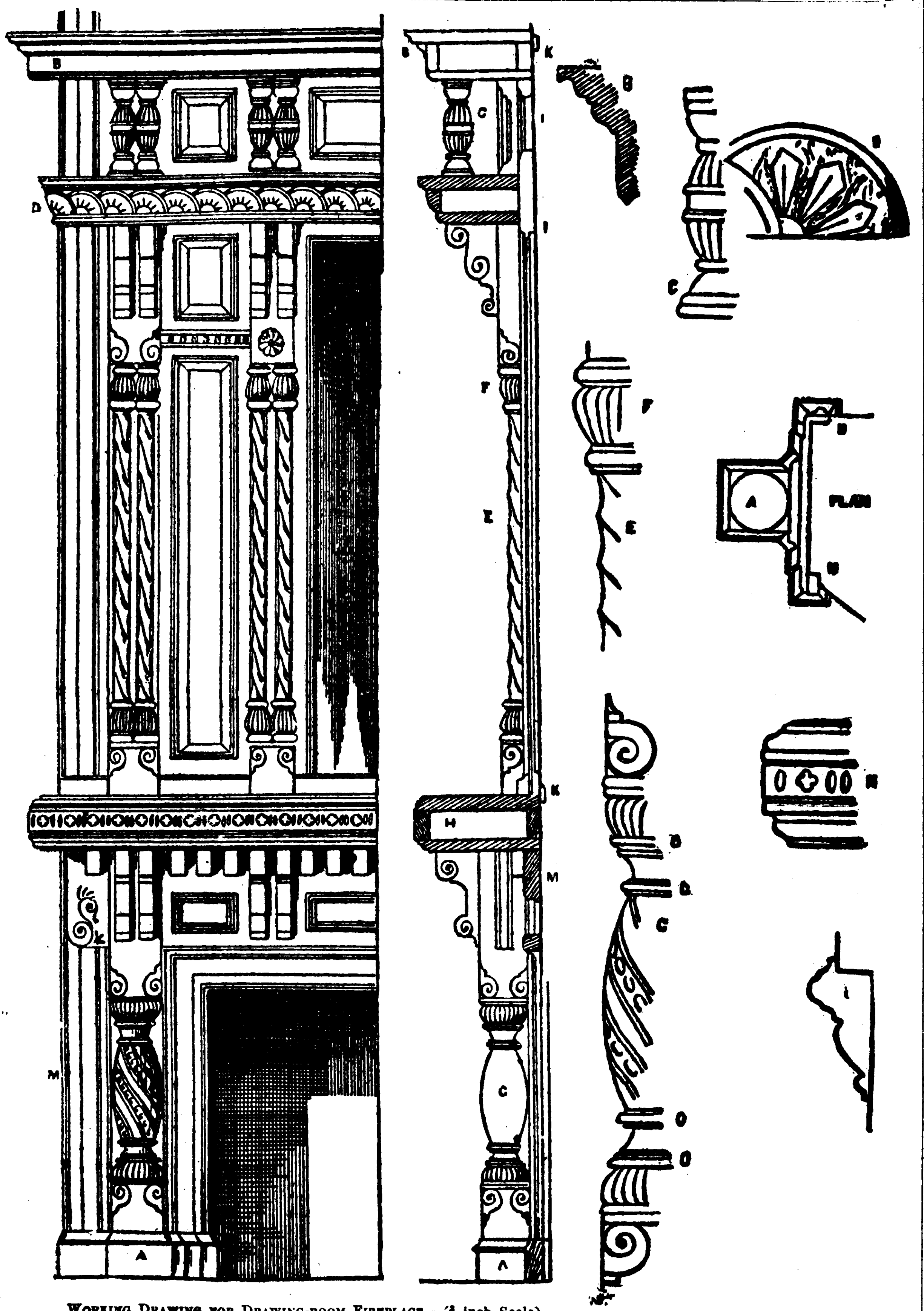
In this electrical furnace some time, of course, is occupied to bring the temperature of the crucible itself up to a considerable degree, but it is surprising how rapidly an accumulation of heat takes place. In working with the modified medium-sized dynamo-machine, capable of producing 36 webers of current with an expenditure of 4 horse-power, and which, if used for illuminating purposes, produces a light equal to 6,000 candles, I find that a crucible of about 20 centimetres in depth, immersed in a non-conductive material, is raised up to a white heat in less than a quarter of an hour, and the fusion of one kilometre of steel is effected within, say, another quarter of an hour, successive fusions being made in somewhat diminishing intervals of time. It is quite feasible to carry on this process upon a still larger scale by increasing the power of the dynamo-electric machine and the size of the crucibles.

By the use of a pole of dense carbon, the otherwise purely chemical reaction intended to be carried into effect may be interfered with through the detachment of particles of carbon from the same; and although the consumption of the negative pole in a neutral atmosphere is exceedingly slow, it may become necessary to substitute for the same a negative pole so constituted as not to yield any substance to the arc. I have used for this purpose (as also in the construction of electric lamps) a water pole or tube of copper, through which a cooling current of water is made to circulate. It consists simply of a stout copper cylinder closed at the lower end, having an inner tube penetrating to near the bottom for the passage of a current of water into the cylinder, which water enters and is discharged by means of flexible india-rubber tubing. This tubing being of non-conductive material, and of small sectional area, the escape of current from the pole to the reservoir is so slight that it may be entirely neglected. On the other hand, some loss of heat is incurred through conduction in the use of the water pole, but this loss diminishes with the increasing heat of the furnace, inasmuch as the arc becomes longer, and the pole is retired more and more into the crucible cover.

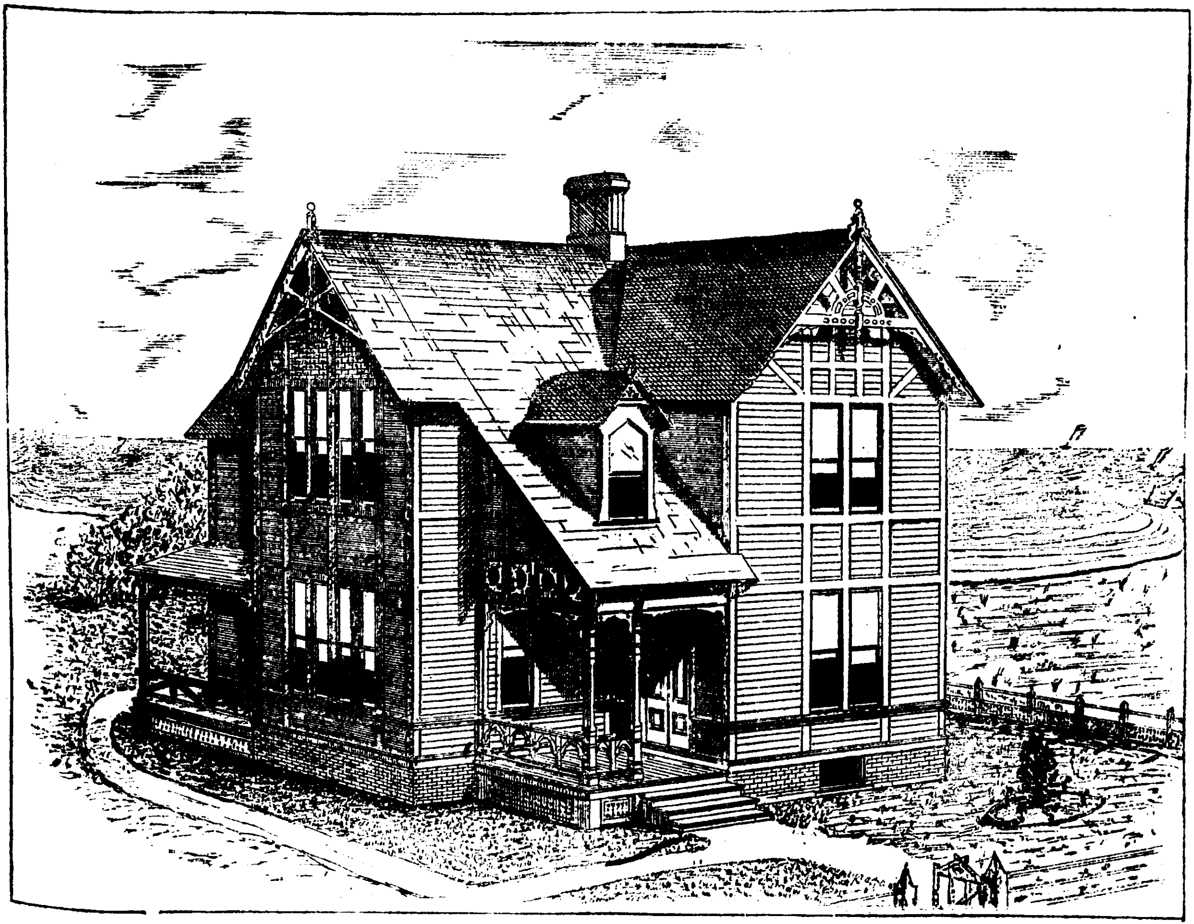
To melt a gram of steel in the electric furnace takes, it is calculated, 8,100 heat units, which is within a fraction the heat actually contained in a gram of pure carbon. It results from this calculation that, through the use of the dynamo-electic machine, worked by a steam engine, when considered theoretically, 1 lb. of coal is capable of melting nearly 1 lb. of mild steel. To melt a ton of steel in crucibles in the ordinary air furnace used at Sheffield, from 2½ to 3 tons of the best Durham coke are consumed; the same effect is produced with 1 ton of coal when the crucibles are heated in the Regenerative Gas Furnace, whilst to produce mild steel in large masses on the open hearth of this furnace, 12 cwt. of coal suffice to produce 1 ton of steel. The electric furnace may be therefore considered as being more economical than the ordinary air furnace, and would, barring some incidental losses not included in the calculation, be as regards economy of fuel nearly equal to the Regenerative Gas Furnace.

It has, however, the following advantages in its favor: 1st, That the degree of temperature attainable is theoretically unlimited. 2nd. That fusion is effected in a perfectly neutral atmosphere. 3rd. That the operation can be carried on in a laboratory without much preparation, and under the eye of the operator. 4th. That the limit of heat practically attainable with the use of ordinary refractory materials is very high, because in the electric furnace the fusing material is at a higher temperature than the crucible, whereas in ordinary fusion the temperature of the crucible exceeds that of the material fused within it.

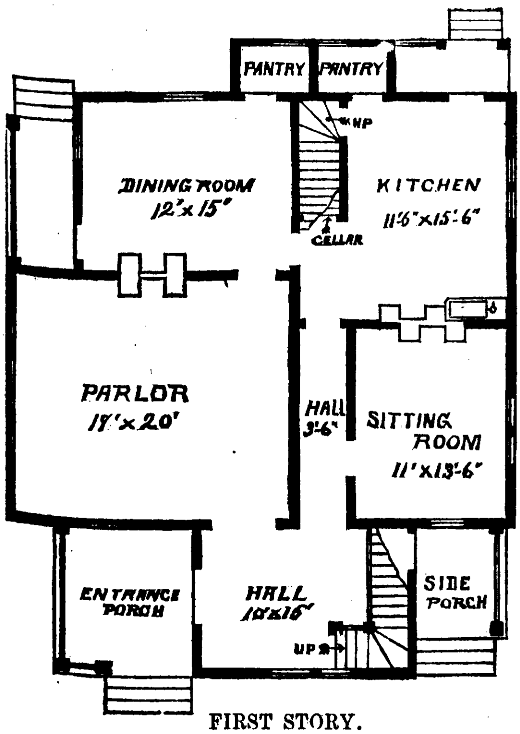
Without wishing to pretend that the electric furnace here represented is in a condition to supersede other furnaces for ordinary purposes, the advantages above indicated will make it a useful agent, I believe, for carrying on chemical reactions of various kinds at temperatures and under conditions which it has hitherto been impossible to secure.—*Industrial News.*



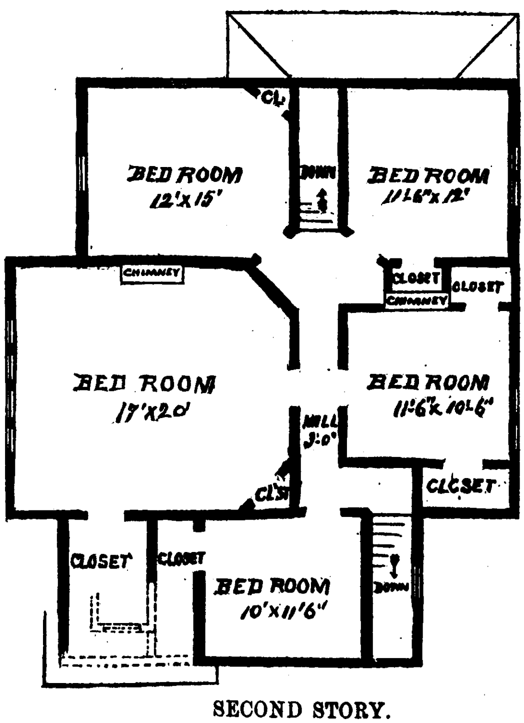
Working Drawing for Drawing-room Fireplace.—(¾ inch Scale).



DESIGN FOR SEASIDE OR COUNTRY DWELLING, COSTING $3,500.



FIRST STORY.



SECOND STORY.

Architecture, etc.

DESIGN FOR A SEASIDE OR COUNTRY DWELLING.

The picturesque dwelling shown on the opposite page was erected during the past year, and is here published as likely to meet the wants of some of our readers who may intend building at the seaside or providing a permanent home for themselves.

The interior arrangement is compact and admirable, the rooms being all of very generous proportions, while the large entrance hall, almost a room in itself, gives to the house an air of most pleasant hospitality ; and opening as it does on a porch at each end, makes a delightfully cool resort from the glare on the porches or the naturally warmer air of the interior rooms. The window in the hall is fitted with outside blinds that are hung both on top and on the side. By this arrangement the blinds can be thrown out from the bottom, perfectly shading the hall, and this without excluding the air in the slightest degree.

The lower floor is taken up by the parlor—a spacious room, 17 x 20 feet ; a sitting-room, 11 x 13.6 feet ; the dining-room, 12 x 15 feet ; and kitchen, 11.6 x 15.6 feet. From the kitchen, stairs lead to the cellar and to the second story. In the second story the bedrooms correspond in size very nearly with those of the rooms down-stairs ; and with closets on this floor, it seems as though the architects have been lavish enough to please the most exacting housewife.

In place of one large piazza, the owner preferred having several porches as shown ; but as a piazza is deemed by many an indispensable portion of a seaside house, one can be easily provided here if desired, and in such a manner as not to have the appearance of being an after-thought.

The cost of this house will vary according to location, but will be in the neighbourhood of $3,500. The architects are in a position to furnish, for $2,000, all the material necessary for the erection of the house above the foundation and exclusive of white lead and tinning. The materials furnished include all the timber framed ready to be put in place, sash, (glazed), blinds, doors, trimming to doors and windows, flooring, stairs, finish to piazza, shingles, lath, studding, nails and other hardware—in short, all that will be necessary to erect the building, as stated, above the foundation. These materials will be delivered on car or boat in New York or Jersey City. By availing themselves of this arrangement, parties will have to contract only for the foundation and painting and the necessary labor on the building, an estimate for which can be readily obtained from the plan and specifications, which will be furnished with the materials.

Any further information may be obtained by addressing the architects, Smith & Howe, 7 Warren street, New York.—*Manufacturer and Builder.*

HOUSE PLANNING.—I.

As many builders now combine the duties of architect and builder, we think that hints upon house planning may be of great use to them in enabling them better to carry out their designs with success, or to choose with greater descrimination designs that may be submitted to them by architects. The first point of consideration to the builder should be the site. There are several points of importance to be considered as affecting such choice. First, the most economical site as affecting future operations. Second, the situation most likely to favourably impress occupiers or purchasers. Third, the smallest frontage which can be conveniently turned to account for the accommodation of a suburban dwelling.

Under the first head, as to the effect of the site upon the economy of future operations, the nature of the soil is important. A very stiff clay makes the cost of excavation greater for every cubic foot that has to be removed. On the other hand a light or made soil is not suitable for foundations, without considerable footings of concrete, requiring greater depth of excavation and outlay of material. On the other hand a stiff clay bottom is an excellent foundation for strength, if not on a watery slope, and the clay may, if operations are extensive, be utilized for brick making, or in small quantities may be burnt for brick ballast. This ballast finds a ready market in many ways, and is now, if well burnt, frequently used after grinding, for admixture with mortar. A sandy or rubble sub-soil is an extremely healthy and valuable site, particularly if backed by a bottom of hard marl or clay for the foundations. If the material is sand it will usually pay cost of excavation, as good sand is now so expensive an item. If rubble and sand it may be screened, the sand being reserved for mortar and the larger rubble may be used to make the foundations and basement walls in concrete. If there is no accommodation for "spoil" or valueless excavated earth, the expense of delivering by hand-barrow some distance, or removing by cart will add a serious item to the cost of building, if a basement floor is desired. We think it is cheaper in the long run to avoid excavation to any great extent in such case, and to build with kitchen and offices all on the ground floor.

Under the second head, as to situation, most likely to favourably impress occupiers or purchasers, we think the most important point is that a most powerful impression is made by the fact whether the street or principal front of the house receives the light or sunshine during the latter part of the day. This is likely to be particularly the case in houses built to let or sell in the Autumn, Christmas, or spring quarters of the year. A south-west or western aspect of the principal front of a house is thus, in our opinion, most to be desired. This applies only to the question of most effective aspect to the outside observer, and to the case of houses in streets, thus largely protected from the weather. As regards aspect, it must not be forgotten that in many cases the after comfort of the tenant is more to be considered than external effect, and in such case we think a principal frontage south-east with back north-west is the most comfortable position under the difficult conditions of our variable climate. Due north is too dull even for the back part of a house which may contain living rooms on that face. Due east is not much better, as there the sun shines only whilst we are for the most part in bed. Due west or south also give too great and too lengthened a proportion of the sun-light during the hottest parts of the day to be either pleasant in summer, or good for drapery or carpets liable to fade.

South-east, however, gives an excellently cheerful yet cool aspect for morning rooms, and north-west equally well lighted rooms for afternoon or evening. It must be remembered that the south-western aspect receives the hottest rays of summer and the most violent storms of rain. Very few doors or windows can be constructed sufficiently water-tight to resist such rain storms if on a bleak and exposed situation. A grove of trees is an excellent protection on the south-west face of a detached house, both against the too fervid rays of summer and the boisterous south-westers of winter. The third question as to minimum amount of frontage, which can be most profitably turned to account for a suburban dwelling where ground is dear, is an important consideration. We have found that in the best neighbourhoods of London the proportion of one third of the rental in feet frontage is the smallest to which the building plots in terraces can be reduced with convenience or advantage. This is running economy of space to the lowest limits, but we hope in a succeeding paper to suggest arrangements in the planing of the house to make such frontages fairly available.

Cabinet Making.

A DINING-ROOM FIRE-PLACE.

BY A PRACTICAL WORKMAN.

[From the London *Furniture Gazette.*]

When the chimney-breast is being prepared for the plasterers, great care must be exercised in fixing the grounds. These are strips of timber, 2 or 3 inches wide, and ⅝ of an inch thick, and bevelled on one edge, so as to act as a key to the plaster. If these grounds are fixed by plugs to the wall, and made exactly straight, then the work of fixing the mantel and all its belongings, will be comparatively easy ; but if the grounds are not fixed straight, difficulties will occur at every step, the plaster will be uneven, and the work will not fit, absolute straightness being essential in preparing for fixing, as well as in fixing and making up ; hence the woodworker is the leader in a building, the plasterers, painters, furnishers, and others, depend on his skill in preparing for them, as well as for himself. The grounds will be seen, marked K, in the working drawing ; and it is very essential that they be quite straight, for they are the foundation of all the work that follows.

In making the mantel, shown in our working drawing, the first part which claims our attention as the framework M I, containing the two jambs and the lintel, as far as the mantelshelf. The jambs will be framed into the lintel, the architrave round the fire-hole being also framed in a piece with the lintel and jambs, so as to prevent its warping out of shape. The edge of the architrave next the fire-hole is protected by a small slab of blank marble, as shown in the plan at N. The details of the mouldings in the small panels of the lintel are shown at I ; these should be made of blackwood and mitrered in. The panels may be carved if expense be no objection. The brackets on the lintel and on the pillars of jambs are shown at H.

It will be noticed that the keynote of the ornamentation is an incised scroll. The dentils are quite plain and square. The plinth, marked A, is put together separately and fixed firmly to the floor. It is made out of thick wood, and is wrought out in a deep hollow and small square; it is mitred round the column and jambs and interior and exterior architraves, as shown on plan.

The pillar of the jamb is 6in. thick, and is turned as in detail G, the cap and base and shaft being carved. The shaft must first be turned in the lathe, the carving will have to be done by band, and will require carefully marking out before it is cut; it will be advisable to make a cardboard pattern for the carving of shaft, and this pattern will be a little narrower at the top and bottom ends than in the middle, owing to the swell of the shaft. The scrolls of the square have been previously explained. The moldings marked O should be turned in black wood, and a corresponding trench turned to receive them in the pillar, they can then be split and glued in. The scrolls shown at the end of the lintel are incised deeply and blacked. The mantel-shelf is built up as shown in section at H, the central front member being ornamented with bars and pateræ; the pateræ may be turned out of black wood, and the petals indicated with the V-tool.

The upper part of the mantel is framed in one piece, as shown at section I K, and is secured to the grounds, K. The central panel is intended for silvered plate-glass, and will be rebated accordingly, the molding, I, running round the top and sides only. The glass will be covered with a pad at the back, and secured by a framed pine back, the whole of the upper part being secured to the ground by screws, so that it can easily be taken down if the glass becomes damaged. The side-panels are narrow, raised, and surrounded with back moldings, as at I; these may also be carved, if desired. The long, slender pillars are twisted in reverse form to the usual pattern, instead of showing the pattern of a stranded rope, they will appear similar to a twisted bar of square iron, as shown at F E. The part of the work can be readily done in the lathe. Turn the shafts plain round first, then make a long parallel cardboard strip, and, having twisted it round the shaft, mark it with a pencil, put it in the lathe, and set the latter very slowly in motion. Follow the center between each pencil line with a gouge as it revolves in the lathe; if the latter goes too fast, take the power off and turn the lathe with the left hand, giving the gouge the proper direction with the other. Once the gouge has made a gutter from end to end, it will be easy enough to finish, as the gouge gutters will guide the gouge itself. The caps and bases are shown at F. The brackets are scrolled as below, and secured with dowels. The shelf D is also hollow, and runs from end to end, the flat round being enriched as at detail D, the triangular space between each pateræ being sunk. The caps and bases of the small pillars at the top must be of the same strength as those of the twisted ones, the pillars being thicker in the shaft (see enlargement at C). The upper and lower parts of the shafts will be carved, and the caps and bases left plain. The panels at the back will be planted with black molding, as shown in section I. The cornice is enlarged at B; the frieze can be enriched with a scroll pattern if desired; it is made hollow, as shown in section B K. The line I in the elevation is not the center line, the width being regulated by the chimney-breast and size of the stove.

The plan K shows the architrave running round the corner of the chimney-breast; this should also run up to the ceiling, and terminate in a suitable cap under the cornice of the room, partaking of the color of the cornice, from the top of the cornice B and upwards.

THE absolute strength of a well-glued joint is given as follows:

	POUNDS PER SQUARE INCH.	
	Across Grain end to end.	With Grain.
Beech	2,133	1,095
Elm	1,436	1,124
Oak	1,736	568
Whitewood	1,493	341
Maple	1,422	896

It is customary to take from one-sixth to one-tenth of the above estimate to calculate the resistance which surfaces, joined with glue, can permanently sustain with safety.—*American Cabinet Maker.*

Miscellaneous.

NEW METHOD OF SPACING AND LETTERING SIGNS.

The engraving represents a new method of spacing and outlining the lettering for signs lately patented by Mr. John C. Callow, of 56 Beech St., Cleveland, O. With this device the spacing of letters in sign work can be easily and rapidly executed by unskilled persons with all the facility of practical sign painters, and letters and other forms can be readily traced around the edges preparatory to filling in with paint, and accuracy in spacing is secured.

This improved method consists in stretching a cord or wire at the proper point, and attaching thereto the appropriate pattern letters either by means of hooks or by passing the wire or cord through eyelet holes formed in the letters. In laying out a sign where several letters of the same kind occur more than once, it is only necessary to substitute any other letter of the same width temporarily, replacing it afterward with the outline of the proper letter.

The alphabets are cut from tough, heavy boxboard, and the letters are of modern shape and style, such as are used by the best sign painters. The letters themselves when painted, grained, gilded, flocked, or otherwise ornamented, and tacked upon a suitable backing, form a handsome and durable sign. The lettering outfit furnished by Mr. Callow enables any one, without previous practice, to proceed and produce a good sign.

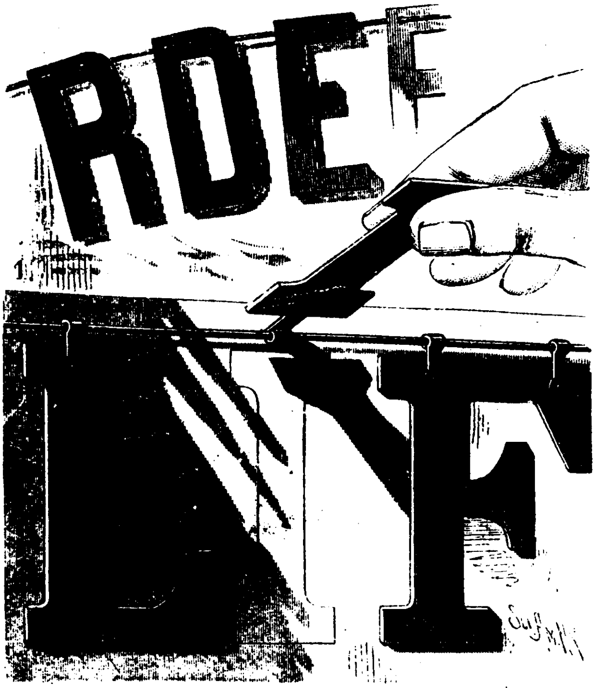
NEW MACHINE FOR PRESSING AND PACKING PRINTED SHEETS.

The novel and interesting machine which we herewith illustrate is designed to perform the operation known among printers as dry-pressing, which consists of removing from the printed sheets the indentations made by the type, and obtaining a smooth surface on the paper. This new device which is the invention of Mr. J. W. Jones, of Harrisburg, Pa., State Superintendent of Printing presses printed and folded sheets without offsetting, or blurring the page, and does away with the necessity of placing glazed boards between the sheets, which has to be done in the cold-pressing process usually employed.

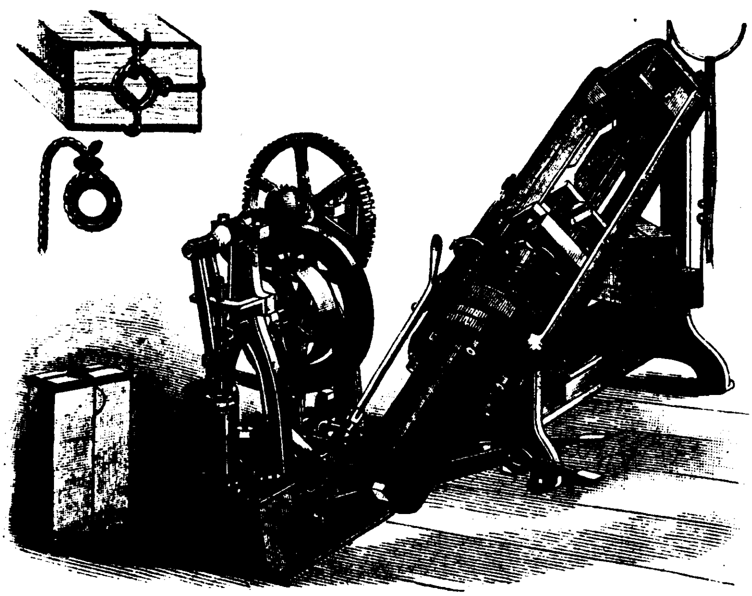
The operation of the machine is as follows: The pressure is applied with two powerful hydraulic pumps, driven by hand or power. The pumps are provided with a safety valve, which is so nicely adjusted that it can be set for any pressure that may be required. When that is obtained an automatic gong instantly sounds an alarm. The motion of the plunger or ram is very quick, traveling its entire length in thirty seconds, when for practical use it is required to travel about two-thirds its length, or twenty seconds. About five hundred folded sheets, taken immediately from the folders, are placed in the trough of the machine, with a board at each end. The operator places his foot on the treadle; this throws the machine in gear and starts the pumps, which press the plunger or ram at a rapid motion upwards. When the desired pressure is obtained the automatic gong gives the sound, the foot is removed from the treadle and the pumps are stopped instantly. The pressure on the ram is retained until the bundle is tied with cord or other suitable tying material (a chain tie has lately been adopted which gives better results and has the advantage of permanency.) The cords which come around the bundles of paper from the mill answer well the purpose. The machine is so arranged with slotted ways, both in the heads and in the sides of the trough, that the hands can pass freely around the bundles in the process of tying, which requires about forty seconds, the bundles being tied while under pressure. A valve is opened, letting the water out of the cylinder, the plunger then travels back and closes the valve automatically, the bundle is removed and set aside for gathering, the pressure being retained by means of the tie. The operation is then repeated with fresh sheets. A bundle of about five hundred sheets is put up every three to five minutes.

From 6,000 to 7,500 sheets an hour can be dry-pressed by the machine, which can be readily run by a boy of average intelligence. To completely dry-press the sheets, so that they will be free of all indentations, and perfectly smooth, the bundles need remain only from twelve to twenty-four hours under the retained pressure of the ties, and this time can be considerably lessened by applying heavier pressure and employing stouter cords or chain ties.

It is claimed that the work of dry-pressing, as done by the new process, takes one-fifth less space, crumples and tears no sheets as by the old method of tying and storing the sheets, and possesses many other minor advantages.



CALLOW'S METHOD OF LETTERING SIGNS.



MACHINE FOR PRESSING AND PACKING PRINTED SHEETS.

THE LEMUR VARI.

Natural History.

THE LEMUR VARI.

Lemur is the name applied to many animals of the order *Quadrumana*, or monkeys, of the families *Galeopithecidæ* and *Lemuridæ*.

The fingers are not all provided with flat nails, some of them terminate in claws. They stand with difficulty, and their gait is generally like that of a quadruped. They have no pouches; their nostrils terminate in folded elastic sides, which permits of opening and closing them at pleasure. The incisor teeth are separated by vacant spaces, and the molars provided with sharp conical points adapted to tearing. The lemurs live principally upon fruits and roots, and are fond of insects; if they eat flesh at all it is in very small quantities. If the physical conformation of the lemur is similar to that of the carnivorous animals, their habits place them among the monkeys, and like them they live habitually upon the trees in the midst of the foliage. There, concealed and suspended by their lower members, they watch for their prey. If an insect comes within reach it is the work of an instant to catch and devour it.

The lemurs comprise five principal genera, almost all natives of the island of Madagascar or the adjacent countries. The *indri*, one of the largest species, are tamed by the natives of Madagascar, and being very agile are trained like dogs for the chase. The *loris* have no tails, a characteristic which distinguishes the other species. There are also *galagos, tarsiers*, and *makis*; these last are subdivided into many species: the *macoco*, the *mongoux*, and the *vari*. The animals represented in our engraving belong to the species *vari* of the genus *maki*. They are remarkable for their lank forms, their long bushy tails, the ruff around their faces, and their peculiar eyes, large and round, which give them the ghostly appearance to which they owe their name.

It is known that the Romans believed that lemurs were malevolent spirits who returned at night to the earth to torment the living and that they instituted special ceremonies with the design of removing them. "Lemurs, gods of the infernal regions, come out of this abode." But one has never been tempted to address this objurgation to the lemur vari, notwithstanding his name and astonishing appearance, because he is gentle, sociable, fawning, and attaches himself quickly to persons who care for him and treat him well.—*L'Illustration.*

A WATER CARRYING TORTOISE.

At a meeting of the Academy of Sciences the other evening, a very fine specimen of the desert land tortoise, from Cajon Pass, San Bernardino county, in this State, was received. The specimen had been carefully prepared, and was as large as an ordinary bucket. The tortoise is a native of the arid regions of California and Arizona, and Prof. E. T. Cox, who was present, related a curious circumstance connected with it.

He found on dissecting one of them that it carried on each side a membrane, attached to the inner portion of the shell, in which was about a pint of clear water, the whole amount being about a quart. He was of opinion that this water was derived from the secretions of the giant barrel cactus, on which the tortoise feeds. The cactus contains a great deal of water.

The tortoise is found in sections of country where there is no water, and where there is no vegetation but the cactus. A traveler suffering from thirst could, in an emergency, supply himself with water by killing a tortoise. They are highly prized by Mexicans, who make from them a delicious soup. The foxes of the desert attack the tortoise and finally overcome it by dragging them at times for miles.

B. B. Redding said he would try to obtain a live one for the Academy, in order that its habits and peculiarities may be carefully observed and noted. He instanced being on the Gallapagos islands in 1849, and assisting in the capture of 92 land tortoises, varying from 450 to 600 lbs. in weight, which the vessel brought to San Francisco and sold for more money than the whole cargo of lumber netted at that time. They were two months on board the vessel, yet ate nothing and those killed had in them considerable quantities of pure water. They live on the high lava rocks, which rise as mountains on the island, where there are no springs or streams, and the only dependence of animal life for water is necessarily upon the irregular and uncertain rain showers.

It may be mentioned that the tortoises are of different species, though they may have the same habit in respect of carrying water. The famous edible species of the coasts of the Pacific and Indies, of which the headquarters is at Gallapagos islands, is the *Testudo Indica.* They grow to five, six, and even seven hundred pounds or more. Those found in this State are smaller and are the *Agassii* species, first described some years ago by Dr. J. G. Cooper, if we recollect aright. Those Mr. Redding describes from the Gallapagos were offered water while on the ship but refused it. Yet when killed they all contained water. The place they inhabit is a dry one, lacking water. It may be that they go to the high places and obtain it from the vegetation, the same as our species does.

Health and Home.

A WHOLESOME HOUSE.

A "F.R.C.S.," on this subject, in a late issue of the leading journal, gives the following narrative of his own efforts to convert an old London house into a perfect wholesome and comfortable habitation:

I may premise that I am a consulting surgeon, that my house is on the Portland Estate, in one of the streets frequented by the members of my calling, and that it is well filled by children and servants. We are not crowded, but we have not the luxury of a spare bedroom. I entered into possession some ten or twelve years ago as a sub-lessee, paying the full value in the way of rent; and it chanced at the time to be so important to me to secure the house that I was not very scrupulous in my investigation of its condition. It was then in the hands of the Portland lessee, my immediate landlord; it had by him been swept and garnished, painted and papered, and presented a fair outside appearance. The tenant who preceded me, and who although his name was certainly not Hogsflesh, I may disguise like the hero of the well-known comedy, under the simple appellation of Mr. H., was himself before the public a conspicuous sanitary reformer; but even this fact did not produce in my mind the distrust which I now know it was calculated to inspire. The house had been for several months empty and I discovered nothing offensive on visiting it before I concluded my bargain.

My first awakening to a knowledge of the actual state of things was brought about a week or ten days after the commencement of my occupancy by a squeal from the basement, this squeal being the remonstrance of one of my servants against the sudden appearance of a rat. My first thought was that the intruder had opened up a connection between my kitchen and the Barking outfall; but on investigation I discovered that the house was not even connected with the street sewer, and that we were living over a honeycomb of cesspools. I sent off the family next day to Brighton, had the cesspools emptied and filled up, laid down a pipe drain to the sewer, and was for a while content. My immediate landlord very liberally and kindly allowed me to deduct from my rent one-half of the cost of the actual work; but he did not share the expense of sending my family away or the loss incidental to the temporary unfitness of the house to be used as a place for the reception of patients.

In due time we were all re-established in our dwelling, and soon afterwards a medical neighbor called upon me. My visitor did not know what we had gone through, but he had been accustomed to visit my predecessor in the tenancy, and was well acquainted with the house. After talking for a time, he began sniffing about, and at last exclaimed "Dear me, you have got rid of the smell of H!" He had actually attributed the faint odor which had formerly clung about the room in which we were to the personal presence of the distinguished sanitarian to whom he referred.

I had furnished the house in the way common to habitations of its class. There were window curtains in the dining-room, window curtains in the consulting-room, window curtains in the drawing-room, window curtains in the bedrooms. There were carpets on all the floors; there were unprotected papers on the walls; there were wardrobes and other pieces of furniture, which had their apparent height increased by cornices, within which were hollow spaces, seemingly made on purpose to form harbours for dirt. In dry weather the dust found its way through every chink; in wet weather the feet of visitors brought in mud, which dried into dust speedily. If the children romped for ten minutes in a carpeted room, the dust would lie in a thick layer upon the tables and chairs when they had finished. Dirt seemed to be omnipresent and all-pervading. It was plentiful in the air we breathed, it mingled with the food we ate, and with the liquids we drank. The house, thus arranged was a scene of perpetual *malaise* and ailing. The children were in London during the greater part of the year; but it was absolutely necessary to send them frequently away for change, to the seaside or into the country, where they soon exchanged their pale cheeks for rosy ones. Two deaths occurred among them, in both cases from maladies the origin of which it seemed impossible to trace. In the early part of last year another child suffered from dangerous and prolonged illness; and after that the germs of a disease which only too soon proved fatal were developed in my wife. The conviction was at last forced upon me that we were placed under unwholesome conditions of living; and I set myself to consider how these conditions might be changed. In the very nick of time I had the opportunity of acquiring possession of the Portland lease, so that, in popular phrase, it was "worth my while" to expend money upon improvements. The principal upon which I started was that the house, for the future, should be kept wholly free from superfluous contents, that all dirt-traps, whether mixed or movable, should be abolished, and that all surfaces should be rendered washable. The first thing was to send away cartloads of the varied materials, which have I already described as rubbish, the terms including all carpets, all window curtains, all the muslin blinds which people hang across the lower halves of bedroom windows, all books and pamphlets which were not really required, all anti-macassars and the like, everything that was broken, and everything that was useless. Having thus cleared the ground, I commenced the work of reform. The first thing, of course, was to see carefully to the drainage and water arrangements, to the ventilation of soil-pipes, the condition of cisterns, and so forth; but in these respects there was not much to be done. The next thing was to cover the old floors with thin oak parqueterie, both in living rooms and in bedrooms. This was done for me by Messrs. Howard at a very moderate charge—a fact which I am the more desirous to place on record because for one room I employed another firm and paid a larger sum for bad material and defective workmanship. The pattern is very simple and a more ornamental flooring could be laid at a higher price; but my sole object was to secure cleanliness and the absence of dirt-holding chinks. The parquet surface was not waxed, but French polished, so that it is not slippery. It is dusted or swept every day like the top of a table, and it is washed with a sponge and spirit of turpentine when dirt is deposited upon it. The turpentine not only cleans it effectually, but also affords the benefit of its fragrant and antiseptic odor for some hours after it had been used. Upon the parqueterie floors thus laid and maintained I have a few small Oriental rugs, each of which can be taken up and shaken in one hand. In the living rooms they are dispersed about in bedrooms they are placed as hearth-rugs only. In winter, lest the flooring should be cold to the feet on getting out of bed, I provided each child with warm slippers to be placed at the bedside, but the precaution turned out to be hardly required. In the bath-room, at the suggestion of Messrs. Howard, the parqueterie was of cork, than which nothing could be cleaner or more delightful. I need not enlarge upon the general cleanliness of the floor surfaces, especially under the beds and in corners, which by means of parqueterie may be easily maintained. The parqueterie extends over the landing places of the stairs; but on the stairs themselves carpets seem to be required, both as a matter of appearance and also to prevent noise. They are so arranged that they can be taken up and put down again by a housemaid in a very short period of time. The ends of each piece are fixed just under the nose of the corresponding stair, by rods which pass through rings sewn to the carpet, and which pass also through eyes screwed into the wood. Fortunately, the stairs are broken into short flights, so that each piece of carpet is a short length, and they can at all times be taken up and shaken without any extraneous help being required for the purpose. The next thing was to have every unfixed wardrobe, side board or other piece of heavy furniture placed upon castors, so that it might be easily moved by the housemaids, and the wall and skirting behind it kept free from dirt. At the same time the top of every wardrobe and cupboard was levelled by a cover of thin planking or of stretched canvas covered by brown paper so that all these surfaces could be wiped down frequently and kept perfectly clean. The painted woodwork generally was not only painted, but also varnished; and the wall papers were all varnished with the exception of one, which was painted. A large stable sponge or a wash-leather will cleanse all these surfaces by the aid of a little warm water; and the chief precaution which need be taken for protecting them is to see that no "soda" is allowed to enter the house. My servants use whiting for cleaning greasy plates, and they know that to be caught with soda would involve immediate dismissal. The muslin blinds for the lower portions of windows have been replaced by blinds of stained glass, which can be taken down and washed in five minutes; and, in bedrooms, I have not seen my way to get rid of roller blinds. In the principal living rooms I have the windows entirely filled by stained glass of soft and harmonious colouring, and in these room blinds are not required. As for window curtains, I have not a single one in the house, and the woodwork of the windows is painted in warm colours and appropriately decorated. My lady friends, who predicted that rooms without curtains would look very "bare," now tell me that they are prepared unreservedly to retract their assertions.

Ventilation is provided for both in sitting-rooms and bedrooms by that old system of vertical tubes communicating directly with the outer air, to which attention was recalled some few years ago by Mr. Tobin. Outside the house the external portions of these tubes are bent vertically downwards for a few inches, a method by which the quantity of air-borne dirt which would otherwise enter through them is very materially diminished. In the dining-room the tubes are brought up through ornamental cylinders of Doulton ware resembling vases, but made for the purpose without bottoms, and placed upon wooden plinths of similar construction. In the bedrooms the surfaces of the tubes are painted the colour of the adjacent woodwork; and in some of the upper rooms I have been content with a simple board, about 5 in. high, covering the lower part of the window opening, and serving to direct the entering air upwards when the sash is raised to a somewhat smaller extent. With this board the bedroom windows may be left open all night, both rain and direct draught being excluded. For books, a convenient depository is afforded by a sort of passage, which connects the front and back rooms of the first, or drawing-room floor. When all these arrangements were completed, and when the house was so organized as to afford the fewest possible resting places for dirt, the time came for seeing that dirt was not permitted to accumulate. For this purpose the servants required a certain amount of education, but, before long, the possibility of maintaining cleanliness stimulated them to perseverance in the endeavour, and the reasonable satisfaction which they were enabled to feel in the results of their work led to increased care and pains in accomplishing it. As a matter of course, some supervision is required to guard against a gradual relapse into uncleanliness, but this is not more than every householder must be prepared to bestow. As far as I can control the matter, my house contains absolutely nothing which is not required for actual use or for ornament, and all redundancy is mercilessly sacrificed.

My experiment is not yet one of very old standing; but, so far as it goes, I may sum up the results briefly. There has not been a case of even trivial indisposition in my family since the alterations were completed; and this Easter is the first vacation in which there has been nothing in the appearance of the children to point to the desirableness of sending them out of town. They look as healthy, and I believe they are as healthy, as I have been accustomed to see them on their return from the country. I am more than ever convinced that, over and above the sanitary errors for the discovery of which engineers are properly employed, we convert our homes into pest-houses by a style of furnishing which renders accumulations of filth not only likely, but positively inevitable.

I have said nothing about decoration, because that is a matter of taste, and from the standpoint of hygiene is not material. But cleanliness is not incompatible with beauty; and I venture to think that my house, notwithstanding the absence of curtains from the windows, will bear comparison, as regards being pleasant to the eye, with any other which has been fitted up within similar limits of expenditure. In conclusion, I should like to pay a grateful tribute to Mr. R. W. Edis, from whose Cantor lectures, I derived the suggestions which first led me to think of perfect cleanliness as the highest domestic virtue.

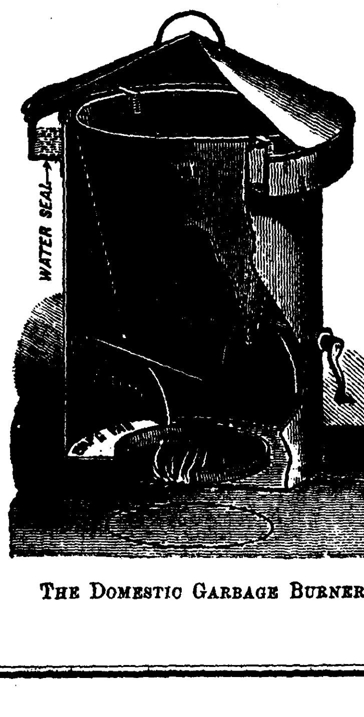
PHOTOGRAPHING MUSIC.

An English paper tells of a gentleman, who, on being asked to sing, produced from his pocket a little case, which contained his music, photographed down to the size of note paper. He had duplicate copies of each song, and handed one to the accompanist, singing from the other himself. The expedient saved all the bother of bringing a roll of music, unfolding it, collecting it again, and so forth. Photo-lithography suggests an excellent method of thus reducing the unwieldy size to which music publishers yet cling.

IMPROVED TIRE SHRINKER.

IMPROVED TIRE SHRINKER.

We illustrate herewith a new tire shrinker called the "Lightning," which has just been brought out by the Wiley & Russell Manufacturing Company, of Greenfield, Mass., widely known as makers of labor-saving tools, such as the "Lightning" Bolt Cutters and Screw Plates, Green River Drilling machines, etc. The jaws of a strong clamp controlled by a treadle stand open to receive the work, and the heated tire being bent or kinked is held firmly by the pressure of the foot as shown in the engraving, and is readily hammered into shape, the required shrinkage being secured in the operation. It is said a good hand can turn off a neat job, especially of light tire, with ease and rapidity in this way. This new tool is intended as a companion to the well-known Green River Tire Shrinker, made by the same firm.



THE DOMESTIC GARBAGE BURNER.

HOW TO DISPOSE OF KITCHEN GARBAGE.

The disposal of kitchen garbage is one of the standing annoyances to the cleanly housekeeper. In the country, or in the suburbs of our cities and towns, where the pig-pen is conveniently at hand, no trouble is experienced in ridding the premises of this form of refuse; but in the cities and towns the best regulated efforts for its removal are but indifferently successful, and in the summer season especially, when the attempt is made to save it, it speedily undergoes decomposition and becomes a putrid offensive and unwholesome nuisance, an abomination to the nostrils, and a menace to the health of those who are forced to inhale its disgusting emanations. To avoid this constant and often intolerable nuisance, many intelligent housekeepers adopt the sensible course of burning it in the kitchen range as fast as it accumulates. Where this is done properly, the method is effective and inoffensive, the gases and vapors evolved during the burning of the refuse being carried off with the other combustion products by the chimney, harmless and unperceived.

There are some practical objections, however to the plan of burning the refuse of the kitchen directly in contact with the fire, which are due chiefly to the fact that the stuff, composed largely of the parings and other rejected portions of vegetables, bones and other animal refuse, is largely charged with moisture. This water must first be driven of before the refuse will commence to burn, and this takes considerable time, or demands that the garbage shall be thrown in in small quantities at a time, which implies personal care and attention to the operation. The proper way to effect the burning of kitchen garbage, is manifestly first to thoroughly dessicate it and throw the dried material into the fire where it will be immediately consumed.

A very practical and excellent household apparatus for disposing of kitchen garbage upon this plan is shown in the acccompanying engraving, and will be understood from the following description: It consists of a pail for the reception of the garbage, provided with a set of perforations, and with a dumping bottom which can be closed to hold the charge or opened to dump it when dried, by turning the crank seen in the cut. This garbage pail is suspened within an outer cylinder having a circular opening in its base, so that it may fit over one of the openings of the range, and a close cover whose edge dips into a water-seal.

To use this apparatus, it is placed over one of the openings of the range. The dumping bottom of the pail is closed by raising the crank and putting the ring over the handle, the garbage is emptied into the pail, the water-seal filled, and the cover put on. After half an hour or so more or less, according to the nature and quantity of the garbage and the heat of the range, the contents of the pail will be found to be thoroughly dried, and may be dumped into the fire and burned by releasing the crank handle from the ring. During the drying of the charge all the disengaged vapors are either condensed in the water-seal or dissipated with the vapor from the evaporating pan. By the peculiar construction of the apparatus, the contents of the pail are hermetically sealed within it, and none of the vapors find their way out of it; consequently no unpleasant odors are given off during the operation. The dessicated garbage is immediately burned as it is dumped into the fire, and the whole operation is effected simply, expeditiously and with no disagreeable accompaniments.

The method and apparatus here described is worthy of the highest recommendation, not only because of its convenience and cleanliness, but also on the much more important ground of sanitary considerations. No intelligent housekeeper requires to be told that the foul emanations from putrefying garbage receptacles, which no amount of cleansing will suffice to keep clean, are, in addition to their extreme offensiveness, also in the highest degree unwholesome, in that they can become the carriers of the germs of pestilential fevers, which are most insidious in their approach and very frequently fatal in their results. To unwholesome influences of this kind the children of the household, by reason of their superior sensitiveness, and women, for the reason that their domestic habits keep them constantly exposed to their effects, are especially susceptible. We highly approve of the method and apparatus here described for disposing of kitchen garbage, as affording a simple, efficient and expeditious means of doing away with an offensive and unwholesome domestic nuisance.

The apparatus is manufactured and for sale at Myers' Sanitary Depot, 94 Beekman street, New York.

Mr. Myers' establishment is essentially a sanitary depot, not only for the sale of all improved plumbing goods, but for sanitary appliances of every description.