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SCIENTIFIC CANADIAN
MECHANICS' MAGAZINE
AND
PATENT OFFICE RECORD

Vol. 10. JULY, 1882. No. 7.

OUR SCIENTIFIC VISITORS.

DURING the last week of August the members of the American Association for the Advancement of Science will hold, in our midst, their thirty-first meeting. This will be the second occasion on which Montreal will have had the honor of receiving such important guests, the eleventh meeting of the Association having been held here in 1857. Since that remote period, a quarter of a century ago, both the American Association and Montreal have changed in many respects—both have grown in extent and in importance. In 1857 the Association met in the Court House and listened to and discussed some fourteen papers, that being the number on the published list, which concluded with the announcement that "when this list is exhausted the Chairman will call for papers that may be found on the Register since yesterday, and it is hoped some gentlemen will come prepared to respond." This year the nine sections will occupy rooms in the large group of buildings at the University of McGill College, and will have to dispose, somehow, of probably more than one hundred papers on all sorts of scientific subjects. These papers are the result of the work of the past year, in some cases of the work of many years, on the part of members of the Association, and the reading and publication of them serves as a most valuable record of scientific progress. The systematic discussion of such matter is extremely useful, too, as affording laborers in the fields of science opportunities to exchange ideas and to place on record their claims to valuable discoveries in the special departments of their work. While the Association will, this year, bring very much more work with it than it did last time, the arrangements for its reception and the conveniences at the disposal of science in Montreal are so much greater now than they were formerly that no trouble whatever will be experienced in alloting to each section a sufficiently spacious hall with every necessary appliance at hand. Section C (Chemistry), for instance, will meet in the lecture room adjoining the laboratory of McGill College; Section G (Histology and Microscopy) in a hall in the Redpath Museum.

The number of visitors expected is very large—it may, perhaps, be larger than at any previous meeting of the Association. Canada, in August, has great attractions for Americans, and Montreal and Quebec, not to mention Ottawa, besides being favorite places of resort, offer a greater change to our American cousins than Cincinnati, Boston, or St. Louis. Then there is the powerful attraction sure to be exerted by the presence at the meeting of an unusually large number of distinguished scientific men from Europe. Great Britain, Germany, Belgium, Russia, Austria, Hungary, Roumania, will all be represented by such men as HAUGHTON, of Trinity College, Dublin, Dr. WILLIAM CARPENTER, HERBERT SPENCER, and others, and there is the bare possibility of the presence of a real Prince of scientific tastes from Japan. All this will, probably, result in the presence among us of some fifteen hundred strangers from among the most intellectual and cultivated of our American and European neighbours. This large influx will, undoubtedly, tax to the utmost the resources of the city at a time when we are accustomed to see our streets full of visitors; but we do not think that we need fear the result. The committee of citizens is not only large, but it consists of the leading men of Montreal, and they have shown a willingness to work and a determination to make perfect the mechanical arrangements that have, already, placed the entire matter on a perfectly safe foundation. These gentlemen are ably led by Dr. DAWSON, President of the Association for the current year, and by Dr. HUNT, Chairman of the Citizens' Committee. No one, probably, has had more experience in meetings of this kind than Dr. HUNT, and all the details are carefully supervised by him. Dr. DAWSON's tact and ability as a Chairman and President are too well known in Montreal to need mention, and he possesses, besides, that happy faculty of making things go off well, which is so valuable on occasions of this kind.

The programme of proceedings, outside of the scientific discussions, has already been provisionally arranged for almost the entire week during which the Association will be in Montreal. These arrangements include Excursions to Ottawa, Quebec, Newport and St. Hilaire; Steamboat trips on the Harbour and to the Victoria Bridge and G. T. R. Works, and numerous receptions and garden parties. The daily programme will consist merely of morning and afternoon sessions for business, reading of papers and general scientific work, a lecture in the Queen's Hall by some of the most distinguished guests from eight to nine o'clock each evening that is not taken up with some special ceremony such as the inauguration of the Redpath Museum; after which the remainder of the evening will be spent at the various receptions or in resting for the labours of the morrow. The Excursions will be arranged to take place on Saturday and at the close of the meeting.

All the meetings and lectures are open free to the citizens who may, also, become members of the association by causing their names to be presented and by payment of the usual fees. This, however, is not enacted as a necessary condition of attendance at any of the meetings or lectures. There is little doubt but that the meeting in August will be creditable to the American Association and to the City of Montreal. Our guests will come in large numbers and with much scientific work prepared, and we shall be able to afford them every convenience for their labours and ample amusement and relaxation for the intervals of their labours. In this age when science seems to reach everywhere and to affect everything, the gathering together, in our midst, of its representatives and exponents is an event of no small importance, and it is to be hoped not only that the presence of the Association may do good to science in Montreal, but, also, that Montreal by careful preparation and by a fair exhibition of its scientific and economical capabilities may produce a favourable impression on our scientific visitors.

THE OLD TIME MILLWRIGHT.

An English writer of a book on mechanical progress pays the following passing tribute to the old millwrights, whose distinctive occupation, like Othello's, has now well-nigh gone. It was very truly remarked that the millwright of former days was to a great extent the sole representative of the mechanical art, and was looked upon as the authority in all the applications of wind and water, under whatever conditions they were to be used, as a motive power for the purpose of manufacture. He was the engineer of the district in which he lived—a kind of Jack-of-all-trades—who could with equal facility work at the lathe, the anvil, or the carpenter's bench. In country districts far removed from towns he had to exercise all these professions, and he thus gained the character of an ingenious, roving, rollicking blade, able to turn his hand to anything. He wandered from mill to mill in search of work, and was everywhere recognized as an itinerant engineer and mechanic of high reputation. He could handle the ax, the hammer, and the plane with equal skill and precision. He could turn, bore, or forge with the ease and dispatch of one brought up to these trades, and he could set out and cut in the furrows of a mill-stone with an accuracy equal or superior to that of the miller himself. These various duties he was called upon to exercise, and seldom, in vain, as in the practice of his profession he had mainly to depend upon his own resource. Generally he was a fair arithmetician, knew something of geometry, leveling, and mensuration, and in some cases possessed a very competent knowledge of practical mathamatics. He could calculate the velocities, strength, and power of machines, draw in plan and section, and could construct buildings, conduits, and water-courses in all the forms and under all the conditions required in his professional practice.

CANADA has twenty-one cotton factories aggregating nearly 400,000 spindles.

AN OLD STAGER'S EXPERIENCE.

Modern improvements in machine tools, and the establishment of the factory system of labor is developing a different class of workmen from the old school of machinists. It would be difficult to get a supply of workmen now-a-days capable of doing the heavy work that was done at the Soho, at Birmingham, by Bolton & Watt's men, at the close of the last century, with such imperfect tools as were in vogue at the time. Even as late as thirty-five or forty years since, at Niagara Dock, in Canada, good marine engines were made without a planing machine in the shop, and only one slide lathe. They had, however, powerful stiff hand lathes with compound slide rests.

There are marine shops now in the lake cities where large cylinder faces, and heavy wrought iron shafts have key seats chipped and filed by hand. Such shops must develop better chippers and filers than where everything is done on self acting machines. In some of the gigantic eastern shops, where upwards of three thousand men are employed, the hands are more machine-tenders than machinists. I saw an article in a paper, stating that "very few machinists of the present time would be found capable of chasing a true thread out of the solid iron." I should just think they would not. One-half of those that come along now show such extreme awkwardness in the use of hand tools that they can hardly make out to round the end of a shaft or a bold, and are totally incapable of finishing cast iron in the lathe with a scraper without shattering and jarring. An engine was exhibited at an exhibition some years ago where all the wrought iron was finished with a water-cut and the cast iron scraped — no filing was allowed—in order to show what first-class work was. Look at the flashy color some agricultural machinery is painted, with red, blue and yellow stripes. Whitworth, in the construction of his machine tools, was exactly in the opposite direction. He had them painted in plain bluish gray color, as near the color of first-class cast iron as possible, in order to show off the moulders' work, with beautiful straight lines, terminating in graceful curves. Sharp corners and edges were his special aversion. But he spared no expense in the working parts, as far as hardened steel and perfectly ground, dead true journals could make them durable.

I recollect, many years ago, watching an old stager chasing coarse square threads with a chaser, and he could start a perfectly true thread every time. I asked him the secret of it, and he said: "Practice was what did it." He informed me that he had worked some years at Naysmith's (the inventor of the steam hammer), ar Patrickroff, and that his work at that time was principally chasing. Another fitter informed me that "he would not give a button for a man that could not file hollow, and that it was only those that began young and went through a long apprenticeship that could do it."

In England, where most trades have to be learned by going through a long seven years' apprenticeship, journeymen are very jealous of promoted laborers coming in through the cabin window without any preparation. They are just as much opposed to that class as doctors are to quacks, and have just as much reason to be. Naysmith once undertook to take a young fellow out of the moulding shop and put him on a lathe, and the machinists all struck. I wonder what they would think of boiler maker and blacksmith helpers coming into a machine shop and claiming to be erectors?

Boys in a machine shop learning their trade are pretty shrewd, and are generally quick to detect the difference between a skillful and accomplished workman, who keeps well-shaped, clean cutting tools and finishes his work off in a workmanlike manner, and a miserable, rushing, spluttering, file-rasping, dulltoll, chawing butcher, who tries to make up in quantity what he lacks in quality. An apprentice ought always to be encouraged to finish his work so that nobody can make it better, and to take plenty of time at first and then speed and precision will come naturally. A great deal depends on how a boy is started at first. Manual dexterity is only to be acquired by practice and patience. When Mace, the famous pugilistic champion, was asked the secret of his success, he said "It was constant practice with the gloves from the time he was knee high, with all the shapes and sizes of men." The same rule will hold good with an apprentice. Put him next to the vice or lathe of an out-and-out good workman, and let him imitate him in everything, even is to how he grinds, sets and holds his tools; and if he gives his mind to his work and takes pride in doing a good job he is sure to turn out a good one. Who is it that is generally kept at rough, coarse, laborious work? The man who has been trained in a slovenly, rushing,

MECHANICAL DRAWING.

For an outfit, procure two drawing-boards 42 inches long and 30 inches wide, to receive double elephant paper. Have the boards plain, without cle ts or any ingenious devices for fastening the paper, and made from thoroughly seasoned timber at least 1¼ inches thick.

Two boards are required, so that one may be used for sketching and drawing details, which, if done on the same sheet with elevations, dirties the paper and is apt to lower the standard of the finished drawings by what I will term bad associations.

Details and sketches should, when made on a separate sheet, be to a larger scale than on the elevations. By changing from one scale to another, the mind is schooled in proportion, and the conception of sizes and dimensions is more apt to be based upon the finished work than the drawing itself.

In working to regular scales, such as a half, eighth, or sixteenth size, it is a good plan to use a common rule, instead of graduated scales. There is nothing more convenient for a mechanical draughtsman than to be able to resolve dimensions into various scales; and the use of a common rule for fractional scales trains the mind so that the computation come naturally and after a time almost without effort.

Use a plain T square, with a parallel blade fastened on the side of the head but not impeded into it. In this way, the set square can pass over the square head in working at the edges of the drawing. It is something strange that a draughting square should ever have been made in any other manner than this, and still more strange that people will use squares that do not allow the set squares to come near to the edge of the board.

A bevel square is often convenient but should be an independent one; a T square that has a movable blade is never fit for general use; combinations in drafting instruments, no matter what their character, should be avoided; such combinations, like those in machinery, are generally mistakes, and effect just the reverse of what is intended.

For set squares, or triangles, as they are sometimes called, no material is so good as ebonite; such squares are hard, smooth, impervious to moisture, and contrast with the paper in color; they will also wear longer than those of wood.

If wood squares are used, pear wood is best, because of its flexibility. A coat or two of shellac varnish improves such squares by making them smooth, and preventing their derangement by moisture.

For instruments, avoid everything of the elaborate or fancy kind; such sets are for amateurs, not engineers. It is best to procure at first only such instruments as are really required, of the best make, and then to add others as necessity may require; in this way experience will often suggest modifications.

One pair each of 3½-inch and 5-inch compasses, two ruling pens, two pair of spring dividers, for pen and pencils, a triangular box-wood scale, a common rule, and a hard pencil, are the essential instruments for machine drawing.

At the beginning, when "scratching out" will probably form an item in the work, it is best to use Whatman's paper, or the best roll paper, which, of the best manufacture, is quite as good as any other for drawings that are not water shaded.

In mounting sheets that are likely to be removed and replaced, for the purpose of modification, as working drawings generally are, they can be fastened very well by small copper tacks driven along the edges at intervals of 2 inches or less; the paper can be very slightly damped before fastening in this manner, and if the operation is carefully performed, the paper will be quite as smooth and convenient to work upon as though it were pasted down; the tacks can be driven down so as to be flush with, or below the surface of the paper, and will offer no obstruction to the squares.

If a drawing is to be elaborate, or is to remain long upon the board, the paper should be pasted down. To do this, first prepare the mucilage, and have it ready at hand with some slips of absorbent paper about 1 inch wide. Damp the sheet on both sides with a sponge, and then apply the mucilage along the edge, for a width of ½ inch; then set the edge of the board upon the floor, so that it will lean against the desk at steep angles. In this position the paper can be applied without assistance. Then, by placing the paper along the edge, and rubbing over them with some smooth, hard instrument, the edges are pasted firmly to the board, the paper slips taking up a part of the moisture from the edges which are longest in drying. If left in this condition, the center would dry first, and the paper be pulled loose at the edges by contraction before the paste had time to dry. It is therefore necessary to paste over the center of the sheet with a wet sponge at intervals, until the edges adhere firmly, when it can be left to dry, and will be tight and smooth. In this operation much depends upon the judgment of the learner and much will be learned by practice. One of the most common causes of trouble in mounting is not having the mucilage thick enough; when thin, it is absorbed by the wood or paper, and is too long in drying; it should be as thick as can be applied with a brush, and made from clean gum arabic or tragacanth; glue is not so good.

Thumb tacks are but of little use in mechanical drawing, except for the most temporary purposes, and can very well be dispensed with altogether: they injure the drafting boards, obstruct the squares, and disfigure the sheets.—*J. Richards* in *Engineering*.

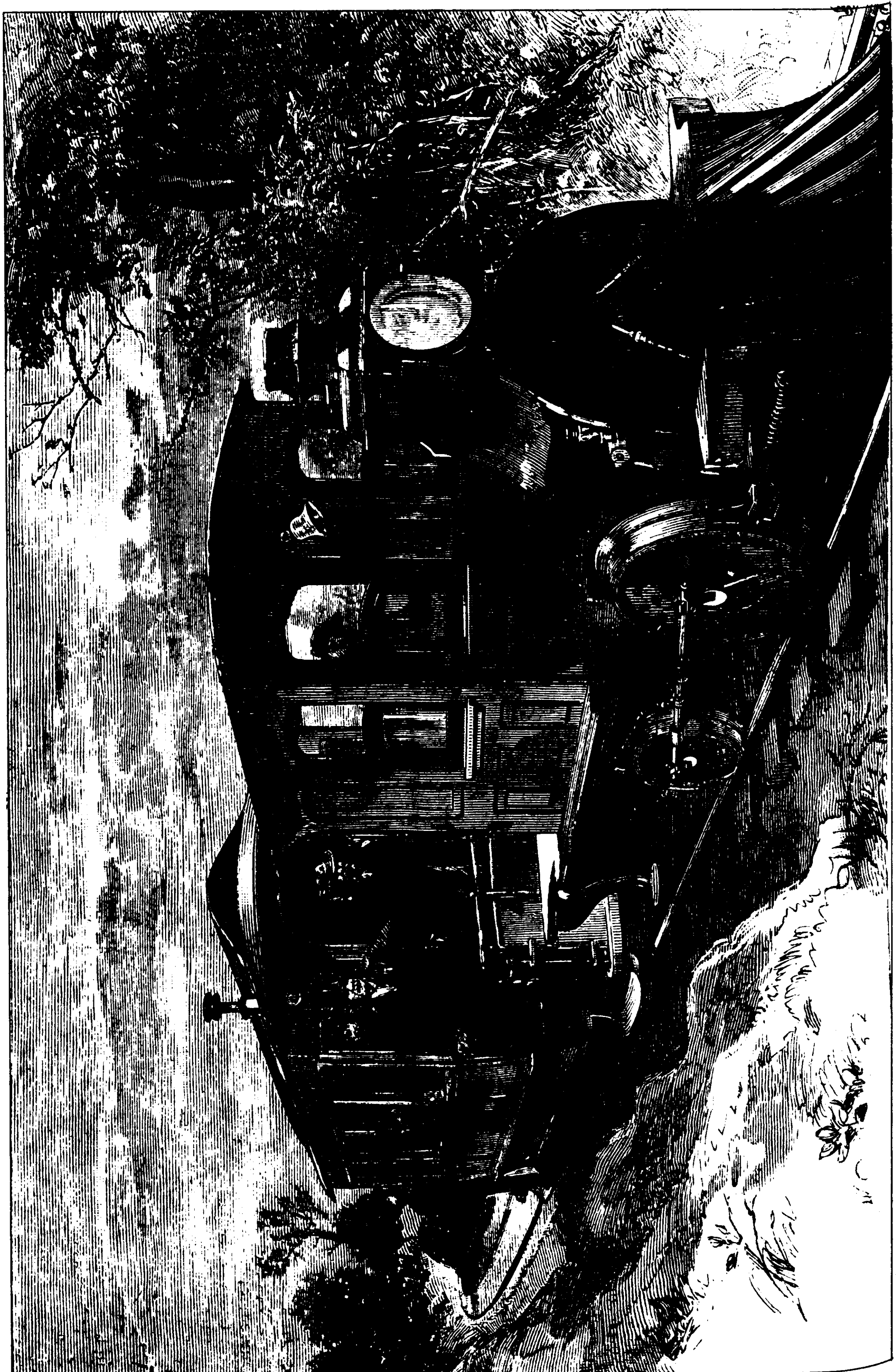
THE GLORIES OF THE STARLIT HEAVENS.

BY R. A. PROCTOR.

If the eye could gain gradually in light-gathering power, until it attained something like the range of the great gauging telescopes of the Herschels, how utterly would what we see now seem lost in the inconceivable glories thus gradually unfolded. Even the revelations of the telescope, save as they appeal to the mind's eye, would be as nothing to the splendid scene revealed, when within the spaces which now show black between the familiar stars of our constellations, thousands of brilliant orbs would be revealed. The milky luminosity of the Galaxy would be seen aglow with millions of suns, its richer portions blazing so resplendently that no eye could bear to gaze long upon the wondrous display. But with every increase of power more and more myriads of stars would break into view, until at last the scene would be unbearable in its splender. The eye would seek for darkness as for rest. The mind would ask for a scene less oppressive in the magnificence of its inner meaning; for even as seen, wonderful though the display would be, the glorious scene would scarce express the millionth part of its real nature, as recognized by a mind concious that each point of light was a sun like ours, each sun the center of a scheme of worlds such as that globe on which we "live and move and have our being."

Who shall pretend to picture a scene so glorious? If the electric light could be applied to illumine fifty million lamps over the surface of a black domed vault, and those lamps were here gathered in rich clustering groups, there strewn more sparsely, after the way in which the stars are spread over the vault of heaven, something like the grandeur of the scene which we have imagined would be realized—but no human hands could ever produce such an exhibition of celestial imagery. As for maps, it is obviously impossible by any maps which could be drawn, no matter what their scale or plan, to present anything even approaching to a correct picture of the heavenly host. There is no way even of showing their numerical wealth in a single picture.

It is not till we have learned to look on all that the telescope reveals as in its turn *nothing* compared with the real universe, that we have rightly learned the lessons which the heavens teach, so far, at least, as it lies within our feeble powers to study the awful teaching of the stars. The range of the puny instruments man can fashion is no measure, we may be well assured, of the universe as it is. The domain of telescopically visible space, compared with which the whole range of the visible universe of stars seems but a point, can be in turn but as a point compared with those infinite realms of star-strewn space which lie on every side of our universe, beyond the range —millions of times further than the extremest scope—of the instruments by which man has extended the powers of visions given to him by the Almighty. The finite—for after all, infinite though it seems to us, the region of space through which we can extend our survey is but finite—can never bear any proportion to the infinite save that of infinite disproportion. All that we can see is as nothing compared with that which is: all we can know is as nothing; though our knowledge "grow from more to more," seemingly without limit. In fine we may say (as our gradually widening vision shows us the nothingness of what we have seen, of what we see, of what we can ever see), not, as Laplace said, *The Known is Little*, but THE KNOWN IS NOTHING; not *The Unknown is Immense*, but THE UNKNOWN IS INFINITE.—*Knowledge.*



THE EDISON ELECTRIC RAILROAD.—EXTERIOR OF THE CAR.

THE EDISON ELECTRIC RAILROAD.—INTERIOR OF THE CAR.

Scientific.

AN ELECTRIC RAILROAD.

About an hour's ride out of Jersey City the traveller on the Pensylvania Railroad by night is whirled through an expanse of white light and suddenly into darkness again. While he is passing through this lighted area the whole country for miles around seems illuminated. Of a summer night he can see broad fields white with daisies and clearly outlined shadows of trees and fences. In winter there is a shimmering expanse of snow, while the icicles glisten like frozen moonbeams. To the right, as the train runs from Jersey City, a line of bright silver beads seems to run along the plateau, and every now and then a house whose windows are alight with the same silvery sheen comes in sight.

It is Menlo Park, the domain of the wizard Edison and his attending sprites. The glistening silver beads are electric lamps, whose soft radiance bathes the country in light, and the houses are similarly illuminated. And all this light is generated at one point—Edison's laboratory on the plateau. From that one point he can control it all. A touch of his hand—it vanishes, and all is dark. Another touch—and all is light again. He seems to have one of the great forces completely in his control; and when he stands in his laboratory and illuminates the surrounding country, as far as his system extends, by a simple gesture, the light appears to us for a moment as the irridescence of his bright intellect.

But from this point he also controls motive power as well as light; and this control extends over miles, and can include a complete railroad system. Already at Menlo Park he has such a system operating on a small scale. Behind the laboratory the plateau slopes down to a woody level, over which are laid for some two miles the tracks of a narrow-gauge railroad. The other day a car which was being repaired stood just outside of the laboratory on the plateau, in full view of the engines on the Pennsylvania Railroad, which went puffing sullenly past this evidence of rivalry. It is a singular fact, however, that, although Mr. Edison proposes to supplant steam power by electrical power, he can not get along without the former himself, for the simple reason that the dynamos which generate the electricity have to be worked by steam.

The electric locomotive and car now in use stand in the shed at the terminus, not far from where the wires fed from the dynamo in Mr. Edison's laboratory strike the rails. The locomotive has four wheels, and a driver's house, like any ordinary steam locomotive, and does not differ much at first sight in appearance from this. Even in the driver's house there are levers and mechanical arrangements which at first appear familiar. On closer inspection, however, certain differences in outline and detail are noticed. Of course there is no smoke stack, but simply something resembling it, in which the head-light is fixed. Then, too, the arrangements in the driver's house are to connect and close electric circuits instead of to regulate the supply of steam. Yet, taking it all in all, the electric railroad does not present in appearance a startling difference from the present narrow-gauge steam railroad.

The track runs straight for a short distance, and then curves into the woods. Mr. Hughes who exhibits, explains and runs the engine, puts in a couple of plugs to make connection in the electric circuit between strips of conducting metal in the driver's house, pulls the lever for a similar purpose, and without puffing or snorting, without smoke or cinders, the train glides out of the shed, switches on to the main track, and turns the curve into the woods, gradually increasing in speed and diminishing until the other terminus is reached. Then in order to show how the motive force may be reversed, the train is backed down again to the point from which the start was made. During the entire trip, as at the start, there has been no smoke, no cinders, no heat, and no noise, excepting such as made by the running of the wheels.

A detailed analysis of the manner in which this road is operated, and the incidental mechanical devices, would confuse rather than aid the unscientific reader. He would probably know less about it than he did before. So only a broad outline is given of the minute and elaborate explanation of Mr. Hughes, who seems to have swallowed a dictionary on applied electricity.

The electricity which runs the locomotive is generated in the laboratory, and fed to the tracks by wires. As the tracks are conductors, the electricity runs over the entire length. It is taken up by the wheels of the locomotive, conveyed from them by metal brushes on to the conductors leading to the driver's house, and from this led again by conductors to other brushes, which are magnetized from a magnetic field fed by a shunt or branch of the current. These brushes are placed near and on either side of an armature in the forward part of the locomotive. The brushes on one side being magnetized, naturally attract the armature in that direction, but as the armature is fixed on an axle, it, instead of moving toward the brushes, has to revolve in their direction. Let the other brushes on the other side be magnetized, and the armature revolves in the opposite direction. Thus forward and backward motion can be produced.

Mr. C. L. Clarke, who has written on the electric railroad, claims a number of advantages for it. The mechanism of the locomotive is very simple, and requires but one man of ordinary intelligence for driving and attendance. The dynamos from which the electricity is fed to the tracks are stationed at distances of ten miles. From these central stations the signals and switches can be worked automatically, power can be furnished to the brakes, and light for the cars and night signals. Where there are heavy grades the locomotive by a mechanical device is firmly clasped to the rails, so that all the power is exerted in drawing the cars. Where, as on large plantations, there are long tramways, and steam locomotives can not be used on account of sparks, no such objection can be urged against the electric locomotive, while it is also evident that were it used on elevated roads the absence of steam, smoke, and cinders would be pleasant not only to the passengers, but to people living along the line.

It is also more economical to run an electric road than to run a steam road, the gain being principally in a saving of fuel, while there is also less loss by friction, and consequently a gain in power.

When asked concerning the speed at which an electric railroad might be run, Mr. Hughes remarked, lightly, that an electrician did not think much of two hundred miles an hour.

THE DOUBLE INDUCTION MOTOR.

One of the most difficult problems in mechanics has been to produce a safe, compact, economical, and manageable motor for household and other uses only requiring a small amount of power. The motive force has been sought for in various directions, and as the latest result of experience and experiment, electricity has proved itself to be the most available, and in all respects preferable to other motive agents for small power. Among motors employing electricity as a source of power we know of none so simple, so compact, or so powerful in proportion to its size and weight as the double induction motor shown in our engraving. It is the invention of Mr. William W. Griscom, and is manufactured by the Electro Dynamic Company, 121 South Third street Philadelphia, Pa.

In describing the construction, operation and advantages of this motor we cannot do better than use a portion of the report of the Franklin Institute of Philadelphia, in which the mechanism is described as follows:

The motor consists briefly of two semi-circular electro magnets, which together form a ring; their poles project inward, and, together with the wire coils, form a cylindrical tube, with which a Siemen's armature revolves. The poles extend laterally beyond the ring, forming supports for the brackets which carry the bearings of the armature and the brushes of the commutator. In order to reduce the wear of the journals to a minimum, the bearings are made four times the diameter of the shaft, and the direction of the wear is away from the point of nearest approach, so that the poles of the armature and magnets can never come in contact from this cause—a frequent source of annoyance and danger in former motors.

The battery consists of six one-gallon cells, into each of which plunges a plate of zinc four inches long and two inches wide, and two plates of carbon exposing a like surface.

The large amount of liquid (electropoion) is merely to save the trouble of frequently recharging; a battery containing six drachms per cell gives equal power, but for a shorter period. It is estimated that the battery once charged will continue to supply the motor with efficient power for all ordinary use of a sewing machine, in a private family, for many months, or probably one year, without refilling. It is inclosed in a tight box, which, covered with a cushion, serves as a seat for the operator.

The power of the motor depends upon the quantity of electricity furnished by the battery: this is easily regulated by raising or lowering the zinc and carbon plates in the exciting fluid. It is found that when the plates were partially plunged in the bath, sufficient mechanical power was developed by the motor for all ordinary requirements of a sewing machine, and when fully immersed it was more than sufficient to drive a large needle through sixteen layers of cotton cloth at a very rapid rate. The motor is 2¼ inches in diameter and 4 inches long, and its weight is but 2½ pounds; it is securely attached by a light frame to the table of the sewing machine. The entire apparatus is simple in its construction, excellent in all its mechanical details, and its adaptability to general use is not questioned by the committee. The battery differs from the ordinary Grenet form mainly in the automatic arrangements for removing the plates from the bath, and in the large size of the cells, holding one gallon of "electropoion" fluid each.

The method of graduating the strength of the current and consequent speed of the motor, is as simple as it is effective; a very slight pressure of the foot on the treadle suffices to start the machine as gradually as may be desired; the speed may then be increased up to one thousand or more stitches per minute, which it is said is considerably faster than is now attained by professional sewing women, while others seldom sew more than 300 or 400 stitches per minute.

Two forms of the battery were shown, in both, of which the plates are automatically raised above the bath when not in actual use. In one form this is accomplished by means of a spiral spring attached to either end of the bar, in which the plates are permanently fastened. In the other a similar result is attained by means of a counter weight on the small arm of the lever attached to the treadle.

The important novel feature of this battery consists in the size of the cells, which thus enables it to continue its operative without recharging for a great length of time, as the current is necessarily intermittent when the motor is running, and as the plates are frequently raised and lowered by the operator, to acommodate the needs of the work of sewing, the main objection to the ordinary Grenet battery, viz., the rapid deterioration when a constant use is required, is avoided to a great extent, while its advantages for household and occasional use are retained. These advantages are: that it generates no gases or vapors that are practically deleterious; the zinc elements do not (as in other batteries) require frequent amalgamation or attention, and when not in use, are simply raised above the fluid, and allowed to drain.

The committee, in conclusion, recommended this electric motor and battery to the favorable consideration of the Franklin Institute. as an apparatus possessing great power in proportion to its size, simplicity in its construction, excellence in its mechanical details, and general adaptability to household use.

This new electric motor is not only the most compact and powerful small motor we have examined, but it is also low in price.

THE TELEPHONIC SYSTEMS OF DR. HERZ.

(*For Illustrations, see page 220 and 221.*)

M. du Moncel has thoroughly studied the different telephonic systems of Dr. Cornelius Herz, and the object of the present article is to describe some new experiments, and especially the efforts which have been made to simplify the apparatus and give it a practical and convenient form.

The apparatus represented in Fig. 1 is specially designed for lines most affected by induction, which renders communication impossible with ordinary telephones.

This plan utilizes two principles discovered by Dr. Herz: the alternation of the current in the line, and employing condensers as receivers. The instrument constitutes a station, completely inclosing, under a compact and appropriate form, all the parts necessary for the call and for communication.

The diaphragm is horizontal, but a funnel placed in front of the box collects the sound and concentrates it upon the diaphragm, and the instrument will transmit words spoken fifty centimeters from it.

Four pairs of microphonic contacts are placed upon an oscillating platform, under the diaphragm and connected with it by a rigid rod, communicating to it all the vibrations of the diaphragm. These contacts are of a special composition, and communicate with the battery and with the line.

In this apparatus it is not necessary to use the induction coil, but it is necessary that the number of elements of the battery in the line be proportioned to the distance of the two stations; for example, between Paris and Orleans it was necessary to use thirty elements of Daniell at each station, in order to obtain the maximum intensity. Besides, the condensers have to be charged, in order to reproduce speech, so that it is necessary to employ another battery which is interposed in the line. It would seem at first sight that the number of elements employed would perhaps be an obstacle to the use of this apparatus, but it must not be forgotten, on the one hand, that the battery designed to charge the condenser, working always in an open circuit, costs very little, and on the other hand, the instrument is designed to work over lines where the employment of magneto receivers would be impossible.

Figures 2 and 3 represent an apparatus where the alternation of the current is accomplished in a different manner, and in which the induction coil is used in order to diminish the number of elements necessary in a long line.

Originally this instrument was formed of a vibrating plate, having at each side a contact point touching the diaphragm lightly, and the vibrations increased or diminished the pressure alternately upon each one of these contacts, but this form being inconvenient, M. Herz preferred that which is represented in Figs. 2 and 3, which gives the same results.

The vibrating plate, A, is of conducting material. Below, and touching it lightly, is a cylinder, B, which rests upon a disk, C, the two being made of the same material as the plate. The disk, C, rests, in its turn, upon a thin metal spring, which is made adjustable by means of a screw, so as to vary the contact between the three pieces, A, B, C.

The plate, A, and the disk, C, are connected with one of the poles of a battery of four elements, which is grounded at the center. Finally, the cylinder, B, is connected with one of the extremities of the primary wire of the induction coil, the other end being grounded. The secondary wire of the coil passes out from one side to the line, and from the other side to the ground.

It may be seen by referring to Fig. 4 what occurs when the instrument is spoken to. The vibrations determine alternately the increase and diminution of pressure upon the cylinder, B. During the first vibration the power of conducting electricity increases suddenly at A (Fig. 4), while the inertia of the cylinder, B, prevents increase at C, the current follows the route, A, B, P, to the ground. On the contrary, in the second vibration the power of conducting electricity diminishes at A, but increases at B, and the current follows the route, C, B, P, to the ground. It may be seen that during these two phases there are alternating currents passing through the primary circuit of the induction coil, and that in the secondary circuit there will be produced four impulses, two in one direction and two in the opposite direction, passing over the line. By this arrangement the telephones are placed in a derived circuit between the line and the ground. This instrument has always given very good results upon a long line, of which the static charges are often considerable.

Another arrangement has been given to the same instrument which does not work with alternating currents, but as an ordinary microphone having great power. This arrangement is represented in Fig. 5. The current enters through the cylinder, B, and issues through the contacts, A and C, and is delivered to the primary circuit of the two induction coils, then to the ground.

The secondaries are independent, as the sketch indicates, or arranged upon the same circuit; in either case they are connected with the line on one side and with the ground on the other. The engraving of this apparatus will show how the distribution of the current is made, and in order that the instruments may give good results it is indispensable that there should exist a certain relation in the resistance of the coils, between themselves, and the coils with the line.

Another principle has been utilized by M. Herz, to augment the power of his telephones: it is that of derivation from the ground. Fig. 6 represents an apparatus which is based upon the principle of derivation. Under the vibrating plate are four pairs of contacts arranged as in Fig. 1, but with different electrical connections. The four lower contacts are connected together, and the four upper ones also, in such a way that all the pairs work together without producing an alternating current. Fig. 8 shows how the instruments are arranged in two corresponding stations.

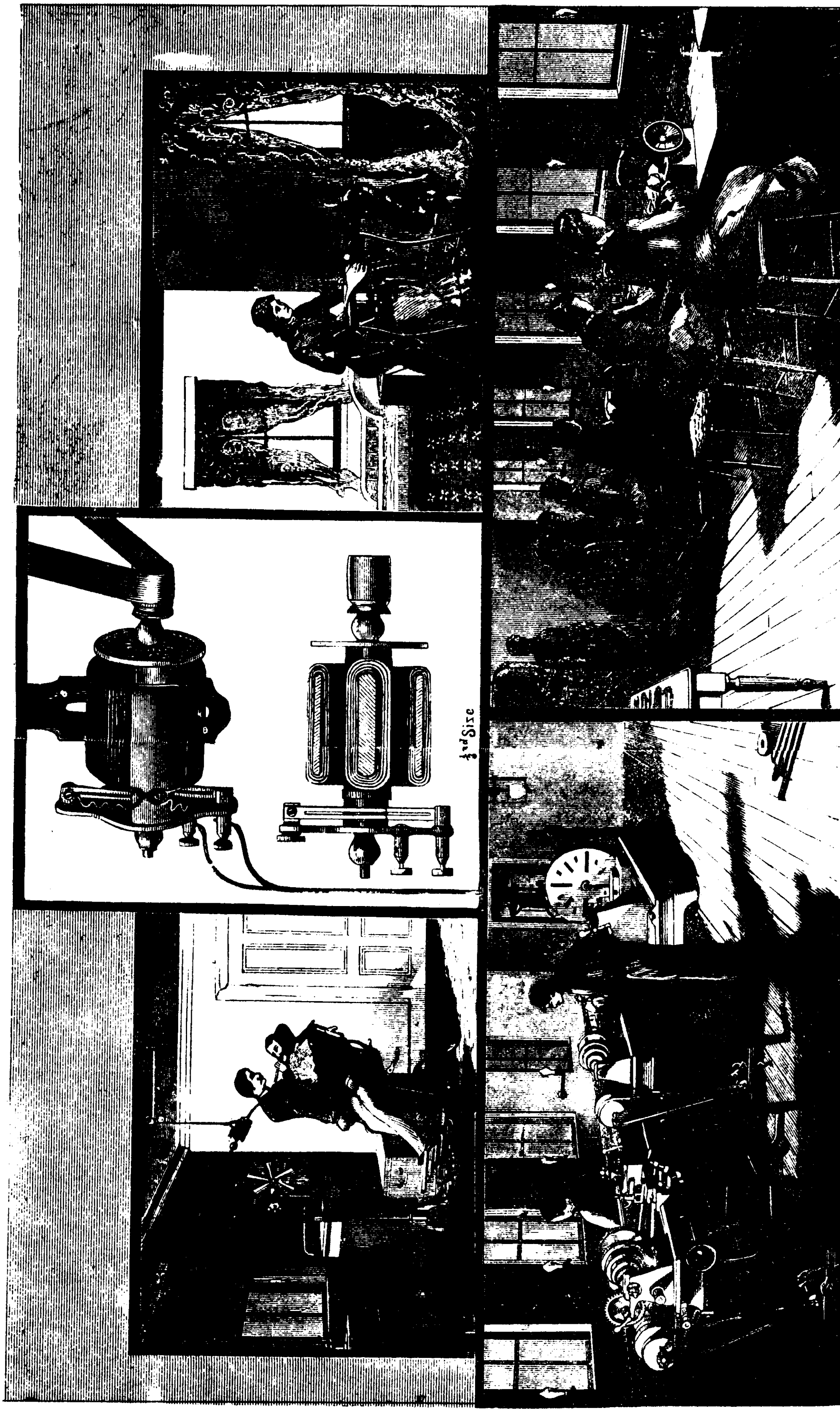
When the two receivers t, t_1 are hung up, each one of the stations may call the other by pushing on the button, C. When the station called has responded, the telephones are taken down; this changes the switches, and conversation may be carried on by the two instruments. Suppose, at first, that the station at the right speaks, the current from the battery P, passing by the contact, t_1 re-established by the raising of the telephone, is divided, the one part passing to the line, and the other to the microphone, M, then to the ground. The variations of conductivity produced by the microphone in the derived circuit, M, T, will be varied in the same manner as the current of the line of which the resistance is constant.

At the receiver of the other station, the current from the line passes in at C, then into the telephone, and finally to the ground, the lever, t^1 having established the lower contact.

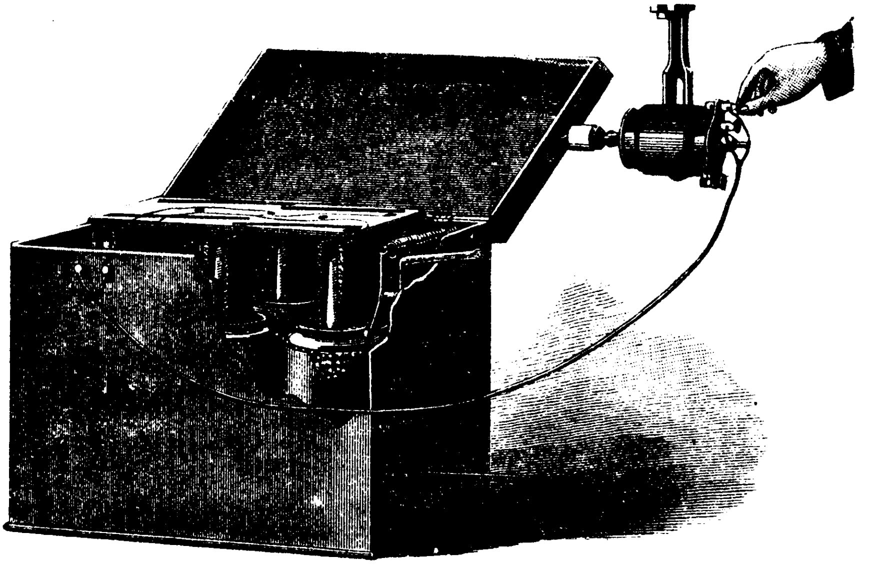
The apparatus described is placed horizontally, and may be spoken to directly over the diaphragm, but it may also have a vertical form as shown in Fig. 7; this arrangement, however, is only on the outside, and does not change the interior arrangement of the horizontal plate and the contacts.

The instruments which are the subject of this article put in practice three principles adapted to facilitate communication in various circumstances. These principles are the employment of condensers as receivers, the alternation of the current in the line, and the system of derived circuits. This does not form, altogether, a new method of telephonic communication, but either of them may be employed in cases where their application is specially indicated, and they constitute an important modification of the telephone.—*A. Noaillon, in La Lumière Electrique.*

DR. SIEMENS' PLAN OF DEFENDING THE CHANNEL TUNNEL.—The active and ingenious mind of Siemens has evolved a plan for the defence of the Channel Tunnel, if that work is accomplished, which is at once novel, economical, and *prima facie* practical, and he has by request presented this plan to the Military Committee on the subject. He proposes that immediately above the lateral drainage tunnel there should be a driftway or tube, terminating on the tunnel side in a double arch, with numerous perforations into the tunnel, and on the land side in several chambers of wrought iron sunk into the ground. These chambers he proposes to fill with lumps of common chalk and to connect each of them by means of a pipe with a large cistern filled with dilute muriatic acid. Upon opening the communication this acid would flow into the upper portion of one of the chambers, where it would be distributed by perforated pipes over the entire area. The result of such an inflow would be a powerful chemical reaction, giving rise to a generation of carbonic acid gas, which would for half a mile or more form an insuperable barrier to the passage of human beings through the tunnel. The valves by which the acid was turned upon the chalk might be worked from a safe distance by electricity. The scheme thus briefly sketched is recommended by Dr. Siemens as being comparatively cheap and easy of adoption, while leaving the tunnel intact and fit for use after a reasonable interval for proper measures to clear it from the carbonic acid gas.



THE DOUBLE INDUCTION ELECTRIC MOTOR.



THE BATTERY.

NOVEL INDICATOR FOR WEIGHING SCALES.

We give an engraving of a device for indicating by sound the overbalancing of the scales, so that audible evidence of full weight may be given to purchasers.

An electric alarm is set in operation by means of a circuit closer operated by the arm of the scale beam, which receives the article to be weighed, and a wedge adapted to be moved longitudinally varies the position of the circuit closer with relation to the arm.

In the engraving, A is a box or counter top, within which there is an electric bell, B, of usual construction, together with a battery for operating it.

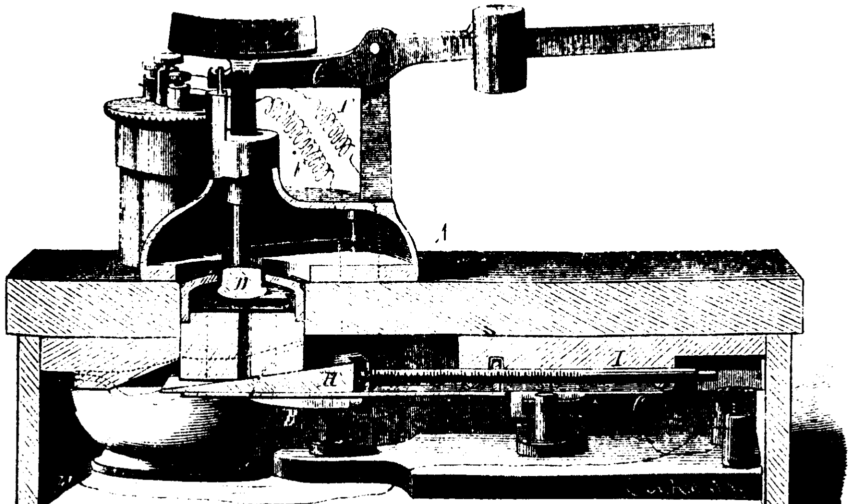
In the top of the box, A, there is a push button, D, which is held in an elevated position by a spring. This button is connected with the battery by means of a wire, E, and when depressed comes into contact with a wire, F, which extends to the bell, B, and thereby closes the electric current and sets said bell mechanism in motion in the usual way.

On top of the box, A, over the button D, is a pair of scales, G, which are so arranged that the depression of the end of the beam, upon which are placed articles to be weighed, will press down the push button, D, and sound the alarm, indicating the overbalancing of the scales, and enabling those interested to know that there is full or over weight upon the scales of the article being weighed.

In order that the vertical position of the push button, D, may be varied to adapt it to the scales, and to render their action certain, the inventor fits the casing of the button loosely in an opening in the box cover, and supports its lower end upon a wedge, H, arranged to move horizontally and longitudinally. The forward movement of the wedge operates to raise the casing, and a rearward movement to depress it. A threaded rod, I, having one end swiveled within the rear end of the wedge, serves to move the wedge longitudinally in either direction, as may be necessary for the adjustment of the push button.

The apparatus not only affords purchasers protection against light weight, but also assists the seller in weighing out articles by giving him warning whenever the necessary amount has been placed in the scales.

This invention was recently patented by Mr. Walton W. Wright, of Cairo, Ill.



WRIGHT'S ELECTRIC INDICATOR FOR WEIGHING SCALES.

Mill Work and Carpentry.

AN INTERESTING PAPER.

At the meeting of the Regular Millers' Society of Dublin, held May 23rd, an interesting paper on the subject of new process milling, in which the author opposed the system of high-grinding, was read by Mr. Murphy. We append a portion of the article :

"Of late years the milling world has been much exercised over the much-vexed question of rollers and millstones. Of all the various papers which have been written on the subject it is a remarkable fact that their authors, whilst possessing literary merit in a high degree, and having, to a certain extent, a fair theoretical knowledge of the Alpha and Omega of milling, are largely, if not wholly, incompetent, from the non-possession of practical experience, to speak with any authority on the proper method of the manufacture of flour. As yet no practical miller that I am aware of has attempted to place before his brothers of the trade his experience of the different systems of milling past or present. For these and kindred reasons I have endeavored to place before you, in as presentable a form as my limited abilities will allow, my opinions and impressions as a practical working miller. In the selection of machinery for a flour mill we will first consider the machines for cleaning wheat. The cleaning of wheat plays an important part in the manufacture of flour. In selecting cleaning machinery the miller should bear in mind the class of wheat he is likely to work, whether winter or spring, whether hard or soft.

First, I do not intend to deal severely or otherwise with the roller system, as it is now apparent to all practical intents and purposes the roller, as a rival of the millstone, carries within it the marks and tokens of its own condemnation. Its authors and champions point with pride to the fact of several mill-owners throwing out the millstone and putting up rollers instead. Well, really, Mr. Chairman, I, for one, cannot for the life of me see what is in that argument, if argument it be. I meet it by saying that it does not prove the superiority of the roller to the millstone ; it proves, if one thing more than another, either that the millowners alluded to were victimized, or else, the millstone with them was a failure, simply because they did not treat it justly or fairly. I go further, and say that in those countries where the roller *seems* to be ousting the millstone the cause and effect are due to ignorance, incompetency, and bad workmanship on the part of the millers of the several countries where the roller had perforce to be called into operation. Second : As to the manufacture of flour by stones, there are three systems known, as high grinding, half-high grinding, and low grinding ; as to the first-named process, I do not intend to enter at any great length upon it, as I am of opinion that high grinding, if adopted by any millowner and followed up for any considerable period, will result in either driving the man who adopts it into the workhouse or the lunatic asylum.

As regards half-high grinding and low grinding, I am in favor of the former ; in saying this, I know there are many millers of more experience than I, who are in favor of the last named or low grinding system. They say, we are making a very good, strong, and white flour by the low grinding system, and our employers are getting a good price for our flour ; granted, but to them I would say, if you could make a better, a stronger, and a whiter flour, and if your employers could get a higher price for your flour, where is the harm? But then you may say to me, what about the yield ? Even so, I claim that a better, a stronger, and a whiter flour, and a greater yield per barrel, will accrue from the half-high than the low grinding system ; but then I am met with what I must admit is, from their standpoint, a very fair and reasonable objection to the adoption of half-high grinding; they say, with our present mode of driving, and with the dressing machinery at our command, it is impossible for us to leave the paths so long trod by our fathers. I freely grant it is impossible ; except they are prepared to adopt some trifling and not over expensive changes in the milling machinery, they cannot hope to attain what should be the aim and ambition of every miller, viz., the best method of making the best flour with the best possible and profitable results to both miller and millowner. Low grinding millers maintain that they get a greater percentage of flour by its adoption, also that they will have less sharps or middlings ; now, I say, herein lies the whole germ of the case, for I believe a greater fallacy never existed than that of killing the middlings which undoubtedly close, or low grinding will do. Perhaps it would be better that I should explain how half-high grinding is superior to that known as low grinding, therefore I proceed at once to do so.

I set out with three clear distinct propositions, first, to make good flour you must have your wheat properly cleaned, second, your millstones must be well dressed and running fair ; third, you must have proper bolting or dressing machinery for finishing off your sharps or middlings. A word on each of these subjects, and I consider the case is proved, if not to your satisfaction, at least to mine. In reference to cleaning machinery, I do not intend to recommend any one class to select from, but as the cleaning of wheat is the first step in the process of manufacturing flour, great care should be taken in selecting proper machinery to do so, and as wheat can be cleaned too much, it is desirable that millers should bear in mind the class of wheats they are likely to work before erecting or changing their cleaning machinery. Of course hard wheat has a thicker bran than soft wheat, and in mills where two sets of screens do not exist, I would suggest that the one set be adjustable, in order to clean the wheat, more or less, as the case may arise ; care should be taken that the grain should not be broken during the cleaning process. If I might hazard an opinion on the number of degrees of cleaning, I would say, first, a separator, next a good scourer, also a brush and polishing machine. Of course soft spring wheats will not require much if any scouring. Next in order comes the grinding process.

In treating of the millstone, I do not presume to dictate to any miller any one system of dress more than another ; only this I would say, that I am firmly convinced that no matter how good your wheat may be, no matter how well cleaned it may be, if it be spoiled in the grinding no amount of dressing afterwards will make good flour. Therefore, I say no matter what dress you may use for your stones insist on having it well done and properly done, as the stone plays the most important part in the whole art of milling. A few remarks on this part of the work, and my object is accomplished. Great care should be taken by the miller when ordering stones for his mill ; in selecting the burrs, he should know what sort of wheats he will have to manufacture from ; for instance, burrs suitable for the proper grinding of hard wheats will not give the same satisfaction if worked on soft wheat. Again, in striking out the stone, he should bear in mind that a stone for soft wheat will not require as much land-surface as if for hard wheat, and *vice versa*. Also, I would say that stones intended for different wheats should vary in size, the softer wheats requiring less grinding ; naturally, smaller stones should be used for soft wheats. I need not pursue this subject further than merely to remark that stones cannot be too well cared for, and none but sober, intelligent men should be permitted to handle them. With a perfectly level face, well dressed, smooth furrows, and the centre in a corresponding degree of perfection, and under the command of a competent practical miller, one result only can follow therefrom, viz., success.

Thirdly, and lastly, the bolting or finishing off plays no unimportant part in the new process system, but I must confess my inability to compress into this paper anything like an elaborate description of this branch of the subject ; in fact each of the three branches supply matter for three different papers ; suffice it to say, however, that I am in favor of the middlings being purified, in fact the more purifiers you have in your mill the better the middlings will be purified, and as a necessary consequence the better your flour will be. In conjunction with purifiers I would have stones specially adapted for the purpose of finishing off, and I may here remark that I am of opinion the stone known in this country as the sharp-stone should be perfectly smooth faced ; every miller of even a limited experience will see the reason therefor. Whilst on this matter, I may mention what I should have mentioned when treating of stones, viz,, that I consider brown Belgian burrs the best to build stones from.—*Grain Cleaner.*

MR. G. W. Webster has discovered a method of correcting over-exposed gelatine plates. He adds to the developing solution a little citrate of soda, about four grains, presumably of a saturated solution, for every drop of ammonia. The effect is to check development while allowing intensification to proceed. The best proportions are unknown ; those given have yielded good results in Mr. Webster's hands.

Hints to Apprentices.

ARRANGING SAMPLES.

Picking up a popular novel a few evenings since, says the *Crockery and Glass Journal* our attention was attracted by the following extract descriptive of the appearance of a store for the sale of articles of an artistic nature. The proprietor is pictured as entering the door and stopping on the threshold struck by the aspect of his sample tables and room. "Even to an uncultivated eye there was a rigidity and formality about the whole establishment not artistic. At first it was but a feeling—a vague impression that grew upon him without his scarcely knowing why. He soon discovered, however, that everything was arranged squarely, according to systematic order, and not with a view of placing in the best lights and shadows the beautiful things to be sold."

Is not that an accurate description of the arrangement of some of the stores in our trade? Does it not seem sometimes, as the same author expresses it, as if "the building and everybody and everything in it had swallowed a ramrod?" The first point, then, to be avoided in arranging your samples is stiffness. Let the grouping be so thoroughly studied as to have the appearance of accidental tastefulness—if we may so express it. Hide the artificial plan and simulate naturalness. Begin with your handsomest, most attractive pieces, or those calculated to make the best display, and place them in such a position that they will strike the eye (figuratively, we mean) of your customer as he enters the store, so that the first impression may be one of pleasure. Mass all of the articles of the same kind on the same or adjoining tables, and so situated that a person may have a full, unobstructed view of the full line at once. Much of the beauty is lost by scattering articles of the same style, and thus weakentng the effect by seeming to offer a poor or small assortment. If it be true that your assortment is small, it is sometimes a good plan to duplicate your samples as by this means you derive all the benefit of a large display of goods.

Have some thought to the character of the goods or articles, and arrange them so that they may not counteract or injure the beauties of each other. Do not place a Barbotine vase alongside of a delicately tinted Sèvres vase, or other soft enamel ware. Both will be injured by the comparison. The rich colors of the Barbotine piece render the delicate tints of the other tame and insipid. In the same way a short vase is dwarfed by companionship with a row of taller ones, and made to appear even shorter than is actually the case. All the samples should be within easy reach of both customer and salesman, partly to avoid breakage and also for greater convenience in handling and examining the articles. If this be not the case it may produce the impression in the mind of your customer that you do not invite a close examination of your goods. Where goods are sold as represented in all respects, and honest dealing is the rule, there is no reason, except the slight danger of breaking samples, why the freest inspection should be objected to. It has somehow become the custom, by tacit consent of the trade, to show toilet sets under the counters or on the floor, and many a back-ache is the result of stooping down to look at the different sets. Why this should be we fail to see, unless caused by excessive modesty, for there is not the same reason as may be properly advanced for showing cuspadores in this way—that they are designed for use on the floor, and are therefore decorated to show best in this position.

As many samples as practicable should be shown in a position resembling the spot for which designed. Vases should be at the height of an ordinary mantel, or nearly on a level with the eye, as their best features are seen when thus placed. Ornaments, figures and bric-a-brac of all descriptions are much improved in appearance by a background of cloth or other soft material, as we suggested when speaking of "store-fittings." A very pretty effect is obtained by placing these articles on the fancy cabinets for which there is such a great sale at present. We have seen a store in a large neighboring city in which nearly or quite all of the handsome ornaments that form a large part of the stock are displayed on ebony cabinets worthy to receive even the rich goods they hold. The effect is striking and pleasing.

The most difficult place of all to array is the show window or show case outside. The usual mistake made is to put too much into the window and crowd it so full of a conglomeration of all kinds, classes and conditions, that each nullifies the other, and your window is but little better than a stock-room. Put only a few pieces in your window and change them frequently—and this is also an additional reason for having but a few pieces there. If there be a large quantity of goods on exhibition the task of changing them is great, and there is consequently a strong temptation to "let it go another week," which should not be done under any circumstances. No window should be changed less frequently than once a week, and it is a good plan to allow a different salesman or employee to arrange it at different times. By this expedient they are educated in artistic ideas, and the effect of variety is shown in the grouping, as each one has his own idea of how it should be done, and if he has any taste at all it will be a benefit to change the style of "dressing" the window as well as the samples and specimens shown. Above all, keep all your samples well cleaned and polished, especially in summer. If you do not your stock may suddenly change from firsts to seconds, or appear to at least, from the great number of black spots that show themselves on the white surface.—*Metal Worker.*

TO EUROPE IN LESS THAN SEVEN DAYS.

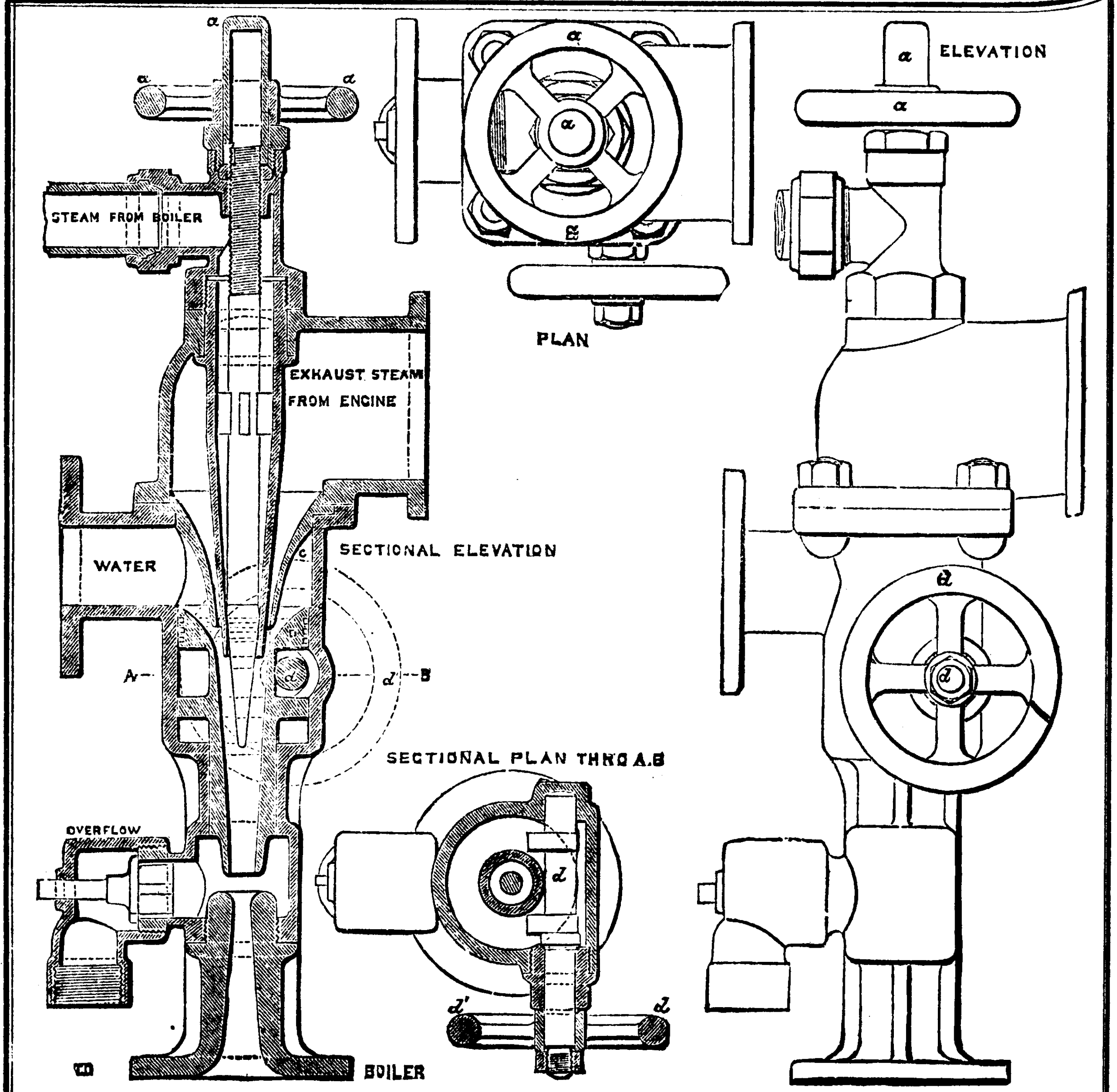
The limit of possibilities of speed in the transit of the Atlantic does not appear to have yet been reached, and with the steady improvements that are being made in the construction of vessels, in giving finer lines to their hulls, and furnishing them with engines of increased power, we may look for steady reduction of the time of passage.

The latest candidate for nautical honors, in respect to speed, is the steamship "Alaska" of the Guion line. This fine vessel had made the fastest trip on record in one of her late passages from England to America, but on the return trip succeeded in beating her own record by several hours. The trip from Sandy Hook to Queenstown was made by the "Alaska" in less than seven days. She sailed from New York on May 30th, clearing Sandy Hook bar at 5.28 P.M., and arrived at Queenstown at 8 P.M., on Tuesday, June 6th. Deducting 4 hours and 22 minutes for difference of time, the actual time of the trip was 6 days, 22 hours and 10 minutes.

The *Tribune*, in commenting on this remarkably rapid voyage, brings the fact into instructive prominence by recalling the fact that in 1848 it was considered remarkable that an ocean steamer should make the Atlantic passage in less than sixteen days.

Balloon Experiments in Germany.—A new steerable balloon, the invention of Herr Baumgarten and Dr. Wälfert, was recently tried at Charlottenburg. It is of huge size, having a capacity of about 473 cubic yards, and is ellipsoid in form, the longer diameter about 58 ft. It differs in principle from all other aërostats in that, although inflated with hydrogen, it has no ascensional force; its total weight is about 2 1-5lb. above that of the air it displaces. The means of displacement, in the horizontal or the vertical direction are a helical system of vanes actuated by machinery in the car. Hence, in making land, the balloon does not require to be partly emptied, and on reaching the ground it has nearly the same quantity of gas as when it rose. Another novelty consists in the mode of connection of the car. This is rigid. Thus the dangerous bounds or jerks to which the ordinary balloon-car is liable in landing are to some extent avoided. The car being usually suspended by ropes, the system is suddenly relieved of its weight when it touches the ground, so that the balloon shoots up again, giving a series of violent shocks. With a rigid connection the total weight cannot be thus temporarily diminished. The mechanism has a double action; one helix of vanes, or screw propeller, driven in one direction or the opposite, producec ascent or descent, while a couple of screws give horizontal propulsion; in a pretty calm atmosphere the horizontal direction may be modified by working one of the couple alone. The first experiments, it appears, were quite successful. The weather was exceptionally calm. In a second trial a slight accident ruptured the envelope of the balloon, and the car mechanism was also injured. The experiment are soon to be resumed. The motor, it may be mentioned, has a force of four horse-power and weighs 80 lbs. The cost of charging, each time the balloon is filled, is about £20.

It has been recently announced by Herr Hermann, that germinating seeds (*e. g.*, peas), in water or moist surrounding, show a regular and strong electric current, the radicle being negative to the cotyledons. The strength is often over one-tenth of a Daniell. He is investigating the phenomenon.



THE BINARY INJECTOR.

THE BINARY INJECTOR.

The accompanying engraving illustrates a somewhat curious injector made by Messrs. Weild & Co., Gorebrook Iron works, Longsight, Manchester. It was for a long time a puzzle how an injector working under a given pressure could force water into a boiler in which there was a still greater pressure, but the Binary injector does more than this, for the exhaust steam from an engine is made use of to feed the boiler with water.

The section which we give will make the interior of the instrument intelligible. The theory of the action of the injector we give as stated by Messrs. Weild. The injector is not perceptibly intermittent in its action, although the exhaust from the engine comes in puffs. The pressure of the steam cannot be less than about 18 lb. absolute, and this, coming in contact with the feed, is condensed, and the velocity of influx of the steam to the injector is thus very high.

Between the blasts or puffs the reciprocation of the piston expels the residual steam or vapor, which must, in the cylinder of a non-condensing engine open to the exhaust, necessarily equal the atmospheric tension. The continual supply and condensation of such steam provides, without intermission, a propulsive energy sufficient to introduce the feed-water under ordinary pressures, as we conceive the following rough calculation will tend to show. Friction neglected, steam of 14·7 lb. per square inch, or 2,118·4 lb. per square foot, absolute pressure, will flow into a vacuum of 10 lb. per square inch below the atmosphere, which corresponds to an absolute pressure of 4·7 lb. per square inch, or 676·8 lb. per square foot, with a velocity

$$=8\sqrt{\frac{2118 \cdot 4 - 676 \cdot 8}{0 \cdot 0378}}$$

$=1,554 \cdot 8$ ft. per sec.

The head of water requisite to balance a pressure of 75 lb. per square inch above atmosphere

$=75+2 \cdot 25=169$ ft.

nearly. Velocity of efflux under such head

$=8\sqrt{169}=104$ ft.

per sec. Suppose each pound weight of steam of atmospheric tension propels 12 lb. of water and is thereby condensed, the equivalent resultant velocity

will be $\frac{1,654 \cdot 8}{113}=119$ ft.

per sec.; this is equal to a head of 219 ft., or a pressure of 97·5 lb. per square inch. If the original temperature of the water be 50°, the resultant heat at which the feed leaves the injector will approximate 140°. The injector has been doing excellent work wherever it has been fitted.

FIG. 4.—EXPLOSION OF THE BOILERS.

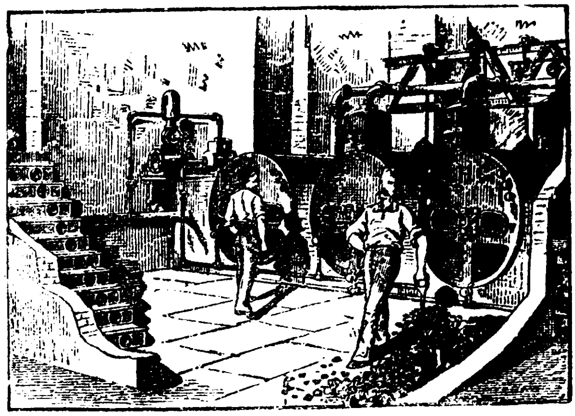


FIG. 2.—INTERIOR OF THE BOILER HOUSE.

EXPLOSION OF TWO STEAM BOILERS.

The subject of our illustrations is the explosion of two large steam boilers, on February 16, 1882, at the Jewell Flouring Mill, in Brooklyn, N.Y. This double explosion caused the death of Levi J. Stevens, the engineer, injury to a number of persons, and the destruction of the boiler house and portions of the main building and chimney, as shown in Fig. 1.

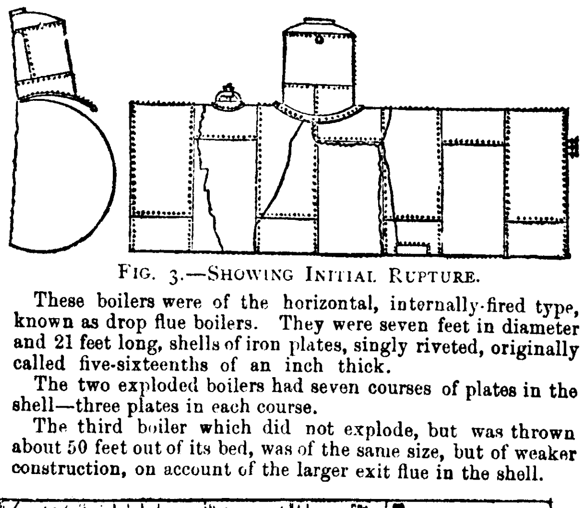


FIG. 3.—SHOWING INITIAL RUPTURE.

These boilers were of the horizontal, internally-fired type, known as drop flue boilers. They were seven feet in diameter and 21 feet long, shells of iron plates, singly riveted, originally called five-sixteenths of an inch thick.

The two exploded boilers had seven courses of plates in the shell—three plates in each course.

The third boiler which did not explode, but was thrown about 50 feet out of its bed, was of the same size, but of weaker construction, on account of the larger exit flue in the shell.

FIG. 1.—POSITION OF THE THREE BOILERS AFTER THE EXPLOSION.

A few minutes before noon, on February 16, while the engine was running at the usual speed, the steam gauge indicating 47 pounds pressure, and the water gauges showing the usual amount of water. and while the engineer was standing immediately in front of boilers, the middle one exploded, and the shell was nearly all stripped off. The remainder of the boiler was thrown high in the air, probably made several somersaults in the air, and brought down beneath it in its fall a corn conveyor which passed above the boiler house roof, and entered the main building about 30 feet above the boiler site. The shaft and worm of this conveyor lay beneath No. 2 boiler, as shown in Fig. I, proof that the boiler rose higher in the air than the position of the shaft and worm.

During the period of time that this boiler was in the air, No. 1, the left hand boiler, having been forcibly struck by parts of No. 2, also broke open, but on such a line of initial fracture that its main portion was projected horizontally to the front, arriving at the front wall of the building in time to fall under No. 2, as shown in Fig. 1. There can hardly be a question about the direction taken by these two boilers. The most probable hypothesis is indicated in Fig. 3, inasmuch as the rupture separates a ring of plates which was found folded together beneath the pile of *débris*. If the initial break had been at some point at the bottom, then this belt or plate would have been thrown upward and flattened, instead of downward, where it was folded by the flood of water from No. 1 boiler.

The third boiler was hoisted out of its bed by the issuing water, and thrown about 50 feet to the right at its proper place,

These two boilers contained probably more than 14 tons of water, which had a temperature due to 47 pounds pressure, and the effect of its sudden liberation equal to that of several hundred pounds of burning gunpowder.

The most reasonable hypothesis is that the middle boiler broke first at the calking edge of the longitudinal seam, Fig. 3, this line having been gradually weakening.

Second, the iron was brittle, although its tensile strength may have been satisfactory—said to have been 45,000 or more.

These boilers had been inspected by the Hartford Steam Boiler Inspection and Insurance Company, and the company has been made the target for some very severe newspaper criticism since the occurrence of the explosion. We are not disposed to join in the general denunciation which often follows occurrences of this character, the only cause for which is too often the necessity of finding some convenient scapegoat to bear the burden of the offense. We are, in common with many of our readers, too well acquainted with the careful methods of the Hartford company to entertain for a moment the belief that its officers would be willfully careless or take unnecessarily hazardous risks. The whole course of the company's history gives an emphatic denial to any such suggestion, and the record which it has made during the many years of its existence will furnish the doubtful with ample evidence to demonstrate these statements.

From a careful reading of the evidence brought out in the public discussion of this notable case, we think it safe to affirm that there were conditions involved, which, if properly understood, and the proper weight had been attached to them, would go far to modify the general verdict as to the responsibility for this occurrence. Some of these are hinted at in the following: It may be asserted from an examination of the parts of the exploded boilers that the incipient rupture was not at the theoretical weakest point. It did not commence at or along the longitudinal seam, but began at the drop connection, and followed along at the girth or "round-about seam. The boilers were supported from a girder in the rear, and rested on a wall or foundation in front. The peculiarity of the fracture indicated the presence of some strain other than that caused by internal pressure. The settling of the foundations has been suggested, and in studying the locations and surroundings, there appears to be good grounds for such an opinion. The buildings are located on a dock of "made ground," driven thick with piles so as to secure a foundation. The chimney settled some time ago, and it became necessary to fasten it to the walls of the building by iron rods or straps to hold it in position. The foundations of the engine have settled once or more, and it has been necessary to relay or to readjust them. The boilers were located outside the main building, and nearer the water's edge than either the chimney or engine. Now, a slight settlement of the foundations of the support at either end would cause a strain that might ultimately result in fracture, and the rupture, once started, the rest is easily accounted for. It might be said that the settling of the chimney and engine foundations should have called the inspector's attention to the boiler foundations. But those familiar with the business can readily see that it would be no easy defect to discover, and the influence of heavy rains and high tides may have been an important element in the problem. In forming a conclusion, these and other probabilities should be duly considered.—*Manufacturer and Builder.*

NEW NUT TAPPING MACHINE.

We give herewith perspective and plan views, also a sectional elevation, of a new and very efficient nut tapping machine made by Messrs. Howard, Brothers, Fredonia, N. Y. This machine has seven spindles, and its capacity is 8,000 nuts per day of ten hours.

The efficiency of this machine is sufficiently attested by the fact that a large number of the most important railway corporations, car manufacturers, locomotive works, machine shops, agricultural tool manufacturers, iron works, etc, etc., in the country are using them. Some of these firms are using as many as fifteen machines.

This machine runs seven taps with three different speeds, and is so arranged that two of the taps may be run with the fastest, two with the slowest, and three at the medium speed, at the same time—the gearing being arranged to enable the operator to get the desired speed, for any given sized tap; or all map be run at any of the three speeds, if so desired, by having the necessary gears. By the substitution of the necessary gearing —which is easily done—three, two, or one of the taps can be run "left hand." The machine has a tight and loose pulley, to accommodate itself under a main line or counter line. The necessary oil is regularly supplied by graduating cocks, a device in itself a source of economy.

Of these machines two sizes are made, No. 1 and No. 2. No. 1 machine taps from one and one-half inches down to the smallest size. No. 2 taps from two inches down to the smallest size.

These machines are arranged so as to provide against any gumming, or obstructions in the sockets from the chips or oil. The sockets for holding the taps are made so that any tap will fit and work in or on any spindle. The nuts, when finished, drop below the teeth of the tap, and when the tap is full it can be removed and replaced without stopping the machine.

With these machines nuts of the same or different sizes may be cut as rapidly as one man can put them on and take them off the taps. The attendant can be kept busy and at the same time run at a speed sufficiently slow to avoid destroying the tap; the motion or speed of the tap being within the control of the operator can be made fast or slow as desired; and one or any number of the taps may be used, as required.

Further information in regard to these machines may be obtained by addressing Howard, Brothers, Fredonia, N. Y.

PROTECTING IRON.

A new process for preserving iron is described by *Les Mondes*. It consists in treating the casting with dilute hydrochloric acid, which dissolves a little of the metal and leaves a skin of homogeneous graphite holding well to the iron. The article is then washed in a receiver with hot or cold water, or cooked in steam, so as to remove completely the chloride of iron that has been formed. Finally, the piece is allowed to dry in the empty receiver, and a solution of caoutchouc, gutta-percha, or gum resin in essence of petroleum is injected, and the solvent afterward evaporating leaves a hard and solid enamel on the surface of the ironwork. Another plan is to keep the chloride of iron on the metal instead of washing it off, and to plunge the piece into a bath of silicate and borate of soda. Thus is formed a silico-borate of iron, very hard and brilliant, which fills the pores of the metal skin. As for the chlorine disengaged, it combines with the soda to form chloride of sodium, which remains in the pickle.

THE annual wire product of the United States is said to be 135,000 tons, and of England 200,000 tons.

CRYSTALS.

Most of the metals assume, under certain conditions, a crystalline form, and those particularly which are found native occur frequently as crystals. The Lattrobe nugget, at present in the Natural History Museum, is a magnificent instance of crystals of gold. It consists of natural golden cubes, welded, is it were, together in one mass. Among the metals, bismuth is remarkable for its tendency to crystalize, and by following the directions given, a crystalline mass of bismuth is readily obtained. Take about a quarter of a pound of the commercial metal and melt it either in a small clean iron ladle or over a Bunsen lamp in a porcelain crucible; when quite melted, set the ladle or crucible on a cold metal surface. Let it remain perfectly still, and watch the bismuth carefully, until it is seen to solidify round the edges, then quickly pour out the metal still remaining liquid, and you have the whole of the interior lined with more or less perfect cubical crystals of bismuth. There is one striking peculiarity about these crystals, however. They are but skeleton crystals; the lines forming the edges of the cubes are there, but there is a depression in each face of the crystal evidently not as yet filled up. The growth of the crystal was arrested by pouring out the still liquid metal, and there we have not only shown us the shape of bismuth crystals, but also the manner in which the crystal grows.

For purposes of comparison, try now to make sulphur crystals. To do this, melt down roll sulphur in the ladle or crucible, using, however, a very gentle heat, and not prolonging it beyond the point at which the whole of the sulphur is melted; allow to cool in the same manner as with bismuth, wait until a crust has formed over the surface, and then immediately bore two holes through with a red-hot wire, the one for the liquid sulphur to run, and the other to admit air. Pour out the sulphur still remaining liquid, and cut carefully round the upper crust with a penknife, remove it, and the whole of the interior is interlaced with delicate needle-shaped, amber-like, crystals of sulphur. Here, then, are two substances, of widely different appearance and properties, both possessing in common this property of crystalizing, but with each there is a definite shape. Further experiment and observation teach us that the form of a crystal is as characteristic of a body as any other property it possesses. In the next paper the writer proposes to give further directions for the preparation of crystals, and hopes to add sketches of crystals as viewed by the microscope.—*W. Jago, in Knowledge.*

MANUFACTURE OF GREEN TEA IN INDIA.

A correspondent of the *Indian Tea Gazette* says:

"Manufacture can be commenced as soon as the leaf is plucked, but as it is more convenient to manufacture a day's plucking at once, the leaf plucked during the day is allowed to be all night in the leaf shed, spread out from two to four inches deep, and is constantly turned over to prevent heating.

"The manufacturing process is as follows: A large iron *karai* or pan, 36" diameter by 12" deep, is heated almost red hot, and when ready is filled with green leaf, which is rapidly turned about to prevent burning, until it has become quite soft, and the mass reduced to about half its former size. This process takes about three minutes. It is then thrown on the rolling table, and while the next panful is being prepared, is rolled by the tea makers. As the leaf is perfectly soft and flaccid, the rolling is done in the same time as the panning takes. If there is any sun, the rolled leaf is then thinly spread out in it until it becomes a blackish green and is very stickly to the touch; or if cloudy is put in *chalnccs* over charcoal fires until in the same condition. It is then put into smaller iron pans, 25" in diameter by 12" deep, which are only heated to such a degree that the hand cannot be kept on the iron. These pans are about half filled, and the leaf is kept turning over until it has become quite soft again, when it is again rolled. When the day's batch has all been rolled a second time, the small pans are filled to the brim, the heat being gradually lowered, and the leaf is cooked, being constantly turned about as before for about four hours, when it is almost dry to the touch. If a large quantity of the two classes of gunpowder are required, it is then screwed up in bags as described by your correspondent, but this is not necessary nor indeed advisable at present, as the gunpowders do not bring the same prices as young hyson and hyson, a quantity of which classes become gunpowder in the screwing. The tea may now be left for weeks in the bins before being classed and colored, but we will suppose that next process takes place next morning. The small pans should be heated to the extent of burning the hand if kept on the iron for a short time, and about half filled with the tea, which is worked rapidly from side to side until it assumes a light greenish tint, which will take about an hour and a half. It should then be classed, fanned, and picked. Before being bagged for market, about the same quantity is put into the pans, heated to the same degree as before, and is again worked rapidly to and fro for about two hours until it has assumed all the bloom it will take—usually a whitish green; but if the leaf is hard and old when plucked, the color will turn out yellow green, and will require coloring matter, usually pounded soapstone. It is in this last panning that the coloring matter is put in, but I believe that the Europeans in this district do not use it unless requested to do so by the native buyers. It is easily detected by taking a handful of unadulterated tea and breathing on it, when it will be found that as the damp dies off the bloom will return, but will entirely disappear in adulterated tea. The tea is then packed hot in 200 lb. bags composed of an inner cloth and an outer gunny bag, and is dispatched in this state to market. In heating the pans, wood is always used, and it is quite as efficient as and much cheaper than charcoal.

AN INTERSTELLAR RESISTING MEDIUM.

O. Backlund recently made a brief report to the St. Petersburg Academy on his investigation of the hypothesis of a resisting medium in space, from which the *Naturforscher* extracts the following:

Encke's hypothesis of a medium filling interstellar space has met with no serious opposition from scientific men. Encke himself thought that it received strong confirmation from the theory of the comet that also bears his name. Asten, who has continued the theory of these comets since 1848, advocated Encke's hypothesis, and believed that his results offered a still stronger proof of the correctness of the hypothesis. Encke first found that the periodic time of the comet referred to decreased by time proportional to the square of the time, and he proposed this hypothesis: Interstellar (or interplanetary) space is filled with some substance that gravitates toward the sun, and its density decreases inversely as the square of the distance; it therefore offers resistance to the motion of the heavenly bodies, which is proportional to the square of their velocity. It can be proven mathematically that such a medium must cause secular as well as periodical disturbances in their mean motions and eccentricity, but only a periodical one in the length of the perihelion. The period of the periodical disturbance agrees with the orbit, but such a medium has no effect on the inclination of the orbit or on the nodes.

Since Encke only took strictly into account the disturbance that took place in its mean motion, and did not investigate the periodical members of this disturbance, the theory of the comet named after him afforded no proof of the correctness of the hypothesis; for, if we are to adhere to the existence of a resisting medium, an infinite number of suppositions can be made concerning the properties of this medium, all of which shall fulfill the requirements mentioned.

An essential limitation of the possible number of hypotheses has been established by Asten's investigation, inasmuch as he independently deduced the secular disturbance in its mean motion and eccentricity from the observation.

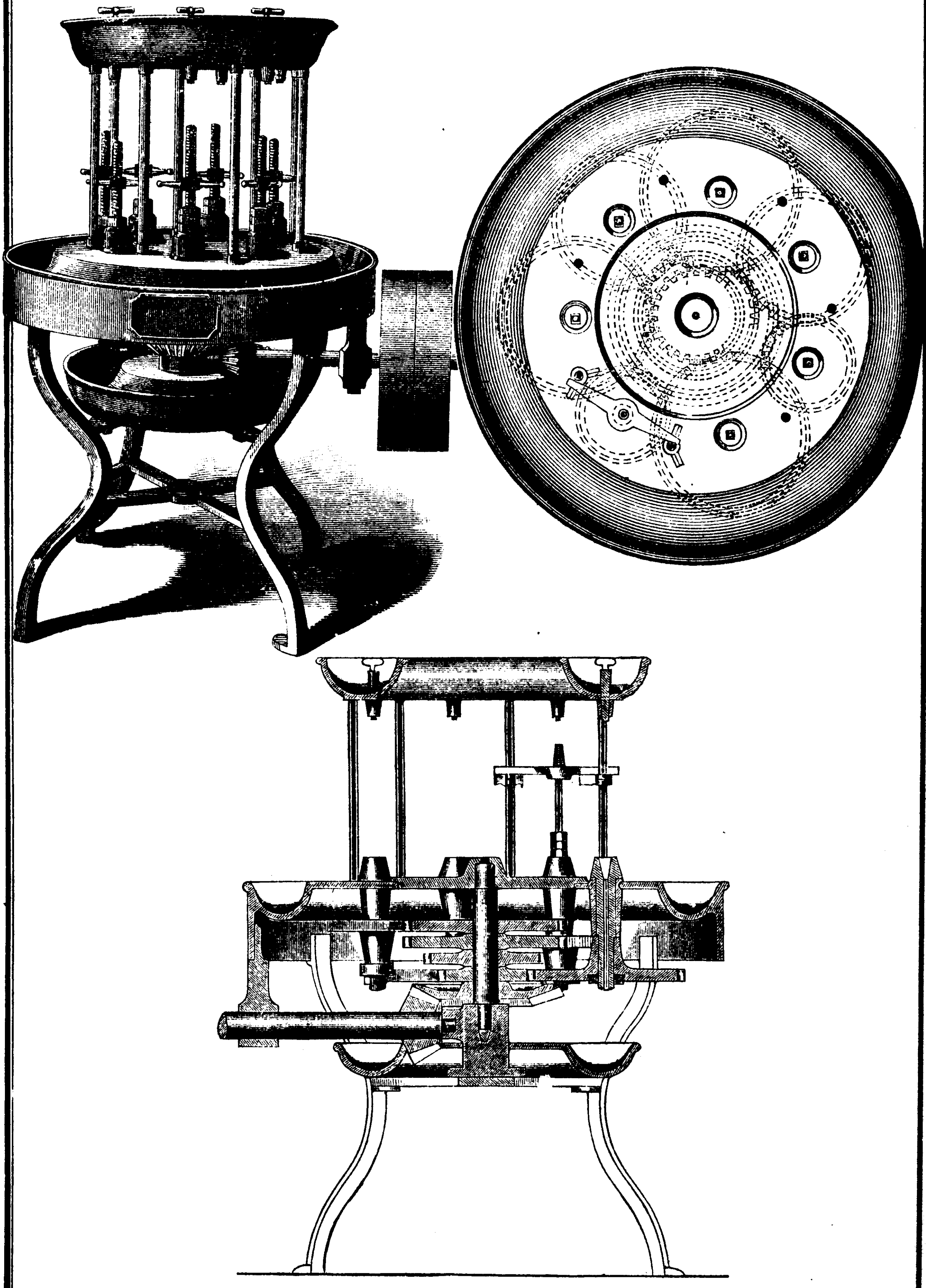
The results of my investigations regarding this resisting medium are of a negative character, and can be summarized as follows:

As yet the treatment of the theory of Encke's comet has really proved nothing regarding the existence of a resisting medium in space.

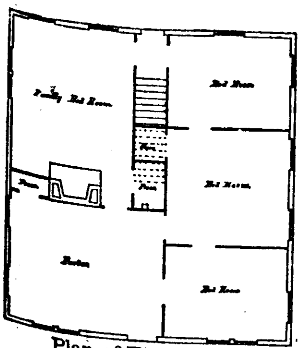
If any one should succeed, on any hypothesis whatever, in explaining the increased mean motion, and the decreased eccentricity, during the interval between 1819 and 1848, so simple a hypothesis will not suffice to explain the course of the comet of 1865, inasmuch as the mean motion has very probably changed since that time. After the phenomena from 1865 to 1881 have been fully worked out, and their relation to former phenomena ascertained, it will probably be impossible to find out the nature of the hitherto unknown forces acting upon comets.

The diamond is highly electric, attracting light substances when rubbed, and, after long exposure to the sun's rays, becomes phosphorescent in the dark.

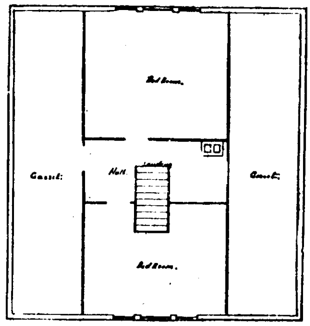
It is observed that trees in the peach gardens of France, grafted on plum stock, ripen their fruit at least ten days earlier than the same variety grafted on a peach stock.



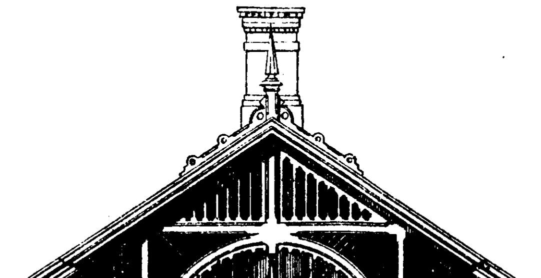
DURRELL'S NUT TAPPING MACHINES.



Plan of First Story.



Plan of Second Story.




DESIGN FOR COTTAGE, COSTING $1,200.—FRONT ELEVATION.

SIDE ELEVATION.

Architecture.

DESIGN FOR COTTAGE, COSTING $1,200.

The cottage shown on the opposite page was built near the little village of Orangeburgh, S. C., for Dr. DuBois, of Hudson, N. Y. As will be seen by the plans, it is arranged for a small family only. The kitchen and apartments for servants are in another building, tastely arranged and close at hand—a custom peculiar to the Southern States. As the house is occupied but about two months during the winter, it has not the completeness that characterizes the owner's house on the Hudson. The large fire-place in the parlor for burning wood, is a positive requirement in that latitude.

The piazza, 10 feet wide, which extends around the entire building, is not shown on the floor plans. The manner of carrying it the full height of the main building in the gables gives a fine effect, while breaking the eaves takes away the monotony of what would otherwise be a disagreeable roof.

The house stands well up from the ground on posts, which are hidden by the open-work under the piazza. The frame is of thorough balloon construction, and is finished inside with Southern pine, except the trimmings. The roof is of shingles, and painted.

It is doubtful if a more commodious, comfortable or pretty cottage could be built, at the same cost, than this would be when handsomely painted in colors, heightened with occasional vermilion chamfers, etc., the roof also coming in for a reasonable amount of ornamentation. The cost was $1,200. The arrangement of the interior can be readily modified to suit the wants of our latitude.

The design is by J. A. Wood, architect, of 240 Broadway, New York, who is now, among other work, completing at Poughkeepsie, for Mr. Allen, proprietor of the Astor House, the most ornamental and beautiful cottage on the banks of the Hudson. Some idea of the ornamentation may be arrived at from the number of colors and shades employed in decorating the exterior, which is upwards of a dozen and a half. The effect is perfect, and nothing like it has ever before been attempted.

Notes and Clippings.

MR. E. Berliner, of Boston, Mass., says he finds that a Planté battery is rapidly "formed" when 5 per cent of alcohol is added to the ordinary acid solution. In practice he connects both lead-plates to the carbon-pole of several Fuller cells, and a carbon electrode to the zinc-pole, thereby developing both lead-plates simultaneously. The carbon electrode is subsequently removed and the lead-plates connected to different electrodes. One hour is sufficient to create a heavy oxide surface capable of taking a large charge.

A new lamp combining gas and electricity is said to have given good results. A small strip of platinum foil is so arranged in connection with the burner that when the gas is ignited the platinum becomes heated, and then offers so much resistance to a current of electricity that it becomes incandescent, and in turn heats the gas to a high temperature. It is stated that a light equal to 30 candles can be obtained from two cubic feet of gas per hour when a small current is used in aid.

IN a paper recently read to the French Society of Civil Engineers, M. Cœne expresses surprise that the Seine is not better utilized for traffic between America and Europe. Rouen with its new quays, has had an increase in tonnage of merchandise from 400,000 to 1,500,000 in five years, and is the fourth port in France. But it should be made possible (M. Cœne holds) for the large ships of modern build (some of them 5,000 tons) to come to Rouen; and the first thing to be done is to form, in the bay of the Seine, an embankment of large size giving a better direction to the principal channel of the estuary. The estimated cost, 25 million francs, would be diminished by 15 millions for recovered land. An immense sheltered roadstead, 4,500 metres long by 2,200 broad, would be formed before the port of Havre capable of accommodating the largest fleets.

THE smallest circular saw in use is a tiny disk about the size of a 5-cent piece nickel, which is employed for cutting the slits in gold pens. They are about as thick as ordinary paper, and revolve some 4,000 times per minute. Their high velocity keeps them rigid, notwithstanding their extreme thinness.

A SELF WINDING CLOCK.

Mr. Dardenne's self-winding clock may be considered to have had a fair trial. A specimen clock was fixed at the Gare du Nord terminus, Brussels, last September, due precaution being taken to avoid tampering with it by affixing the Government seal. After six months' trial it was found in perfect time with the Observatory clock. The clock is wound by a small anemometer or windmill, which is, by a reversed train of multiplying wheels, continually drawing over each wheel an endless chain, in one loop of which the clock-weight is supported. As the loop hangs between the clock and the winding machine, the weight is continually drawing through the clock the slack chain drawn up by the wind motor, and thus a constant motion is maintained. A ratchet-wheel prevents the motor from turning the wrong way, and whenever the weight is wound right up to the top the motion is checked by a friction brake automatically applied to the anemometer by the raised weight lifting a lever. When the weight is fully raised the clock has a sufficient store of energy to go for twenty-four hours.

ELECTRIC LIGHTING AND STEAM HEATING.

Two great improvements in the business and domestic economy of New York city are being pushed with vigor. These are the Edison electric light system and the steam-heating system. By the former it is proposed to introduce electric lights into private and business houses to take the place of gas—such a prolific source of fires; and by the second it is intended to substitute steam for the great variety of heating appliances now in use, this doing away with a fruitful source of danger. The electric light company has nearly completed its arrangements for lighting one district in the lower part of the city, and it is expected that the system will be in full operation in that section by the first of July. The steam-heating company is engaged in putting down their pipes, encased in wood to prevent condensation of steam, and the numerous streets that are rendered almost impassable by their operations, testify to the energy with which they are pushing their work. By fall they expect to have their pipes laid in all the lower part of the city, and to be ready to supply steam as required for heating or for motive power before "snow flies."

IMPROVED PORTABLE ENGINE.

In these engines the cylinder and steam chest are cast together, the cross head guide is separate, which enables the manufacturers to do away with the heavy and unnecessary cast iron bed plate; the bearings are large and wide, reducing the friction; the cylinder is jacketed and covered with Russia iron. The crank shaft is double and extends beyond the bearings far enough to receive a pulley on either side; it is made of the best American forged iron. The guides are of an improved kind, and have very large bearing surface. The pump is driven by an eccentric from the shaft, and is bolted to the side of the boiler and is accessible at all times. The heater is large and well constructed. The governor is of an improved kind, and is so arranged that the speed of the engine can be altered while running. The boiler is made of the best American boiler plate; every sheet is tested to a tensile strain of 50,000, and the boilers are all tested to 200 pounds, and are fired and the engine run before leaving the shop.

A large wrought iron dome is placed on every boiler; this is greatly superior to those made of cast iron, as experience shows that cast iron is liable to give way at any time under pressure. The stack of this engine is made of heavy iron, and is very durable and has a very efficient spark arrester.

The engine and boiler is mounted on a strong truck or wagon; the wheels have cast iron hubs, the axles are made of the best refined wrought iron, and extend under the boiler without the objectionable bends sometimes used.

The engine is also mounted on skids when it is unimportant to have it perfectly portable.

For further particulars in regard to this engine, address the manufacturers, Phœnix Foundry and Machine Company, Syracuse, New Zork.

THE report on the incandescent lamps exhibited at the Paris Electrical Exhibition has been published, and from that we find that the maximum efficiency cannot be assumed to exceed 300 candle-lights per horse-power of current. Edison's lamp takes the first place in these experiments; but since they were made considerable improvements have been effected in some of the other systems.

Educational.

SOME DISPUTED POINTS IN FOUNDRY BOOKKEEPING.

Some attention has lately been attracted to two questions in foundry bookkeeping which, while simple enough to a practical accountant, seem to have given rise to some discussion among manufacturers. They are:

1. To the debit of what account should "discounts" go, and are they not as much a part of the cost of stoves as iron or labor?

2. Should the cost of patterns and flasks be charged in separate account and carried as part of the assets, or charged directly to the expense account?

The latter part of the first question is the one item for consideration. Are not discounts as much a part of the cost of stoves as iron or labor? This question is one upon which experienced manufacturers may take opposite sides and argue with all sincerity, the difference in their conclusions being for the most part dependent upon the standpoint from which the matter is viewed. The term "discounts" in the above connection we understand to mean the amount deducted from a selling price. It is quite customary in other lines of business as well as in the stove trade to sell goods at a certain price 30 days, 60 days, or even three months, with the understanding that 2 per cent., 5 per cent., or some other deduction will be made if cash is received within a certain specific number of days after date of invoice. The question which arises is, What is the nature of this deduction? Is it a part of the cost of the goods, or is it something of an entirely different nature? If it is a part of the cost of the goods, it evidently should be charged to some account representing the cost of production. In the simplest system of bookkeeping this would be directly to the debit of merchandise or manufactures, or whatever the general account is called representing the production of the establishment. If, however, this amount is not a part of the cost of the goods produced, it does not belong there, but should be charged to some account representing the expense of conducting business, or to an account called by whatever name it may be which stands for the cost of use of capital.

If a certain lot of stoves when manufactured are worth absolutely $1,000 in the warehouse and are sold for that sum in cash, there being no discount or deduction, the question does not arise at all. If, again, they, being still worth $1,000 are sold for $1,100, with a discount of nominally 10 per cent., simply for the purpose of reducing the bill to a fair cash basis, the charge for the deduction evidently goes to the debit of the account which has received a credit in excess of what was right, in order to equalize matters. If, however, the goods being worth $1,000, cash, are put at $1,000, 3 per cent. off, in order to convert them into ready money because the concern wants capital, still another set of conditions must be taken into account. These several examples, it seems to us, throw enough light upon the subject to indicate the direction of a correct solution to the question. In considering each of these cases, we have based our calculations on the actual value of the goods in the market. Nothing has been said about cost of production, and we would remark parenthetically, that ordinarily, the cost of production has very little influence upon the selling price of goods in the market. The question is, What can I get for my product? Then, How can I reduce my cost so as to sell it at market rates and still make a profit? It is very seldom that the order of these questions is reversed, and that the calculations are made, first, as to the cost and then as to a selling price based upon a definite percentage of advance upon cost. Given, a certain lot of goods ready for the market; they have a certain value dependent upon general market conditions. Any discount that is made from the price set upon them becomes therefore, one of two things: It is an abatement to meet the market or else a deduction to induce cash payment, because the cash is wanted. Therefore the account to be charged with the discount becomes either the merchandise account, not because the discount is a part of the cost of manufacture but because the credit received by it was originally too great, and must be reduced to equalize things; or, it becomes a discount, or interest account, called by whatever name it may be, representing the price paid by the concern for the use of capital furnished by the purchaser of the goods.

There are other discounts entering into the business transactions of a stove founder, among which may be mentioned those in connection with the purchase of pig iron. It is customary to buy iron at a certain figure, four months, with the understanding that, if cash is paid, a discount will be made. We have already referred to this question in the columns of *The Metal Worker*, and have advanced the opinion that the difference between the cash value of the material bought and price paid for the four months was an interest charge. In other words, it was the sum in which the concern was paying for the use of that much capital. It is recognized in the accounts of the most advanced concerns that everything must be reduced to a cash basis in order to obtain a common measure of comparison. Take, for example, life insurance, which probably embraces the most scientific system of accounts and values known at the present time. In it, it is customary to reduce everything to a cash basis, in order to present statements of results and actual conditions. In the question under consideration, we think the true solution to the problem will be found in estimating everything at a cash basis, and charging whatever difference there is between cash and the actual amount paid to an account which represents the use of capital. This rule is a broad one, and much might be said about it. There are, however, various side issues that arise. The final solution and the method adopted in any individual concern will depend very much upon the ability of the accountant or business manager to grasp some of the subtleties of business calculations. Books of accounts are, in a certain sense, indications of compartive results rather than absolute statements. For example, it makes very little difference to a proprietor at the end of the year, whose net profits, for example, have been $20,000, whether the amount has been actually earned in the foundry, or whether a certain portion of it has been gained by judicious manipulation in the way of purchases and sales. On general principles he will assume that careful management in the foundry has made some profit, and that careful business manipulation has not only taken care of that profit, but added to it; but just how much has come from either source, if he be a man who manages upon general principles rather than specific details, he will care very little. We hold, however, that it is to the interest of every man to know just where he is gaining and where he is losing, and to be able to analyze his business in such a manner as to give particular attention to those departments that most need his supervision.

The second question proposed above—should the cost of pattern and flasks be charged in a separate account and carried as part of the assets of the concern or should they be charged directly to the expense account of the establishment?—is very easy of answer. It depends entirely upon the facts of the case. At the end of a year's business do the flasks, pattern and follow-boards represent an actual value, or do they not? Have they been entirely superseded, or will they still be in use for the succeeding year's business? Probably, in the present state of trade, the middle ground is the safe one to pursue. The constant change in styles ordinarily wipes out the value of the patterns made each year. Whatever styles are produced this year are calculated for this year's business alone. Something else will be the leading style next year, and so it goes. However the patterns which are produced this year will have some use in the business next year, and possibly the year following, even though they are not by any means leaders. The question of repairs—the odd plates that are to be furnished at some future time—must also be taken into consideration. The proper answer to the question therefore becomes very simple of statement. Let each year's business bear that portion of the cost of patterns and flasks that properly belongs to it. Let a fair estimate be placed upon the patterns at the end of the year, and let the amount so determined be entered upon the inventory, the balance of the cost being borne by the current year's business. At best, this is only an estimate, and since estimates are always liable to error, it is well to err upon the safe side. Better make the value of the patterns and flaks remaining on hand too small than too large. In no sense can they be considered desirable assets in case the business is to be closed out. The value of patterns and flasks, to the extent of a very large percentage, whatever the estimated amount may be, depends upon the perpetuation of the business under the same management. It is, therefore, simply a question of accounts, partnership settlements, of a fair division of cost between one year's business and another, and the discriminating business manager will see the problem clearly in this light, and solve it accordingly.—*Metal Worker*.

BOILING POINT OF ZINC.—M. Tiolle has determined the boiling point of zinc to be 933°, or very near the temperature (932°) given by Becquerel.

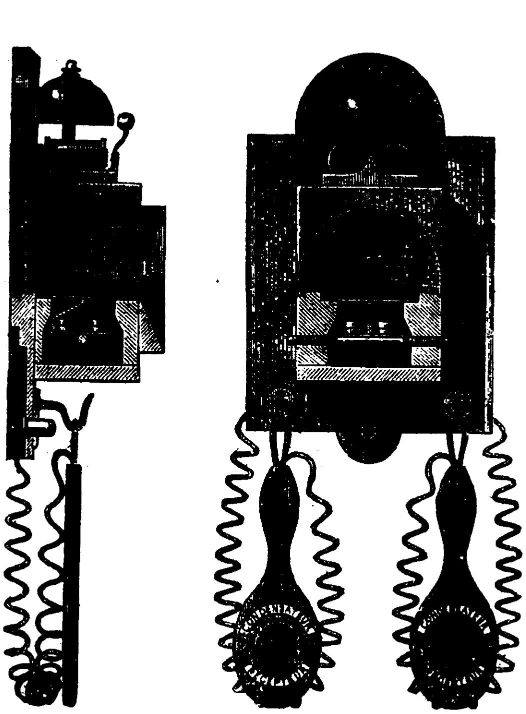


FIG. 1.

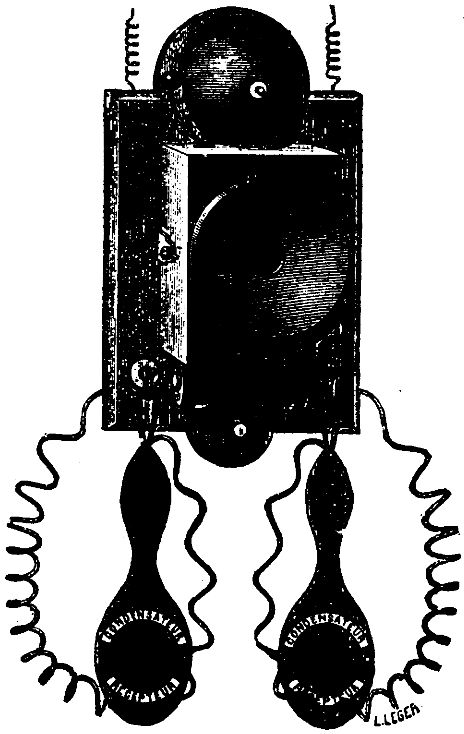


FIG. 2.

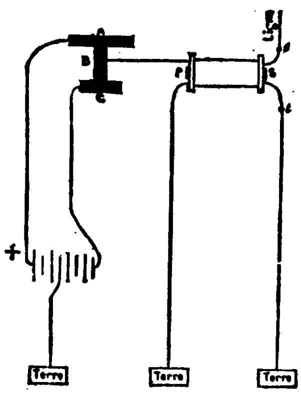


FIG. 4.

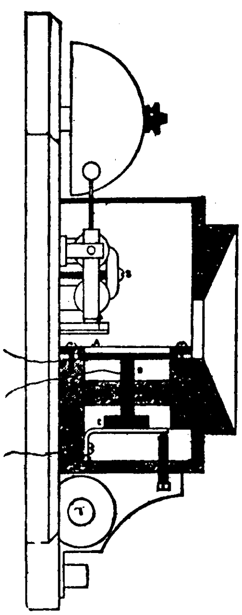


FIG. 3.

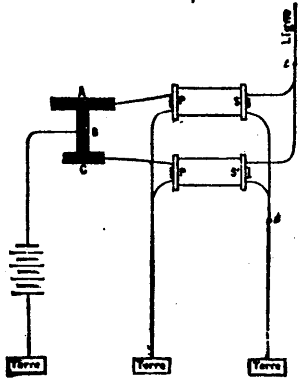


FIG. 5.

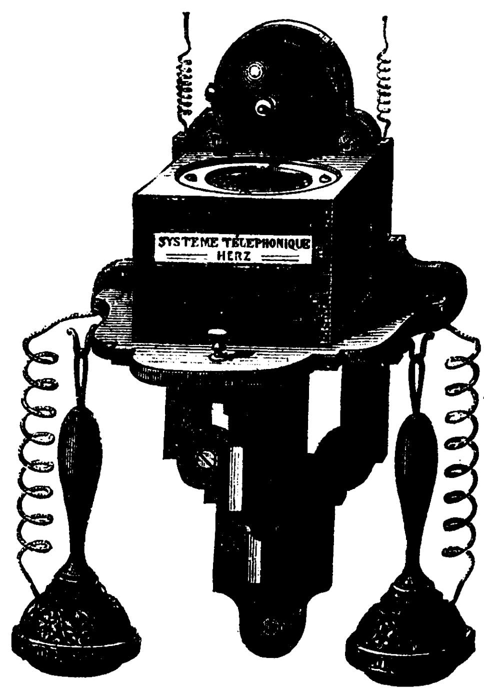


FIG. 6.

HERZ'S LONG DISTANCE TELEPHONE.

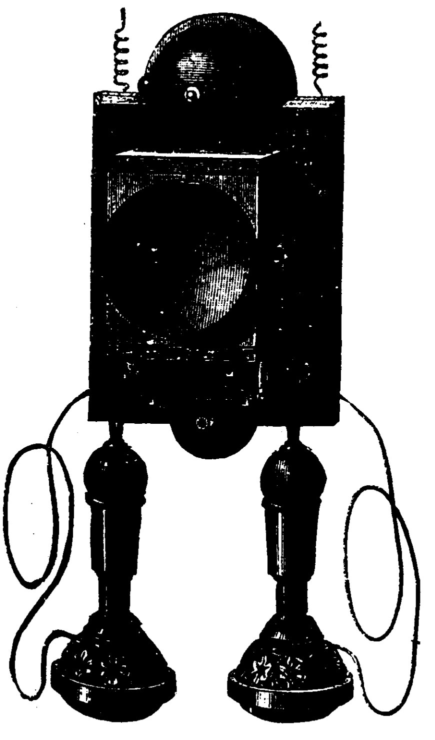


FIG. 7.

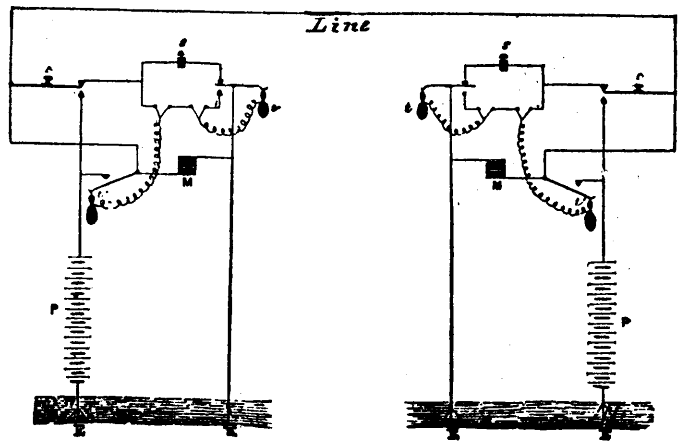
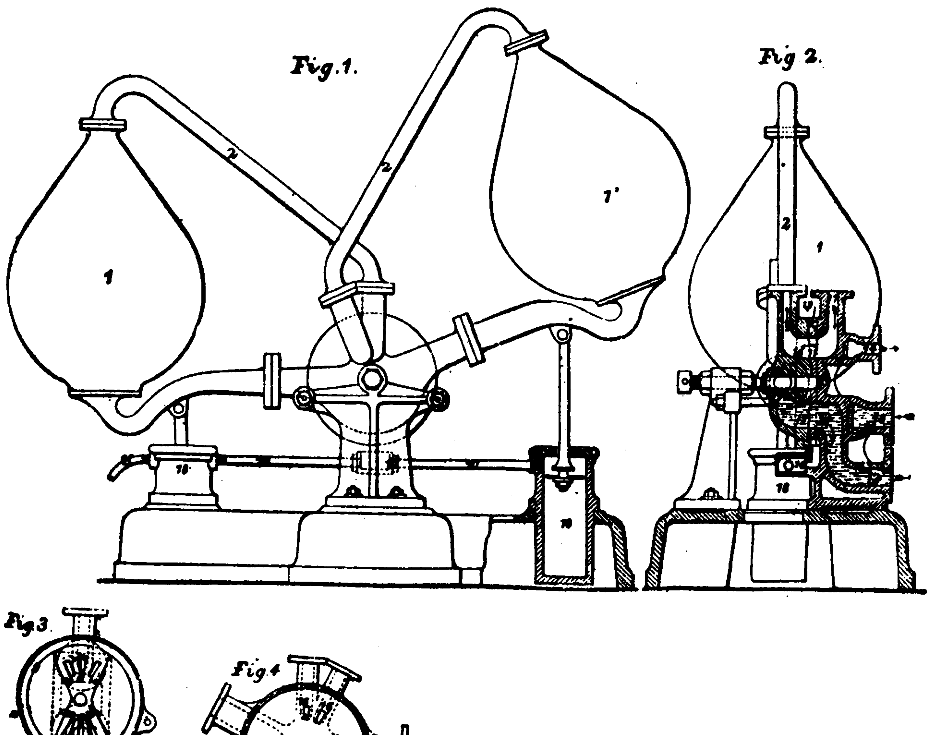


FIG. 8.

AUTOMATIC BOILER FEEDER.

The apparatus we here illustrate takes its name from its inventor, M. Edouard Fromentin, of Paris. It may be designated a water bottle feeder, and is made automatic by coupling two "bottles," as they are technically named, on to one and the same axis, on which they turn. The bottles are alternately placed in communication with the boiler, through the pipes connected to the former at both the top and bottom of the latter, and thus a slight additional pressure only is required to allow the water to pass freely into the boiler; this is obtained by placing the apparatus slightly above the water level, and thus utilizing the force due to gravity for that purpose.



THE FROMENTIN AUTOMATIC BOILER FEEDER.

Referring to the annexed illustrations it will be seen that the Fromentin self-acting feeder consists mainly of the two pear-shaped bottles, circular in cross section, and each capable of holding about 12 gallons of water, these two bottles being connected to the central disk by means of two sets of pipes. The pipes marked 2, 2_1, connected to the top of the bottles, are those through which steam finds its way alternately into the two bottles each time the apparatus moves or makes a stroke, this taking place whenever the water level in the boiler is lower than it should be, or than the bottom end of the plunge, or steam supply pipe inside the boiler. This steam supply pipe finds an inlet to the apparatus at the top flange 11, Fig. 2; the outlet for the non-condensed steam is at 14, this steam by means of a wipe being led back into the water supply tank and thus assisting in heating the cold supply water before it goes into the bottles. The water supply inlet to the apparatus is at 13, and the outlet or delivery to boiler at 12, the water passing into the boiler through an ordinary check or back pressure valve mounted close up to the boiler in the usual manner; the arrows shown at each of these passages in Fig. 2 indicate the direction taken by both steam and water.

The two disks on which the apparatus turns are represented in Figs. 3 and 4, that shown by Fig 3 being stationary and bolted down to the foundation plate, while that represented by Fig. 4 is movable, the latter being that disk to which the two bottles are connected by means of the pipes before mentioned. In the fixed disk Fig. 3, and which receives at the back all the flanges and connections, including both the water and steam supply as well as the delivery to the boiler, there are, as is seen, two distinct sets of ports, the top set being for steam and those at the bottom for water; the movement given to the apparatus is just sufficient to open and close these ports.

The two cylinders, 18, 18, Fig. 1, contain water, and the descent of the pistons in them is met with just sufficient resistance to allow the loaded bottles to come down noiselessly and and without knock; the stroke is about 10 in., and is adjusted by means of the pistons in these cataract cylinders. The apparatus moves or makes one stroke on the average about every three or four minutes, but its action being purely automatic and its function to maintain a constant level, the number of strokes in a given time must necessarily depend upon the rate of evaporation.

The general action of the apparatus may be summed up thus: for instance, in the above illustration we will suppose the feeder has just moved or made a stroke in consequence of the now lower bottle 1, Fig. 1, having while uppermost been filled (and thus become the heavier of the two) with water from a small supply tank or from the town water service pipes, while at the same time the opposite bottle 1_1, Fig 1, while lowest has been emptying a portion of its contents into the boiler; this state of things has, however, been now reversed, and, as seen in Fig. 1, the bottle 1 is open to the boiler, and the water level in the latter being slightly lowered by evaporation, steam passes at once into the now full bottle up the pipe 2, and presses on the surface of the water with a force due to the boiler pressure, the water gradually passing out of the bottle by way of the pipe attached to the bottom of the same into the boiler through the delivery pipe and check valve, the flow of the water from the apparatus boilerwards being simply due to gravity or to the elevation of the apparatus above the level of the water line in the boiler—an elevation which need not in any case exceed three feet.

It may also be remarked that when the water level in the boiler is at its maximum, or say when the lower end of the plunge steam pipe is sealed, steam is then of course no longer able to pass up the pipe into the bottles, this state of affairs continuing until by evaporation the water level has again become lowered sufficiently to unseal the pipe. It is while the water is at the maximum level that certain returns of water from the boiler take place back into that bottle then in communication with the boiler through either one or other of the two steam pipes, 2, 2_1, attached to the bottles, the steam which had previously found its way into the bottle having condensed and left the latter partially empty, but the vacuous space being soon filled up again by these rapid returns of water from the boiler. This reversal of current through the pipes and the intermixture inside the bottle of the water of a higher temperatuce direct from the boiler, with that already remaining in the bottle is found by experience to be productive of the most beneficial results, as it not only keeps all the ports, pipes, bottles, etc., clean and free from all scale or deposit of any kind, but also lends material aid by way of preventing incrustation in the boiler, the solids contained in the water being precipitated in the bottles under the action of a higher temperature before admission to the boiler, and thus scaling or incrustation inside the boilers fitted with this apparatus being, it is claimed, greatly diminished.—*Engineering*.

NEW ICE CUTTING MACHINE.

(*See page 220.*)

The enormous and very general consumption of ice for manufacturing and domestic purposes has made ice harvesting one of our great industries. Important as the ice crop is, it is extremely precarious, being controlled not only by the variable forces of nature, but also by a great army of men, who cut, gather, and store the ice for distribution and use. The ice harvesters, like men employed in many other kinds of business, are liable to disaffection, and it has at times occurred that the best ice of the season has been wasted in consequence of the want of a force of men necesssry to secure it.

In view of the great amount of labor required in harvesting ice, and in view of the necessity for accomplishing it at the most favorable time, Mr. Chauncy A. Sager, of Valparaiso Ind., has devised a very ingenious and effective steam ice cutter, which makes a longitudinal cut while the machine is advancing, and at the same time making transverse cuts, thus forming cakes of suitable size for handling.

The machine propels itself forward slowly, the engine at the same time driving the saws. The saw making the longitudinal cut is suspended on a long arm pivoted to the rear end of the machine on the axial line of the driving shaft, and extending some little distance rearward, and is driven by a cord or belt from the sheave on the driving shaft.

At the side of the main frame of the machine there is a swinging frame supported from a countershaft journaled in an overhanging frame. The swinging frame carries at its lower and free end a saw shaft, on which is secured the cross-cutting saw, and which is provided with a key way, receiving the spline of the driving pulley, the shaft being free to move endwise while the pulley remains in one position. On the end of the saw shaft is a sharp edged curved shoe, which engages the ice, and is steadied by a rod extending from the forward end of the swinging frame. Motion is communicated to the countershaft of the cross-cutting saw by means of miter gearing and a shaft running lengthwise of the main frame of the machine. On the forward end of the shaft geared to the longitudinal shaft there is a crank, which gives lateral motion to the swinging frame, and causes the saw to make the crosswise cut.

The motion of the saws is controlled by levers at the forward end of the machine. The driving wheels are provided with spikes to give them a firm hold on the ice, and the forward axle of the machine is movable on a king bolt to permit of steering.

The two saws with their supporting frames are capable of being folded over on the machine when they are not in use, or when the cutter is to be moved from one place to another.

In operation the machine is propelled forward by the action of the engine, the saw at the rear is revolved, cutting the ice longitudinally, at the same time the cross-cut saw is engaged in the ice and the swinging frame receives lateral motion through its crank connection. When the cross-cut saw enters the ice the sharp edged shoe engages the ice and prevents the cross-cutting saw raft from end motion while the saw makes its cut. While this is being done the machine gradually moves forward, causing the saw at the same time to make the longitudinal cut which separates the ice into blocks as the transverse cuts are passed. When the cross-cutting saw has completed its excursion it has also compressed a spring which carries the shaft and saw back to the point of starting as the saw is released from the ice either by running out or by being raised by cams provided for that purpose. The cross-cutting saw is now ready for another cut, and the operation just described is repeated.

For gauging the distances between the longitudinal cuts in the ice and for facilitating the making of parallel cuts the machine is provided with a graduating gauge which extends downward from the under surface of the main frame.

This machine is capable of very rapid operation, and will doubtless be appreciated by ice harvesters and dealers who know the value of time in ice harvesting seasons.

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

Miscellaneous.

THE GREAT BELL FOR ST. PAUL'S.

The large bell manufactured by Messrs. Taylor, of Loughborough, Leicestershire, for St. Paul's Cathedral, arrived in London on Monday, May 22, having been eleven days on the road, drawn by a traction-engine a hundred and fifteen miles. The contractors for the safe conveyance of this ponderous bell were Messrs. Coles and Matthews, of Coventry, who have performed their task with entire success. The bell weighs nearly seventeen tons, and stands above nine feet high, with a circumference of thirty feet at the rim. It was placed on a massive trolly, with low iron wheels of great width, the weight of the trolly and bell together being not less than twenty-two tons. A traction-engine took the heavily-laden carriage in tow; another engine drew a covered van, or hut on wheels, stored with jacks and engineers' tools of all kinds, for raising or repairing the trolly, in case of need. Attached to the rear of this travelling tool-house, which served also to shelter the men at night, was a cultivator, made for steam plowing, laden with boiler-plates, which could be laid down to assist in getting the wheels of the trolly over soft ground. Last of all, came a cask-shaped tank, to supply the two engines in traversing country where water might be scarce. The strange procession excited great curiosity and wonder in the rural districts of Northamptonshire, Bedfordshire, and Hertfordshire. In some places the local volunteers' band turned out. The bell was piloted along the road by Mr. R. Coles, riding on a tricycle, and accompanied by Mr. Taylor, with several London newspaper correspondents and others.

On Saturday afternoon, having arrived near Highgate, on the road from Finchley, the bell was met by thousands of Londoners, who came up the Archway Road to witness such an unusual spectacle. It was taken into the coalyard of the Great Northern Railway at the Woodman Station, and was left there till Monday morning, when it was brought at an early hour into London, reaching St. Paul's Churchyard at eight o'clock. The arrangements made by Mr. Penrose, architect and surveyor to the Dean and Chapter of St. Paul's, for removing the bell from its travelling-carriage and introducing it within the south tower of the west front of the Cathedral, were not the least remarkable part of the undertaking. Some difficulty had been presented by the fact that the doorway into the tower proved too narrow by about 2½ feet, and the solid stone walls had to be cut away on each side, near the ground, while the masonry above had to be shored up with great care and ingenuity. Between this door and the spot at which the bell-carriage was drawn up, an elaborate timber slope had been constructed of beams 12 in. or 14 in. square, surfaced with slabs of oak, rendered slippery by a smearing of tallow and black lead. On to this slope the bell was dragged by the force of ropes and crabs or windlasses, but resting upon a circular wooden disk, to which it was fastened. The bell was thus enabled to slide slowly down in front of the door, and was then dragged up another short incline into the center of the tower. The machinery for lifting the bell to a height of 125 feet in the tower was very simple, consisting of two "crabs" from Woolwich Dockyard, each worked by four men, two men at each handle, to haul the ropes, 2½ in. thick, through a series of blocks and pulleys, two above and two below. The operation would be done very slowly, but was expected to be performed on Wednesday or Thursday. There is a clear passage for the bell up the center of the winding staircase in the tower. Its destined position is beside the clock, and below the present big bell of St. Paul's, which strikes the hours.—*London Illustrated News.*

FRAUDULENT INFANT FOODS.

There are about twenty European preparations styled infant foods, beginning with that of Nestle, and at least twice as many American, all of which profess to furnish a complete nutrition for the infant during the first few months of its existence, while yet the conversion of starch into dextrine and sugar is beyond the capacity of the untrained digestive function. The examination of these with the microscope, assisted by such simple tests as iodine, which turns starch cells blue, and gluten (or albuminous) granulates yellow, has engaged the careful attention of Dr. Ephriam Cutter, of Cambridge, and his results will startle most mothers who have relied upon the extravagant pretenses set forth in the circulars of manufacturers.

Eliza McDonough who preceded Dr. Cutter in this field, has been in a measure discredited; but it appears that her assertion—that the starch, so far from being transformed into dextrine, was not sufficiently altered to render the recognition of its source difficult, whether from wheat, rye, corn, or barley—was strictly true, and that these pretentious foods are, without exception, nearly valueless for dietetic purposes. All of them consist of baked flour mainly, either alone or mixed with sugar, milk, or salts. In some cases, the baking has been very inadequately performed, and the doctor found one that consisted merely of wheat and oats whose starch cells were proximately in their natural condition.

The general result of Dr. Cutter's examination may be stated in brief terms as follows: There was scarcely a single one of the so-called infant foods that contained a quantity of gluten as large as that contained in ordinary wheat flour. That is to say, a well-compounded wheat gruel is superior to any of them, particularly when boiled with a little milk: and mothers are in error who place the slightest dependence upon them. As respects one very expensive article, professing to possess 270 parts in every 1,000 of phosphatic salts in connection with gluten, Dr. Cutter was unable to find any gluten at all. The thing was nearly pure starch, sold at an exorbitant price as a nerve and brain food and a great remedy for rickets. So all through the list. Sometimes a trace of gluten was present; more frequently none at all. In one case there were 90 parts of starch to 10 of gluten; but this was exceptional, and the majority were less valuable, ounce for ounce, than ordinary wheat flour. Considering the semi-philanthrophic pretensions that have been put forth by the manufacturers of these foods some of them sustained by the certificates of eminent physicians, the report of Dr. Cutter is one of the dreariest comments upon human nature that has recently fallen under the notice of the journalist. But if the revelations he has made of fraud and pretense on the part of manufacturers in this field shall serve to protect mothers from further betrayal and to rescue infant life from quack articles of nuitriment, his work, though giving a tremendous shock to our sensibilities and to our faith in medical certificates, will not have been done in vain—*N. Y. Times.*

CANADIAN EXPERIENCE WITH CATTLE.

The superintendent of the model farm at Guelph, gives as below the results of some experiments made there in cattle breeding:

1 A steady frosty winter is better than an open one in feeding cattle.

2. An average two or three year old steer will eat its own weight of different materials in two weeks.

3. Two or three year old cattle will add one-third of a pound more per day to their weight upon prepared hay and roots than upon the same materials unprepared.

4. It is 30 per cent more profitable to premature and dispose of fattening cattle at two years old than to keep them up to three years.

5. There is no loss in feeding a cattle beast well upon a variety of materials for the sake of manure alone.

6. Farmyard manure from well fed cattle three years old is worth an average of $2.30 per ton.

7. A three year old cattle beast, well fed, will give at least one ton of manure every month of winter.

8. No cattle beast whatever will pay for the direct increase to its weight from the consumption of any kind or quantity of food.

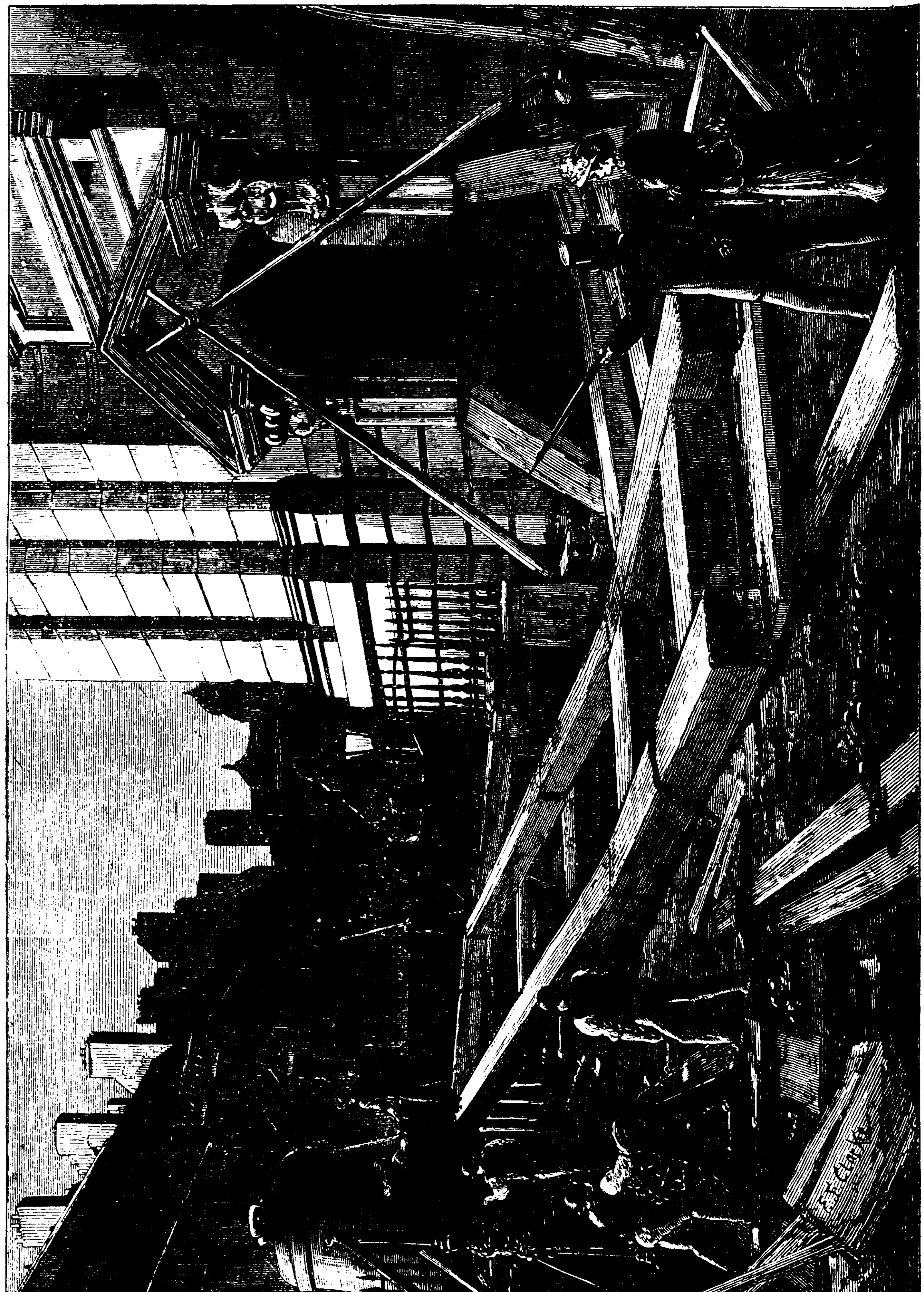
9. On an average it costs twelve cents for every additional pound of flesh added to the weight of a two or three year old fattening steer.

10. In Canada the market value of store cattle can be increased 36 per cent during six months of finishing by good feeding.

11. In order to secure a safe profit, no store cattle beast, well done to, can be sold at less than four and one-half cents per pound (live weight).

12. In the fattening of wethers, to finish as shearings, the Cotswold and Leicester grades can be made up to 200 pounds, the Oxford Down 180 pounds, and the South Down (grade) 160 pounds each, live weight.

13. A cow wintered upon two tons and a half of hay will produce not far from five tons of manure, provided that she be well littered and none of the excrements be wasted.



ARRANGEMENTS FOR GETTING THE BIG BELL INTO ST. PAUL'S CATHEDRAL.

THE BIG BELL FOR ST. PAUL'S: A REST ON THE ROAD.

Cabinet Making.

FIRE-PROOF SUBSTANCES FOR FABRICS AND WOODWORK.

As early as 1735 a patent was granted in England for "making or preparing paper, linen, canvas, and such like substances, which will neither flame or retain fire." The material employed was a mixture of alum, borax, and copperas, of which a strong solution was made, and the articles were dipped in it. From time to time other substances have been suggested, until now the difficulty is not a lack of suitable material, but rather a disposition on the part of the public to apply the knowledge which we possess. Occasionally public attention is drawn to the subject by the record of some serious accident by fire, caused too often by the igniting of clothing, curtains, or theatre scenery ; and in many directions spasmodic efforts are made to encourage or compel the application of some fire-proof material to these easy combustible substances. While there is no real opposition from those who should take these precautions, the matter of expense, and the feeling that such accidents will never happen to us, lead to neglect and soon entire forgetfulness of the subject, until brought to mind by the next serious conflagration.

The burning of the Vienna theatre has raised the question afresh as to what can be done for the protection of our private dwellings and public buildings ; and a most commendable effort is being made, both by private parties and by public officials, to introduce and encourage some protective measures.

The theory of the use of fire-proof substances for fabrics, woodwork, etc., is, to cover the combustible material with some mineral matter which shall prevent the approach of flames. It is practically impossible to render combustible material incombustible ; but it is not difficult to so protect it that it will only smoulder, and thus allow time for extinguishing the fire by other means.

The following is a list of the principal mineral substances which have been suggested, and many of which have been successfully employed for rendering fabrics and woodwork non-inflammable : Alum, borax, sulphate of iron or copperas, silicate of soda or soluble glass, sulphate and phosphate of ammonia, tungstate of soda, sulphate of magnesium, sulphate of lime, and asbestos preparations.

In 1859, at the request of Queen Victoria, Drs. Graham, Versmann and Oppenheim made an investigation to ascertain what substance is most suitable for application to fabrics to render them non-inflammable. The conditions to be fulfilled in this case are : 1st, that the salt shall not injure the strength of the fabric ; 2nd, that it shall not stain or interfere with the color ; 3rd, that it shall not leave the fabric when the latter is washed, or, if this be the case, that it shall be easily applied in the laundry ; 4th, that it shall not interfere either with the character of the finish or with the ease with which this finish is produced ; 5th, that it shall be cheap ; 6th, that it shall be efficient. No salt was found that would adhere to the fabric and bear washing without injuring the color. The salts experimented with were phosphate of ammonia, a mixture of phosphate and chloride of ammonia, sulphate of ammonia, and tungstate of soda. The phosphates, while efficient, were considered too expensive ; the sulphate of ammonia was found to act injuriously upon the iron or ironing ; but the tungstate of soda fulfilled all the conditions, and to-day is recognized as the most suitable for family use. A solution is prepared by dissolving the salt in water and diluting to a specific gravity of 1.14, and then mixed with three per cent of phosphate of soda. This latter salt is added to prevent the formation of the bitungstate, which is much less soluble than the tungstate. The goods are dipped in the solution just before starching, after which they are ironed without difficulty. In some cases the tungstate is mixed with the starch during the manufacture of the latter ; and where this preparation can be obtained it saves the trouble of making the separate tungstate solution.

The objection to most of the substances which have been recommended for application to fabrics is that they injure the fibre or leave the goods harsh to the touch. This is true of preparations containing borax, alum, or sulphate of magnesia.

In the application of fire-proof substances to wood, the conditions are more easily fulfilled; but for want of more careful investigations in this particular direction, no one substance has been decided upon as greatly superior to others, if, indeed, it could be shown that there was any material difference between several of the best.

One of the oldest fire-proof paints consists of 3 parts wood ashes, and 1 part boiled linseed oil.

Sieburger proposes to apply to the wood two coats of a hot saturated solution, of 3 parts alum and 1 part copperas. After drying, he applies a coat of dilute solution of copperas, thickened with potter's clay to the consistency of paint.

In one of the collieries of Westphalia, the following preparation has been successfully employed : 2½ parts of sal-ammoniac, 1 part of white vitriol, 2 parts of joiner's glue, 20 parts of zinc white and 30 parts of water.

Silicate of soda, or soluble glass, has been recommended. Petera employs 28 parts of the silicate in 100 parts of water. Gossage applies several coats of solution of silicate of soda, and finishes with a mixture of this solution and sufficient of common whiting to make it about as thick as ordinary paint. It is also recommended to apply to the wood three coats of a hot solution of the silicate of soda, having a strength of 25° B.

The use of soluble glass has been objected to, on account of its liability to effloresce ; but others do not find this objection, and it appears that some study is necessary to obviate the difficulty, if it really exists.

Perhaps the most promising material for application to screens and woodwork is the asbestos paint, which is being largely manufactured for this purpose. It consists of the addition of finely-divided asbestos to the liquid material of the paint.

Some experiments recently made with this paint at the Crystal Palace, London, show that it is well suited to protect from fire any inflammable material to which it may be applied. Among other experiments two miniature theatres were constructed, one of which had been painted with the asbestos preparation, and the other not. The unprotected one readily caught fire from the ignited shavings used, and in twelve minutes was in ruins ; whereas the one protected by the paint successfully resisted the flames.

The Fire Department of this city have made some experiments with the preparations of asbestos, both as paint and woven into fabric. From the statements made, it appears that the principal object sought was to have each theatre provided with a stage curtain which should keep the flames within the limits of the stage until the audience could leave the building. Doubtless the experiments had other objects in view ; but with regard to the one mentioned, we may say that it is a matter of great difficulty to make a strong fabric containing much asbestos, on account of the short and brittle fibre of this substance. Moreover, an asbestos curtain, if made, might not be kept in order, or, in case of fire, might not be lowered in time to confine the flames to the stage. The obvious remedy for any such difficulty consists in protecting the screens, woodwork, and other inflammable material about the stage, by the asbestos paint, or some other fire-proof preparation. There does not appear, at present, to be any difficulty in applying the paint, and it is certainly more reasonable to take such measures as will prevent a fire in the first place, than to provide means of doubtful practicability for confining the flames within certain limits after they are once started.—*Sanitary Engineer.*

HOW TO MAKE A SEVEN-FEET PEDESTAL PILASTER WITH THREE-PANEL BACK.

[The *Cabinet Maker* of London awarded to Mr. William Robinson of Dublin a prize of two guineas for the following description :

Having set out the work full size, proceed first to get out the top, which is a piece of inch stuff, 7ft. long, and shot to 2ft. 2in. broad. This, when finished, has a 2-inch ovolo on the top edge, and an eighth bead sunk on the face edge. Get out some ½ inch stuff, 4½ in. wide, and line it up on the under side of the top, letting the end lining run the same way of the grain as the top. Cross line the top also over the inside ends of the pedestals : this and the back lining may be pine. Next proceed to get out the drawer frame. It will be made of inch pine, and its extreme length, with its end facings out, will be 6 ft. 5 in., and its extreme breadth from the outside of back to the front edge of the top blade will be 1 ft. 10½ in. ; the lower blade sets back 2 in. In getting out the cross rails of the frame, frame a piece of 2 in. stuff, 5 in. wide at one end, crossways the grain, and in putting the frame together let the flash sides of the cross rails go next the centre drawer and the outside respectively. When all is fitted, place the four cross rails side, and shape all together, and leave them with the carver to run three flutes 5-16ths wide on each. Next proceed to get out the pedestals. These are simply a frame, with the stiles of 2 in. scantling, with 2 ¼ in. cross framing, precisely as the door, the panels being ⅝ in. thick, and beveled in 1¼ in. from their edges. Clean off the face of the panels, and finish off the moldings and let the polisher body them in.

In the meantime the framing can be got on with. The top and bottom rails run across, and are framed into the pilasters or angle pieces, and the stiles are checked or sunk into the pilaster ¼ inch (see section of pedestal). The inner frame is connected with the outer frame by four short rails. Note: the end panels are framed in grooves, but the door panels are framed or fastened in with beads. Having got the panels from the polisher, frame the 1¼ in. framing together, and mitre the moldings in, etc., first having cleaned off the face, and got it bodied in. Now proceed to frame the pilasters to the frames, and having dovetailed the top and bottom to the ends, clean all off, and let the carver flute them, and cut the elliptic pateras in the centers.

The doors may now be got out, and, of course, letting the stiles run through.

As the molding forms the rebate for the panels, it will be seen that the panels will be narrower by 5 16th on each edge than the pedestal panels were, in consequence of no groove being in the stiles, etc.

The frame may now be taken in hand, the drawer fronts fitted on the rake, and the drawer sides fitted and shot to the proper shape, the front dovetails being on the rake in order to take the front.

Get out four blocks the same shape as the blocks between the drawers, and glue them on the end of the frame over the pilasters, as at E. Now get out two mock drawer fronts, and fix them between them, and face the frame to represent the blades over and under the drawer. (Note that the blades have a sunk bead on the center of their faces.) The plinth rails may now be got out and fixed, as also the bases of the pilasters.

To make the bases, get out a piece of cross grain stuff, 5½ in. wide by 1 in. thick. and about 2 ft. 2 in. wide, and run the molding along the edge, and then cut it in length, and fix them, leaving their sides flush with the pilasters. The trays and cellarette drawer may now be made, the frame cleaned off, and pieces fitted on the fronts, etc., and carved as drapery. The flutes on the fronts of the drawers can then be carved, and the ram's head and angle brackets, and center ornament under drawer, finished.

The door moldings may now be mitred in, and the panels beveled ⅞ from the edge. Place the frame on the bench, and put on the runners for the drawers, and afterwards place it on the pedestals and block it in its place. Now fit and hang the doors, etc., and let the carver have them to cut the circular pateras at the angles.

After this take the top, shoot the back edge, joint two pieces of stuff 3½ in. long by 2½ in. wide at each end, and run the moldings through. These are to finish the top off level with the plate glass back. The top and frame may now be finally screwed together, the drawers run and stopped, and their fittings put on. The carcase backs of the pedestals may be put in, leveled, and colored, and all given to the polisher.

We now proceed with the back. This is composed of three frames, the groundwork of which is 1¼ stuff; the two outside frames have their outside stiles faced on the outer edge by a pilaster, 2 in. square, and which projects 2 in. above the top of the frame to receive the carved urn F. The breadth of the outside frames, including the pilasters, is 1 ft. G in. and the extreme height is 2 ft. 2 in. exclusive of the pilaster. These two frames are faced with ⅜ in. stuff, and the beveled glass is surrounded by a molding G. The pilaster is carved and fluted, and the dentiled cornice then mitred round the top, showing a ½ in. break. A small console is placed at the bottom as a suitable finish.

The center frame is got out of the same stuff as the side frames, viz., 1¼ in., and faced with ⅜ in. stuff. In getting out this frame, the breadth must ⅞ in, narrower than the finished size, in order to allow a side facing to hide the joint of the ground work and its front facing. The extreme height of this frame will be 3 ft. 9 in. and the extreme breadth 3 ft. 1 in. Now glue two pilasters 3 ft. 7 in. long by 2 in. square on the face, keeping them flush on the top ends, also on the outsides; and on the faces of the two, glue two shaped pilasters of same length, but only 2in. by 1½ in. Mitre the cornice round, and also the necking H, and leave a break of 2in. at the center J. This tablet is to be 3½ in wide.

The edging of the facing on the center frame is a ½in. hollow. Now get out the O G pediment, and fit the looping of drapery to the urn, and give all other carvings, etc., to the carver. Having got all fitted, and the back offered to the top, give all to the polisher, and when done screw the side panels to the center panel, place on its face, and block in the silvered glass; put on the blind frames, then screw the job altogether. Screw the brackets, pediment, etc., on, and see that the doors work easily, and the locks are oiled. The doors may be hung with cente, hinges, or with strong brass butts, 3 in long, letting the knuckle stand ⅛in. past its centre of motion, and an ornamental hinged plate screwed to the stile. Note that it is always better to have the glass before finishing the sight measurements as the bevels can be matched to mitre with the moldings, and a more even margin secured.

Fig. 1 . . . Front Elevation.
Fig. 2 . . . Section through Left Pedestal.
Fig. 3 . . . " " Center of Back.

The details are half real size, and can thus be easily enlarged.

Migratory birds, when flying by night, are at an elevation of from one to four miles above the earth's surface.

In the United States there are 1,942 establishments for the manufacture of agricultural implements. They use $5,761,916 worth of timber a year.

Boy Inventors.—Some of the most important inventions have been the work of mere boys. The invention of the valve motion to the steam-engine was made by a boy. Watt left the engine in a very incomplete condition, from the fact that he had no way to open or close the valves except by means of levers operated by the hand. He set up a large engine at one of the mines, and a boy was hired to work these valve levers. Although this was not hard work, yet it required his constant attention. As he was working these levers he saw that parts of the engine moved in the right direction, and at the exact time that he had to open or close the valves. He procured a strong cord, made one end fast to the proper part of the engine, and the other end to the valve lever, and had the satisfaction of seeing the engine move off with perfect regularity of motion. A short time after, the foreman came around and found the boy playing marbles at the door. Looking at the engine he soon saw the ingenuity of the boy, and also the advantages of so great an invention. Mr. Watt then carried out the boy's inventive genius in a practical form, and made the steam-engine a perfect automatic working machine.—*Manchester Times.*

Do the Chinese Invent.—Heretofore it has been popularly supposed that the Chinese invented the printing press, gunpowder, and the mariner's compress. The best authority seems to deny them the honor of these inventions. The Count de Gobineau, in his able "History of the Diversity of the Races," absolutely lays it down that they had nothing to do with these inventions. It is a well-known fact, says Senator Jones of Nevada, that the Chinese have been in a state of general decadence for the last 500 years. Their pottery, their porcelain, and all their other arts are in a very low state compared to what we know they were 500 years ago. They have been constantly deteriorating in arts and manufactures. Prof. Draper, on page 303 of his "Intellectual Development of Europe," says: "The practical Arabs had not long been engaged in those fascinating but wild pursuits when results of very great importance began to appear. In a scientific point of view, the discovery of the strong acids laid the foundation of chemistry; in a political point of view, the invention of gunpowder revolutionized the world." Again, on page 352, "they, that is the Arabs, also introduced inventions of a more curious kind—gunpowder and artillery. The cannon they used appears to have been made of wrought iron. But perhaps they more than compensated for their evil contrivances by the introduction of the mariner's compass." The late Mr. W. F. Mayers, Chinese Secretary to the British Legation at Pekin, a critical Chinese scholar, in vol. 6 of the Journal of the North China Branch of the Royal Asiatic Society, page 82, treating of the introduction and use of fire-arms among the Chinese, says, after noting the Chinese authorities: "As regards gunpowder, therefore, it is concluded that, firstly, no proof of its invention by the Chinese can be adduced; secondly, there is reason to believe that it may have been introduced from India or Central Asia about the fifth or sixth centuries of our era."
—*Industrial News.*

SAGER'S ICE CUTTING MACHINE.

THE GREAT ANT-EATER AND ITS YOUNG.

Natural History.

THE GREAT ANT-EATER AND ITS YOUNG.

BY C. F. HOLDER.

The ant-eaters (*Myrmecophagidæ*) form one of the most interesting families known to science, and comprise a number of forms that, as their name indicates, gain a living by assaults upon the nest of ants found in the countries to which they are indigenous. The largest and best known of the family is the great ant-eater, or ant-bear, which is covered with long, coarse, shaggy hair, except the head, where it is short and close ; it has a very long and slender head, and a bushy black tail of enormous size and length, the whole animal measuring often eight feet from the tip of the snout to the extremity of the tail. Being plantigrade, it stands lower on the hind legs than before, which is the case with bears and other quadrupeds similarly formed. It hos four toes on the fore feet, the second and third being provided with long, sharp-pointed, and trenchant claws ; so that nothing upon which it has an opportunity of fastening can escape. The hind feet have five toes, furnished with short weak claws, resembling those of ordinary quadrupeds. In the fore limbs we notice that the ultimate phalanges of the toes, which support the claws, are so constructed as to allow the movements of the latter being restricted to flexion inwards ; and in order to maintain this position there are powerful ligaments which keep the phalanges directed toward the palm, and never allow the digits to be stretched out in the manner of the plantigrade carnivora. The relative size and strength of the toes are also very significant in this family ; in those which have five toes the central digit attains an enormous bulk, while the outer pair are comparatively very small. And, in order to afford adequate power for the digging and burrowing propensities of these animals, the phalanges are all closely connected together up to the base of the ultimate phalange, converting the hand into a kind of trowel, similar to that found in moles.

From what has been advanced, it will readily be remarked that ant-eaters do not walk on the soles of their feet ; neither do they tread on their strongly-curved toes, which would damage the claws, but, in the fore feet at least—as may be seen by referring to the engraving—the anterior part of the body is seen to rest entirely upon their outer edge; and that part of the hands thus subjected, as it were, to an unusual pressure, is, in these creatures, supplied with an efficient callous pad to protect the outer phalanges from injury.

The prevailing color is a deep gray, with a very broad band of black running from the neck downward on each side of the body; its habits are slothful and solitary; and it sleeps during the greater part of the day. It lives entirely upon ants, to procure which it opens their hills with its powerful crooked claws, and draw its long flexible tongue, which is covered with glutinous saliva, lightly over the swarms of insects who flock from all quarters to defend their dwellings. It is a native of Brazil and Guiana.

It seems almost incredible that so robust and powerful an animal can procure sufficient sustenance from ants alone; but this is nothing strange to those who are acquainted with the tropical parts of America, and who have seen the immense quantities of these insects, which swarm in all parts of the country to that degree that their hills often almost touch one another for miles together. The favorite resort for the great ant-eaters is the low swampy savannas, along the banks of rivers, and stagnant pools.

The enormous claws of the forelegs are terrible weapons. Waterton records an instance of their power in his "Wanderings," and in Brown's "Canoe Life in Guiana" there is a similar account. He says: "We had not gone many miles before the guide lost the path, and we all scattered to look for it. In doing so, I almost walked on the top of a sleeping ant-bear, which, springing up, sat on its hind legs, and grasped at me with its huge fore claws. I sprang quickly to one side, and thus escaped. Thinking that it was good eating, I shot it, but the Indians said that it was not wholesome food, although, from the great interest they took in seeing it killed, I thought it was." (Waterton says that its flesh is good eating.)

These large ant-eaters are very dangerous customers, and have been known to kill men. Williams told me that an Indian, living near Roraima, was hunting in the forest to the north of that mountain with some others, armed with his long blow-pipe. In returning home, considerably in advance of the rest of the party, it is supposed that he saw a young ant-eater, and, taking it up in his arms, was carrying it home, when its mother gave chase, overtook, and killed him; for, when his companions came up, they found him lying dead on his face in the embrace of the ant-bear, one of its large claws having entered his heart. In the struggle he had managed to stick his knife behind his back into the animal, which bled to death, but not before the poor fellow had succumbed to its terrible hug. It was evident that he had only heard the ant-eater coming when it was close upon him, and in turning round to look, his blow-pipe got caught across the path in front of him; then, as he turned to run, it formed a bar to his progress, and he fell over it as the animal seized him. So firmly had the animal grappled him that to separate it from the corpse the Indians had to cut off its fore legs.

It is very rarely that an opportunity offers to observe in this country the habits of one of these curious creatures, but recently an ant-bear was brought here alive from South America, and on the passage give birth to two young, which the writer afterward saw, and watched with great interest their movements about the mother. The poor creature fared badly on the voyage to the United States, as the sailors were ignorant of the nature of the animal, and its curious appearance impressed them with such a feeling of aversion that no one could be found to approach the family of compulsory immigrants and they were only kept alive by the boiled eggs that were tossed them by some of the more humane of the crew. The little ones, as we saw them, were about a month or six weeks old, and were perfect images of the mother, with the exception that the tail was not so large in proportion to the body, and the curious color markings were not so pronounced as in the adult. As we approached the cage, nothing could be seen but a bunch of coarse grizzly hair; but a word from the owner, and the enormous tail of the parent was raised, and the young were seen. She was lying on her side, the young embracing her abdomen, after the fashion of young monkeys, and over all came the tail of the mother, shutting and inclosing them like a lid, forming effective protection. As she clumsily rose the young scrambled over and attained a position on her back, clinging to her with their long claws, their bushy tails in air, lost in the voluminous folds of the mother's, that covered them even now as a canopy, being equally protective.

At a word from the keeper, she came laboriously toward us, walking upon the outside of her sharply clawed feet, and the long noses of the entire family were presented and rubbed against our hands with every demonstration of friendliness.

The tongue is extremely long, and below its roots are two large glands that emit a glutinous secretion that is so effective in conveying the swarms of ants to its mouth. They were fed exclusively upon hard boiled eggs, upon which we were informed they thrived. The climate, however, is against them, and since our first visit one of the young has died, and the other will probably follow.

In the accompanying illustration the position of the young on the mother's back is shown, where they presented an amusing spectacle.

The little ant-eater occurs also in Brazil and other countries of South America. Its habits are similar to those of its more powerful species.

Von Sack, in his "Voyage to Surinam," gives an interesting account of the tame ones in his possession; and, after describing their characters, he tells us that the inhabitants of that country aver that when captured these animals cannot be induced to eat, and only lick their paws after the fashion of a bear. "When I obtained the first," he says, "I sent to the forest for a nest of ants, and during the interim I put into its cage some eggs, hone, milk, and meat, but it refused to touch any of them. At length the ant's nest arrived; but the animal did not pay the slightest attention to it either. By the shape of its fore paws, which resemble nippers, and differ very much from those of all the other species of ant-eaters, I thought that this little creature might perhaps live on the nymphæ of wasps, etc. I therefore brought it a wasp's nest, and then it pulled out with its nippers the nymphæ from the nest and began to eat them with great eagerness, sitting in the posture of a squirrel. I showed this phenomenon to many of the inhabitants, who all assured me that it was the first time they had ever known that species of animal to take any nourishment. The ants with which I tried it were the large termites upon which fowls are fed here." According to Von Sack and most observers, the tail is employed as a prehensible organ. It is larger than the body, very stout and broad at its origin, thickly clothed with short hairs, and much attenuated toward the extremity. Generally speaking, the fur displays a thick, soft, shining, woolly texture. The female, it is said, produces a single young one at a birth, although it is furnished with four mammæ.

In the Old World the ant-eaters are represented by the aard-vark and spiny ant-eater (*Echidna hystrix*), the latter a curious creature with a long, slender, toothless bill, with a palate armed with rows of strong sharp spines; the tongue is similar to that of the great ant-eater of South America, while the body is covered with quills like a porcupine. It is common in various parts of Australia, Port Moresby, New Guinea, and quite recently a new species has been discovered in Northern New Guinea.

The aard-vark, a South African ant-eater, is a strange-looking creature, and a very distinctive character is seen in the head, which was long-pointed ears; while the tail, being of moderate length, not so long as the body, is very thick, rounded at the root, and densely clothed with hair. Altogether it is a stout, heavy animal, the large bones of the neck, in particular, demonstrating its strength in the cervical region. The fur, which is very scanty, is generally of a grayish-brown color. The permanent teeth of the adult, twenty in number, have a simple form and structure, being made up of rootless cylinders, those in front displaying a slightly flattened aspect at the sides. It is rather larger than the common badge, attaining a length of upward of four feet. Its habits are nocturnal, and it contructs large subterraneous burrows with extraordinary rapidity. It appears to live entirely upon ants, and for this purpose the tongue is largely developed, and armed with a glutinous secretion It is not so long, however, as in the true ant-eaters, while it is at the same time more flattened and attenuated. The aard-vark invariably fixes his retreat near to some large ants' nests, which he ventures only to attack after dark. He is a timid creature, and does not move far from his burrow; and when attacked, should he succeed in gaining access to his abode, it is next to impossible to get him out, for it is said he can burrow faster than his enemies can dig. According to those who have witnessed its method of procuring food, the aard-vark, having approached an ant-hill, forthwith proceeds to scratch a small part of it, just sufficient to allow of the introduction of its long, narrow snout. These ant-hills are sometimes three or four feet in height, and contain myriads of insect inhabitants—strongly ensconced in fancied security complete!

"Here," observes Mr. Ogilby, "after having previously ascertained that there is no danger of interruption, he lies down, and inserting his long slender tongue into the breach, entraps the ants, which fly to defend their dwellings upon the first alarm, and, mounting upon the tongue of the aard-vark, get entangled in the glutinous saliva and are swallowed by whole scores at a time. If uninterrupted he continues this process till he has satisfied his appetite; but on the slightest alarm he makes a precipitate retreat, and seeks security at the bottom of his subterranean dwelling. Hence it is that these animals are seldom seen, even in those parts of the country in which they are most numerous. Like other nocturnal animals, passing the greater part of their lives in sleeping and eating, they become exceedingly fat, and their flesh is considered to be wholesome and palatable food. The hind-quarters particularly, when cut into hams and dried, are held in great esteem."

There are some ants that these animals cannot face, and the so-called fire ants of South America will put to flight the largest ant-bears.

To any one who has handled the soft, velvety nose of those animals, it is a mystery how they are able to withstand the savage attacks to which they are subjected. The rapid movement of the snake-like tongue, however, is probably the secret of its boldness.

Scientific Items.

In view of the large use now made of hempen straps for driving-gear, means of transport, slaters' chairs, etc., Herr Weinlig has recently made experiments with a variety of those straps (from a manufactory in Halberstadt), with reference to rupture. While cotton straps stretched about 6 per cent., the double hempen ones stretched 11 per cent., and the four-fold 9.5 per cent. It appeared –(1) That Russian hemp is superior to Italian, about 10 per cent.; (2) that cotton straps bear scarcely more than half the breaking load of hempen straps per square millimetre of cross section. (3) Straps broke quite gradually one thread after another. There was first a slight crackling, then the threads broke with distinct sound. This property is valuable, as it insures great safety, if the straps are often tested. (4) The considerable uniformity of breaking loads in each case proves that these straps can be woven of great regularity and perfection. (5) In use of the straps for slaters' chairs and lifts, 8 to 10-fold safety could be attained; so that, on an average, 0.4 kg. per square millimetre cross section (not counting vacant interstices may be taken as the permissible load.

Some interesting physical methods were described at the Séance of the French Academy on 5th June. One is for ascertaining the specific heat of mineral substances, which it is difficult to get in large mass. It is devised by MM. Thoulet and Lagarge and is on the following principle:—Suppose two thermo-electric junctions in two small tubes contain a known specific gravity. The substance under examination being heated to a known temperature and put in one of the tubes, the deflection of the galvanometer measures the rise of temperature. This result is compared with that obtained from a typical substance—*e. g.*, pure copper. Water or oil of turpentine was the liquid used. A comparison of the numerical results for several minerals whose specific heat was measured by Regnault, with the numbers got by that physicist, proves the exactness of the method. Again, a hygrometer, acting by condensation, was described by M. Crova. It consists of a nickelised tube, brightly polished, interiorly, at one end with ground-glass, and at the other with a lens. The observer looks through it towards a source of light, applying the lens to the eye. The air to be examined is drawn slowly through the tube, entering and leaving by tubulures at the ends. Round the tube is a cooling arrangement, a cylinder holding sulphide of carbon, through which air is passed. When the dew-point is reached, striking changes occur in the interior aspect of the tube, the dew appearing as dark brown spots. By raising and lowering the temperature several times, these are made to go and come, and a thermometer-bulb being inserted in the sulphide, the dew-point can be estimated very accurately. M. Violle described a new calorimeter.

ELECTRICITY AS A MOTOR FOR AERIAL NAVIGATION.

M. Tissandier gives an account in *La Nature* of some experiments which he has carried on in regard to the propulsion of air ballons by electric motors. Since the commencement of these experiments considerable progress has been made in the construction of accumulators, but the Faure and Planté accumulators, constructed by M. de Kabath, are of considerable weight in comparison with the work which they are capable of doing. It takes but little less than two hundred and fifty kilogrammes of accumulators to produce one horse power. It would not be impossible to construct special accumulators much lighter and of large capacity, but without renouncing in any manner the secondary batteries, M. Tissandier wishes to take into account all that can be obtained from primary batteries of great power. The batteries of large power are but few, numbering three: the Bunsen, the Daniell, and the bichromate of potash battery. The last is the most advantageous in the present case.

After numerous experiments for determining the best composition for the exciting liquid, the nature of the jars, the limit of thickness of the carbons and zincs, the number of the latter in each element, finally to have a maximum power under or below a minimum weight, M. Tissandier constructed a model with a large surface, which has given preliminary satisfactory results. The idea of this model was obtained from seeing the bichromate batteries of M. Trouvé work in his electrical boat, and the first experiments were made with four Trouvé batteries.

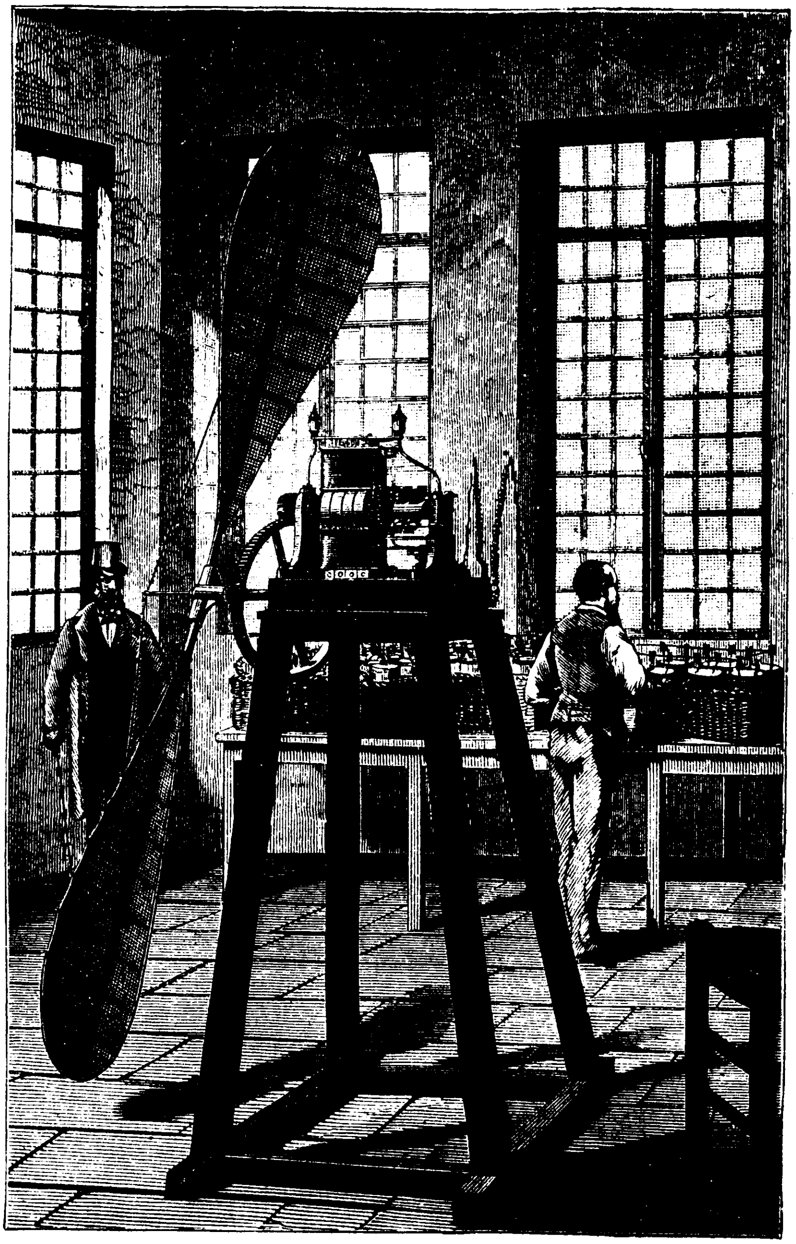
The twenty-four elements, mounted in tension, put in motion a small Gramme motor of half a horse power. The work produced measured was 14 kilogrammeters per second during one hour, and 10 kilogrammeters during the following hour. The Gramme motor employed was not constructed to work with these batteries, and the experiment was made under the worst conditions, but it was demonstrated that the bichromate batteries are much more constant than is generally believed. The new model of battery is composed of an ebonite trough, 5 millimeters thick, measuring 0·55 m. in length, 0·16 m. in height, and about 0·14 m. in width In this trough are placed vertically thirteen carbons and twelve amalgamated zincs, arranged in alternation. The carbon plates are two and a half millimeters in thickness, the zinc plates about one millimeter. These plates are fixed to longitudinal bands of copper, which are screwed upon the exterior edge of the ebonite trough. Notwithstanding its lightness, the elements thus mounted are very solid and may be shaken quite violently without the carbons or zincs being deranged.

The ebonite vessel is furnished with an opening in the lower part to admit a tube which, by the aid of a rubber pipe, communicates with a receiver containing the bichromate solution. By raising or lowering this receiver above or below the battery elements, the battery may be filled or emptied. The battery contains about 4 liters of liquid strongly charged with bichromate and sulphuric acid (the composition of the liquid, in weight, is, water 100 parts, bichromate of potash 16, and sulphuric acid 37). The solution being very concentrated, the electrical resistance is less. The electromotive force of this battery is very variable, and may become considerable when the exterior resistance is very feeble. In an experiment performed with a hot and very concentrated liquid, a mean current of 110 ampères was obtained during twenty minutes with a difference of potential at the limit of 1·68 volts. This represents transferable work equivalent to 18 kilogrammeters per second. The boiling was so violent the liquid escaped outside of the vessel and put an end to the experiment.

This result may be obtained practically, but the returns which may be depended upon in the normal condition of work are favorable enough, and then the battery will be nearly constant from one hour and a half to two hours. We give the figures, from which one may form a correct idea of what may be obtained. These are the mean figures obtained by a series of experiments made upon variable resistances:

A battery of eighteen elements, arranged for tension, weighs 140 kilogrammes. Over a circuit of 0 54 ohm resistance it gives a transferable electric energy of 135 kilogrammeters per second for about one hour and a half with a current of 50 ampères. A motor adapted to this battery will yield better results. The motor weighs about 50 kilogrammes; the results obtained are as follows:

With a weight of 200 kilogrammes, battery and motor, it is possible to produce a continuous and constant work of 100 kilogrammeters per second during one hour and a half.



ELECTRICAL PROPELLER FOR BALLOONS.

Some experiments already performed show that the production of electricity may be prolonged:

1st. By agitating the liquid; this is facilitated by employing communicating vessels;

2d. By adding new quantities of bichromate of potash to the warm and wasted liquid;

3d. By protecting the negative plate.

A battery of 18 elements, weighing 140 kilogrammes — the weight of two men — will probably furnish for over two hours a work of from one and a quarter to one and a half horse power, or the work of twelve to fifteen vigorous men. A similar battery with its motor may be easily carried by an elongated balloon of small dimensions and of small diameter, and offering in consequence little resistance to the air.

While testing the power of the battery, M. Tissandier experimented with a screw attached to a dynamo-electric motor. A screw of 2·80 m. in diameter was fixed to a small Siemens dynamo-electric machine, weighing 65 kilogrammes and mounted upon a large stool (Fig. 2). The screw is composed of two plane wings, formed of wooden frames, on which silk, varnished with gum lac, is stretched in such a manner as to form a smooth rigid surface. Slender bands of iron strengthen the wooden arms, and small wires prevent the screw from being put out of shape during its rotation. The wings have an inclination of about thirty-five degrees. The motor was worked by a Faure accumulator, constructed by M. Reynier. The experiments were carried on in the Siemens workshop. With forty accumulators mounted in tension, the screw made one hundred revolutions a minute, the armature of the motor making one thousand.

Under these conditions it was easy to calculate by the column of air displaced, that the screw worked very energetically. The current of air at from one to two meters from the apparatus was intense, and could be sensibly felt at a distance of ten meters. This fact was authenticated at the Observatory where the system was exhibited.