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NOTE AND COMMENT.

IF we may believe the statements of those who are in a position to know, the human race will doubtless, in the future, get its food and drink, its sustenance and stimulus, from an article that has been not generally esteemed at its true worth. It will be a very excellent thing too, in may respects, if ammonia does what is claimed for it. The *Scientific American* publishes the statement that common ammonia can be properly put to use as a leavening agent. The carbonate of ammonia is an exceedingly volatile substance. Place a small portion of it upon a knife and hold it over a flame, and it will almost immediately be entirely developed into gas and pass off into the air. The gas thus formed is a simple composition of nitrogen and hydrogen. No residue is left from the ammonia. This gives it its superiority as a leavening power over soda and cream of tartar when used alone, and has induced its use as a supplement to these articles. A small quantity of ammonia in the dough is effective in producing bread that will be lighter, sweeter and more wholesome than that risen by any other leavening agent. When it is acted upon by the heat of baking, the leavening gas that raises the dough is liberated. In this act it uses itself up, as it were; the ammonia is entirely diffused, leaving no trace or residuum whatever. The light, fluffy, flaky appearance, so desirable in biscuits, etc., and so sought after by professional cooks, is said to be imparted to them only by the use of this agent. The bakers and baking powder manufacturers producing the finest goods have been quick to avail themselves of this useful discovery, and the handsomest and best bread and cake are now largely raised by the aid of ammonia, combined, of course, with other leavening material. If the use of the salt becomes general, in the preparatiom of our daily food, dyspeptics will hail its discovery as a boon. It is the practice, almost generally, among physicians, to prescribe whiskey as a stimulus to persons whose powers are waning, and in times of crisis. A case is reported in a recent number of the Boston *Medical and Surgical Journal*, where a woman was given whisky in repeated doses, but she gained no strength. The physicians were perplexed, and each moment was critical. At length one-sixteenth of an ounce of liquor ammoniæ was injected into a vein of one of her arms. The effect was plainly perceptible in a few seconds. The pulse, which, under the whisky treatment, had become so feeble that it could scarcely be discovered, could be felt at the wrist. The patient continued to improve and eventually recovered. Whisky is given for cold, for heat, for restlessness, for everything, or a few grains of some medicine in a pint of whisky are the remedy, and then more whisky. The fact that a quarter of an ounce of carbonate of ammonia dissolved in a pint of distilled water, an ounce of honey or loaf sugar added,and the whole thoroughly dissolved, taken in doses of from 30 to 40 drops for a child, up to a tablespoonful for a man or woman, will furnish positive stimulant of the most healthful kind to a deranged system, to the extent of many times that of the best wine or brandy, without any of the effects which invariably follow that of alcoholic mediums, is not generally practiced by our physicians; in fact, it is an old matter, and so simple that it has not always recommended itself to the M. D.'s, for with many of them, to depart from their books is to depart from all right. In view of the facts stated and the woman's experience the human race may be said to be in possession of another boon, the treasure in each case—food and drink—being furnished by a very humble cumberer of the drugman's shelf.

MONTREAL has been the scene during the past month of no less than three important meetings, of which one at least has created considerable interest outside the city in the Dominion. The session of the American Association for the Advancement of Science has given us much to think and talk about during the interval which separates us from the still greater honor which is in store for us in the visit of the British Association the year after next. We gave last month the names of a number of gentlemen who were expected to make the congress their excuse for a visit to our city, and almost the only disappointment to which we were obliged to submit was the absence of Mr. HERBERT

SPENCER, who was detained in New York from ill health to the great sorrow of some who had come from great distances in the hopes of seeing him. In other respects the meeting was highly successful, whether we consider the large number present, over a thousand strangers being in the city during the week, or the social enjoyments provided and heartily enjoyed, and lastly, but not least, the work done by the sections in the way of papers and lectures. Some two hundred papers on various subjects were put in, and the majority of them were disposed of. Full accounts of these appeared in the daily papers, and we cannot pretend to reproduce them here. Those who wish to preserve a record of them will find it in the proceedings of the Society next issued. We will only say that, if no startlingly new discovery has made the session remarkable, yet the general character of the papers shewed the steady progress which science is making in the hands of the members of the Association.

The social pleasures provided for our visitors were many and various. After the formal opening of the session by the retiring President Professor BRUSH on Wednesday the 23rd August, the new President Dr. DAWSON on the following day held a grand reception in the Redpath Museum, which was made the occasion of the presentation of that fine building to McGill College by its founder Mr. PETER REDPATH. This was followed by a series of receptions which filled almost every evening of the stay of the Association. On the Saturday, excursions were organized to Quebec and Ottawa in which the members divided their forces, and on the Thursday following, the end of the session was celebrated by a visit to Newport and Lake Memphremagog on the South Eastern Railway, from which the majority of the visitors did not return, taking that route back to their American homes.

We may add that portraits, with carefully written sketches of the principal visitors appeared in the CANADIAN ILLUSTRATED NEWS of the 2nd September, which also contained some illustrations of the proceedings.

Although of less general interest than the meetings of the American Association, we must not grudge a few words to the two meetings which were arranged to immediately precede the session of that body—the Agricultural Congress and the American Forestry Congress. At both of these good work was done, and matters of interest and importance to our country discussed. We are, of course, especially interested in Canada in the subject of Forestry, which is only now beginning to be at all thoroughly understood, and which bids fair to take its place at last in the rank of the main science. Many of our principal citizens have of late years taken a great interest in forwarding the objects which the Congress has at heart, among whom we may mention the Ex-premier of Quebec, the Hon. J. G. JOLY, who as Chairman of the Congress took a large share of its work upon his shoulders, and Mr. WM. LITTLE, the energetic Vice President of the Congress.

COMPRESSED AIR LOCOMOTIVE ENGINES.

An important step has been made towards the mechanical working of tramways by the introduction of the Beaumont compressed-air engine on the Stratford and Epping Forest branch of the North Metropolitan Tramways. This engine comprises a store tank or reservoir for the compressed air, which is utilized in cylinders of small diameter, motion being given to the pistons by the expansion of the air in the cylinders and transmitted to the wheels by gearing. The reservoir is charged at a pressure of 1,000 lb. per square inch at the commencement of each journey. An inspection of the air-compressing machinery and of the working of the tramway engine was made on Friday week, when the details were explained by the inventor, Colonel Beaumont, R. E. The compressing machinery consists of a fix compound engine having a high pressure cylinder 12 in. in diameter, cutting off at half stroke and using steam at 95 lb. boiler pressure. The low-pressure cylinder is 20 in. in diameter. The air compressor is on what is known as the "stage" principal, the air being compressed in a series of cylinders of gradually decreasing diameter. From the compressors the air is conducted through about 250 ft. of 1½ in. iron pipe to the street in the Broadway, Stratford, where there is a flexible hose attachment for filling the reservoir on the engine. This occupation occupies about fifteen minutes, during which time the compressing engine is working. There is only one tramway engine running at present, but the compressing arrangements are equal to the supply of compressed air to four engines, working continuously. The tramway engine takes a tramcar to Leytonstone and back, and then stops a quarter of an hour to replenish its air supply, when it starts with another car, the intermediate journeys being performed by horses. On the occasion of the run last week, the engine having brought in a car from Leytonstone was replenished in a quarter of an hour, the pressure at starting being 1,000 lb. per square inch. The distance from Stratford to Leytonstone is two and a quarter miles and an ascent the whole way, the total rise being 82 ft., and incline 1 in 25 and a curve of 50 ft. radius being encountered at Maryland Point-bridge.

THE KNACK IN BREADMAKING.

Three slices of bread shown by a Lewiston flour dealer Thursday, spoke for themselves. Placed side by side, they shaded very abruptly into three strikingly distinct tints. One was of the hue of Graham and fell into your hand like a half-baked brick. Another was nearly white, and would be greeted with pleasure by a hungry man. The third was so white that snow would have to be bleached to compare with it; moreover, it possessed that spongy texture which is so gratifying to the eater and a source of so much pride to the cook. It threatened to dissolve in one's mouth, and would tempt a gorged epicure. It would not be a strain to say any one could distinguish them in the dark. The flour dealer deposed that the three slices of bread were made by three women from one and the same kind of flour. The cook who produced the first slice was dissatisfied with the flour, while the woman who made the bread last mentioned said she could make good bread out of flour that didn't cost less than $4 a barrel. It is evident that bread-cooking is not one of the lost arts, but it is an art which still contains sufficient mystery to puzzle many and confound not a few of the angels who hover over flour barrels.—*Ex. from Maine.*

CAR WHEELS OF STRAW.

The straw is first made into common straw board ; these are cut into round pieces perforated at the center, and 26, 33 and 42 inches in diameter, for use in wheels of these various sizes, then pasted together and pressed repeatedly in a powerful hydraulic press under a force of 3,000 lbs. to the inch. The block is then fitted into a steel tire bound with plates and bolts, and finally makes a wheel which sells readily at $80, while an iron wheel costs but $15. But the paper takes up all the vibration from the rail, which is so injurious to the tire and axles when iron wheels are used, causing breakage and costly accidents. These paper wheels never break, while the iron wheels break very often. An iron wheel will run 100,000 miles, but a paper wheel 400,000 or 500,000 before the tire is worn out, and then the tire can be replacad at small cost. Other important uses are being found for straw, and in course of time it may become too valuable for feeding, and will be more profitable for sale than the grain which it bears. Near the large cities and straw-board mills rye straw is worth a sum equivalent to about $30 an acre ; this is equal to the price of a larger yield than an average crop of grain.—*Rural New Yorker.*

Scientific.

BARNEY'S IMPROVEMENTS IN TELEPHONES.

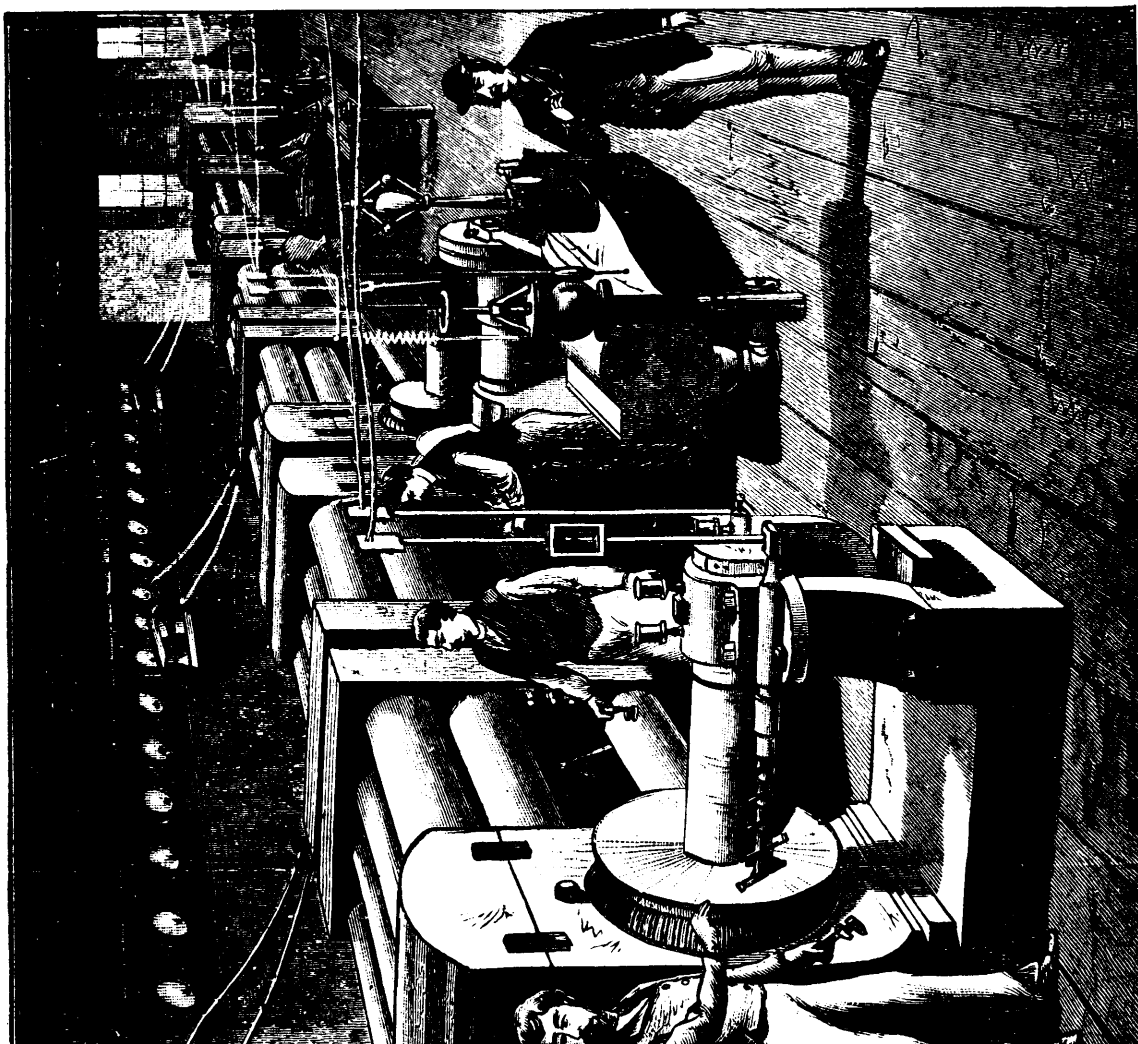
Amongst recent patented improvements in telephonic instruments we find as specially deserving of notice, those devised by Mr. W. C. Barney, of 53, Bernard street, London, whose specification (No. 4905, 1881,) describes several forms, the most useful of which have perhaps to be discovered; but excellent results have, we understand, been obtained with one form already tried. The invention comprises both transmitting and receiving instruments. In microphones heretofore constructed the quantity of electricity passing through them is extremely small, and represents an almost infinitesimal part of the electric power emanating from the source of electricity employed. The current which passes through a microphone used for telephonic purposes should be as great as possible, having due regard to the sensitiveness of the microphone to the action of sound-waves upon it, because the variations of the intensity of the current produced by the action of the sound-waves are in proportion to the variations of the resistance of the microphone. Various forms of microphone have been devised, some in which the variations of the contact-points of the several parts of the microphone are caused by means of a spring or springs, others by means of a tympan. The microphone invented by Professor Hughes is simple and effective. In a microphone constructed on the principle of Professor Hughes, the greater the number of points of contact the greater will be its conductibility, which is a great desideratum. The microphones devised by Mr. Barney offer the least possible resistance to the passage of an electric current, and, at the same time, possess the greatest sensitiveness to the action of sound-waves; consequently, the current induced in the secondary wire of the induction-coil, to the primary wire of which the microphone and battery are connected, has great variations of tension, and its action on the coil of the receiving instrument is proportionately great. In one form of the microphone, which we select for illustration, Fig. 1, a number of pencils, P, of hard coke-carbon, or other equivalent material, are used, the ends of the pencils being held loosely in blocks C of carbon. A block of carbon B, to which is connected one terminal of the primary wire of an induction coil, about one inch in diameter, and about half an inch thick, forms the centre of the series of blocks of carbon placed around at a distance of about two inches from it; this periphery of blocks is connected together by any good conductor, to which is connected one pole of a battery, the other pole thereof being connected to the other terminal of the primary wire of an induction coil. The centre block has a series of holes around its circumference, equal in number to the blocks surrounding it, and in each of these blocks is a hole, in which lies loosely one end of a carbon pencil P, the other end of which lies loosely in a hole in the centre block. Each pencil is covered with a metallic sleeve, which must not be in contact with any of the blocks; this metallic sleeve increases greatly the conductivity of the pencil, and also increases its specific gravity, both of these effects being advantageous. Another form is made with carbon pencils and carbon bars in the following manner:—Two carbon bars about half an inch thick, having a length proportionate to the number of pencils used, are placed parallel to each other about two inches apart. They have a series of holes in the sides facing each other, in which holes lie loosely the ends of carbon pencils, thus connecting electrically the two bars of carbon, one of which is to be connected to one terminal of the primary wire of an induction-coil, and the other bar to one pole of the battery, the other pole thereof being connected to the other terminal of the primary wire. A third carbon bar may be added with carbon pencils connecting it electrically with one of the other bars; in this arrangement the two outer bars should be connected together by a good metallic conductor, to which one terminal of the primary wire should be connected, and the centre bar should be connected to one pole of the battery. In another form the patentee dispenses with carbon, and uses pencils of wood, bone, ebonite, or any equivalent suitable material, placing on each end of the pencil a small capsule of hard tin, or of any hard metal, preferably platinum; the capsules on each pencil are connected together by a metallic conductor, such as fine copper wire or tinfoil; the capsule ends rest loosely in similar capsules placed in holes in blocks or bars of wood, ebonite, bone, cork, or any suitable non-conducting material. The exterior surfaces of the capsules on the pencils are roughened, and the interior surfaces of the capsules in the holes of the blocks are also roughened. The connections of this microphone with the induction-coil and battery are made in the same way as above described for carbon microphones. In order to confine the movements of a microphone to the direct action exclusively of sound-waves, and to avoid any secondary movements of it which must occur when sound-waves act upon a microphone through the medium of a tympan or of any vibratory plate, which movements interfere materially with its faithful response to the sound-waves, the blocks or bars are firmly secured to a flat surface of a non-resonant, non-vibratory, sound absorbing material, such as cork. This material may or may not form one side of a box made of the same material. If inclosed thus in a box, or not inclosed, the material on which the carbons are fixed must not be fastened to any other material, but should rest loosely in a narrow frame of wood or other suitable material, or it may be suspended in any convenient manner; when pumice-stone is used the bars or blocks may be clamped between two pieces of pumice-stone. The sound-waves may fall directly upon the carbons or other pencils, or upon the obverse side of the material to which they are fixed. The object of leaving the material to be kept in its place by its own *vis inertiæ* only is to allow the whole mass to be moved by the impact of sound-waves upon it. The molecular movement in these light, porous substances being much greater than in dense compact substances, will communicate to the fixed blocks or bars a much greater movement than denser material would. Microphones thus attached to porous substances will be affected by the molecular movement in these substances, as well as by the movement of the mass, and there cannot be any compression of the carbon; but the effect of sound-waves upon it is to vary the surface contacts by a shaking or joining, or molecular motion; it may be possible that there occur rapid makes and breaks of the circuit; but these, however, are so rapid that an undulatory current flows, corresponding faithfully to the sound-waves, which is not the case when sound-waves act on the microphone through the medium of a tympan or vibratory plate, because the vibrations of a tympan or plate produce secondary motions.

In order to protect a microphone from the secondary action of any vibrations which might occur when the fixed parts of a microphone are attached to the surface of any material whatever, the patentee attaches the series of blocks surrounding the centre block, Fig. 1, to a narrow flat ring of copper, or other suitable metal, and the centre block is attached to a narrow strip of wood, ebonite, or any non-conducting equivalent material, lying across the centre of the ring, to which its two ends are secured.

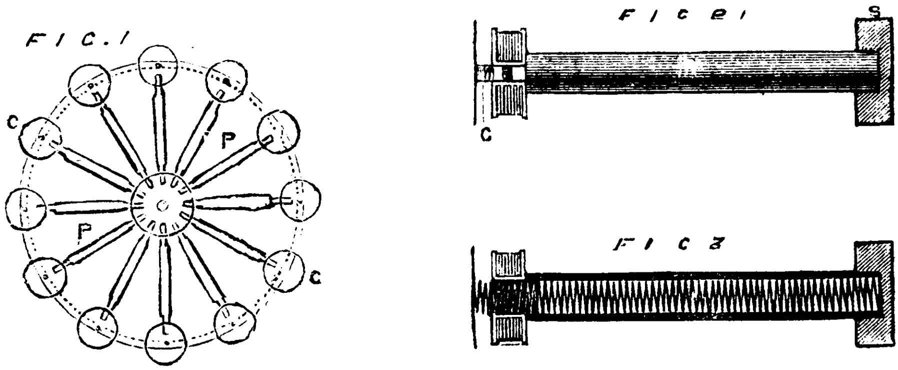
The efficiency of microphones constructed with pencils and blocks or bars depends in a great measure upon the angle of inclination which the pencils make with the perpendicular. When the pencils stand perpendicularly their *vis inertiæ* is almost entirely at their lower ends, and when they lie horizontally their *vis inertiæ* is equally divided between the two ends. In this latter position the force of the sound-waves necessary to overcome their *vis inertiæ* is the maximum force, and in the former position the force required to overcome the *vis inertiæ* of their upper ends is the minimum force; but the contacts there being very slight, the current passing through these ends will be very feeble, and consequently the variations of the current passing through the microphone would be very slight, inasmuch as the current passing through the lower ends of the pencils would be almost uniform. The greater the variations of the quantity of current passing through a microphone used in a telephonic circuit, the greater will be the effect on the coil of the receiving instrument; hence it is necessary that a microphone should combine great sensitiveness to sound-waves with the bearings of the contacts of its several parts so arranged as to present the greatest surfaces of contacts where the variations of the current are produced.

A microphone composed of from eight to ten pencils connected together for quantity, inclining at an angle of about 20° from the perpendicular, gives excellent results. The microphone can be placed in a box of wood, ebonite, brass, iron, or any suitable material, about one inch from one of its sides, in which there is the usual hole with a mouthpiece, care being taken to have a hole in each side of the box between the microphone and the side of the box to which the mouthpiece is attached.

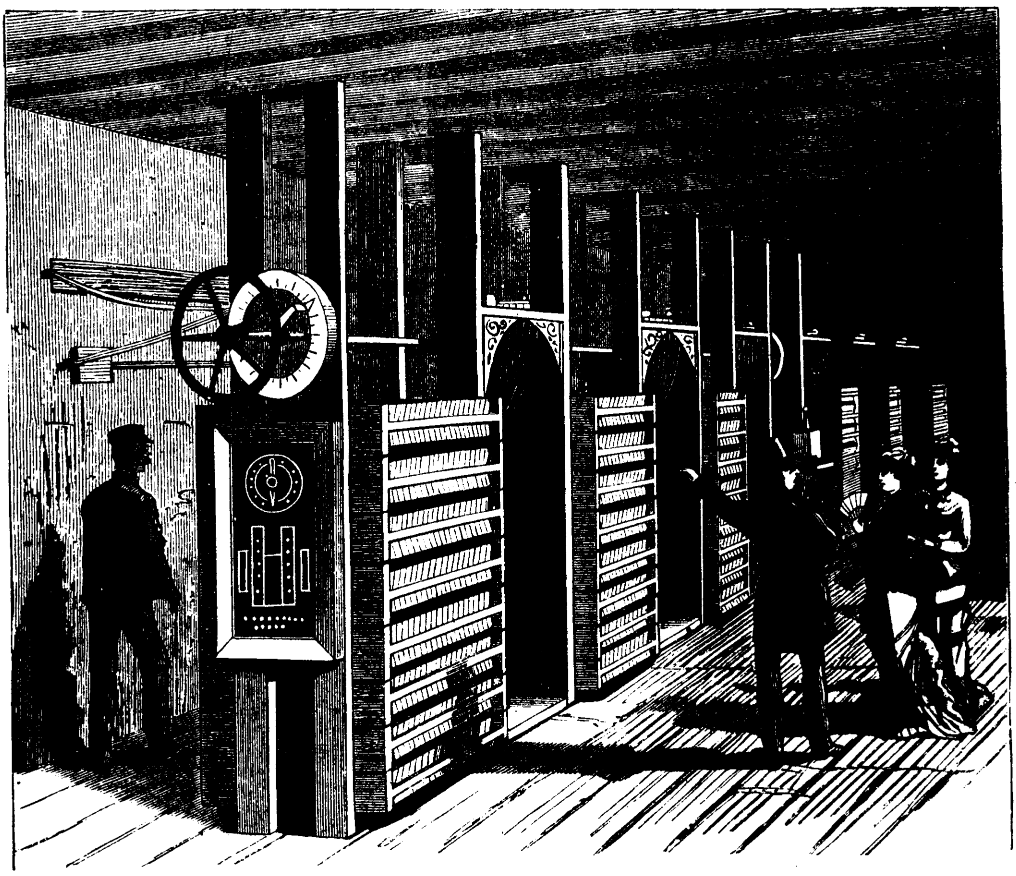
In the case of telephones, the patentee asserts that a plate, or diaphragm, or tympan must be held in close contact with the pole or poles of a magnet, and the plate, diaphragm, or tympan need not necessarily be made of iron or steel, or of any



THE DYNAMO ROOM.—FIRST EDISON ELECTRIC LIGHTING STATION IN NEW YORK.



BARNEY'S IMPROVEMENTS IN TELEPHONES.



THE REGULATOR.

material capable of inductive action, but may be of cork, wood, ebonite, glass, or brass. Words spoken in any good transmitting instrument are reproduced in a clear, loud, and distinct tone in his receiving-telephone placed in the same circuit with the transmitter.

The action of the magnetic force in his telephone seems (he says) to be of a totally different character from that in the Bell telephone, in which the magnetic force acts directly by attraction upon the plate armature, whereas the magnetic force cannot possibly have any direct magnetic effect on the plate or diaphragm when this plate or diaphragm is not made of any material capable of inductive action, nor with any such material attached to it. The diaphragm, tympan, or plate may be made of cork, wood, cardboard, ebonite, ivory, glass, brass, iron, steel, mica, or their equivalents, and must be held by a constant pressure applied upon its edges, corners, or points, as the plate is made round, oval, square, star-shaped, or triangular, against the spiral end of the magnet. One function of the diaphragm or plate seems to be to confine within a narrow range the molecular elongation of the magnet produced by the passage of an electric current through a helix encircling the magnet, and it doubtless serves to intensity the sounds emitted by the magnet at this time.

The patentee was led to use a spiral wire for an extension of the core in the helix on an electro-magnet, from the results of numerous experiments made with a thin strip of iron, having one end firmly secured to a board and the other end slightly bent over by a weight attached to it, with a helix placed on a strip of iron. When a current of electricity was sent through the helix, the strip of iron instantly made efforts to resume its normal position, and sounds were emitted during the passage of the electric current.

In constructing his telephones, Mr. Barney uses several combinations of a spiral wire with electro-magnets, the spring being sometimes continued around the core and fastened to the shoe.

In Fig. 2 a bar of iron or steel, which may or may not be a permanent magnet, has one end fastened to a shoe S of soft iron equal in weight to about five times the soft iron elongation E of the other end, on which is placed a helix H. To the end of this elongation is fastened a short spiral spring G of iron extending about one half an inch above the end of the core of the helix. The end of this spiral spring may be capped with a disc of iron or steel, D, the same size as the end of the core, or larger; or the terminating convolutions of the spiral spring may be wound in a plane gradually diminishing to a centre.

In another form, inside of a tube of iron or of steel, Fig. 3, upon one end of which is fitted a shoe of soft iron, is placed a spiral wire of iron or steel fastened to the soft iron shoe, the spirals being in close contact with the inside of the tube throughout its entire length, and extending above the end of the tube. On the spiral wire above the top of the tube is placed a helix, and a soft iron plug is placed inside the spirals encircled by the helix — the end of the spiral wire being arranged as in the first form. The connections are those usual with other telephones, and the cases may be of any suitable material.

FOURNIER'S ELECTRIC BATTERY.

An electric battery possessing some novel features has been recently patented in this country by Mr. George Fournier, of Paris. The principal novelty is the use of a paste, or compound of lead oxide and glycerine, which is moulded into any suitable form for use as a battery plate, either in primary or secondary batteries. The patentee claims the use of any other metallic oxides capable of forming with glycerine a solid compound insoluble in water. In forming the plates, the lead oxide and glycerine are mixed in such proportions as to form a thick paste, sufficiently fluid to be run into moulds. In about twenty-four hours after being thus "cast," the mixture sets into a solid mass which is insoluble in water. This compound is exceedingly reducible, so much so that when immersed in dilute sulphuric acid together and in circuit with metallic zinc, it becomes reduced to the metallic state as fast as the zinc is attacked. It is, therefore, says the patentee, eminently suited for use in galvanic batteries, as it will prevent galvanic polarization, and it may either wholly replace carbon or be applied in layers upon carbon or other conductor of electricity. Being an excellent depolarizing agent, it enables one to obtain a constant single-fluid battery.

As above mentioned, the compound becomes completely reduced, and, therefore, in the present example we have metallic lead as the product of the reduction, which, being in a complete state of division will be very readily reoxidised for use again as a depolarising agent, or even become peroxidised, and may therefore be employed with advantage in the construction of secondary batteries, which may be prepared by the direct peroxidation of plates composed of a compound of lead oxide and glycerine without the intermediate reduction of the lead to the metallic state.

The oxide of lead is the oxide best suited to form the plastic mass with glycerine, but other matters still better adapted to oppose polarization of the electrode, such as the peroxides of lead, manganese, &c., may be added. These, although not capable alone of combining with glycerine, are nevertheless susceptible of being agglomerated (when mixed in suitable proportions) with lead oxide and glycerine and form therewith a solid mass. The addition of peroxides confers greater depolarizing properties, as the compound then contains, weight for weight, a higher proportion of oxygen; besides which the peroxides being better conductors of electricity than the oxides, the internal resistance of the battery is notably reduced and its power considerably increased. This quality of conductibility consequently enables the portions of the mixture not already peroxidised to be more easily peroxidised by the passage of the electric current, and permits of the production of plates of any desired thickness wholly composed of lead peroxide, and very suitable for use either in primary or secondary batteries.

Let us consider, first, the action of a primary battery, in which a plate composed of glycerine, lead oxide, and lead peroxide, agglomerated as above mentioned, and plunged in a dilute solution of sulphuric acid contained in a cell, forms the negative plate or element, and a copper plate, for example, of suitable thickness forms the positive plate or element. When the circuit is closed the sulphuric acid attacks the copper plate forming sulphate of copper, and disengaging hydrogen which passes to the plate composed of glycerine, lead oxide, and peroxide; that plate would soon be covered and polarised were the hydrogen not in contact with a matter capable of very readily oxidising it. No polarization will therefore take place, and the battery will act with uniform constancy so long as the acid acts on the copper plate, and there remains in the compound plate any oxygen to oxidise the hydrogen thereby disengaged.

A battery thus composed is, so to speak, of indefinite duration, as it may be readily reconstituted or reconverted into its primitive elements by the passage of an electric current. Suppose that the whole of the sulphuric acid has combined with the copper and formed sulphate of copper, and the hydrogen thereby disengaged has combined with the whole of the oxygen of the compound plate of lead oxide, lead peroxide, and glycerine, there will remain in the battery only the plate of copper partially attacked, sulphate of copper, and the plate of reduced lead. If now an electric current be passed through the battery in the proper way, the sulphate of copper will be decomposed, copper will be deposited on the copper plate, the oxygen of the decomposed sulphate of copper will combine with the reduced lead plate and reoxidise it, the sulphuric acid will be set free again, and the battery will then be reconstituted and ready for further action.

In the case of secondary batteries the compound plate of oxide, peroxide, and glycerine is immersed in a dilute sulphuric acid solution, in presence either of a sheet of lead, or, better still, a plate composed of lead oxide, metallic lead in powder, and glycerine. A current passed through this battery under proper conditions will decompose the water, the oxygen combining with the plate of oxide, peroxide and glycerine, completely peroxidising it, the hydrogen passing to the other plate. Thus we have the elements of a Planté accumulator, with the difference that the substances employed are in a condition more favourable for oxidation and reduction than sheet lead.—*English Mechanic.*

UTILIZATION OF SEA WAVES.

The recent progress of electric machines has largely directed attention to the economical production of force. The sea, with its tides and surge, offers stores of force little utilized as yet. Two schemes for turning the wave-motion of the sea to good account have lately appeared. M. Victor Gauhee (whose method is described in *La Nature*) would suspend a large float by ropes from a pulley, outside of a stone enclosure built a short way from the beach. Within the enclosure is a bell-shaped iron vessel, suspended from a central-pulley system, connected with the float pulley. This moves up and down in correspondence with the float, on a block of masonry, which has passages communicating with the air-space above and with a pipe below, which extends to a reservoir on shore. The bell in rising sucks in air through valves in its upper surface, and in falling forces the air along the passages to the reservoir. The ropes are kept always taut by means of a weight hung in air from a pulley connected with the central system, and the bell has at its lower part a caoutchouc membrane connected with the block of masonry. M. Gauchez specifies the dimensions which, he thinks, would insure a rapid flow into the reservoir and involve no special heating. In the other scheme, by Professor Wellner, of Brun, (an account of which appears in "Dingler's Journal") there is fixed along a sea wall a sort of air-trap—a metallic case, open below, now in air, now in water, as the waves beat on it. At the top this communicates through valves and pipes with a reservoir, in which the air is compressed, and the force thus supplied may be directly utilized for some purposes. Herr Wellner brings a pipe from the reservoir to the lower part of an air-wheel, which is like an overshot water-wheel, immersed in water. The air displaces the water from the cells, and drives the wheel round, while expanding and rising to the surface. The system works with different degrees of compression, if the air-conducting tube be provided with several valves, so that the air may be admitted to the wheel at different depths, according to the pressure. With small waves and compression it is admitted higher. This apparatus the author proposes also to use by way of supply cooled air for beer-cellars, larders, &c., in hot climates. —*Glasgow Herald.*

THE EDISON ELECTRIC LIGHTING STATION.

On Pearl street, near Fulton, under the shadow of the Third Avenue Elevated Railroad, and a minute's walk from Fulton Ferry, is an iron front building, originally put up for commercial purposes, but which for a year or more has been in process of preparation for a central electric lighting station under the Edison system. The beginning of this great work was indicated by the laying of underground conductors around every block in that portion of the city bounded on the east by the East River, on the west by Nassau street, on the north by Spruce and Ferry streets and Peck Slip, and on the south by Wall street. This district includes 946 consumers, whose premises are already wired. The number of lamps to be used in connection with these wires is 14,311. From the basement of the building referred to radiate large semi-cylindrical copper conductors, insulated from each other and arranged in pairs, each pair being inclosed in an iron pipe. At the adjacent ends of these sections of double conductors there are boxes which perform the double function of expansion joints to permit of the free expansion of the individual lengths of conductor, and of service boxes from which to take the electric current to the premises of the consumer.

While the blocks in this district were being encircled with these bands of copper, the buildings of the district, with scarcely an exception were being fitted with wires leading it to the sockets intended finally to receive the "electroliers" and single lamps, and to such localities as are to be supplied with the electric current for motive power. Simultaneously with all these preparations, the machine works of the Edison Electric Light Company in Goerck street was completing as rapidly as possible the gigantic dynamos to be used in supplying this district with the current, while the Porter-Allan Engine Company of Philadelphia was building the high speed 120 horse-power engines to be used in driving the dynamos.

Now the street conductors are laid, the service conductors are put in, the buildings are wired, the dynamos with their attached engines are in place, and the district and central station are fully equipped, and we have no doubt that before this paper meets the eye of the reader the district will have been illuminated.

Although we have many times given the various steps of progress made in this great enterprise, it will, doubtless, be of interest to enter somewhat into detail in describing the appointments of this illuminating station. The building, as we have said, was originally erected for commercial purposes, and, as might naturally be supposed, it was found to be totally insufficient in strength to sustain the great weight of the dynamos and their attached engines. Consequently a separate structure was erected within the walls of the building. It consisted of iron pillars planted on heavy plates resting on three feet of solid concrete, and supporting iron trestle work, carrying the heavy iron girders on which the machines were placed. The building is 50x100 feet, four stories high, and divided by a median wall into two equal parts. It is in one of these parts that the machinery is placed. The other part is soon to be fitted up as a duplicate of the one already completed. Beginning with the basement, the area in front, underneath the sidewalk, is used for the reception of coal and the discharging of ashes from the boiler furnaces. In this place there is a special engine of about twenty horse power for driving the screw conveyers that carry the coal up over the boilers and deliver it to the stoke-hole between the boilers, and the screw conveyers that take the ashes and deliver them to barrels under the sidewalk in Pearl street. This engine also drives the fan-blower which supplies air to the boiler furnaces, and also to the stoke-hole to keep it cool and well ventilated. Pipes also lead from the main air trunk of this blower to the dynamos on the floor above.

The boilers—of the Babcock and Wilcox style—four in number, are 250 horse power each. They all feed into a single 8-inch supply pipe, from which steam is taken through vertical 5-inch pipes to the engines above.

A gallery extends over the boilers and stock-hole from which the visitor may gaze into the depths below.

Each boiler is provided with an injector, and a steam pump is provided with connections for each boiler, so that any or all of the boilers may be fed by it. Water is supplied to the boiler at a temperature above 212°, being forced into a heater that receives the exhaust of all the engines. By heating the water to this temperature before admitting it to the boilers the impurities are deposited, and the boilers are supplied with pure water.

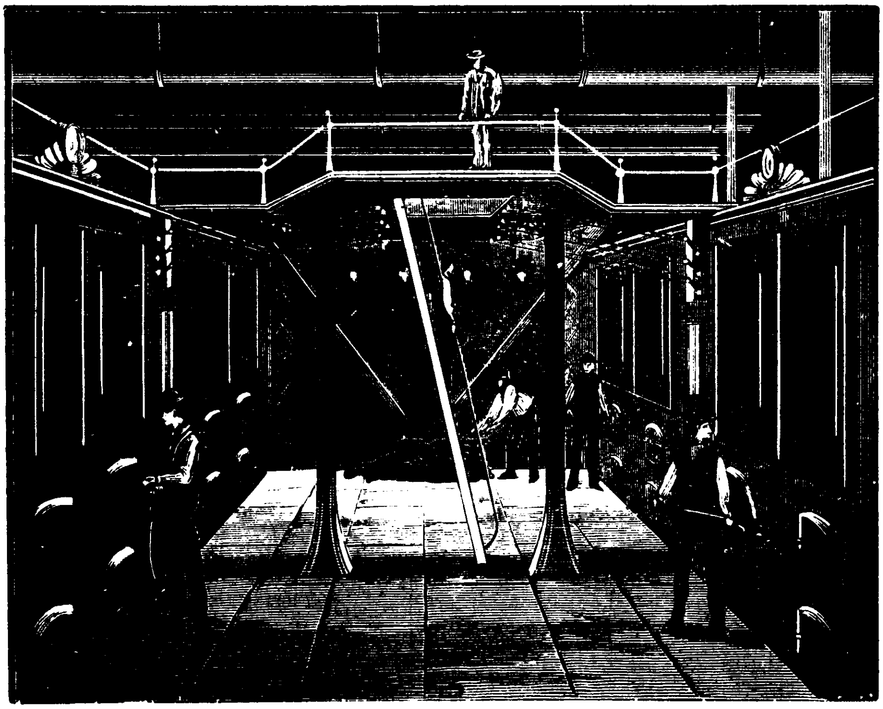
Over the boiler is supported the dynamo floor by the trestle-work, entirely disconnected from the main building or its foundations. On this floor are six of the largest Edison dynamos. The gigantic proportions of these machines will be appreciated by reference to our engraving, although one can scarcely realize their immense solidity and weight without personal inspection. Each machine complete, with engine dynamo, and base, weighs 62,000 pounds. The field magnet weighs 33,000 pounds. The armature at its shaft alone weighs 9,800 pounds. The length of the armature is 61 inches; its diameter, 27·8 inches. The height of the machine from the floor to the top of the field magnet is 6 feet 4 inches.

The engine whose shaft is coupled directly with the dynamo shaft is upon a base which is common to both engine and dynamo. The cylinder of the engine is 11 3-16 inches in diameter, and the stroke is 16 inches. The cut-off of the valve is variable by the governor.

The normal speed of the engine is 350 revolutions per minute, steam pressure 120 pounds. With this great velocity it is found that both engines and dynamos are so perfectly balanced as to scarcely create a tremor in the trestle work upon which they rest.

The nominal capacity of each of these dynamos is 1,200 lights of 16 candle power each, but the maximum capacity is about fifty per cent in excess of this. The resistance of the armature is 0·0038 ohms, and the current generated by the machine is of such low intensity that one may grasp both conductors leading away from the machine without danger and without serious inconvenience.

The dynamos are arranged alternate in position with each other so as to economize room, three of them being connected by heavy copper conductors with the large copper bars extending along the sides of the room. The bars of like name from opposite sides of the room are connected together at the front of the building, where the entire current from all of the machines is centered in two large horizontal copper bars, with which the several street conductors are connected, as shown, one of the parallel street conductors being connected with each of the dynamo mains. In the conductor extending from the dynamos to the walls, along the walls there is a huge switch (shown in detail in one of the smaller engravings), having three contact surfaces about four inches broad which wedge between three pairs of fixed contacts. By means of this switch the circuit of any dynamo may be instantly broken. The sizes of the various conductors vary with the requirements. The street conductors are equal to a copper rod of one-half inch diameter, and the service conductors vary, some of them being equal to two and other to ten No. 10 wires. Of the street conductors there are something over fourteen miles altogether. The field magnets of the dynamos are placed in a shunt circuit derived from the main circuit, and including a switch and a number of rheostatic coils, one or more of which may be thrown



BOILER ROOM.—STOKE HOLE.

into the shunt circuit, so as to add to the resistance of the shunt circuit from a small fraction of an ohm to seven and a half ohms, which is the greatest resistance necessary to control the current exciting the field magnets, and thus control the current in the main circuit. This regulating apparatus is shown in one of the views.

There is a set of resistance coils for each dynamo, each set being provided with a circular switch, operated by a horizontal shaft through sets of miter gearing. An attendant is stationed at the wheel at the end of the horizontal shaft, and turns the switches one way or the other, according to the requirements. He is able to judge of the amount of current required by watching an indicator above the regulator. This indicator is provided with two lamps, one red and one blue, and with a device for throwing one or the other into the circuit, according as the current is strong or weak; and neither lamp is illuminated when the current is normal. When the blue lamp is lit more resistance is required in the shunt circuit to reduce the amount of current passing through the wires of the field magnets, consequently the attendant turns the switch, throwing in one coil after another until the blue lamp ceases to shine. When the red lamp shines, the switch must be turned in the opposite direction to increase the power of the field magnet and to strengthen the current in the main circuit.

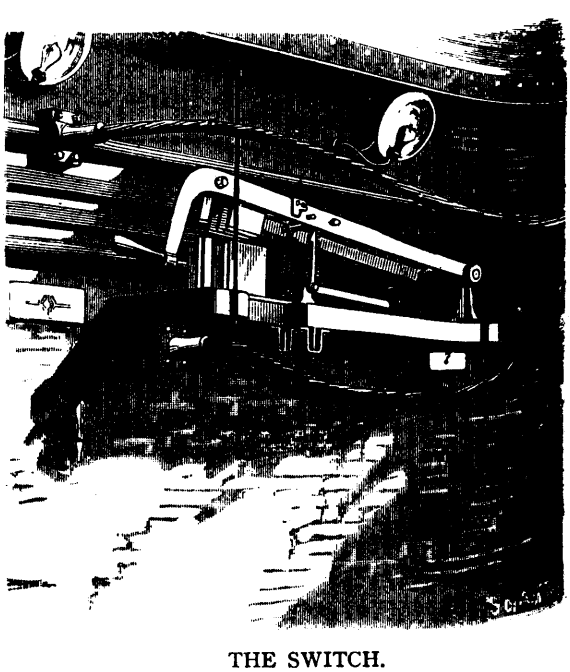
As before mentioned, all of the dynamos work in the same circuit when everything is normal, but if from any cause it is supposed that one of them is not doing its work properly it is immediately disconnected from the main circuit by letting go the huge switch by which it is connected with the main conductors. The switch is provided with a strong spring that opens it instantly as soon as it is released. The isolated machine is now connected with a battery of a thousand 16 candle lamps arranged in two rectangular groups in one of the upper rooms of the building, as shown in one of our engravings. If the machine brings these lamps to brilliant incandescence, it is in usable condition, and if any trouble exist it must be looked for elsewhere.

On one of the upper floors of this building is a room for testing the meters employed in registering the amount of current used by the consumer, and for taking a record of the meters, the amount of current used being determined by the amount of copper deposited by the meter in a given time on one of its plates.

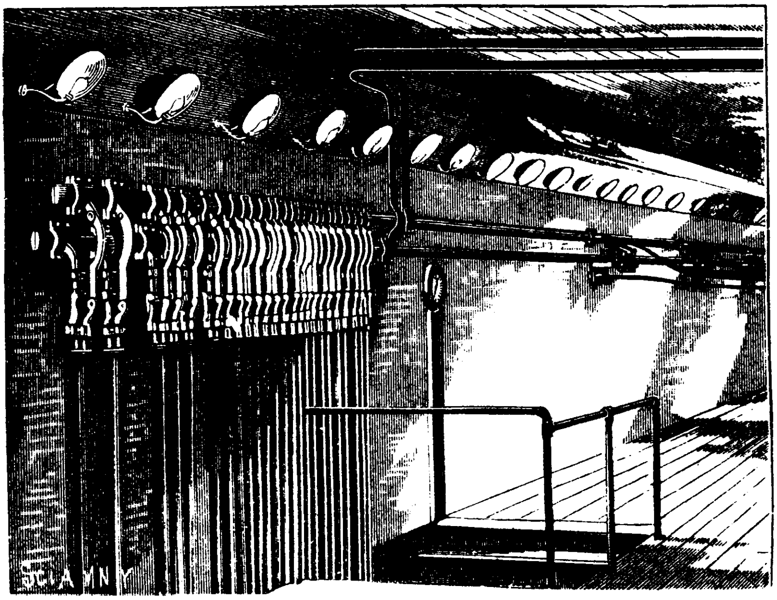
This electric lighting station is very complete in all of its appointments. Every imaginable emergency has been provided for: coal bunkers in the top of the building to hold a reserve of coal, water tanks to supply water in case of any deficiency or cessation of supply, thorough protection against fire, and thorough workmanship everywhere.

For convenience in handling the heavy parts of the machines, the dynamo room is provided with a traveling hoist capable of running the entire length and breadth of the room, and having power enough to easily lift the heaviest part of any machine and of holding or carrying it as may be required.

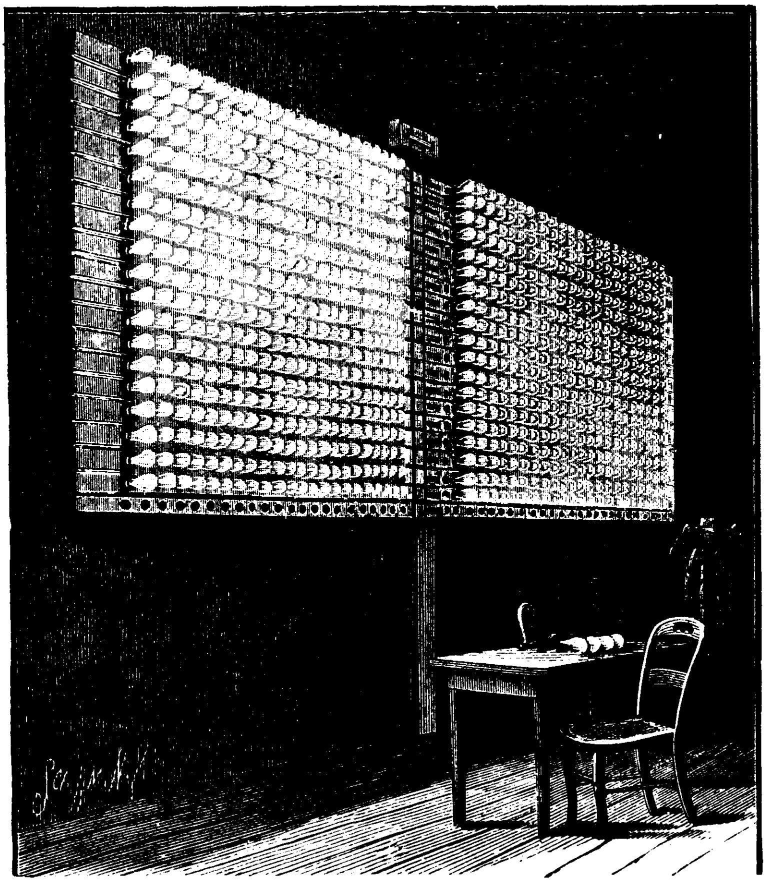
The projectors of this gigantic enterprise have met with no adverse experiences, all the tests thus far made proving entirely satisfactory.—*Scientific American.*



THE SWITCH.



STREET CONNECTIONS.



THE BATTERY OF 1,000 LAMPS.

EXPERIMENTS WITH THE ELECTRIC ARC.

A few weeks ago MM. Jamin and Maneuvrier, in the Paris Academy, described some instructive experiments in which the electric arc was maintained between various "electropyres" (to use a recently coined word), by action of a Gramme machine with alternating currents. With two quite similar carbons as electropyres, there is no deflection of a galvano-meter in the circuit, the two rapidly-successive contrary currents neutralising each other. But, with one carbon thick, the other thin, there is permanent deflection (as though a battery were inserted in the circuit); the current from the large carbon to the small denominating over the other, and giving a differential current. There is also a differential current where the electropyres are a mass of metal and a carbon point. With lead a deflection of 29° was had; with iron 30°; with carbon 31°; with copper 60°; with mercury 70°. In the case of zinc, the current, at first as strong as with copper, falls off, probably owing to formation of oxide.

The electromotive force of the differential current is small, and about the same, for lead, iron, and carbon. For copper it is equivalent to 50 Bunsens, for zinc (at first) to 66, while mercury shows 103·7. It is proved that the first three substances offer the greatest resistance, while copper and mercury offer the least.

The differential current can only be explained in two ways: by a difference in the resistence, or by an inequality in the inverse reactions of the arc in one direction or the other. As no difference of resistance was observed with change of direction, it is concluded that the current in question is due to a particular property of alternating currents.

Whatever the explanation, it is clear that, the arc once produced with mercury, the differential current quite alters the action of the machine. One system of currents is, if not extinguished, considerably weakened, and the other constituted by excessive currents of greater intensity and duration. The commutator by which alternating-current machines, like those of Nollet and Meritens, are rendered available for chemical operations, might be replaced automatically by one or several arcs formed between a bath of mercury and a carbon point. It remains to ascertain the economic conditions of this transformation.

The effects obtained from the Gramme machine, with alternating currents in the electric egg, are remarkable. The two currents contribute equally (say the authors) to the phenomenon, which is that of Geissler tubes, but which assumes incomparable brilliancy, owing to the considerable quantity of electricity which passes and rapidly modifies the appearances observed. The carbons get heated, redden, and reach a pale white, not only at their extremity, but throughout their length; then they are rapidly volatilized by the combined effect of heating and of the currents. Whatever the cause of this volatilization, it is certain that a carbonaceous matter spreads in the state of vapour. The globe gets filled with a blue gas, like vapour of iodine, deepening in hue to indigo. The vapour is abundantly condensed on the glass, rendering it opaque. The authors avoided this termination by using instead of single carbons two bundles of crayons, diverging from the rheophores, conewise, towards each other. Here the currents are divided into a large number of effluves, less intense than the single effluve; all the carbons are illuminated at once, and less the more numerous they are. The volatilization is nearly *nil*. A still brighter effect was obtained with copper rods.

In a more recent paper MM. Jamin and Maneuvrier have described some striking modifications of the arc when sulphide of carbon vapour is introduced into the vacuous space. The carbons in these experiments were parallel—fixed at the base and separable at the top by a simple mechanism. With a vacuum as complete as possible in the receiver, the arc, of course, does not form; there is the Geissler tube phenomenon: but when a few drops of sulphide of carbon are introduced, increasing the pressure about 0·05m. or 0·06m., one sees the arc between the points, and it persists as they are separated. At this moment there is, as it were, an explosion of light, so bright as to be unbearable, incomparably superior to the usual brilliancy of the arc. Looking through colored glass, one observes the arc to be of horseshoe form, or like a large Omega, resting with its two ends on the carbon points, and about 0·05m. in height. A long flame rises vertically from it. The points of the carbons seem red and very brilliant, but the arc is pale-green, and, as this colour denominates, the whole room is as if illuminated by a Bengal flame with copper in it. The brilliancy increases with increase of tension of the vapour; but, the resistance also increasing, the arc may go out and have to be started again and again.

The spectrum of the light is formed of four channeled spaces in the red, the yellow, the green, and the violet, very similar in appearance, though the green is the most luminous. They probably obey the same harmonic law, which remains to be discovered.

While these appearances are in progress, a chemical action takes place. If air has remained in the receiver, the sulphide of carbon burns incompletely; a cloud of sulphur fills the space, and is deposited on the glass; the carbon burns alone. If the air has been well removed these clouds do not form; a brown deposit is produced on the glass and becomes black. This deposit is volatile. Its odour recalls that of sulphur. "It is evidently a compound of sulphide and carbon; perhaps a proto-sulphide corresponding to carbonic oxide, perhaps an isomeric combination of ordinary sulphur. One finds, indeed, neither a deposit of sulphur nor one of carbon, and the crayons have neither lost nor gained. It is probable that the sulphide of carbon is dissociated, the sulphur volatilized, the carbon in vapour disseminated in the arc, and that this carbon and this sulphur recombine in the flame to reconstitute a combination under different conditions; but this is merely a conjecture, no analysis having yet been made. *En résumé*, this experiment is remarkable for the extraordinary quantity of light produced, for the size of the arc, for its colour, for the composition of the spectrum, and for the chemical actions which take place. It is not probable that it could ever be turned to advantage for illumination, on account of the colour, unless for lighthouses and signalling at a distance."

A TORPEDO DETECTOR AND A SCIENTIFIC DIVINING ROD.

Two inventions which are based on the principle discovered by Prof. Hughes and illustrated in his induction balance, claim some little attention, as being probably very useful appliances. These are Capt. M'Evoy's torpedo detector and Mr. C. F. Varley's "divining rod," a simple arrangement by means of which it is believed that it will be possible to discover the existence and position of metallic lodes without the practical test of sinking costly shafts. M'Evoy's apparatus will probably be found of use as an indicator of the position of lost anchors, cables &c., as well as of torpedoes, and the following will give an idea of its construction. It consists of a small mahogany box, containing a pair of coils or bobbins, a vibrator similar to that employed in electric bells for making and breaking contact, and a telephone. To this box is attached a given length of flexible cable, with four conducting wires in it. To the other end of this cable is attached a flat wooden case, in which there are two coils. This case is weighted so that it will readily sink when placed in the water. There are also terminals on the box for attaching battery wires, and an arrangement for putting on and cutting off the current is provided. There are two complete circuits through the box, cable, and wooden case, the one primary, and the other secondary. The battery, the vibrator, one coil in the box and one coil in the wooden case are in the primary circuit, while the telephone. one coil in the box, and one coil in the wooden case are in the secondary circuit. When the battery is on, the coils in the box are adjusted so that little or no noise from the make-and-break action of the vibrator is heard in the telephone. When thus adjusted the instrument is ready for work, and if the wooden case is then brought near a metallic body a loud noise is heard in the telephone, thus indicating the proximity and locality of such a body.

Mr. Varley's instrument, which has been patented (No. 5353, 1881), consists of a rod of one metre to two or three in length, pivoted in a frame. At each end it carries two helices of 20 to 30 centimetres in diameter, the planes of the rings being parallel with the axis, and the centres of the two helices placed about one metre apart, more or less. These helices are connected together by two wires passing along the rod so as to form one circuit, but broken at a convenient part of the axis and attached to two insulated semi-cylindrical pieces of metal mounted upon the axis and against which two springs press. This arrangement forms a commutator, and the contacts change during the rotation as the planes of the rings or helices become vertical. The axis is connected by means of a pulley and cord with a large wheel carried on the frame, which supports the pivots, or is otherwise geared so as to permit of its being rapidly rotated. The two springs of the commutator are connected to a delicate astatic galvonometer at a convenient distance, or to a movable coil placed in a magnetic field. At right angles to the plane of the rod projects a pointer. This pointer is attached to the frame carrying the rod. The frame is mounted on pivots so as turn in any direction; the stand carrying the frame having two axes, one horizontal, the other vertical as in the altazimuth mounting of the telescope. If there be an electric current passing in a straight line of indefinite length underneath the axle it will produce a magnetic field diminishing in power as the distance from it increases. This magnetic field, when cut by the helices, tends to generate currents in them. The commutator causes all the currents to flow through the galvanometer in one direction if the pointer is placed in a line perpendicular to the lode, but when the rod is suitably placed and the pointer is in the direction of the lode, the currents are directed half in one direction and half in the other through the galvonometer, which returns to zero. Thus if the galvonometer is defected with the rod in any position, it shows the pressure of a lode. By inclin ng a rod until no current is produced, the pointer is brought to a position in which it indicates the direction of the lode, and by taking two observations, one on each side of the lode, at which the pointer shows an angle of 45 degrees, half the horizontal distance of the lode beneath the surface of the earth supposing the surface to be level or uniform. As cases may arise where it is not possible to place the apparatus on each side of the lode, for example, suppose the lode to be near the side of a sloping mountain, the apparatus may be provided with means of shunting the lower coils until the currents generated in the two coils are equalized, then by a little calculation based upon the known laws of electricity the distances of the lode from the surface is indicated.

Lastly, if desired, by making the resistance coils of the shunt suitable functions of the resistance of the coils, and making them into the form of a slide resistance box and numbering them, the position of the shunts at which neutrality is obtained may be arranged to indicate without calculation the number of metres that the lode is below the surface. The hollow helices at each end of the rotating bar may be varied in form and may be replaced by two bar electro-magnets.—*English Mechanic.*

ILLUMINATION BY ELECTRICITY AND GAS COMBINED.

The report reaches us that by a recent English invention light is produced by electricity and gas combined, the electric current operating to decompose carbon from a flow of gas, bringing about complete combustion, the result being a clear white flame.

That the heat of the electric arc has a tendency to separate the carbon from any hydro-carbon gas or vapor, is proved by Maxims' method of building up the carbon strips for his incandescent lamps; he places a very fine platinum wire or its equivalent in an atmosphere of gasoline vapor, and heats it to incandescence by an electric current which is just strong enough to do so. Carbon is thereby gradually deposited on the wire and increases its thickness until it becomes so good a conductor that its incandescence by that current ceases, it will then require a stronger current afterward to use it, which is the current for which the lamp is intended.

These Maxims' carbon strips show under the microscope a crystalline deposit or carbon glistening like little diamonds, quite a contrast with the carbons made by the carbonization by fire, of fibrous lignite, such as wood, paper, jute, etc.

We may by the way suggest the highly interesting question if this may not put some enterprising chemist on the track to manufacture crystalline carbon, that is diamonds. It would be a new triumph for applied chemistry.

In regard to using the electric arc for illumination in connection with hydro-carbon gas, we remark that this was done in this city two years ago, by passing the arc from carbon points through a jet of gasoline vapor, which amounts to about the same thing. The result was satisfactory; but practically the electric light without the hydro-carbon vapor or gas, was considered good enough not to warrant extra complications. It would however be worth while to find if economy could not be effected in this way, and a weaker electric light be increased, so that a ten light dynamo-electric machine could be made to feed fifteen lights, each of which by the addition of a gas jet could be made equal to one of the ten lights without gas.

MODERN IMPROVEMENTS IN GLASS MAKING.

The following is a record of the principal improvements in glass making during the last fifty years, as given by a prominent manufacturer.

Robert Lucas Chance, of Birmingham, England, successfully introduced the manufacture of Bohemian sheet glass into his district in 1838. James Chance perfected the process of grinding and polishing sheet glass, now known as patent plate.

The substitution, about the year 1830, of carbonate of soda, as the alkaline ingredient in glass in place of kelp, and subsequently for crown and sheet glass, of sulphate of soda (saltcake) in the place of carbonate.

An increase in the size and improvement in the workmanship of the plates, sheets, and tables produced.

An improvement in the color of the glass by the use of purer materials and modifications in the process of melting.

Numerous improvements in the flattening of sheet glass, resulting in the removal or diminution of many imperfections.

The use of the diamond in the process of splitting cylinders in the place of a red hot iron.

An increase in the size of the melting pots and furnaces, with the view of economizing coal and labor.

The adoption, in the casting of plate glass, of various mechanical contrivances. The origin of some important improvements of this class is due to the manager of the Birmingham Plate Glass Works.

The use of the same pot for the two processes of melting and casting plate, superseding the old method of transferring the contents of the melting pot into the vessel used for casting.

The substitution of small coal, or slack, in the melting processes in the place of the large coal or lumps.

The application of Siemens' regenerative process to the melting of glass, by which the amount of smoke is greatly diminished, the colour of the glass is improved, a greater control is obtained over the furnace, and a saving of fuel is effected wherever, by this process, slack can be substituted for large coal or lumps. These advantages are to some extent counterbalanced by the increased cost of the furnace, and its increased liability to get out of order. The process, however, as applied to glass making, is so new that there has been scarcely time as yet to overcome the difficulties that have presented themselves.

The introduction of the Gill furnace, whereby coal is economized to a remarkable extent without sacrificing the effectiveness of the combustion of the evolution of heat.

There have been many improvements, besides, in machinery for pressing and ornamenting glassware, but they are too numerous and intricate to detail here. The most important of these, too, had their origin in the United States, which have rapidly come to the front with labor-saving devices in glass manufacture as in other industries.—*Pot. and Glass Reporter.*

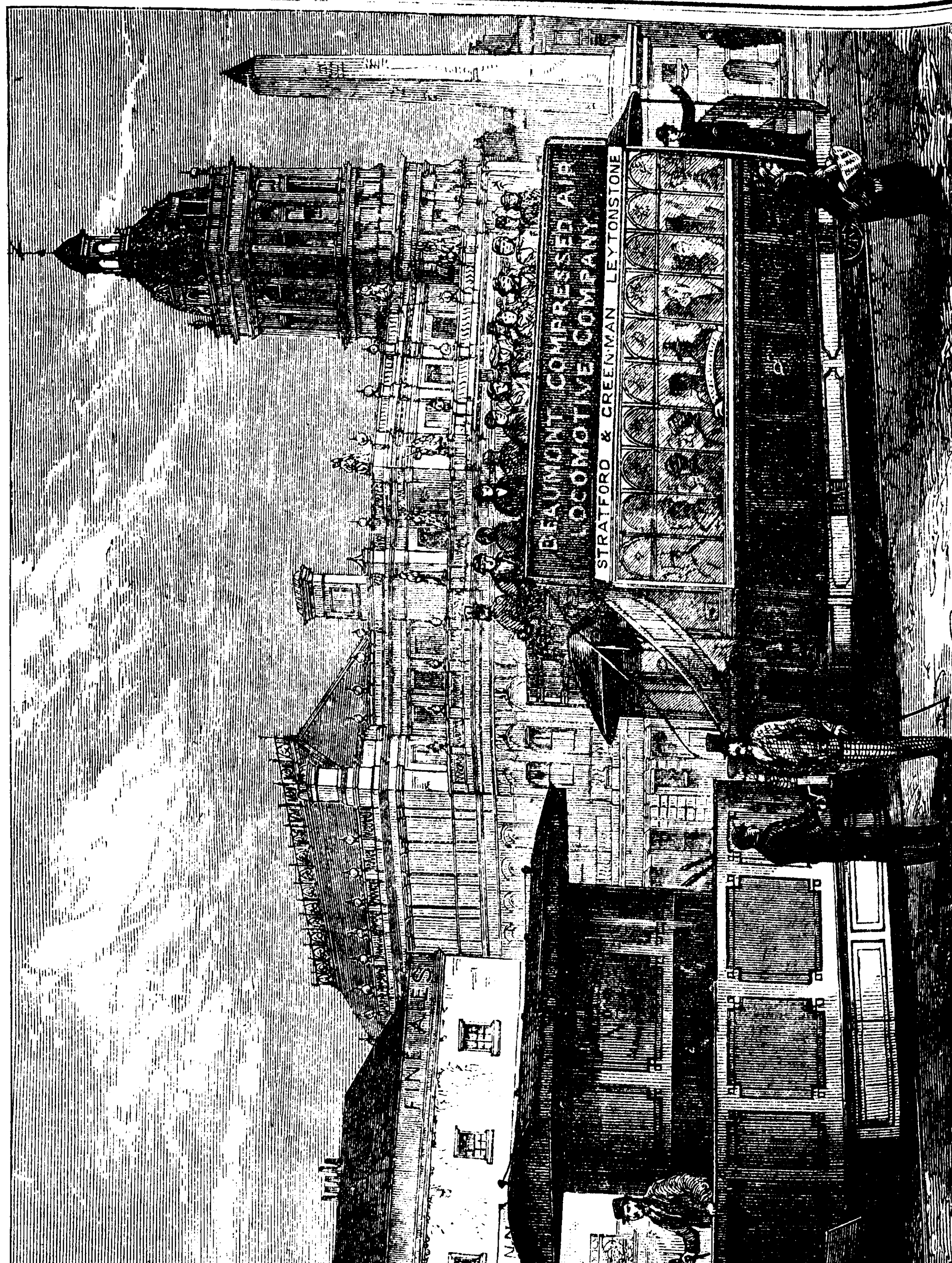
RISING INDUSTRIES IN INDIA.

The marked success of the cotton spinning and weaving mills in Bombay, after preliminary failures, has led to a great extension of this industry in the Presidencies of Bombay and Bengal, and in other parts of India. Nor does there appear to be any limit, practically speaking, to their extension, seeing that the mills work successfully in the heart of the cotton producing districts, where there is an abundant population from whom to draw for labor, and who are also the consumers of the manufactured fabrics.

The jute mills in Bengal are well known as successful enterprises, having eclipsed the special industry of Dundee, thanks, in some measure, to the transfer of Dundee capital and Dundee skill from the banks of the Tay to the banks of the Hooghly. The demand for their products continues to increase, and keeps so ahead of production that some other jute mills are making extraordinary profits. The growing trade in seeds and cereals in India is sufficient to take off any extra quantity of bagging that may be produced, and the Australian requirements are increasing year by year.

Coal is worked in Bengal by the East Indian Railway, and by upwards of sixty other collieries, the total output being not far short of 1,000,000 tons per annum. Rope making is already a large industry. Dye works, tanneries, soap works, sugar refineries, silk works, and paper mills are all going concerns and presumably profitable.—*British Trade Journal.*

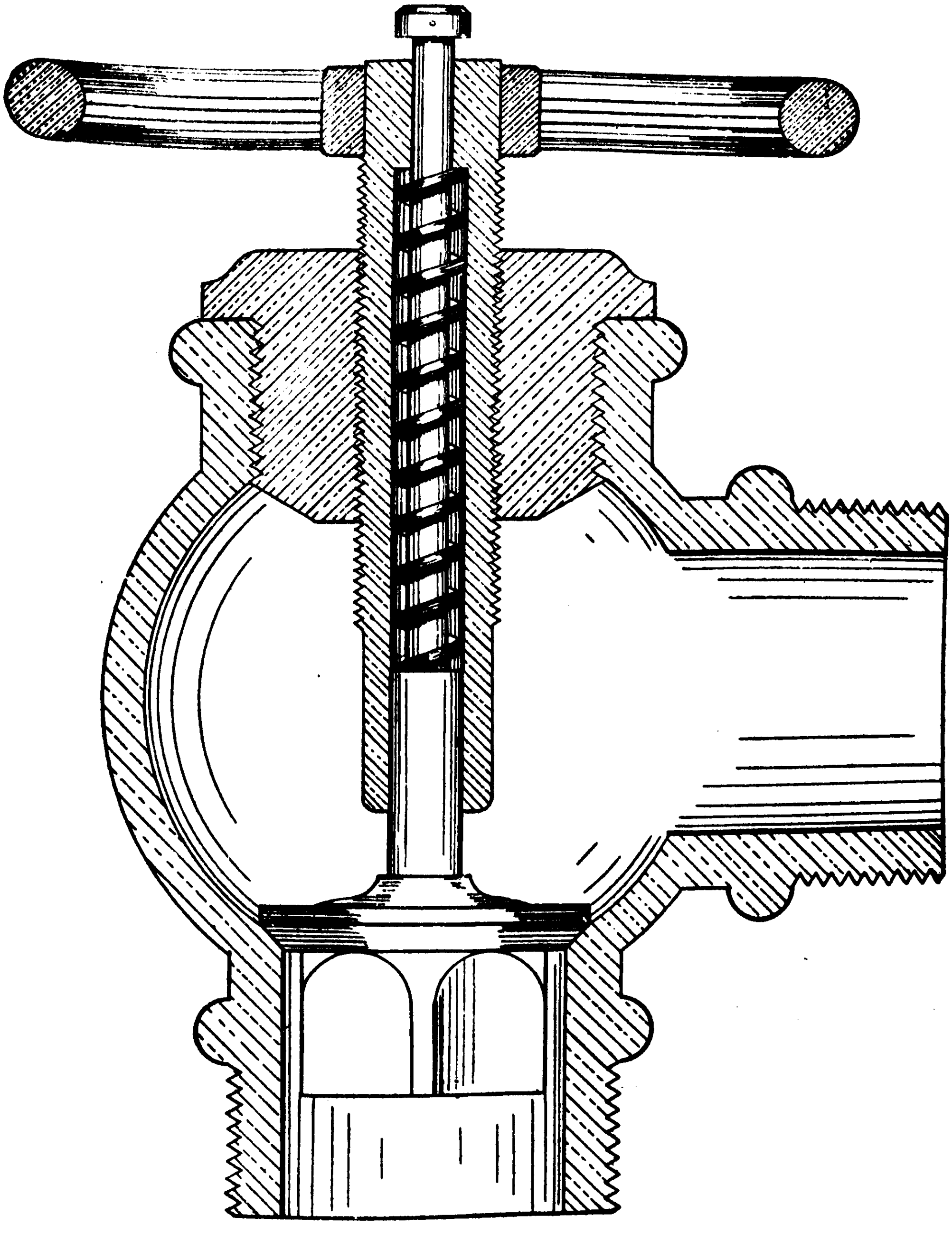
Southern sweet gum is coming into general use as a finishing wood, and for furniture and similar uses.



THE BEAUMONT COMPRESSED-AIR ENGINE, FOR TRAMWAYS.

SAFETY VALVES FOR STEAM CYLINDERS.

In steam engines working up to the full capacity of the boilers with which they are connected, and on board of steam boats, there is often serious danger of the cylinder being destroyed by water coming over with the steam. In fact in nearly all engines there is more or less of danger from this cause. Our illustration shows a safety valve which can be screwed into the cylinder covers and adjusted to withstand any desired amount of pressure, and open whenever the pressure exceeds that amount.



SAFETY VALVES FOR STEAM CYLINDERS.

It can also be used as an ordinary blow-out valve, and be held open or shut as necessary.

We commend this valve especially to the attention of saw mill owners, using steam power, as a great safe guard against break-downs of their engines. The frequent and sudden changes of the load on these engines and the manner of firing the boilers are very apt to induce currents of water from the boilers into the steam pipe, and thence into the engine cylinder.

Engineers in charge of engines will find this valve a great relief to their minds as to the cylinder. It will be found to act promptly, and allow water to escape instead of having to force its way by taking the cylinder cover with it, and the knowledge of this fact must relieve the mind of the engineer in charge, of a great amount of anxiety.

Mechanics.

TRANSMITTING AGENCIES—BELTS.

But very few persons interested in mechanics seem to have given the matter of transmitting power by belts very much consideration. It is true, of course, that in almost all establishments machinery belts are used to perform a part of the duty, and all mechanics or others engaged in the running of machinery, are more or less familiar with the working of belts. But, as in the case of gear wheels but little knowledge of fitness or proportions exists. A belt of a given width is expected to do about the same amount of work at all times without much reference to the difference in circumstances.

The tendency, however, is to usually select belts too light to do the work intended. Two reasons are to be given for this; first, ignorance of the requirements; second, a disposition to economise in the first cost. The latter reason figures less with the mechanic who plans and selects than it does with the man who has the bills to pay. Therefore, the man who foots the bill may make a mistake in the selection of a belt through mistaken ideas of economy; but in nine cases out of ten the mechanic who makes a mistake of that kind does it through ignorance.

My attention was recently called to the belting arrangement of a new mill, the plans of which had been made by a mill furnishing establishment not very well known, who were furnishing the entire outfit by contract. A stranger combination I think I have never seen, and it has been my misfortune to come in contact with quite a number that were most provoking. In the new mill referred to I was at a loss to know whether the mistake was on account of ignorance or greed, or both. I am inclined to think that both figured largely, with ignorance in the lead. I cite the fact to show that when the mechanic, if furnishing a mill by contract at a stipulated price, may sometimes for economical reasons make belts and pulleys too small.

Now the reader must not jump to the conclusion when I say small pulleys that I mean large pulleys have better holding qualities than small ones, (not too small). A small pulley of reasonable size will hold just as well as large pulleys, same amount of contact in both cases, measured by degrees.

It will be found that if two belts of the same kind and width are used, one of them running over pulleys each 24 inches in diameter, and the other over pulleys each 48 inches in diameter, pulleys made of same material and finished in same way, and both belts traveling 1,000 feet per minute, each will do the same amount of work. If the belt running over the 24-inch pulley be increased to 2,000 feet per minute, then it will do twice (theoretically) as much work as the one on the 58-inch pulley running 1,000 feet per minute. I say theoretically but I mean actually, if all the other conditions can be maintained exactly equal. The belts referred to have in each case 180° contact on the pulley, and in that respect are equal. The reader will bear in mind then that the working capacity of the belt is proportional to its lineal speed, and at this point is where the value of the large pulley comes in. A man is attempting to transmit a given amount of power with a belt running over 24-inch pulleys; the shafts makes 150 revolutions, which gives him about 1,000 feet motion for his belt. He finds though that there is a great deal too much for the belt to do; in fact he cannot make it hold at all with any kind of satisfaction. He dares not increase the speed of his shafts because that would disturb the speeds all around. The only thing left to do, and really the right thing to do, is to increase the size of the pulleys. He makes the pulleys 48 inches in diameter. That makes the belt travel twice as fast as before, and also makes it do its work with ease. Thus you see large pulleys by increasing the travel of the belt have cured the trouble, and it is from noticing such effects that the impression has got out that large pulleys are in themselves superior to small ones in holding or preventing the belt from slipping. It is simply the result of reasoning from false premises. Without investigation the mind of man is very apt to be led astray by apparent effects. Thus, if one is quietly seated in a railroad car while the train is standing still at the station, and flanked by other trains, one of the adjoining trains moves slowly out, invariably the passenger in the standing train who observes the motion of the other train through the window imagines the train he is in is moving and the other standing still. And just so it is that persons often arrive at wrong conclusions, apparently right, by observing from a wrong standpoint or by reasoning from wrong premises. It appears that large pulleys are better than small ones because it has been observed that by increasing the size of the pulleys the belt holds and does its work well. The real cause, that of increasing the travel of the belt, is not thought of.

The same observer may at times have noticed that a belt on certain sized pulleys was doing more work by far and doing it easier than another belt of the same width was doing on much larger pulleys. The reason was the first belt was traveling faster than the last. But then that was one of the things they had not thought of or could not see.

But it was not so much to establish the principal of belt transmission as it was to show how errors creep in in arranging a system or combinaiion of belts that I digressed to illustrate first principles. Undoubtedly many have observed that a smutter, brush machine, or some other heavy running machines is driven with say a six-inch belt, and it seems to require a six-inch belt to do the work easily. This machine is driven from a counter-shaft which is probably driven from a main upright. The belt leading from the main upright to the counter-shaft is probably only six inches wide, at the most but seven inches wide. To get at the problem more intelligently we will suppose the size of the pulley on the machine to be 12 inches in diameter and the driving pulley on counter-shaft 36 inches in diameter; the driving pulley on counter-shaft 12 inches in diameter and its driving pulley on main upright shaft 36 inches in diameter. That is not an unusual combination, because main uprights generally run slow while machines run fast. The conditions, except one, are the same all around; the two drivers are the same size and the two driven the same, hence the arc of contact will be the same with all. Now then, I will ask how wide might the belt leading from the main upright to the counter-shaft be to have the same transmitting capacity as the belt that drives the machine? It would require a belt 18 inches wide. Now I know that statement will fall with astounding effect upon the ears of those who have not given the matter much thought. They will not be inclined to believe it at first sight, but a little reflection, observation and practice will bring them to their senses. To investigate a little further we will change the combination and call the driven pulley on the counter-shaft 18 inches instead of 12 inches. That change in size changes one of the other conditions somewhat. The driven pulley being made larger without increasing the size of the driving pulley gives to the small pulley a greater arc of contact, which will make the belt hold a little better. But we will ignore that slight gain and call the conditions equal, and I would again ask the questions how wide ought the first belt be to equal in driving capacity the belt that runs the machine? It would have to be 12 inches wide, and, if willing to allow for the gain in pulley contact, we might call it 11 inches wide.

Still another change in the combination: instead of the 18-inch pulley we will put a 24-inch pulley on the counter-shaft, and course there is, by increasing the size of the driven pulley without altering the driver, another gain of pulley contact. But leaving that out of the question, the query again arises how wide ought the first belt be to equal in driving capacity the one on the machine? It would have to be 9 inches wide, or allowing for gain in pulley contact, say 8 inches. Now that is bringing the matter down to within the comprehension and nearer the preconceived notions of the everyday user of belts who does not bother his brains much about principles, laws, causes or effects.

The reason why greater difficulties are not experienced in the manner referred to is that usually machines of all kinds have larger belts than they actually need, so that the fact of the preceding slow motion belts being too small is not so noticeable. Whatever difficulty there may be is in a measure overcome by keeping the belt very tight. But that is not the proper thing to do. A belt should never be subjected to an unnecessary strain to make it do its work. It shortens the life of the belt, besides increasing the friction of the bearings or journals thereby requiring more power to run the machinery. Ordinary single leather belting should not be be subjected to a constant working strain of much in excess of 45 pounds to the inch in width. Less would be better for the health and longevity of the belt.

Other combinations besides these I have given might readily be given to further illustrate the disproportions practiced in the use of belts, but I think the reader will sufficiently understand the matter by what has already been said. A few words about how to determine the power a belt will or ought to transmit and the lesson is fairly complete.

The basis upon which the writer makes all calculation for belt transmissions is that a belt one inch wide and running over pulleys both the same size will transmit one horse-power for each 800 feet of lineal speed. If it travel 1,600 feet it will transmit two horse-power; if 2,400 feet three horse-power, and so on. If eight inches wide in the first case it will transmit eight horse-power, in the second 16 horse-power, and in the third 24 horse-power.

If the pulleys vary in size then the transmitting power of the belt is lessened no matter if the lineal speed is the same. When the pulleys are the same in size without the interposition of idlers or tighteners the contact on both pulleys would be 180°. But if we so change the size of the pulleys, or otherwise arrange it so that the belt will have but 90° contact on small pulley, no matter whether driver or driven, the useful transmitting effect of the 8-inch belt cited would be in the first case say five horse-power, in the second 10 horse-power, and in the third 15 horse power. That is about the relation that a 90° contact sustains to a 180° contact. The variation approximately amounts to about .02 for every 5° of change. By keeping that fact in view some excellent guessing in selection and arrangement of belts compared with the old method, or the method which knows no rule, could be done. If some of the principles involved are studied and rules observed there need be no difficulty about the transmitting power of belts. If they are arranged properly and the right width to do the work required at the speed given, they are sure to do it and do it well. Of course it will be understood that single belts are referred to in the rules given. Double belts are supposed to be from 35 to 40 per cent. better, or will transmit that much more power. Rubber belting when new, will undoubtedly hold better than leather, but on an average all the way through the life of the belts it is doubtful if there is much difference in useful effect, both being well taken care of. In damp places it is better to use rubber than leather as it seems to stand a damp climate better than leather.—*The Millstone.*

TRANSMISSION OF MOTIVE POWER BY RAREFIED AIR.

Manufacturing on a small scale, which numbers in Paris so many representatives in what are called workers at home, is still in search of a small and economical motor, which shall be easy of installation and simple of operation, without any special *personnel*, and unaccompanied by any annoyance, for either him who employs it or for his neighbors.

A small and economical motor presenting all the advantages just enumerated, would work a transformation in the small industries, which, up to the present time, have been obliged to perform by hand a large number of operations that an ever ready motive power would permit of doing by machinery. The solution of the problem lies in the distribution of such power to houses, and solutions up to the present have not been wanting; for water under pressure, illuminating gas, compressed air, and electricity have already received a certain number of applications, or have been submitted, with this end in view, to some experimentation. We have no desire to pass in review the advantages and disadvantages special to each of these modes of distribution; for our design is to make known now a new champion which has entered the contest open between these different systems, and whose first passes are not without interest. This new system is *rarefied air*, or the *pneumatic transmission* of power.

In qualifying this system as new, we should be understood as speaking of the application to a *distribution* of motive power, and not of the pneumatic system itself. It is now nearly two hundred years ago that Denis Papin spoke of it in the Acts of Leipzig (*acta Eruditorum*, Lipsiæ, 1688). In another work, which appeared at Cassel in 1694, this same individual showed the advantages that would accrue from being able to *tranmit* a power from the point where it is disposable to that at which it can be utilized, by means of a relatively small tube; and he indicated the use of thin lead for the manufacture of such a tube, remarking that it would never contain any water. The authors of the system that we are about to describe, however, makes no pretentions to priority, but, on the contrary, pay homage to the genius of one of our most illustrious compatriots. Their sole aim has been to develop Papin's idea by applying it to the *distribution* of motive power for small manufacturers. The need of such a power which was far from being felt in 1688 or 1694, is at present becoming more and more imperative.

The pneumatic system consists, in principle, in establishing a line of pipes, in which a certain amount of vacuum is kept up by means of powerful pumps located at a central establishment. This piping terminates, as with water and gas pipes, at the house of each subscriber, where it receives the atmospheric air whose pressure is more elevated, and which effects the work by traversing an appropriate motor.

Central Works.—The power of the engines located at the central works must be proportioned to the extent of the pipe line, and to the total power of the motors to be supplied; friction, loss of charge, leakage, etc., being taken into the account. The *quantity* of air to be extracted from the pipes in order to keep up a pressure proper for the good performance of the receivers is equal to the quantity that enters therein through the different motors at each moment in action; but, as a consequence of expansion, the *volume* to be extracted is about four times greater than that occupied by the air at atmospheric pressure. The vacuum kept up in the system of pipes is about 75 per cent, or about 57 centimeters of mercury, or 7·75 meters of water.

The extraction of one cubic meter of air, at the mean pressure of the atmosphere, requires a theoretic power of 14,310 kilogrammeters. In the installation for study made on Boulevard Voltaire, the pump is run by a belt; but there will be an evident advantage in fixing the rod of the pump on the prolongation of the piston of the steam engine, in an installation which is established specially for an application of the system.

The system of piping.—The piping is calculated for an anticipated extension of one kilometer distance from the central works, and for losses by friction in the mains not exceeding 3 per cent. The pipes may, according to circumstances, be laid in the sewers or in trenches. The installation for study is made in Boulevard Voltaire and Avenue Parmentier. The distance is about 600 meters, and the piping is 6 centimeters in diameter.

In practice it is proposed to employ cast iron pipes for the mains and principal branches, iron ones for the secondary branches, and lead pipes for service.

The joints of the iron pipes laid in Boulevard Voltaire are of rubber, and have given good results, as the pressure is not excessive, and elongation and contraction of the pipes is almost null, owing to the light variations in temperature in the trenches in which they lie.

The Motors.—The receiving apparatus furnished customers must present very peculiar features. By the very fact of the nature of the power distributed, the motors must be scattered in great numbers among consumers without being subject to continual surveillance and keeping in repair by the company. The type of motor, then, should be as simple as possible, without any delicate parts, and should be capable of being taken apart and put together in a few instants, and, finally, the price should be moderate, and the space occupied by the apparatus should be small. All the motors applied up to the present time have been oscillating ones. They have answered requirements perfectly, and have not necessitated the least repair during several months of service.

Fig. 1 represents one of these machines of the 5 kilogrammeter model. An analogous machine of smaller size actuates a sewing machine (Fig. 2), without any change being requisite in the parts of the latter, as constructed for being operated by a pedal. The operation of these machines is analogous to that of oscillating steam engines, the air at the pressure of the atmosphere acting in the place of steam, and a vacuum being effected on the side of the escapement. The machine is of a double-acting and of expansion type. Admission ceases at about three-eighths of the piston's travel and the volume of air before and after expansion is in the ratio of 1 to 2·66. Expansion being incomplete as a consequence of the practical ratio adopted, the work effected per cubic meter of air is only 13,500 kilogrammeters, the theoretic loss thus not exceeding 6 per cent. The *practical* performance that is to say, the ratio of theoretic or utilizable work, measured by the brake, increases rapidly with the power of the motor. With the 3 to 5 kilogrammeter sizes, the practical performance varies between 0·40 and 0·50, while it easily attains 0·60 in machines of 25 kilogrammeters.

The velocity of the oscillating machines also has an influence on the performance, as well as on the absolute work effected in a unit of time. Thus, for example, in one experiment, the performance did not reach 0·40 at a speed of 145 revolutions per minute, while it exceeded 0·54 on reducing the speed to 120 revolutions. In this second case the motor, on revolving at a less speed, furnished more work.

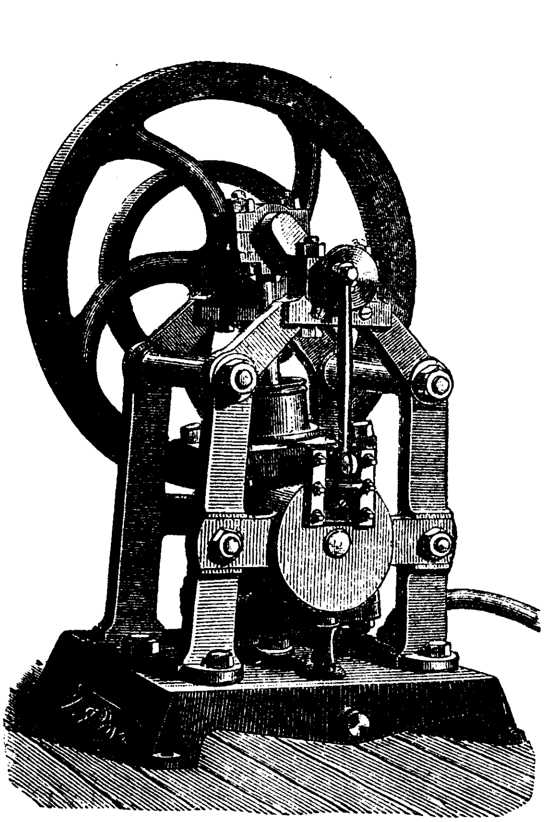


FIG. I.—RAREFIELD AIR MOTOR FOR DOMESTIC USE.

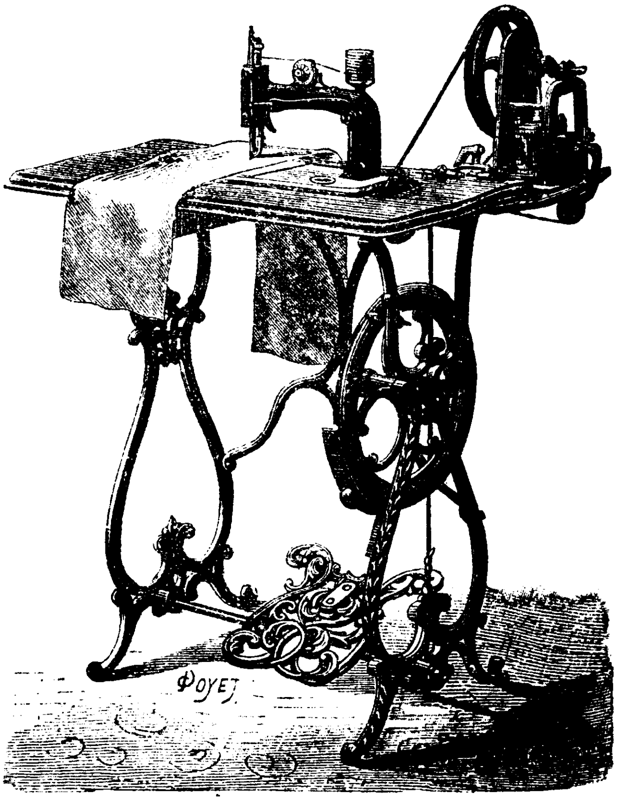


FIG. 2.—RAREFIELD AIR MOTOR APPLIED TO A NEW MACHINE.

In a new system of rotating motor now under study, phenomena are discoved that are slightly different. The performance diminishes with the speed, but the quantity of work effected increases with the latter.

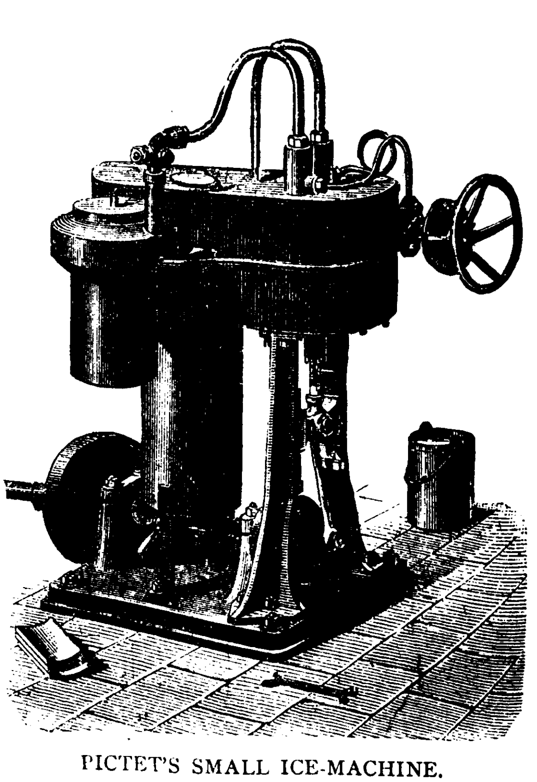
To avoid the introduction of lubricating oil into the service pipe, which might, in the long run, retain atmospheric dust and produce an inevitable obstruction, the motors are mounted upon hollow bases (Fig. 1). The air that has just operated rushes into this base through a wide and short aperture. This empty space, being always in communication with the conduit, performs the role of an intermediate reservoir that is always kept at a medium degree of rarefaction. The receptacle retains the oils that are deposited at the bottom, and allows of their extraction from time to time through the removal of a simple screw-plug located at the lowermost part.

Each motor is so arranged as to run at a medium speed, according to the application for which it is designed, and deviates but little from it in practice. Under these circumstances the work by all is perceptibly constant, and there results from this one of the simplest of methods of making the consumer pay in proportion to the use he makes of the machine.

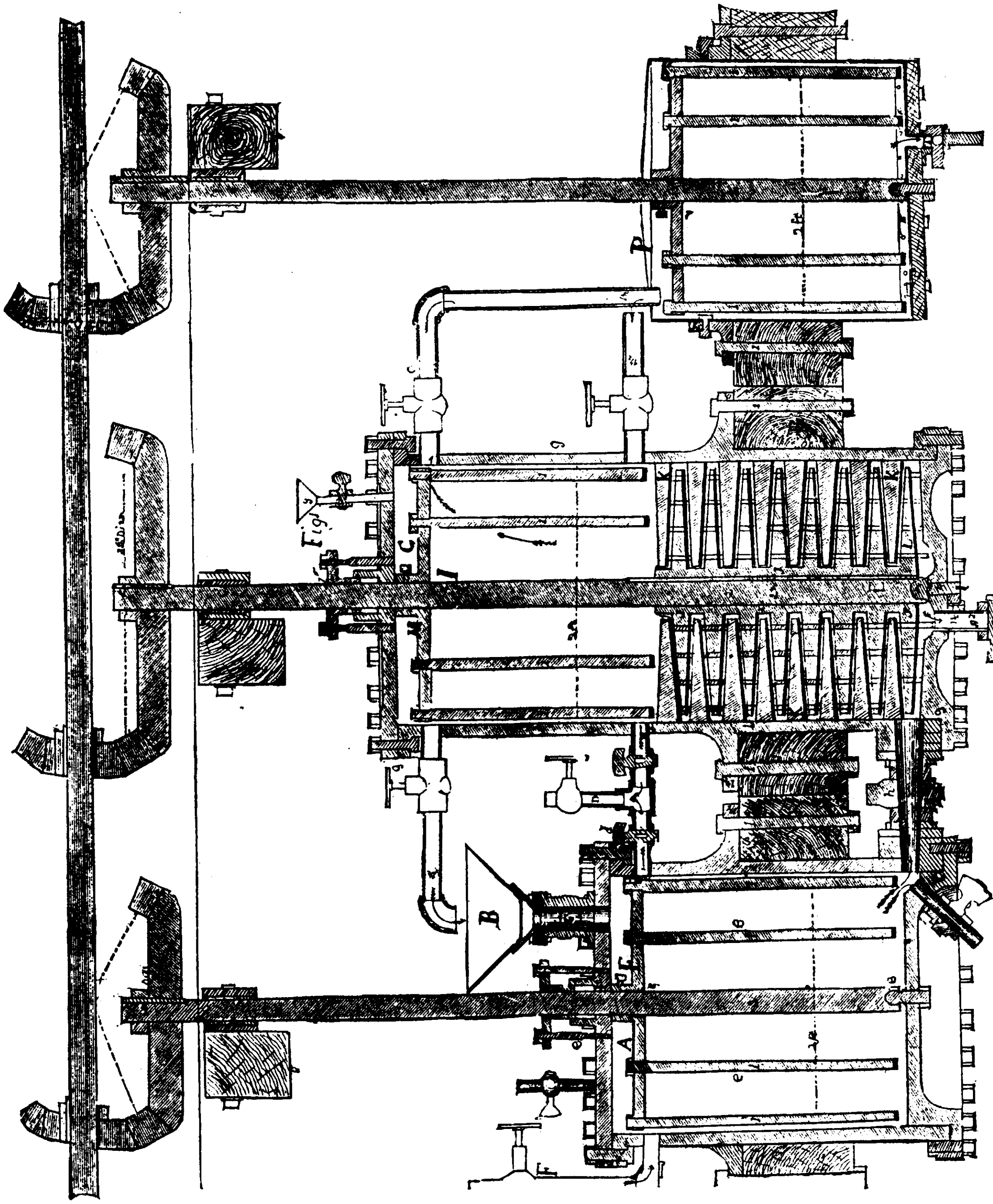
It is only necessary to count the number of revolutions made by the motor during a given length of time (a day, a week, or a month) by means of a very simple counter in order to fix the price that the customer must pay, according to the type of motor furnished him. Changes of speed are very easily brought about by opening the cock that lets in the air, more or less, and a stoppage by closing the same cock completely. The maximum work is obtained by opening the cock to its full extent.

In sewing machines, wood and metal lathes, etc., it is convenient to utilize for this purpose the pedal which formerly served to put the machine in operation. The hands of the operator are thus rendered free, and the operations of setting in motion, slackening the speed of, and stopping the motor are easily disposed of.

In the experimental installation of Boulevard Voltaire, we have seen a series of machine tools actuated by a distribution established on the principles that we have just explained, and



PICTET'S SMALL ICE-MACHINE.



THOMPSON'S AMALGAMATOR FOR GOLD AND SILVER.

consisting of sewing machines, drilling machines, wood and metal lathes, sausage choppers, etc. All these tools were running with the greatest regularity, and those who were employing them were entirely satisfied with their operation. It is well to remark that the system of distribution by rarefied air is in reality a *negative* one, seeing that nothing is sent to the customer, and that the air is withdrawn from the room in which the motor is located. The latter feature proves very advantageous, moreover, in that it effects a ventilation and aeration of the apartment.

Although the merit of these labors and experiments reverts to the technical commission which has presided over their installation, we think that in all justice a large part of it ought to belong to Mr. V. Tatin; for it is due to his intelligent initiative and profound mechanical knowledge that the Société Civile d'Etudes has been enabled to make the application of the system whose success we now record.—*La Nature.*

PICTET'S SMALL ICE-MACHINE.

The small ice-machine shown in the accompanying cut is designed to produce small quantities of ice at a time. It is capable of operating intermittingly and produce a killogramme of ice in about fifteen minutes, or continuously and give 4 to 5 kilogrammes per hour, with an expenditure of power always below that of a one-horse power steam engine. It is adapted, then, for use on steamboats, in country seats, in colonial dwellings, in agricultural industries, and in all cases where it is easy to take a horse from his ordinary work, or to use him when idle, long enough to effect the operation; in a word, it is applicable in all cases in which there is a motive power at one's disposal, and in which the only means of obtaining ice economically is to manufacture it one's self.

The apparatus is not very different in principle from Mr. Pictet's large ice-machines which we have already made known. It is merely very much simplified so as to supply the special wants of the new applications for which it is designed.

The apparatus consists essentially of a compressing pump actuated by the motor; of a congealing refrigerator, with a condensing tank that also surrounds the cylinder and pump; and of a congealing refrigerator in which are placed the moulds filled with water to be frozen. All these parts and their accessories—suction valves, frame, driving shaft, gearing, etc.—are skillfully grouped so as to occupy but a very limited space, inasmuch as the bed plate is only 40 centimeters square, and the total height does not exceed 1·3 meters. The operation of the apparatus may be readily understood. At the beginning the sulphurous anhydride is in the congealing refrigerator. The pump sucks it up, and evaporation absorbs a large quantity of heat from a solution of glycerine in the refrigerator, and from the moulds filled with water placed in the glycerine. The anhydride is afterward forced by the pump into the condenser, where it liquefies, and gives up to the water in the condensing tank a certain quantity of heat. The colder this water of condensation is, the less the work demanded by compression. The anhydride, then, constitutes an intermedium, which permits, after a manner, of *drawing heat* from the congealer and *pouring* it into the condenser. When the apparatus is operated continuously, it becomes necessary to keep the condenser at a low temperature, this being easily done with a circulation of 200 liters of water per hour in the condensing tank. When the operation, which requires from twelve to eighteen minutes, is finished, the moulds are removed from the congealer, and a distributing cock is opened so as to allow the liquefied anhydride in the condenser to run into the congealer. In about a quarter of a minute the former communication is again established, and the machine is then ready to begin operations anew.

All that the apparatus demands, then, is motive power, since it is closed up, and the anhydride describes a complete cycle at each operation. The duration of the initial change of sulphurous anhydride is indefinite. In practice it depends only on the degree of tightness of the joint of the piston-rod stuffing box.

The ice produced in the moulds is in the form of three slightly curved layers, which are afterward superposed as to make a single compact block, weighing one kilogramme.—*La Nature.*

FROM the Syriac translation of the Bible we find that pumps were invented by Otesibus, of Alexandria, 224 B.C. and were wholly or partially made of cast brass or bronze.

Mining and Metallurgy.

THOMPSON'S COMPULSORY AMALGAMATOR FOR GOLD AND SILVER ORES, BY A THERMO-ELECTRIC PROCESS.

Letters patent have just been granted to H. M. Thompson, Esq., of St. Louis, Mo., for an amalgamator, whereby the treatment of refractory gold or silver ores is revolutionized. Treatment placer and free milling ore is a comparatively simple matter, but the treatment of refractory ores has heretofore been an expensive and tedious process, involving roasting, calcining and chlorination. With Thompson's amalgamator these are all dispensed with, or they may be used if desirable. Several runs have already been made of very refractory ores with entire success.

With this amalgamator all that is necessary is to mine, crush and grind the ore fine and put it through these machines. The tailings are all thoroughly washed in the amalgamating chamber above the disks.

The ground ore—500 pounds or so at a charge — is into the chamber filled with running water, where it is cooled and washed, to set all the mercury tangled in it free to fall down and rework, while the tailings flow out through the discharge pipe O into a second tub, P, for rewashing in case any mercury should be carried by. A stream of water flows through this tub to float the tailings away.

The under face of all the disks is covered with thick sheet copper, amounting to over 50 square feet, where fed into the cylinder A, which is connected by a steam pipe with the boilers. There the ore is stirred and heated with live steam, after which it is forced by the pressure of the steam through the pipe H into the mercury at the bottom of the amalgamating cylinder G. The sectional view shows a shaft with eight disks, J, upon it by which they are revolved. There are also eight disks, K, which are stationary. All of the disks are placed so as to leave about half an inch space between their faces, and all of these spaces are full of mercury, into which the ore is forced, spread out thin between the disks and stirred up by the pins shown in them. The arrows show the course the ore is forced to travel; first into the shaft and up through a hole larger than the shaft in the stationary disk K, then back to the side of the cylinder, and up by the edge of the revolving disk, and back to the shaft, continuously, until it arrives above the upper stationary disk, by a strong galvanic action is exerted upon the contents of the cylinder. This, together with the effects of the live steam and the scouring between the disks under great pressure, removes the oxidations of base metals, and acts upon the sulphur and refractory elements in such a way as to set the precious metals free, so the mercury readily takes hold of every particle contained in the ore. No "flour" gold can possibly escape through this amalgamator. The ore has to slowly travel about 16 feet, immersed all the while in mercury, being acted upon before it can reach the chamber above the disks.

Ore can be put through the machine slow or fast, as desired, according to the steam pressure applied, a steady stream of ore coming out at the discharge pipe.

The following is an epitome of the advantages combined in this amalgamator:

1. Treating ore in live steam under galvanic action and great pressure.
2. The benefits arising from working ore in a large body of mercury kept continually bright and clean, in good condition for work, by live steam and galvanic action.
3. No "flouring" nor "sickening" of mercury and no chance for flour gold to escape amalgamation.
4. Galvanic action, live steam, heat and friction combined in the process for amalgamating.
5. Condensing mercury by cold water inside the amalgamating chamber if any of it volatilizes from being superheated during the process.
6. Separating the mercury from the tailings by stirring and washing them inside the amalgamating chamber, and causing the mercury to drop back and rework continuously.
7. Working ore many feet under great pressure in a large instead of small quantity of mercury.
8. Spreading ore out in thin layers and stirring and rubbing it and the mercury thoroughly together, as long as desired, under pressure and the most favorable conditions possible to obtain for perfect amalgamation.

9. Causing the ore to enter a large quantity of mercury at its bottom, and travel a long distance in it, under the above conditions.

10. Simplicity of machinery and cheapness of construction and repairs, combined with mechanical and practical ease of operation.

11. Arrangements to work ore as long as you please, between the amalgamator disks, and then let it go forward for working fresh ore.

No other concentrators or washers are needed.

ART CASTINGS IN IRON.

A new departure of great interest has recently taken place in iron founding. This is the reproduction of various art works in iron castings. Shields ornamented with repousse work, helmets ornamented in relief, medallions, plaques, and Japanese bronze trays have been used a patterns, and successfully copied.

The work has been done in an iron foundry in Chelsea, Mass. The most delicate patterns have been successfully followed. One large shield represents the siege of Troy, and is a copy of Cellini's shield. The numerous small figures are brought out clearly, and defined with precison. The shield is 22 in. by 28 in., and is coloured to represent bronze. This bronzing is produced by copper deposited by electricity. Another shield, heart-shaped, and 20 in. bv 26 in., depicts the conflict between Jupiter and the Titans. This has the natural colour of the iron. Two circular shields show Bacchus armed with the thrysis and accompanied by a leopard. A triumphal procession is represented on a large salver. A copy of a bronze plaque with a head of Shakespeare and a reproduction of some repousse work after Teniers are also to be seen.

A helmet elaborately ornamented with intricate designs has been reproduced from a casting made at the Ilsenburg foundries, in Prussia. Many fine castings have been made there, but there has been no attempt at classical art in the designs employed. Some antique swords with curious hilts accompany the helmet. Even more interesting are the reproductions in iron of two medallions. One is a profile portrait of F. D. Millet by Augustus St. Gaudens, and the other is the portrait of a young lady. In both the iron is bronzed. There are two small panels in iron, which have been "buffed" until they look like steel. One bears an exquisite chrysanthemum with its delicate grace preserved in the prosaic medium in which it finds expression. The other bears some leopards taken from antique bronzes.

A Japanese lacquer tray with fine ornamentation, has also been reproduced in iron only a sixteenth of an inch thick. A medallion, with a head of Apollo in alto relief, is as striking as the foliage and flowers that have been executed in low relief. The bronzed castings resemble beaten work in copper.

There are no especial peculiarities about the production of these castings. American iron is used, the moulds are of fine sand, and the best workmen and the greatest care are employed. The "facing" of the moulds is of dust from the beams of the foundry. Impressions are secured in the sand of the shield or panel to be cast, and the mould formed in the usual way. The casts are put under a rag-wheel with emery to prepare them for plating. The work has been treated in different ways, being polished to show the colour of the metal, bronzed, copper-plated and oxidized, simply that varying effects might be studied. The experiments have proved that remarkable firmness can be obtained succcessfully in work in iron, and the art castings will now be placed on a commercial basis.

The first work done in this direction was by the same company in 1876, when plates were cast from compression bronze patterns. About two years ago the matter of art casting was taken up, in connection with an attempt to introduce artistic work into the ornamentation of stoves. One advance led to another, until in the course of time the production of these art castings followed.

The attention of architects and interior decorators has been attracted already. For plaques to be hung upon the walls these reproductions are rather heavy. But a ready use is expected for iron panels, reproducing repousse or other ornamental work, to be used in doors, in furniture, on the fronts of the steps, in stairways, or in fire place linings. Original patterns, of course, can be employed. Panels may also be used in friezes and dados and in a great variety of decorative forms. A more directly architectural use of artistic iron castings is in balustrades and railings. Compared with bronze work, beaten by hand, the cost of these iron castings is very slight. An estimate was made that the reproduction of an elaborate bronze salver, with repousse work, in bronzed iron could be sold at a profit for 10 cents a pound.

THE FLOUR MILL OF THE FUTURE.

Whether the roller system or disk system of wheat reduction will finally achieve supremacy, matters little for the purpose of this article, gradual reduction as a process has demonstrated its value so palpably, that a return to low or flat grinding need not be apprehended for many years to come. There are hundred of millers, who, during the past decade, have spared no effort or expense to keep in the van of improvement, while hundred more have given up the effort to do so, apparently convinced that improvements, radical in their nature, would be forthcoming, so long as millers could be found to adopt them.

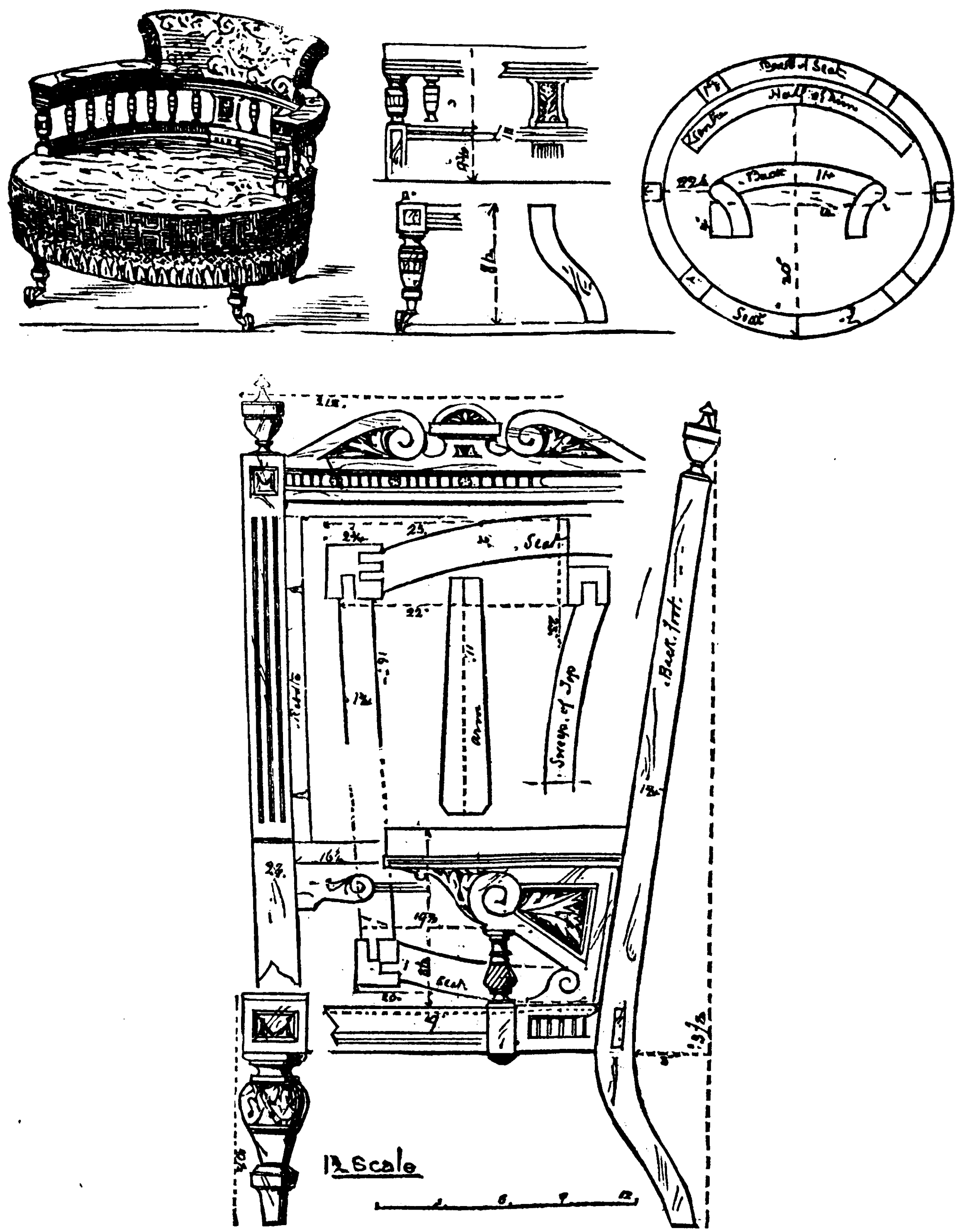
Looking back over the years that are passed, one can now easily determine that it has been but a transitional era in the history of American milling. No valuable, radical changes in systems of procedure are ever the result of a single step, but are brought about little by little, and when thoroughly established, one hardly realizes the devious paths trodden in the attempt to reach a better, more economical or more profitable manner of securing results. It is, perhaps, well that we do not realize how far off perfection may be, when we enter upon a system of improvement, as, in all probability, few would be willing to burden themselves with the anxiety and expense necessary to its attainment could they comprehend the magnitude of the undertaking, and as a consequence, improvements would languish, if indeed attempts in that direction were not altogether abandoned.

Every step taken in the right direction, however, compensates the one taking it, in some measure, and there is a certain degree of satisfaction, to the progressive man, in the fact that his efforts have not been altogether fruitless. He is encouraged to go still further, and, so long as every step taken results in his favor, so long will he continue his efforts to improve. The men who have the nerve to inaugurate improvements, and by inaugurating we mean adopting, are entitled to gratitude for their enterprise, as the results of their efforts in this direction serve as guides for others in the trade. If an improvement is of value it is so demonstrated by them and its adoption by others can be safely undertaken, but, if valueless, others are saved the expense and annoyance of testing.

The past ten years have been, as we said, a transitional era in the history of American milling. Systems and methods of procedure have been adopted, tested and abandoned, until, within a short time, mechanical appliances appear to have reached such a degree of perfection as to almost warrant the belief that the day of radical changes has passed. A system of gradual reduction has come to be recognized as preferable to any other, and, while opinions as to the relative merits of mechanisms for the performance of the reductions differ, the system itself is admittedly correct.

The flour mill of the future will be a very much different establishment from that of ten years ago. We look to see it a clean, tidy establishment, performing its offices almost wholly automatically ; relieved in a great measure of its forests of spouts and elevator legs ; having a pure wholesome atmosphere, almost wholly devoid of dust, and its bolting facilities of a perfect character, readily comprehended, easily adjusted, and reduced in space occupied very materially from the present style. Much has been accomplished in this direction during the past two years ; much still remains to be accomplished, but not, we believe, in the direction of radical changes in systems or appliances. These we have in abundance, giving most excellent and satisfactory results, but there is still room for improvement in the application of them. Improvements and changes will, of course, be made in the machines that go to make up the equipment of the mill, but it is not unlikely these changes and improvements will be simply matters of detail. We believe the day of radical changes in processes and appliances has gone by.—*Milling World.*

A New explosive is reported to have been invented by a Viennese engineer. It contains neither sulphuric acid, nitric acid nor nitro-glycerine. Its manufacture is simple and without danger, and it preserves its qualities in the coldest or hottest weather. It can be manufactured at forty per cent. less cost than gunpowder.

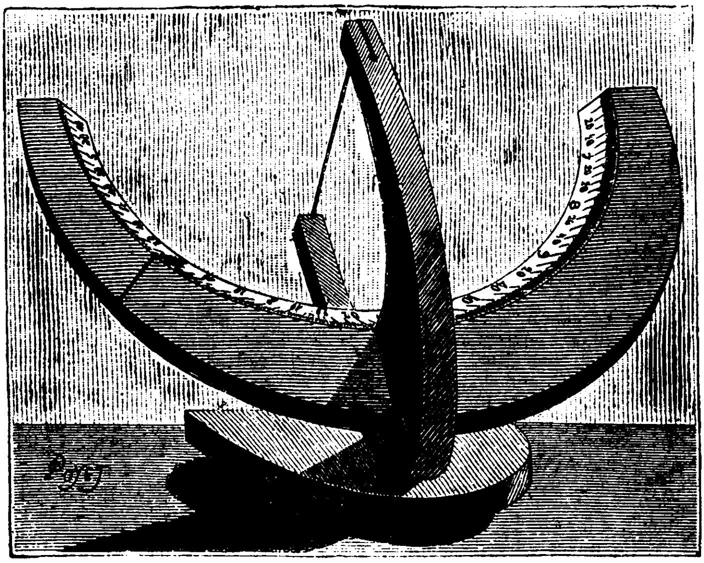


HOW TO MAKE A LADY'S EASY CHAIR

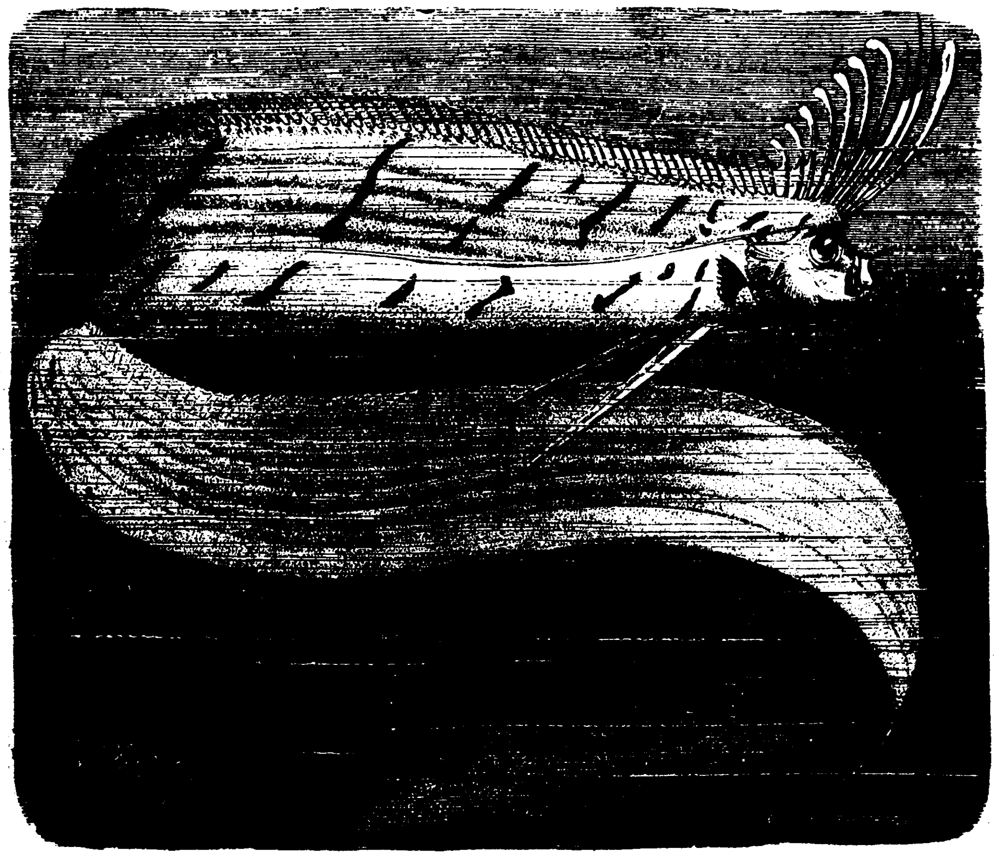
Cabinet Making.

HOW TO MAKE A LADY'S EASY CHAIR.

The old style of "gent's and lady's to match" is fast disappearing in the drawing room; but in the dining-room it is still "the correct thing," that is, when lady's chairs are admitted into the gentleman's apartment. A very common custom is to substitute two gent's easy chairs and leave the fair sex to retire to the drawing-room for their repose. The main points to be remembered are,—keep it low, not too deep in seat, and the arms so arranged that it will receive any fashion of dress likely to come into vogue, from the crinoline to the present style. All these requirements are studied in the drawing annexed, and the instructions for making are the same as those previously given in connection with the gent's chair. We reprint them to save the trouble of referring to a previous number. Our example again illustrates what is



PERAUY'S SUN DIAL.



THE HERRING KING.—*(Regalecus Banskii,)* known as a "show-wood chair," which can be made very comfortable and perfectly strong without any sacrifice of beauty or necessary ornamentation. The carving is varied in order to give our readers choice of pattern. The decoration indicated is known by the name of the Queen Anne style and finds admirers nowadays. The method of making this easy chair may thus be epitomized:

Having got out all the stuff, proceed first of all with the back; mortise and tenon back feet, top, and splat as shown; then put together loose to see if right and to make deal "fits" for angle joints. It is easier to work with these fits than to make the joints without them. After thus building up back, get beech rails out and molding slips laid; having mortised and tenoned, put in side rails and front, and cross frame seat to back. The next portion to proceed with is the arms: get out same to length shown, and shape them to "sleeve-board pattern," wider in front than at back. Glue and screw the molding piece underneath same; then loose mortise and tenon small end of arm into back, doing the same to turned stump. The latter should be "lapped" over side rail of seat to give perfect strength; for if only doweled or mortised on top of seat it is liable to get loose. Having thus fitted arm and stump, the under-bracket can be marked off and shaped: then taking arm and stump away, commence to build up by securing bracket, fixing same to both back and arm, and after this glue up completely. But little now remains to be done besides screwing in rebate pieces at sides of back; this is unnecessary at top and plat, because sufficient wood is left for the upholsterer to tack to.

In a "show-wood" chair perfect rest for the head is difficult to obtain unless the back is carried up to an extraordinary height in order to allow the stuffing to rise some six or seven inches to catch the poll. On this account many persons prefer a stuff-over chair, in which the head can be thrown right back without fear of coming in contact with any wood. We may point out that the working drawing given will answer equally well for a stuff-over back chair if beech rails are placed in back instead of show-wood and the rise on top made flat. Our business is with the chair frame maker rather than the upholsterer in these articles; but we would just say to the latter, in upholstering an easy chair keep the stuffing well to front of seat, in order to give a decided slope or throwback to same. Let the swell in back be adjusted to catch the small of the back and not to throw shoulders or bottom of spine too much forward. Avoid making stuffing too full; always recommend plain instead of buttoned seats, especially in leather.

A valued subscriber objects to our associating dowels with a cheap class of work, and recommending mortising and tenoning in preference. Perhaps in this matter we were rather arbitrary, because some of the best manufacturers use dowels and speak in favor of them; they argue that dowels take less wood away than mortising and the frame is consequently stronger. Such practical views are worth consideration, and, as we said we were anxious to include more than one set of ideas, we give them publicity. If our readers prefer "doweling" by all means use it, but remember that, unless the dowels are dry, the fitting perfect, and the glue good, that "rickets" soon follow. We advocated mortising and tenoning because it was largely adopted by the old chair makers, and if well done, a wonderful bind is obtained from the shoulders of the tenon. Add a pin, and it can never give way, whereas dowels may. A very simple protection for dowel joints is to plaster a piece of strong canvas over them; it is a capital preventative of the afore-mentioned "rickets." — *The Cabinet Maker*, London.

HOW TO MAKE A GOSSIP CHAIR.

Easy chairs that come under the classification of "Gossip," "Occasional," or "Tete-a-tete," were comparatively unknown a dozen years ago. Almost the only style of furnishing the drawing room then adopted was: The couch or settee on one side, and the chiffonnier facing the eagle crowned mirror on the other, and a glossy oval loo table in the center; the ladies' and gents' chairs on either side of the fireplace, and six small upright chairs arranged demurely around the remaining wall space. Such a stiff disposition of the leading reception room was eventually broken up by some, and the fashion came into vogue of filling this apartment with any oddments that had presence to beauty or comfort. When once the fixed law of having a "set suit" was transgressed by the leaders of fashion, admission into the drawing room was obtained for a crowd of chairs of all names, shapes, and sizes. Whilst the old style of a "suit to match" suits the requirements of many people better than the "harlequin" arrangement referred to, it must be confessed that the latter gives greater scope for the inventive genius of the chair and cabinet maker. It affords opportunity to any intelligent chair maker to sit down and think out a new shape, with the assurance that if it is novel, pretty, and comfortable, it will gain admission into the market and probably have "a run."

The type of chair illustrated herewith belongs to the class under consideration, and is of an ordinary character. It is somewhat a favorite because the oval shape of the seat and arms so closely follows the line of the body that the sitter is, so to speak, "cuddled" round the small of the back, and a comforting support is given to the arms. Of course it is not high enough in the back to afford rest for the head, nor is such provision desirable in a 'Gossip Chair."

The following sizes and instructions are for a drawing room chair; but the same design is well suited for library or smoking-room purposes, if the sizes are rearranged accordingly. To make a generally acceptable pattern, likely to suit the ordinary trade, proceed as follows: First make molds twelve times the size of inch scale working drawings annexed, then get out beech rails and frame seat up. In this shape of seat it is difficult to mortise and tenon, in consequence of the cross grain that would be involved; recourse must therefore be had to dowels, and if they are judiciously placed, great strength will be secured. Having squared the legs and fitted the four parts to them with dowels, the seat can be glued up in the following way: First glue up and knock together a short and long rail with two legs, and then the other two rails can be similarly treated; the two corners will then more easily come together to the remaining legs. After glueing and knocking up, the seat must be cramped in order to perfectly close the joints. Two methods are adopted in the trade, the first of which is a long cramp from side to side, and another from end to end of seat. This is a simple way and answers very well for a single article; but if a number of such chairs have to be made the "collar method" is more convenient. A collar is a piece of beech arranged so as to lap over seat rail, top and bottom, with an iron pin through the overlapping parts and seat rail. The swivel action thus allows the collar to be brought round so as to find a bearing on the seat rail; and when another collar is fixed to the adjoining rail in the same way, and the ends of the two collars cramped up, the joints are brought together most effectively without any straining of the dowels. One pin-hole in the middle of each rail will give the needful angle for the leverage of the collars.

The next stage in the work is to get out rims—viz., the two show-wood moldings and the beech capping for the top. After placing stumps on seat, lapped through as indicated, the rims must be fitted up to stump and the banister underneath fitted loose. The spindles, rims, and center bracket, having been carefully adjusted, can now be glued up together; and after placing the small supporting bracket on the seat may be glued and cramped up to stumps already in position. The foundation of the chair being perfectly sound, the joints clean, and the work free from rickets, the two scroll pieces can be dowelled on to the top of beech rim, and the adjustment of the top stuffing rail between the scrolls is then a simple task. Two or three dowels running through the upper beech rim and show-wood molding will permanently bind them together.

This style of chair will come out effectively without the addition of the upper scroll pieces and stuffing rail, leaving merely a stuffed pad all round, or instead of spindles and show-wood stumps and moldings, it may be made entirely of beech and "stuffed in" all over.—London *Cabinet Maker*.

IMITATION OF INLAYING.

The inlaying of one wood into another, in patterns, is a very ancient practice. Various colored woods are used for this purpose, and very beautiful effects are thus produced. The art has been practiced in all ages and is termed marquetry and parquetry respectively. The former name is applied to all the inlaid work on furniture; the latter, to the inlaying of floors.

Marquetry is a kind of mosaic, executed in curiously grained or artificially stained woods, arranged in an infinitely variety of patterns. The outlines are sometimes defined by lines of ebony, copper, brass, ivory, etc.; or the incised ornament is filled in with metal, produced by stamping and cutting them to their proper shapes and sizes. There is also a description of inlaid woods, called Torsela, Torsiatura, a mosaic wood work much practiced in Italy in the fifteenth century, in which architectural scenes, landscapes, birds, fruit and flowers, are pictured by inlaying pieces of wood of various colors and shades, into panels of walnut wood. It was first done in black and white only, but afterwards other naturally colored woods were adopted, and when these failed to give the required tints they were stained the color wanted; thus boxwook was stained yellow with saffron, while various tints of brown were produced by singeing or charring the surface with hot irons, or staining with dyes. This kind of work was frequently employed in decorating the altars of churches, dooor panels, chairs, wainscoting, etc.

The art of inlaying had fallen into disuse in England, until the Exhibition of 1851 gave an impetus to the practice, which has been so far sustained. The manufacture of both parquetry, and marquetry has become a most important business.

Another kind of inlaid work is called buhl work, so named after the inventor, André Charles Boule, and was extensively patronized by Louis XIV. The foundation and structural features are wood, which is pierced and inlaid with tortoise shell, enamels of different colors, silver plates, and ormolu, producing on the whole a most sumptous effect. It was applied to tables, desks, workboxes and cabinets, its rich and gorgeous effect exactly suited the magnificence indulged in by the court at Versailles. Sometimes the tortoise-shell formed the ground, and metal and enamel the ornament. This costly style continued in vogue in France until the Revolution. Its inventor died in 1732, at the age of 90. He held the official position of Tapissier en Litre du Roi, and after his death his manufactory was carried on by his family.

A patent was taken out some years ago for a method of ornamenting wood by burning the pattern upon it with red-hot irons. This was an adaption of an old process, but in this case the pattern on the wood was simply a *fac simile* of the pattern of the iron, which appeared on the wood in a rich brown color. Birds, landscapes, border patterns, etc., were thus produced in brown on white pine, box, or other white wood. There was, however, an indistinctness or want of sharpness of outline, which was one reason why it did not obtain success.

A patent has been taken out for a very ingenious method of inlaying one wood into another. In this process veneers are glued on to the surface of the wood to be inlaid and allowed to dry; it is then subjected to the influence of steam for a considerable time, until it becomes softened to some extent. The pattern to be inlaid is formed or cut in zinc; this is placed upon the veneer and subjected to great pressure between iron plates, this pressure forcing the zinc and the veneer into the wood, and also forces up the wood through the interstices of the pattern to the exact thickness of the zinc. It is then dried and planed down to the level of the sunk veneer, and the pattern is as sharp and clean cut as if it were the best hand work.

It will be evident that, however it is done, it is a subject requiring a very large amount of artistic taste and skill both in design and execution, and although as regards the manipulation in cutting and shaping of both metal, wood and marble many and great improvements have been made in these latter days, more especially in parquetry for flooring, and veneer cutting, which has all tended to reduce the cost very materially, still these works if specially designed and executed by hand, must of necessity be very costly. Our principal object in describing them here is, first to show the kind of work to be done, and then to describe how the same may be imitated so as to produce works of decorative art and at a moderate cost. In pursuance of this object we purpose to first describe the various methods of imitating inlaid woods on painted work, then to treat of staining and inlaying upon white pine and other white woods. The imitation of inlaid woods has been practiced by first-class grainers on painted grounds ever since graining became one of the useful arts.

Our first and most indispensable requisite for inlaying is a good and appropriate design, one that would be suitable for executing in the real wood. for it will be evident that although we have a wide range of ornamental forms which are suitable for this purpose, yet there are many designs which are totally unsuitable. Flat ornament, *i. e.*, without relief or shading, is the best in every respect for the purpose, although, of course ornament shaded, so as to appear in slight relief, is admirable for certain decorations, and some notable works have been executed in this style; but these may all be considered as exceptional works—necessarily of a high class—requiring artistic skill of a high order, and, although coming with the range and province of the decorator's art, only to be used for special purposes.

Strap ornament, in the Elizabethan style, or interlaced lines of various breadths, arranged in geometrical forms, are well suited for inlaying. A series of lines of different colored woods running under and over each others embodied in a general design, afford a good opportunity for the display of knowledge and skill in design, and harmony in the disposal of the colors. Here we may take the opportunity to observe, in reference to the art of design, that we find a great number of workman who are able to execute works in a mechanical sort of way, and very accurately too, who have no knowledge of drawings or design; others again have a talent for putting scraps of ornament together and so producing what they are pleased to call original designs; there are others who are exceedingly economical in this respect, and make a few designs answer all purposes and go on year after year modifying and adapting these one or two designs, thus acquiring a reputation as decorators, founded upon an exceedingly small capital or originality. It is certainly a matter of surprise, considering the facilities for acquiring a knowledge of drawing and design within the reach of every one, how very few really original designs are produced. Ornament for inlaying should be specially designed for the article it is intended to decorate. A design which would be suitable for a cabinet, would not be appropriate for a door panel or a wardrobe. The style of ornament should always be a matter of consideration. The incongruous conglomeration of ornament we sometimes see applied in these ornamental days, is in many cases perfectly ridiculous. The design should be in accordance with the style of the article to be decorated. It is certainly a mistake and a bungling act, and shows a sad want of taste and knowledge, to put a Gothic ornament on a classic structure, a Chinese or Japanese ornament on a Gothic work, and yet this is done every day by those who have had the opportunity of knowing better.

The choice of woods for inlaying, will be in a great measure governed by the nature of the design, and the special purpose it is used for. Color also is quite as essential to the complete success of any work of this kind, as design, for however good the design may be, if the coloring is not harmonious the finished effect will be unpleasant to the eye. By a judicious use of the various colored woods, a richness, and even splendor of effect may be produced with quietness and repose: the two not being incompatible. In using wood inlays, we have the advantage that if we want a particular color and we have no natural wood of that color, we may with propriety, use a stain to produce the color we want. We have the highest authority for this practice. When imitating inlain woods on painted work we should see that the ground for working upon is properly prepared, smoothness and a level surface is an indispensable requisite to the success of all good work, the ground should also be prepared of such a color as will serve for the lightest wood as well as the darkest. In some cases the ground may be white, but we prefer that as a rule it should be of a light cream color, depth and richness of color being produced afterwards by glazing. This is absolutely necessary, as it will be plain that if we were to paint in the various colored grounds for the different woods, we should make a very uneven surface, which would destroy the effect of the whole when finished. Care must be taken so to manipulate the different woods that when finished there shall be no difference in the level of the face of the work. In many cases the ground itself may be grained wood, such as maple, light oak, sycamore, etc. On these grounds the inlay must of necessity be imitations of woods of a much darker color and stronger grain than that upon which it is grained in order that the grain of the underwood shall not be perceived through the grain of the inlay. Walnut wood upon oak maple does this effectually, and as a simple inlay, is very effective and appropriate in color, and where breadth of treatment is desirable, two or three woods will often be found sufficient for all the purposes of effect both in design and color. A much more extensive use of this admirable style of decoration might be made if the decorator would be content to use simple designs, which would be comparatively inexpensive in the execution, and quiet in color. This is especially the case at the present time when so much new woodwork in dwelling houses and public buildings is being stained and varnished, or polished, on the bare wood, or left unstained. A wide field is here opened for the application of ornament in these cases, enhancing the beauty of the surface, while retaining and improving the natural beauty of the real wood.

Natural History.

THE GRAPE PHYLLOXERA—*Phylloxera vastatrix.*

This tiny but formidable foe to the grape vine, which has during the past few years attracted so much attention in Europe and America, has appeared in its worst form, viz., the root-inhabiting type, in Ontario, and is doing a considerable amount of damage in our vineyards. Early this spring the writer received from Mr. A. H. Pettit, of Grimsby, samples of fibrous roots from diseased vines, which had every appearance of being affected by the Phylloxera, but the specimens received were so dried up that if there had been any lice on them they could not be discovered. Request was made for fresh specimens in moist earth, but none were obtained.

Fig. 14.

On the 19th of July, in company with Mr. J. M. Denton, of London, I visited the vinery of Mr. Richard Stephens, in Westminster, about a mile from London, where we found a number of Concord vines growing in heavy clay soil, which were suffering much from some cause; the foliage had become very yellow and some of the vines appeared to be dying. On examining the roots we could find but few living, and the fibrous roots were covered with the little slotted swellings so characteristic of Phylloxera. On digging around some vines that were less diseased, a number of the lice were discovered on the young, fresh roots, puncturing them, imbibing their juices, and causing disease and death.

On the day following we visited our own vinery, on sandy soil, near London, and detected the same form of disease, but much less pronounced, on Rogers' 15 and some seedlings.

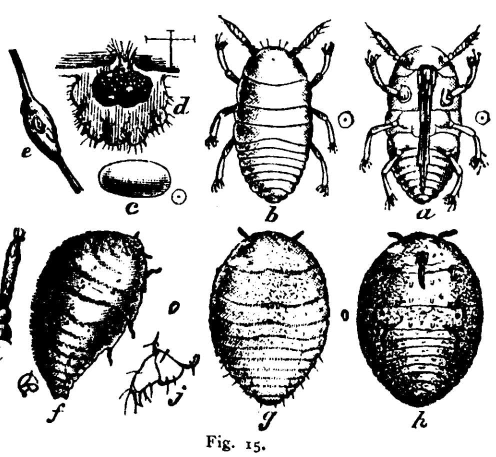


Fig. 15.

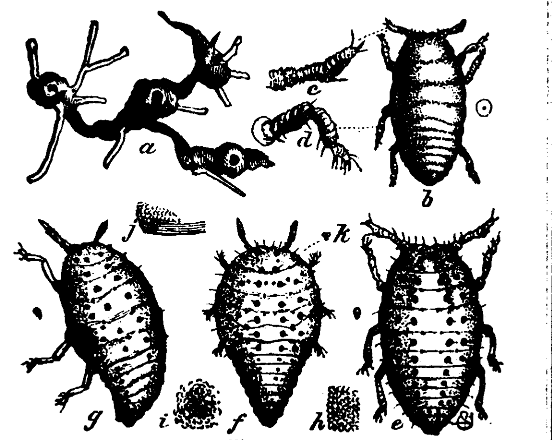


Fig. 16.

On examining the roots Phylloxera were found in their different stages of egg and larva of various sizes, in comparative abundance. In the case of Mr. Stephens the insects must have been at work for several years to have caused the extent of injury which we saw, but in our own case the invasion is probably a more recent one. We are glad to state that on Mr. Stephens' grounds we found the small mite, *Tyroglyphus phylloxera*, which feeds upon the Phylloxera and destroys it, associated with the lice and busy in its useful mission.

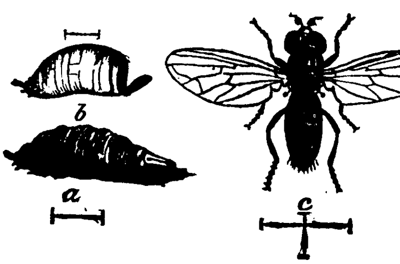


Fig. 18.

Since this insect is now known to be at work in Ontario, and probably to a greater extent than we are at present aware of, a condensed account of its life history will probably be interesting to our readers. The figures are from Prof. Riley's excellent reports, and the facts given mainly gleaned from the writings of this and other authors.

Its progress in Europe has been most alarming, inflicting untold losses in the wine making districts. The destruction it has occasioned in France has been so great that it has become a national calamity which the Government has appointed special agents to enquire into; large sums of money have also been offered as prizes to be given to any one who shall discover an efficient remedy for this insect pest. At the same time it has made alarming progress in Portugal, also in Switzerland and some parts of Germany, and among vines under glass in England. It is a native of America, from whence it has doubtless been carried to France; it is common throughout the greater portion of the United States, and in one of its forms in Canada, but our native grape vines seem to endure the attacks of the insect much better than do those of Europe. Recently it has appeared on the Pacific slope in the fertile vineyards of California, where the European varieties are largely cultivated, and hence its introduction there will probably prove disastrous to grape culture.

This insect is found in two different forms: in one instance on the leaf, where it produces greenish red or yellow galls of various shapes and sizes, and is known as the type *Gallaecola*, or gall-inhabiting; in the other and more destructive form, on the root, known as the type *Radicicola*, or root-inhabiting, causing at first swellings on the young rootlets, followed by decay, which gradually extends to the larger roots as the insects congregate upon them. These two forms will for convenience be treated together.

The first reference made to the gall-producing form was by Dr. Fitch in 1854, in the Transactions of the New York State Agricultural Society, where he described it under the name of *Pemphigus vitifoliæ*. Early in June there appear upon the vine leaves small globular or cup-shaped galls of varying sizes; a section of one of these is shown at *d*, figure 15; they are of a greenish red or yellow color, with their outer surface somewhat uneven and woolly. Figure 14 represents a leaf badly infested with these galls. On opening one of the freshly formed galls, it will be found to contain from one to four orange colored lice, many very minute shining, oval, whitish eggs, and usually a considerable number of young lice, not much larger than the eggs and of the same whitish color. Soon the gall becomes over-populated, and the surplus lice wander off through its partly opened mouth on the upper side of the leaf, and establish themselves either on the same leaf or on adjoining young leaves, where the irritation occasioned by their punctures causes the formation of new galls, within which the lice remain. After a time the older lice die, and the galls which they have inhabited open out and gradually become flattened and almost obliterated; hence it may thus happen that the galls on the older leaves on a vine will be empty, while those on the younger ones are swarming with occupants.

These galls are very common on the Clinton grape and other varieties of the same type, and are also found to a greater or less extent on most other cultivated sorts. They sometimes occur in such abundance as to cause the leaves to turn brown and drop to the ground, and instances are recorded where many vines have been defoliated from this cause. The number of eggs in a single gall will vary from fifty to four or five hundred, according to the size of it; there are several generations of the lice during the season, and they continue to extend the sphere of their operations during the greater part of the summer. Late in the season, as the leaves become less succulent, the lice seek other quarters and many of them find their way to the roots of the vines, and there establish themselves on the smaller rootlets. By the end of September the galls are usually deserted. In figure 15 we have this type of the insect illustrated; *a* shows a front view of the young louse, and *b* a back view of the same; *e* the egg, *d* a section of one of the galls, *e* a swollen tendril; *f g h*, mature egg-bearing gall lice, lateral, dorsal and ventral views; antenna, and *j* the two-jointed tarsus.

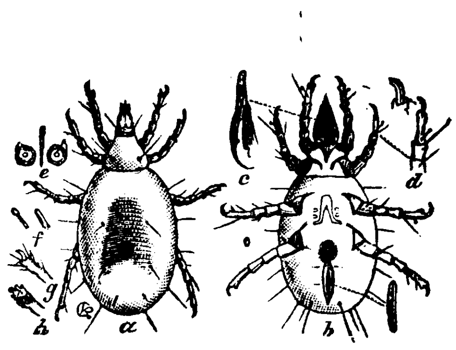


Fig. 19.

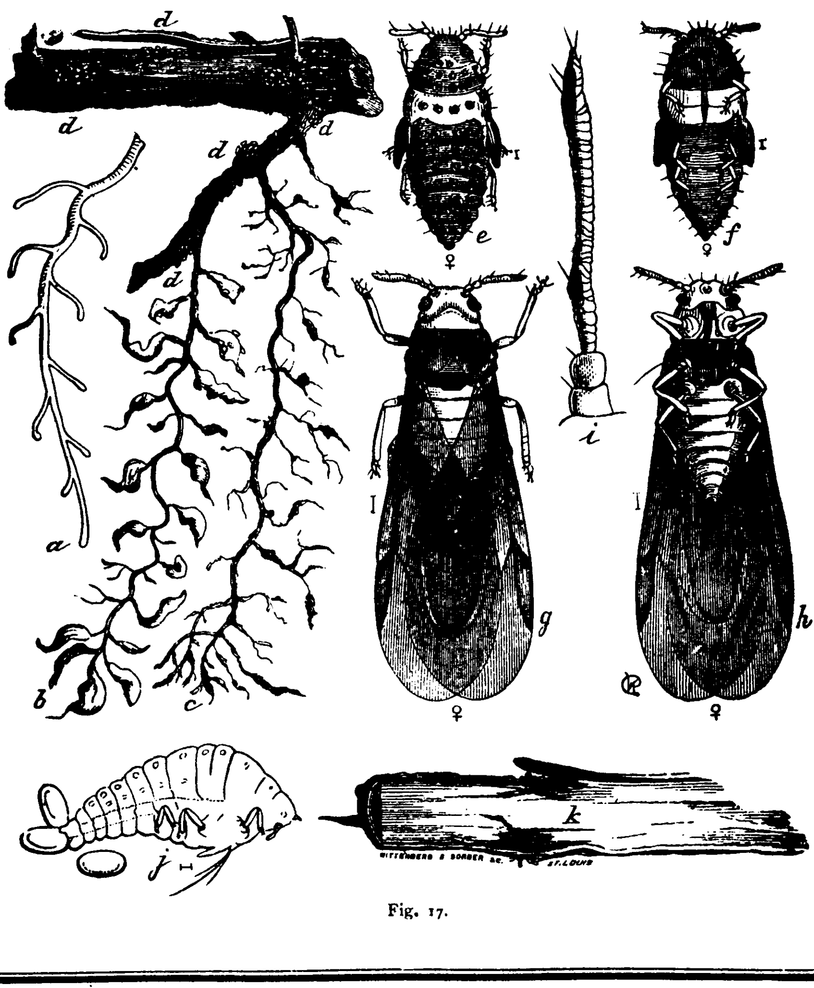


Fig. 17.

When on the roots the lice subsists also by suction, and their punctures result in abnormal swellings on the young rootlets, as shown at *a* in figure 16. These eventually decay, and this decay is not confined to the swollen portions, but involves the adjacent tissue, and thus the insects are induced to betake themselves to fresh portions of the living roots, until at last the larger ones become involved, and they too laterally waste away.

In figure 16 we have the root-inhabiting type, *Radicicola*, illustrated; *a*, roots of Clinton vine, showing swellings; *b*, young louse as it appears when hibernating; *c*, *d*, antenna and leg of same; *e*, *f*, *g*, represent the more mature lice. It is also further illustrated in fig. 17, where *a* shows a healthy root, *b* one on which the lice are working, *c* root which is decaying and has been deserted by them; *d d d* indicates how the lice are found on the larger roots. *e*, female pupa seen from above, *f* the same from below; *g*, winged female, dorsal view; *h*, the same, ventral view; *i*, the antenna of the winged insect; *j*, wingless female laying eggs on the roots, while *k* indicates how the punctures of the lice cause the larger roots to rot. Most of these figures are highly magnified; the short lines or dots at the side showing the natural size.

During the first year of the insect's presence the outward manifestations of the disease are very slight, although the fibrous roots may at this time be covered with the little swellings; but if the attack is severe, the second year the leaves assume a sickly yellowish cast, and the usual vigorous yearly growth of cane is much reduced. Eventually the vine usually dies, but before this takes place, the lice having little or no healthy tissue to work on, leave the dying vine and seek for food elsewhere, either wandering underground among the interlacing roots of adjacent vines, or crawling over the surface of the ground in search of more congenial quarters. During the winter many of them remain torpid, and at that season assume a dull brownish color, so like that of the roots to which they are attached, that they are difficult to discover. They have then the appearance shown at *b* in figure 16. With the renewal of growth in the spring, the young lice cast their coats, rapidly increase in size, and appear as shown at *e*, *f*, *g*, in the figure; soon they begin to deposit eggs, these eggs hatch, and the young become also egg-laying mothers like the first, and like them also remain wingless. After several generations of these egg-bearing lice have been produced, a number of individuals about the middle of summer acquire wings. These also are all females, and they issue from the ground, and rising in the air, fly or are carried with the wind to neighboring vineyards, where they deposit eggs on the underside of the leaves among their downy hairs, beneath the loosened bark of the branches and trunk, or in crevices of the ground about the base of the vine. Occasionally individual root lice abandon their underground habits and form galls on the leaves.

The complete life history of this insect is extremely interesting and curious, and those desirous of further information as to the different modifications of form assumed by the insect in the course of its development, will find them given with much minuteness of detail in the 5th, 6th, 7th and 8th Reports on the Insects of Missouri, by C. V. Riley.

Remedies: This is an extremely difficult insect to subdue, and various means for the purpose have been suggested, none of which appear to be entirely satisfactory. Flooding the vineyards where practicable seems to be more successful than any other measure, but the submergence must be total and prolonged to the extent of from twenty-five to thirty days; it should be undertaken in September or October, when it is said that the root lice will be drowned, and the vines come out uninjured.

Bisulphide of carbon is claimed by some to be an efficient remedy: it is introduced into the soil by means of an augur with a hollow shank, into which this liquid is poured; several holes are made about each vine, and two or three ounces of the liquid poured into each hole. Being extremely offensive in odor and very volatile, its vapor permeates the soil in every direction, and is said to kill the lice without injuring the vines. This substance should be handled with caution, as its vapor is very inflammable and explosive. Carbolic acid mixed with water, in the proportion of one part of acid to fifty or one hundred parts of water, has also been used with advantage, poured into two or three holes made around the base of each vine with an iron bar to the depth of a foot or more. Soot is also recommended, to be strewed around the vines.

It is stated that the insect is less injurious to vines grown on sandy soil; also to those grown on lands impregnated with salt.

Since large numbers of these insects, both winged and wingless, are known to crawl over the surface of the ground in August and September, it has been suggested to sprinkle the ground about the vines at this period with quicklime, ashes, sulphur, salt or other substances destructive to insect life. The application of fertilizers rich in potash and ammonia have been found useful, such as ashes mixed with stable manure or sal-ammoniac.

A simple remedy for the gall-inhabiting type is to pluck the the leaves as soon as they show signs of the galls, and destroy them.

Several species of predaceous insects prey on this louse. A black species of Thrips with white fringed wings deposits its eggs within the gall, which, when hatched, produce larva of a blood red color, which play sad havoc among the lice. The larva of a Syrphus fly, *Pipiza radicum*, which feeds on the root louse of the apple, see figure, 18, has also been found attacking the Phylloxera. Another useful friend is a small mite, *Tyroglyphus phylloxera*, P. & R., see fig. 19, which attacks and destroys the lice, and associated with this is sometimes found another species, *Hoplophora arctata* Riley, of a very curious form, reminding one of a mussel. The lice are also preyed on by several other species of the lady-bird family, and by the larva of lace-wing flies.

To guard against its introduction into new vineyards, the roots of young vines should be carefully examined before planting, and if knots and lice are found upon them, these latter may be destroyed by immersing the roots in hot soap suds or tobacco water.

Our native American vines are found to withstand the attacks of this insect much better than do those of European origin, hence by grafting the more susceptible varieties on these hardier sorts, the ill effects produced by the lice may in some measure be counteracted. The roots recommended to use as stocks are those of Concord, Clinton, Herbemont, Cunningham, Norton's Virginia, Rentz, Cynthiana, and Taylor. The Clinton, one of the varieties recommended, is particularly liable to the attacks of the gall-producing type of Phylloxera, but the lice are seldom found to any great extent on its roots, and the vine is so vigorous a grower that a slight attack would not produce any perceptible effects.—*Canadian Entomologist.*

THE HERRING KING.

The attention of scientists has frequently been called to the band fishes (*Tænioidei*), more on account of their odd form than for their value as a food fish. Their body is of an extraordinary length, and is flat like a band of ribbon, and is covered throughout with small, beautiful, bright and shining scales. The dorsal fin extends over the entire back, and the ventral fin is missing altogether, or consists of a few long thin or fragile bone spurs, which are in the front part of the body near the pectoral fins.

Among the band fishes the herring king (*Regalecus banskii*), which is found in the northern seas, always creates more or less of a sensation every time one is caught, and that is seldom and far between. As this fish lives in the greatest depths of the ocean it very rarely occurs that one is washed ashore. It was first discovered on the Norwegian coast in the neighborhood of Bergen, in 1776, and as the herring were passing along the coast at the time, the new fish was named the Herring King. Later this fish was observed on the Scandinavian and Scotch coast, and lately a specimen was caught at Stavanger, and was preserved in an almost perfect condition. The most striking feature is the exceedingly great length, as most of the specimens caught measured from 9 to 18 feet in length. The head is relatively very small, and provided with minute teeth. The bright, silvery, ribbon-shaped body is provided with dark spots and stripes, and the dorsal fin is of a mild pink color. The first spines or ossicles are of an uncommon length, and form a fan-shaped and exceedingly fragile head ornament, which was not found in a perfect condition in any of the specimens.

THE SALTNESS OF THE SEA.

During a recent voyage to Campbell Island, in the South Pacific, M. Bouquet de la Grye, took occasion to make careful observations on the saltness of the sea. Referring to his paper in the *Annales de Chimie et de Physique*, for details of method, we propose to give here his principal results.

In the Mediterranean, an inclosed sea, with strong evaporation, the saltness reaches as high as 22 grammes of chlorine per litre of water. In the port of Marseilles the water of the surface has only 20·75gr., but in the open water one finds 21·71gr. There is also progressive increase from west to east.

Near the coast of Egypt, the influence of the Nile was observed before that of the land was recognized. The fall was sudden, about 0·80gr., while the densimeter and thermometer showed no variation. Before arriving at Port Said, the chlorination went down to 19·45gr., a certain proof of currents bearing the Nile water eastward.

The analysis of water of the Suez Canal, at 23 different points, led to the following conclusions: The fresh water of the Nile has an influence on the saltness of surface-water, which is felt beyond Lake Timsah. The recovery of chlorine begins about the second station; there is a very slow increase at first, as far as the entrance of El Kantara, then a rapid increase as the Bitter Lakes are approached. At the latter, one finds 37·20gr., and 37·47gr.

Continuing the examination, it appears that the Red Sea diminishes in saltness from North to South; at first the saltness is slightly over that of the Mediterranean, but it soon falls below it. This is explained by the influence of the Southwest monsoon, which is accompanied by torrential rains.

When the voyagers were entering the Indian Archipelago, all the rivers were overflowing—the water was troubled by the mud flowing down—and the chlorination, always under 20gr., descended to 17·42gr., opposite Batavia. This was the smallest figure reached during the voyage.

The waters of Java and of New Guinea also gave low figures so far as the Torres Straits. There a complete change was encountered. The rainy season was five months distant; the coast was sandy and dry, and the water courses were low; thus notwithstanding nearness of land, which was skirted twelve days, the author found only one chlorination under 20gr.; this was off Keppel Bay, where the river Fitzroy enters the sea.

From Sydney to Campbell Island the same saltness. the wind was then blowing from the north, the weather was mild but the spring was little advanced, and the ice of the Polar circle had not commenced to melt. Four months later, at the time of quitting Campbell Island, there was already a change: the water was less salt, and in some places off the New Zealand coast, figures under 20gr., were met with.

In traversing the Pácific Ocean, an extra saline zone is found under the southern tropic; then a zone of comparatively fresh water, the equatorial zone. To the north there is, again, an extra elevation of chlorine under the northern tropic, and beyond a strong diminution: this arises from the polar current descending along the coast of America.

Coming to the last part of the voyage across the Atlantic, the tables show that the neighbourhood of the American coast gave waters very fresh and icy, which are suddenly replaced by hot and very salt waters, when the Gulf Stream is entered; then as the route of steam-packets goes along the great bank of Newfoundland, one passes from the current to find anew the fresh and cold waters; these being succeeded by the average water, in which navigation continues to European seas.

"*En résumé*, we have found in the Pacific the law indicated by Gay-Lussac and by Humboldt, and verified by M M. Roux and Savy in the Atlantic. It may be enunciated thus: *Under the two tropics the saltness is greater than under the equator, and beyond the tropics.*

"In indicating," the author proceeds, "that the saltness usually diminishes as coasts are approached, a fact is stated which is the consequence of the rivers bringing to the sea a large tribute of fresh water, and in some circumstances great advantage might be derived from this knowledge, especially in navigating along the coast of Africa or America. How far out would not the waters of the Amazon be revealed by the sole test of chlorination, where the thermometer and the densimeter indicated nothing? The approach of icebergs in cold seas would likewise be indicated by change in the saltness.

"As regards navigation, then, chlorometry may yield very useful direct results; but, better still, the investigation of currents cannot, it seems to me, be properly carried on without it.

"Maps giving every three months the chlorination of the sea would lead to a more exact notion of currents, and would make known new currents. But the question may further be looked at with reference to the slope producing currents. One may investigate the form taken by the surface of the ocean according to the saltness and temperature of all its component parts. Approaching one side of this new question, should we continue to denote as the mean level in a port the level obtained as the mean of a certain number of heights taken at all seasons? Evidently not, because there is neither equilibrium of height nor comparison possible between waters estimated differently, and having densities variable according to this saltness and their temperature. We may not bring into the same average the fresh waters which in spring spread over our coasts, and the salt waters of other seasons. In summer, a tidal wave whose force is represented by a weight, and not by a height, will lead to figures different from those of winter. And let it not be thought that the corrections belonging to different chlorinations are insignificant. When a new level is now sought in surveying operations, its value might be given to nearly a millimetre; when the stability of a coast is to be measured, it is still this approximation that is had in view. Indeed, for a difference of 15°, we have, with mean saltness, 0·004m. difference per metre height. If the tide be 5m., the correction due to temperature gives differences of 0·02m.; this is the entire value of one of the latter waves considered.

"As to the correction due to difference of saltness it is much greater. At Honfleur, at Havre, and especially at St. Nazaire, the chlorination of the sea may make the density pass from 1·028 to 1·012; for 5m. of tide the correction is 1·08m. It is these differences that render so little comparable the means of heights of the tide obtained for long periods. At Brest, when the maregraph acts at the mouth of the Penfeld, the annual means are discordant.

"We add, that when we have to do with the level of equilibrium, it is necessary to further make a correction which is as the low water, for this latter level remains the same for a great stretch of sea, while the border of the coast, through local circumstances, narrow passages hindering the play of tides, &c., presents various surelevations; but this correction does not apply either to seas without tides, nor to points projecting into the ocean.

"Where the level of equilibrium, then, has to be investigated, one must take account of the density at low-water mark of the place, and there is occasion henceforth to complete the indications of maregraphs, by adding for each day the temperature of the sea and the weight of the chlorine.

As regards the general question of levelling of seas, it is pointed out that the sea is not everywhere a level surface in the geometrical sense. In all seas there is equilibrium of weight, and there are merely tendencies to equilibrium of level.

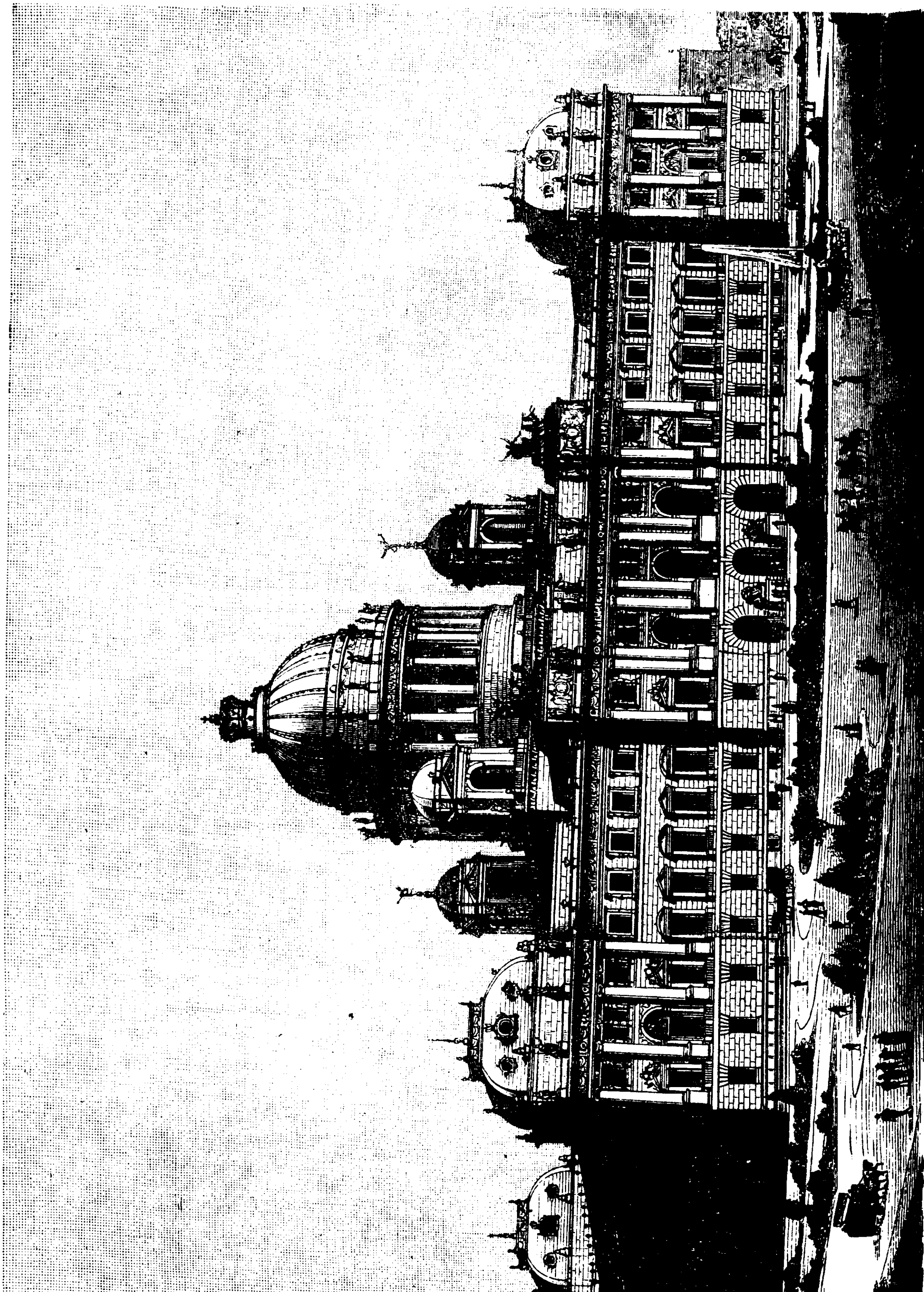
M. Bouquet de la Grye has sought to apply these principles to the level of the Atlantic, and taking as zero the plane which passes through the Cape Verde Islands, we find, under the tropic of Cancer a depression of two metres, and near the United States a considerable surelevation, in some cases exceeding four metres. Thus, we have a difference of level of six metres between two points of the same ocean.

PRAIRIE DOG SKINS FOR GLOVES.

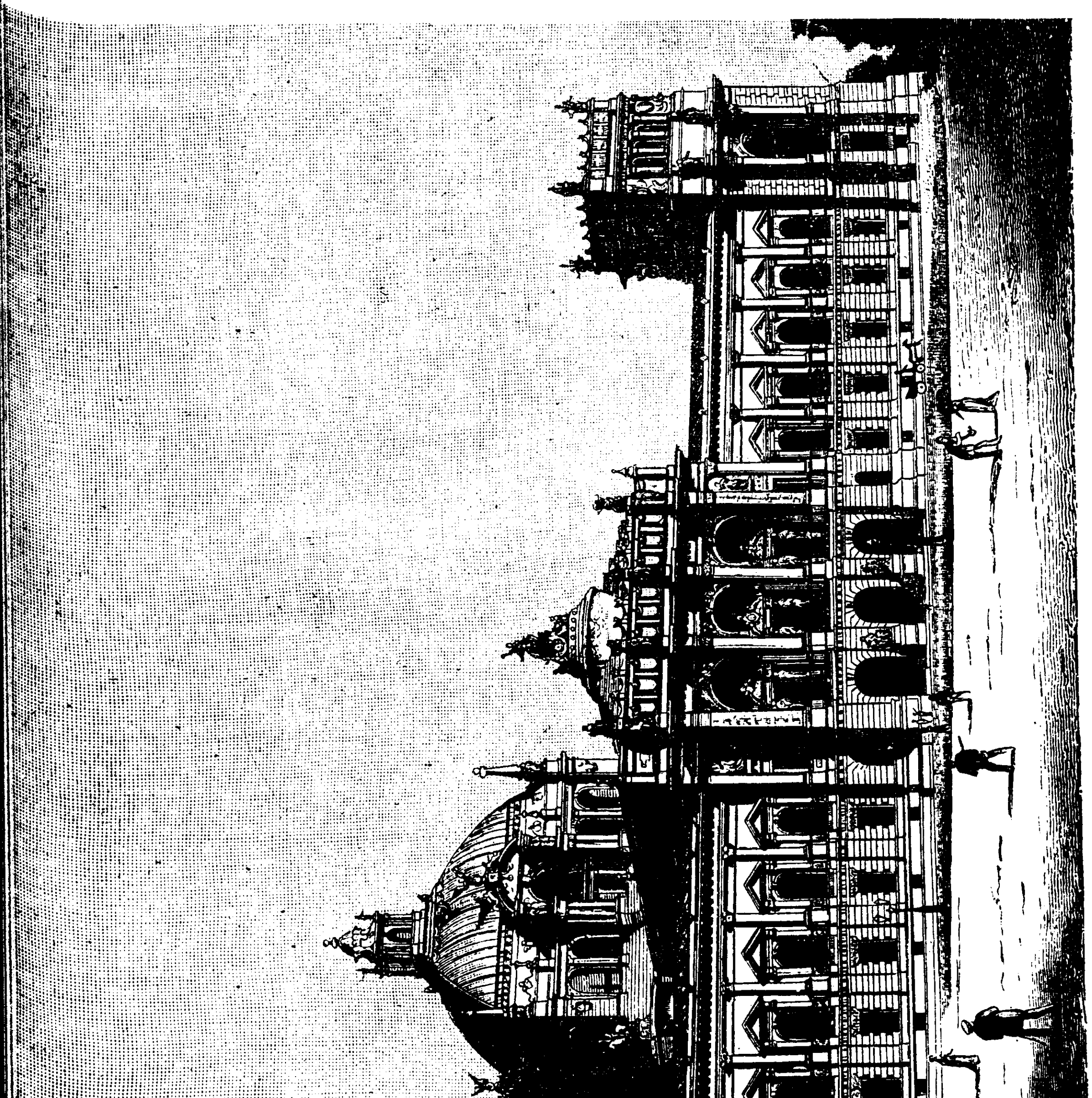
In a recent communication Mr. Courtney Graham, of Colorady City, Texas, suggests that some enterprising tanner undertake the preparation of prairie dog skins for glove leather. The animals are exceedingly abundant in those parts, as they are almost everywhere on the plains and further west. In many places they are a serious nuisance, the grass of the cattle ranges being eaten up by them, and the ground honeycombed with their holes. They might be caught in large numbers, and would be caught by boys and others, if a market were made for their pelts.

It would be interesting to know if any attempt has been made to tan the skins of these animals or to use their hair or fur in the arts. The small size of the "dogs"—really rodents, like woodchucks and ground squirrels—would seem to be the chief bar to the profitable handling of their pelts.

THE SQUARE MAN.—The square man mezzures the same each way, and haint got no winny edges nor shaky lumber in him. He iz freeze from knots and sap, and won't warp. He iz klear stuff, and I don't care what yu work him up into he won't swell, and he won't shrink. He iz amungst men what good kil dried board are among carpenters, he won't season-krack. It don't make enny difference which side ov him yu cum up to, he iz the same bigness each way, and the only way to get at him, enny how, iz to face him. He knows he iz square, and never spends enny time trieing to prove it. The square man iz one ov the best shaped men the world has ever produced; he iz one ov them kind ov chunks that kant alter tew fit a spot, but yu must alter the spot tew fit him.—*Josh Billings.*



THIERSCH'S DESIGN FOR THE NEW GERMAN PARLIAMENT BUILDING.



WALLOT'S DESIGN FOR THE NEW GERMAN PARLIAMENT BUILDING.

Chemistry, Physics, Technology.

ON TANNING.

One of the most important industries of the civilized world is of course the tanning of hides for the preparation of leather. The immense capital invested, the solid profits of these investments, the great number of workmen whose livelihood depends on this trade, and the usefulness of the product, all this contributes to draw attention to it, especially in New York. This city, since 1638, when one of the four brothers Evertsen, owned the first tannery on Manhattan Island, has taken the lead in the business and is still holding the most conspicuous place in the leather manufacture and trade of the world.

As might be expected, the progress in science, especially chemistry, has during the present century had great influence upon the manufacturing details of this business. The first of the improvements were several mechanical appliances for softening, fulling, rolling, and splitting skins and hides, and for grinding tan bark, some of which devices were introduced long ago. Other methods followed for washing, glazing and finishing leather. Then came the application of water-power and especially of steam in many of the operations, and of hot water in others; finally the extraction of tannin in concentrated solutions, and its application under great pressure, together with instruments and chemical devices for determining the amount of the tannic acid, and consequently the tanning power of various liquors, with greater subdivision of labor in large establishments, resulting in more skillful manipulation in the processes of tanning, currying and finishing leather. To this must be added the sweating and other operations, whereby the gelatine and muscular fibre is more completely exposed to the tannic acid and the density or weight of the leather increased. These improvements have greatly influenced the art of preparing leather in an economical manner.

Two important problems have attracted the special attention of chemists, the first, the invention of devices for shortening the time necessary for the proper penetration of hides by the tanning principle, which as done in the old style requires some eighteen months for its proper accomplishment, and which involved of course, so much loss of interest upon the capital invested, and the saving of which enables the manufacturer to increase his business without increasing his capital, in the same ratio that he shortens the time to transform hides into leather. The second problem which has presented itself, is the substitution of other substances having tanning properties, in place of the oak bark, which has been becoming more and more scarce, for the reason that the trees have continually diminished, while on the other hand, the consumption and demand for leather has steadily increased.

The first stimulus given towards the invention of a rapid tanning process was by the government of the first French Republic in 1752, to Armaud Seguin, when shoes and belts were suddenly required for the increased army, called out for the national defence against Royalist Invasion; Seguin succeeded in tanning hides in twenty-five days, and thus the victorious but barefoot soldiers were properly shod. American statistics show, that we exported that year very near three thousand hogsheads of ground oak bark, which caused a rise in its value from eight to twelve or thirteen dollars per cord. The consequence was a request from the tanners for an increase in the import duties on leather.

It had become known that there were other barks and woods which, as well as oak bark, contained the active principle needed for tanning, and which was called tannin or tannic acid; there were several varieties of oak in the United States, unknown to the Old World, which were very well adapted and used for the same purpose, but the greatest impulse was given by the discovery that hemlock bark, with which the forests of New England and of New York abound, also produced a reddish colored, but very good leather, and was successfully used in New England for tanning. On this basis the "New York Tannery," was organized in 1817, and a colossal establishment founded in the midst of the hemlock forests in the Catskill mountains, at Hunter, 1,200 acres of this land being secured for a beginning. This was a movement in the right direction, in regard to economy, because in place of bringing the bulky tanbark to the hides near the city, where land is dear, the hides were brought to the tanbark forests, where land is cheap, by which at the time the expense of removing the exhausted bark was done away with, as it was simply left on the ground. The tannery was moved when the hemlock trees around had been stripped. We saw, in 1849, such a tannery in full operation in the clove of the Catskill mountains above Palenville; a few years later we found it abandoned and in ruins, and now not a trace is left, except heaps of exhausted bark.

Zadoc Pratt erected, in 1824, a mammoth tannery in the heart of Greene county, 500 feet long, containing more than 300 vats, consuming per year 6,000 cords of hemlock bark for the tanning of 6,000 sides of sole leather, of which he sent in 1842 the first hemlock tanned leather to Europe. In twenty years he tanned more than a million hides. We mention these figures in order to show the enormous quantity of bark consumed, and wish the reader to notice that it takes on an average a whole cord of bark to tan a single hide of sole leather, so that attempts to reduce this bulk are not to be wondered at.

An important move in this direction was made by Joseph Gilef of Nermont, who patented the use of a liquid extract or essence of oak and hemlock bark, so concentrated that one hogshead contained the tannin of four cords of bark. He claimed to tan with it calf skin in forty-eight hours.

In 1846 and 1847 some inventions were introduced to hasten the process by mechanical means, such as rollers, between which the hides were squeezed while in the vat; paddle wheels for stirring the stock in the vats; devices to enable two men to work in and out the vats 150 hides per day. Further improvements were made also in tanning liquids by the addition of chemical sails, such as sulphate of potash, sulphate of iron, etc. While in 1865, Towers, of Boston, patented a process by which he claimed to tan sheep and goat skins in thirty minutes, calf skins in five days and the heaviest sole leather in thirty days, also claiming a better product than the old method. The main ingredient by which he caused the rapid penetration of the tanning liquor was alcohol.

But a new era is dawning upon this business by chemical methods, which however, appear not to have developed themselves sufficiently for practical introduction, on a large manufacturing scale; it is the act of dispensing with the vegetable tannin altogether, and in place of it using some mineral astringent substance of similar property. The first step in this direction was proposed in 1850, by Knapp, in his chemical technology; it was an astringent salt of iron, such as the sulphate or chloride of iron, which latter produces a pure yellow leather, while the sulphate makes a yellow red leather; adding soda or potash gives a dark brown leather. Leathers thus obtained are similar to those made with alum, which is used for white leathers, but the iron salts cause shrinking in drying. Knapp mentions also, that the chromium compound possesses excellent qualities as substitutes for tannin.

In Wagner's Jahresbericht for 1858, is a method described for improving the action of the chromium compound, such as the chloride, by the addition of as much soda as can be added without precipitating it. It is claimed that rapidity of action, and good flexible leather is thereby obtained. Finally we find that in 1860, Clark obtained an English patent for a new tanning process, which consists in placing the hides, after the usual preparation, in a solution of bichromate of potash. He leaves them there for six to twelve hours, after which they will absorb the tannin in the ordinary vat in as many days as other hides require months.

The first inventor of the use of chromium compound for tanning, we find to be Warrington.

There are several other substances which have been experimentally used, with more or less success, either to supersede tannin entirely, or to prepare the hides for a more rapid absorbtion of the same. It has been found that the greater the affinity of these substances for the tannin the quicker will be its absorption, and shorter the time needed, which in some cases, has been so far reduced as that less than a single hour, was sufficient to perform a perfect tanning.

We will for the benefit of those, who wish to give practical attention to this important subject, give a list of some of the substances used in place of tannin, or for preparing the leather for a quick tanning operation.

1. Common alum, this as a substitute for tan bark, gives a peculiar leather, and is in use.
2. Sulphate of alumina.
3. Chloride of aluminum.
4. Acetate of alumina.
5. Common salt and acetate of alumina.
6. Chloride of iron.
7. Sulphate of iron.
8. Stearic acid.
9. Margaric acid.

10. Oleic acid.
11. Solution of cod liver oil in ether.
12. Common resin dissolved in alcohol.
13. Various other kinds of resin.
14. Picric acid.
15. Bichromate of potash.
16. Artificial tannin made by the action of nitric acid or concentrated sulphuric acid upon resins, gums, fernambuc wood, peat, etc. In this way a substance is produced which is as astringent as tannin, and will precipitate a glue solution in the same m nner as tannin. It does not however deserve the name of artificial tannin; the investigation of the most eminent chemists having proved that in this way only a modification of the acid used is formed, which does not possess the property of preventing the skin fibres of the hides from adhering after drying and thus make the tanned skins soft and flexible. This is the true function of the tanning process, and not merely the solidifying of the glue or gelatine in the hide as was formerly supposed.

We are willing to expand on this subject by giving further details, if suggested by our readers.—*Industrial News.*

Miscellaneous.

A NEW SUN DIAL.

(See page 277.)

A correspondent of *La Nature* communicates to that journal the following description of a sun dial to be used as a regulator in the house, the instrument being placed in the window when it is desired to ascertain the time.

It consists of three parts, which may be easily disconnected by the removal of screws from two of them. The form, which is purely geometrical, comprehends the right line, the circle, and the ellipse. It is of the equatorial kind — the only one that is capable of giving exactness. In spite of its small size, the hour may be read on it from minute to minute as on a watch. The dividing lines indicate the even minute, while the odd minute is given when the shadow falls between two divisions, its passage through the interval having an appreciable duration of only fifteen seconds. In selecting this form it has been the author's object to obtain sensitiveness. The stability of the style prevents all danger of the instrument getting out of order. The instrument represented in the accompanying engraving was tried and found to be exact to a quarter of a minute, from seven o'clock in the morning to noon. The error, if there was any, diminished on approaching noon, when it became nil.

To make use of the apparatus, a window is selected which receives the sun. Then the exact hour is obtained from a watch, or by other means, and marked on the dial, account being taken of the difference between the true hour and the mean hour; this being indicated in a table glued under the base. Then the position is regulated by means of leveling screws. It is requisite (1) that the mid-day line the style, and a leaden wire shall be in the same plane, and that (2) the style be parallel with the axis of the earth, or make with the horizon an angle equal to the latitude of the place. When the dial has been regulated at the place selected a datum point is made there. It is more convenient to fix a very horizontal shelf on three screws, or to cause the dial to abut against a piece of wood worked into the form of a square, which shall mark the angle that the apparatus makes with the line of the window. We shall always be certain then to put the dial in the same place. By this regulator watches may then be set with all security. Since the invention of clockwork solar instruments have possessed no utility, except as regulators, on condition that they were instruments of precision. The exact hour, since the existence of railways, has become a social necessity.

This system of sun dial, when made of iron, is especially adapted for public uses in temperate regions. For such purposes it is only necessary to fix the base of the dial against a wall, point downward, and turn up the figures. Thus, a sun dial of 1·3 meters diameter, fixed at 3 or 4 meters above the ground, would carry divisions spaced 6 millimeters apart, which would make them perfectly visible. It would present every guarantee of precision, solidity, and durability. If the principal divisions were either hollowed out or formed in relief it would be easy to reprint the instrument. At the side of it there might be placed a table of corrections.

A NAVAL EXHIBITION.

From the 10th to the 20th of April last there was held at the Agricultural Hall, London, a naval and submarine exhibition such as has probably never before been seen in any other country for extent and completeness. England is admitted to be the dominant power on the sea, and her great maritime industry is the most national of all industries. Of merchant steamers alone England possesses nearly 30,000, valued at $442,500,000, while the cost of the 10,000 sailing ships carrying the English flag is $200,000,000. Scarcely one of these ships was built on foreign soil. It is thought that at least one million of persons are interested in the building, maintenance and navigation of this vast fleet of vessels. With such resources to draw from it was an easy matter to hold a naval exhibition in London. During the ten days of its existence it was visited by more than 60,000 people. In the centre of the hall was a diving tank in which apparatus for the raising of wrecks and the saving of life at sea was tested and discussed. The appliances of this class in the exhibition were especially numerous. They comprised life-belts, floating decks, "unsinkable" ships, cork mattreses, air pillows, inflatable petticoats, and many inventions which sea-dogs of the Captain Cuttle school would, without hesitation, have denounced as "fiddle-faddles." There were means of curing a ship of all the complaints to which it may be subject; chains and weights to keep it from heeling over, and to right it again, even when thrown on its beam ends; arrangements to prevent its sagging; and patent railways to remove it from place to place. All the details of a vessel, it seemed, were the objects of inventive skill. Patent scuttles, scuppers, steam whistles, fog horns, rudders, rowlocks, boat lowering apparatus, steering gear, lamps, hammocks, pumps, anchors, cranes, capstans, winches, and similar paraphernalia have been the subjects of recent improvements, which, even if not always needed, yet prove how great is the mental activity in the shipbuilding world, which seems as little disposed to stagnate as the waves which it rules.

To know what an exhibition does not contain is quite as interesting as, and often much more useful than, a knowledge of its minutest details. There were limitations even to the collection, large though it was, under notice. One of the objects asked for but not forthcoming was an automatic lifting apparatus, by means of which all kinds of coal might b "grabbed" or scooped up, shipped, or unshipped, in a way similar to that in which grain is transported. The system now in vogue of "whipping" coal, under which a large staff of laborers must be employed to fill baskets and other receptacles with a spade, which are then drawn up by a steam crane, is altogether too slow and costly for modern requirements. The apparatus required is one which shall take up swiftly and cleanly, and carry without loss, a mixture of slack and large and small pieces of coal. Another class, although of less practical importance, in which there were no exhibits, was that of submarine vessels, such as Mr. Ericsson invented a few years ago. It was thought at that time that much use might be made of them in launching torpedoes against an enemy's fleet, and in passing from one shore to another unexposed to the most violent storms which might disturb the ocean's surface. A third need is connected with boilers for launches, of which there were but very few shown. These are open to much improvement, both in shape and in the position occupied by them in the limited hold of launches. The various stages of construction, and the relative values of steel and iron for shipbuilding, were also unrepresented.

Thoroughly complete, on the other hand, were the series of exhibits relating to diving, dredging, marine engines, steam steering gear, propulsion, life saving apparatus, boat lowering, pumping, rigging and refrigerating. There was also a fine collection of models, of the latest patterns of merchant steamers and men-of-war, lent by the Lords of the Admiralty and and by the leading shipbuilding firms. Among these were the *Servia*, a new Cunarder, long and narrow as an eel, the proportion between breadth of beam and length of keel being so great that Captain Bedford Pim would stand aghast at it. The models of the *Devastation* and of the *Belleisle*—the latest types of ironclad and turret vessels—were inspected with much interest. Under the category of curiosities must be noted a model of the Eddystone Lighthouse, and, perhaps, a steam whistle, which sounded in all the notes of the musical scale, while as a somewhat novel feature was a lecture room in which exhibitors described their inventions, and well known scientific men lectured on points of technical interest.—*Industrial News.*

FIG. 1.

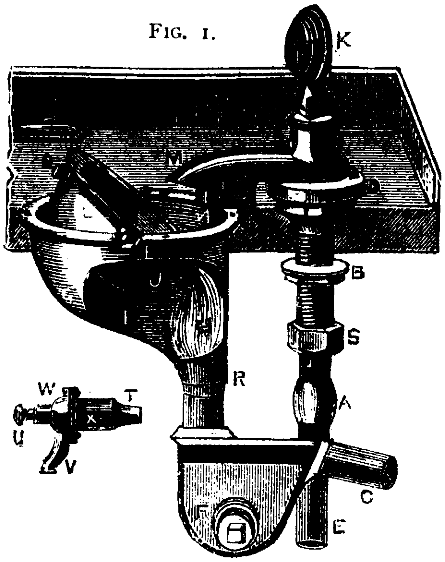


FIG. 3.

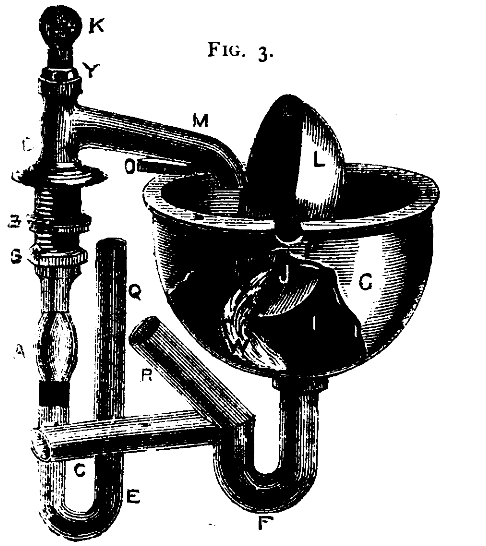


FIG. 2.

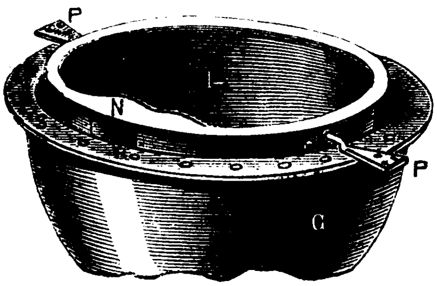
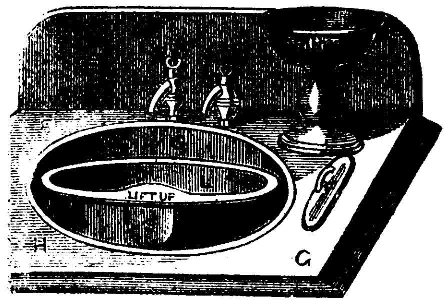


FIG. 4.



PRACTICAL NOTES ON PLUMBING.

FULFILLMENT OF AN ENGLISH PREDICTION.

The following remarkable prediction of the growth of America every word of which has been fulfilled, appeared in the Edinburgh *Review* in 1853, based upon the census of 1850, which showed the then population of the United States to be 23,000,000, of which 18,000,000 were native whites, over 2,000,000 foreign born, 39,000 were of unknown nativity and 3,200,000 were slaves. "It cannot be doubted that, versatile as they are, they soon will give the same attention to art which they now give to more solid but less grateful matters. The incorporation into the community of so large an amount of emigration from Continental cities, educated in art of design, and contributing by the pencil and chisel to the national love of show, will hasten the result. When, in no very distant day, the prairies of the lake country and the Valley of the Missisipi shall be peopled with 50,000,000, gathered from all nations, but guided by the English race and governed by English traditions—when the slopes of the Alleghanies and the Green Mountains shall be covered with sheep and their valleys filled with the best bred stock; when the plains of the South shall be entirely devoted to the production of cotton (let us hope without the curse of slavery); when the higher and more delicate branches of manufacture shall have taken root in Massachusetts and the mechanical arts found a firmer stay in Pennsylvania; when the white man shall have driven the buffalo from the fields which each setting sun shadows with the peaks of the Rocky Mountains; when cities shall fringe the Pacific, towns line the banks of the Oregon, and farms dot the surface of California and the Valley of the Willamette; when skill shall have subdued the mineral wealth of Lake Superior; when commerce shall whiten every lake and ascend every river of the country and shall carry its productions to every clime; when railroads shall unite the Atlantic with the Pacific and bring every part of this vast nation into close contact with every other; when opulence shall have given a home to art in these cities and literature shall have created the traditions which they lack—what a spectacle may they not present to the world if, despising the allurements of ambition and disregarding the erroneous advice of interested leaders, they are content to reap the rewards of their peaceful industry and to enjoy the blessings which Providence places within their reach.—*St. Louis Miller*.

PRACTICAL NOTES ON PLUMBING.

BY P. J DAVIES H.M.A.S.P., &c.

This kind of lavatory basin is shown at Fig. 224 G is the container with its trunk shown bedded into the dip-pipe of the D-trap; L, is the basin. This basin swings upon two pivots at P, suitable bearings being fixed on the sides of the container; the basin has suitable stops or buffers to prevent the too sudden closing; in this case the rubber buffer is shown fixed under the spout of the cock at O, and held there by the claw. The container should be fixed below the top slab, and the hole in the slab made of sufficient size to allow the basin to swing without touching. In fixing these basins take care that the pivots are properly fastened; othewise when the basin is jammed or bumped against the buffers, the basin will become loose and probably get broken. For another method of fixing the pivots see PP, Fig. 225. This is for screwing up to the top or slab, or it may be fixed to the false bottom, the latter method usually being adopted.

Fig. 226 illustrates a skeleton of the round container tip-up basin, as fixed over the ordinary half S trap. When such basins are fixed over these traps, take great care to well ventilate the outlet of the trap, *but not* as shown at R; for reasons, see *Building News*, page 753, December 9th, 1881.

Fig. 227 illustrates the basin properly fitted up, and a little tilted to show the stop S, so that it is not always necessary to have the stops on the cocks.