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SCIENTIFIC CANADIAN

MECHANICS' MAGAZINE AND PATENT OFFICE RECORD

Vol. 9. MARCH, 1881. No. 3.

ATTENTION is being turned to the navigation of the Mississippi in good earnest, and various schemes are suggested for the improvement which it so much needs. The last system proposed, the commencement of which, we believe, has already received support from Congress in the shape of an appropriation, is no less than a return to the old system of reservoirs by which the Babylonians collected the overflowings of the spring to serve them during the drought of summer. To apply such a scheme to the maintenance of a water way is entirely new, and represents a most gigantic undertaking, which however does not serve at all to dismay modern engineers. The total capacity of the reservoirs proposed to be formed will be equal to a vast sea of 400 square miles of surface and a uniform depth of eight feet. The water will be collected by the agency of forty-one dams, to be constructed, seven on the upper Mississippi, fourteen on the St. Croix, twelve on the Chippewa, and eight on the Wisconsin. The construction is to commence at Lake Winnebagoshish, where a dam sixteen feet high is to be commenced at once. This will be a part of the first system which is guard the outlets of Lakes Winnebagoshish, Leech, Mud, and Vermillion, and include dams at Pokegama Falls, Gull Lake and Pine River. It is expected that the vast quantity of water thus held in reserve, and skilfully operated with the assistance of telegraphic communication, will furnish a stream which can be maintained at a uniform depth of four feet on the upper Mississippi from July to November. The advantages which will accrue to the navigation of that region by the successful issue of this undertaking are immense, and the cost is estimated not to exceed a million and a half of dollars, a sum upon which it should not be difficult to pay interest immediately upon the successful completion of the undertaking.

THE subject of the drainage of Ottawa has been ventilated to an extent which should lead to a better ventilation of the sewers themselves. The drainage of the city is itself good, so far as the laying of the pipes and the arrangement of the main sewers is concerned, but the ventilation is abominable, and with an insufficient system of ventilation, the best system of sewers in the world becomes nothing more or less than a mine of death to the inhabitants. Close trapped in the drains and unable to obtain a proper exit, the foul gases produced force their way into the houses themselves, and are the cause of a multitude of evils. Nor is Ottawa the only city in the Dominion which might take a lesson, and see to the reduction of its death rate in time.

THE applicability of the electric light to photographic purposes has been known for some years, and made occasional use of for the photographing of objects where sunlight was not procurable, as in subterranean chambers, or in the night time. It is a new thing however to find electricity in direct competition with the sun, as the source of light for portrait photography. Mr. J. von Ronzelen has recently arranged his studio in Berlin expressly with a view to the accomplishment of this object, and has succeeded beyond expectation. The time of exposure is scarcely longer than that required in ordinary daylight (from 7 to 9 seconds) and the portraits are said to be actually superior in sharpness of outline and distinctness of feature, no less than in the delicacy of their shading. The motive power which supplies the electricity is a 4-horse power electro-dynamic machine situated in the cellar of the house, and the studio is placed on the first floor, in itself no small convenience to those who are accustomed to climb up sky-high to the operating room. It has been found that the direct impact of the light casts too deep and sharply defined shadows, and to obviate this, the light itself is enclosed in a parabolic mirror which throws its beams upon a metallic reflector of about $1\frac{1}{2}$ meters diameter, fastened to the ceiling, thus distributing the light over the whole surroundings of the sitter. By this means the original light power, equivalent to 3000 candles, is reduced 30 per cent. The reflector is arranged for easy adjustment, and the light can be directed at the pleasure of the operator. The advantage of the new system in a

country where the photographer, especially in winter time, is so much at the mercy of fine weather, is very marked, and the process will no doubt speedily come into more general use. We give an illustration of the studio on the last page of this issue.

The U. S. monopolies are being freely discussed in the columns of the *North American Review*. We should be thankful here in Canada for our proximity to the States in one particular at least. We have close at hand an example of a great country growing up from small beginnings and going through the same stages as we ourselves have passed or shall pass through, and while we seek to imitate her in some things, we may be even more grateful to her for the lesson she gives us from time to time of what to avoid. In a recent number of the *Review* we had some startling revelations of the progress of the Standard Oil Company from a small beginning to an almost complete control of the oil trade; of the manner in which such control was acquired, and the unscrupulous way in which the power once obtained has been exercised; the crushing of rival companies by nefarious contracts with railroads, and in fine the establishment of an irresponsible and wide reaching monopoly. In the April number of the same periodical Mr. John Fiske explains the monopoly of business by the large telegraph companies, and the evils which result to commerce from such exclusion of fair competition, offering suggestions as to the propriety of government interference. From all this we have a lesson to learn. The popular sense of justice is always against the taking from a man what he has obtained without breaking the existing laws of his country, and it is a strong, if sometimes a necessary measure for a government to interfere to destroy a monopoly which it has passively allowed to come into existence. The obvious remedy for the evil is the prevention of such at their inception, and it is in this that the moral of our story lies. *Verbum sap.*

The American journals are jubilant over the prospects of the year, and the advancement of trade interests, and we may share their enthusiasm at least in a measure. Immigration is undoubtedly bringing money to the States and may be looked for to help us in the same way, while the general impetus given to railway matters will undoubtedly directly affect our interests, through one important branch of business at least, the lumber trade. The gigantic schemes of this year are unsurpassed in railroad annals. Besides the Canada Pacific, the immediate effect of which cannot fail to be beneficial in the impulse it will give to trade and labour, whatever its ultimate effect on the prosperity of the country, we have the Northern Pacific, which is being pushed with remarkable energy and will be finished in 1882, although it was once considered a "dead duck." The Central and Union Pacific railways are spreading themselves out northward to mineral regions, coal lands and agricultural and grazing districts. The Union will soon have 3,000 miles of roads tributary to it, and the Central is destined to become a part of a line under one management extending entirely across the continent. The Southern Pacific railroad only lacks a few miles of completion, and will unite the Atlantic at Norfolk with the Pacific at San Diego as well as San Francisco. The new south-western system planned by Jay Gould has the ancient city of Mexico as an objective point and will probably be extended to Guayumas on the Pacific. Then there are the several schemes for crossing the Isthmus of Central America, one of which will probably break ground this year and go forward until completed, while there are no end of lesser railroad enterprises, which at other times would have been great undertakings, but now no one takes into account at all. Such an increase of activity amongst us and by our side will undoubtedly give us here in Canada a chance if we are able to utilize it. Lumber especially will be in more demand than heretofore, and with the re-establishment of a prosperous lumbering season we shall see a direct effect upon the business prosperity of the country.

A propos of the Ottawa drainage question of which we spoke above, comes the following clever parody from the Toronto Globe.

"THE SONG OF THE SEWER."

(By the Ghost of Thomas Hood.)

With water filthy and thick,
  With fetid and poisonous breath,
I steal unseen beneath busy feet
  And I breed disease and death.
Stench! Stench! Stench!
  No house, be it rich or poor,
From the laboring man to the judge on the Bench,
  Can exclude the smell of the sewer.

With vapors charged with death
  Three fathoms down I creep,
And I chuckle unseen in my slimy bed
  As right and left I peep.
Blockheads, or asses, or worse,
  Who won't let my breath reach the street,
But bottle me tight for their city's curse,
  Whilst I chuckle and chuckle and cheat.

For, slimily rolling along
  While the city is hushed in sleep,
To right and to left, into every home,
  Does my phantom vapor creep.
See yonder empty cot!
  The little one breathed *my* breath,
And the poisoned blood in the veins ran hot
  Till the parents prayed for death.

When slumber the city enfolds,
  What a zest in being wantonly free
To choose for my own the loved ones of all,
  And with luck, at odd times, an M.P.
Smell! Smell! Smell!
  Nasty and vile and impure,
Shall swell through your homes like a funeral knell,
  The horrible smell of the sewer.

Choke! Choke! Choke!
  In diptheria's deadly embrace—
I love the sound and chuckle low,
  And linger about the place.
And none suspects the sewer
  Buried full fathoms three,
Save the undertaker—oh! best of mutes,
  For never a word says he!

Shame! Shame! Shame!
  The Aldermen knows full well,
And the Mayor, too, how deadly 'tis
  To live within my smell:
For it's Death! Death! Death!
  Maybe slow, but insidious and sure,
That enters your home with the poisonous breath,
  The fatal breath of the sewer.

—*Globe*, Feb. 23rd, 1881.

Glue.—A glue ready for use is made by adding to any quantity of glue, common whiskey, instead of water. Put both together in a bottle, cork it tight and set it for three or four days, when it will be fit for use without the application of heat. Glue thus prepared will keep for years, and is at all times fit for use, except in very cold weather, when it should be set in warm water before using. To obviate the difficulty of the stopper getting tight by the glue drying in the mouth of the vessel, use a tin vessel with the cover fitting tight on the outside to prevent the escape of the spirit by evaporization. A strong solution of isinglass made in the same manner is an excellent cement for leather.

Chemistry, Physics, Technology.

GLASS AS AN OBSTRUCTOR AND REFLECTOR OF LIGHT.

Mr. F. W. Hartley has recently contributed to the London *Journal of Gas Lighting*, three interesting papers in which he aims to arrive at the amount of light absorbed by the various kinds of glass globes and also by sheet glass. This work has been done from time to time by others, but in no case has the subject been treated in the exhaustive manner which characterizes Mr. Hartley's experiments. The author mentions the work done in this direction by Mr. W. King, of Liverpool, and Mr. A. H. Wood, of Hastings and adds, "the statements of these two gentlemen embrace all the published facts upon this subject." We would call attention to the experiments made some years since by Prof. F. H. Storer, of Boston, which certainly deserve mention as having been made with great care, and in which so important an item as the thickness of the glass was taken into the consideration. This may account for the varying results obtained by different experiments. For instance, one reports the light absorbed by a ground glass globe to be 40 per cent., while another gives it as 29.5 per cent. The point of discrepancy cannot be settled, as neither one mentions the style of globe experimented with. Then too, there is considerable difference in ground surface in different globes, some obstructing somewhat more light than others.

Mr. Hartley in all of his experiments used the Methven light unit—mention of which was made some time since in these columns—and he says that "without its aid it would have been impossible for me to make the tests with sufficient rapidity and certainty."

In experimenting on clear sheet glass with the Argand burner, it was found that the loss of light with the glass at 3½ inches was 12 per cent., which increased to 17 per cent. when the glass was placed 20 inches from the light. The cast glass used for gratings, coal-hole plates, etc., absorbs from 13 to 16 per cent., according to the distance from the light; and in the same way the corrugated plate with fine lines, absorbs from 19 to 27 per cent.

With ground sheet glass (24 oz.) the loss of light was 39 per cent. at 3½ inches, and 60 per cent. at 20 inches. It should be mentioned that the burner used gave a light of 17.5 candles. There is a greater loss of light when the rough side of the glass is toward the flame, than when the smooth side is next it, by from 2 to 4 per cent.

With both ground and opal glass the percentage loss of light was less as the illuminating power of the flame increased. Experiments were made with a sheet of thin glass in connection with a reflector of clear sheet glass placed 3½ inches behind the flame, and the gain with the reflector was 3 per cent. With regard to globes it was found that a 7-inch clear glass globe with a 19 candle gas, absorbed 3 per cent. of the light, a globe ground outside absorbed 18 per cent., while an opal globe 7 inches diameter, absorbed 56 per cent.

Mr. Hartley concluded with some interesting experiments on the influence of globes on lights placed overhead. For instance, a bat-wing burner gave, when overhead, the light of 6 candles; when surrounded by a clear glass globe there was a gain of 5.50 per cent. in the light; with a ground glass globe the gain was 9 per cent.; and with an opal globe 21 per cent.

The following are the conclusions which Mr. Hartley deduces from his experiments.

Horizontal Lighting.

Sheet Glass.

1. That ordinary sheet glass, apart from thickness, varies in its obstructive power to the passage of light. That the percentage loss increases with the distance of the glass from the flame, and increases also as the light grows stronger.

2. That ground sheet glass, apart from thickness, also varies in obstructive power. That the percentage loss increases with the distance of the glass from the flame, and decreases as the light grows stronger. That the percentage loss depends on which side, clear or ground is presented to the flame.

3. That with flashed opal the losses follow the same law as ground glass for distance from, and for power of light.

4. That with clear glass as an obstructor of light in front of the flame, and clear glass behind the flame as a reflector of light, the reflected light reduces the loss to a degree dependent on the distance of each glass from the flame.

Globes.

5. That a clear glass globe obstructs light from an Argand flame, but increases the sensible light from a flat flame.

6. That globes of ground glass obstruct less light than sheets of ground glass. That the percentage loss diminishes as the light grows stronger; and is, for an average light, from eighteeen to twenty per cent.

7. That opal globes obstruct an amount of light equal to 33 to 65 per cent.

Overhead Lighting.

8. That the amount of light yielded by a flame in an angular direction is much less than it yields in a horizontal direction.

9. That glass globes with elevated or overhead Argand flames reduce the power of the light—clear globes, about 3 per cent.; ground globes, about 21 per cent.; and albatrine globes about 23 per cent.

10. That glass globes with flat flame burners, at a certain elevation and within a certain radius, increase the power of the light—clear glass, about 6 per cent.; ground globes, about 9 per cent.; albatrine globes about 23 per cent.; and German opal globes about 21 per cent.

11. That reflectors greatly increase the power of the light within a radius dependent upon the shape and size of the reflector; the range of the experiments being from 52 to 92 per cent.

12. That screens at the base of an Argand flame cause a reduction in the power of the light, whatever be the size and form of the reflector.

THE ALBO-CARBON LIGHT.

There is probably no article of consumption which is so much wasted as coal-gas. This waste arises from various causes; uncontrolled pressure and defective fittings, both assisting to rob the consumer of a large proportion of the light obtainable from that which is too often in itself impure and always an expensive though necessary adjunct to the premises of business men and the conveniences of domestic life. Any new discovery, therefore, which offers a fair remedy may with reason be judged on its merits. Our attention was recently directed by a large consumer to the saving in his gas-bill which had resulted from a brief employment of that which is now known as the Albo-Carbon Light, and further investigation has fully shown that the invention is possessed of considerable merit. Some details may be interesting. The material used, of course, in conjunction with ordinary coal-gas, is pure white carbon, in a solid form, and the only addition to the chandelier or bracket is a metal reservoir which requires to be fixed at a short distance from the burner, the heat from which acting upon a small conducting plate vapourizes the carbon which combines with the gas before reaching the point of ignition. Some elaborate experiments have been made by Professor Keats, in his capacity of consulting chemist to the Metropolitan Board of Works, from which it appears that five cubic feet of gas burnt in a Bray's No. 1 burner, in connection with the Albo-Carbon apparatus, gave a mean light of 36·7 candles, showing a gain of 20·7 candles against a similar quantity of gas consumed in another burner unconnected with the new appliance. The latter when subjected to photometrical test gave 2⅛ times increase of light in favour of albo-carbon. The experimenter also found that light for light much less heat was evolved. We understand that the more extensive trial at the Westminster Aquarium more fully demonstrates these economic results. A further photometrical test which has been carried out at the office of the gas inspector to the Great Western Railway Company affords the following data.

Burner.	Consumption of Gas.	Candle power.	Pressure of Gas.
Bronner's Burner, No. 4	3·80	8·02	9-10
Bray's No. 1, without Carbon	2·50	1·08	9-10
Bray's No. 1 with Carbon, 20 minutes after ligthing	2·70	9·08	9-10
Do. 30 minutes after lighting	2·70	13 06	9-10

Such self-evident facts speak more eloquently than words. The experiment was made on the 5th inst. and the report is signed by Mr. J. Mauder. To this we now add no more than our testimony to the exceeding brilliancy of the light as improved by Mr. George Kent, of High Holborn, under whose auspices albo-carbon is likely to become more widely known, especially if the conversion of the carbon into gas can be accomplished in a briefer period of time.—*Building and Engineering Times.*

OVALS AND ELLIPSES.

(FROM THE METAL WORKER).

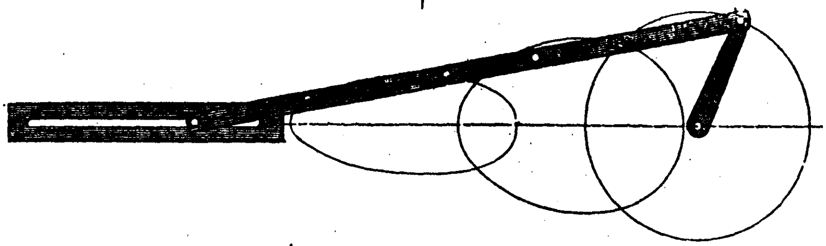
Several months since we published a letter from a correspondent, accompanied by some drawings of ellipses and ovals, which excited the curiosity of many of our readers. The author of the diagrams in question promised at the time to explain the method of their production in a subsequent letter. So far, however, we have had no further communications from him, and therefore in reopening the subject, we present our own ideas, and those of correspondents who have given the matter attention, of how the figures in question were drawn, instead of the solution generally anticipated.

By examination of the illustrations accompanping the article above referred to, it will be seen that the figures produced are of two kinds, ovals and ellipses. Both styles of figures are presented in series, commencing at one end with but a slight remove from a circle, and concluding at the opposite extremity in a long narrow shape. The explanation acccompanying them gives the information that in the construction of both kinds of figures they are derived primarily from a circle. From these conditions and explanations the conclusion is at once forced upon the mind that the figures are produced by some instrument which in its general characteristics is analogous to the connecting rod in the ordinary form of a steam engine. Whether one set of figures consists of perfect ellipses and the other of a set of ovals, or whether both sets are in reality ovals, we will allow our readers to determine after reading what follows. Upon the face of the matter, it seems extremely probable that the only difference in the forms of the figures produced is in the length of the connecting rod of the instrument by which they are drawn. The inaccuracies incidental to drawing figures by instruments of ordinary construction, to say nothing of the roughness of paper, make it impossible to determine a point of this kind by actual measurement, and more especially so when the figures are so small as in this case. Therefore, we invite particular attention to the following explanation of principles involved in the construction of the shapes named.

Numerous letters bearing upon this matter have been received from our correspondents in the interval since the article above referred to was published. Various suggestions have been made in them with reference to drawing ellipses by instruments which are different from trammels in construction and principle, and which are more accurate than the method of two pins and a piece of string. Various attempts to explain the construction of the figures in question have been made. The greater number of those who have written us, and among them W. H. C. of Kingsport, Tenn., and D. C. H., of Kingwood, W. Va., describe an instrument with a crank and connecting rod, one end of the latter moving in a straight line, and the other connected with the crank pin. Holes in the rod are made to take the pencil and draw the figures when the crank is turned.

In Fig. 1 we show a sketch of an instrument given by W. H. C. This method of producing ovals doubtless is very old, and has occurred to almost every one who has given the matter any attention. In drawing an ellipse, however, this plan has one fatal defect, in that the figures which it produces are unlike at the two ends. In other words, such an instrument will only make egg ovals and never true ellipses. This is not easily discovered, because in most cases very long connecting rods are used, which greatly diminish the amount of difference between the two ends. One of our correspondents shows in his letter an instrument where the rod is no less than eleven times as long as the crank.

An ellipse is a figure obtained by making a section of a cylinder at an angle to its center line. Its two halves, whether taken on the long or short diameter, are alike in all respects. The ellipse may be also described as a circle seen in isometric perspective.



Ovals and Ellipses.—Fig. 1.—Sketch of Instrument Employed by W. H. C. and other Correspondents in the Solution of the Problem.

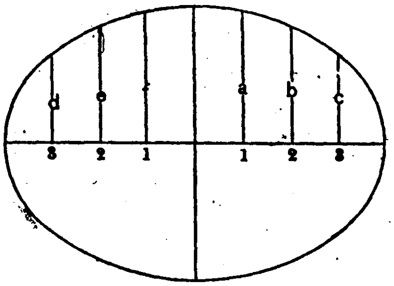
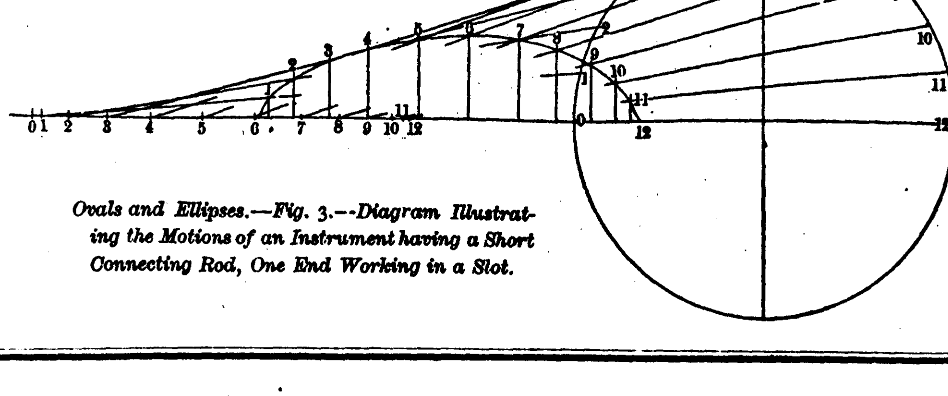
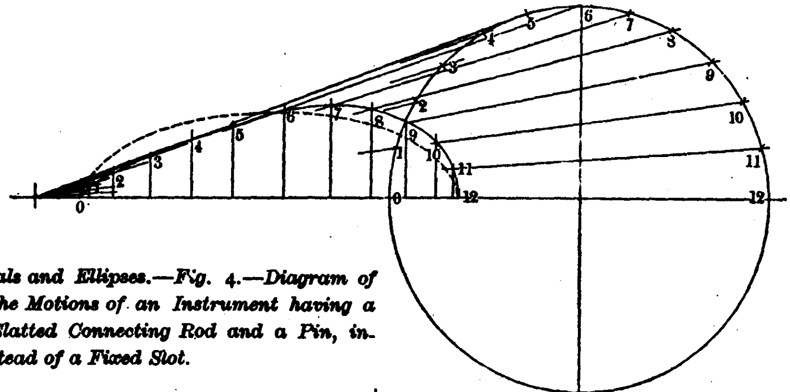


Fig. 2.—A 45-Degree Ellipse.



Ovals and Ellipses.—Fig. 3.—Diagram Illustrating the Motions of an Instrument having a Short Connecting Rod, One End Working in a Slot.



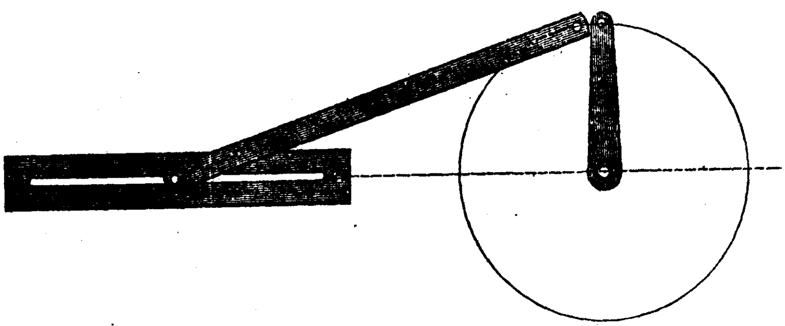
Ovals and Ellipses.—Fig. 4.—Diagram of the Motions of an Instrument having a Slatted Connecting Rod and a Pin, instead of a Fixed Slot.

Fig. 2 represents a 45-degree ellipse—that is, one obtained by cutting a cylinder at an angle of 45 degrees, or drawing a circle in isometric perspective, as though seen at that angle. It will be found that if we divide the diameters into equal parts, beginning from the center, and then erect lines perpendicular to the diameters, we shall have these lines of equal length at equal distances from the center. Thus *a* will be found to be equal to *f*, both being located one space from the center, in like manner $b = c$ and $c = d$.

To demonstrate the form of the figure developed by a point on a connecting rod, we have drawn the diagrams shown in Figs. 3 and 4. Fig. 3 gives motions, etc., of an instrument having a short connecting rod, one end of which is supposed to work in a slot. A glance at the lines perpendicular to the long diameter departure from a true circle is much greater than in the other instrument. This is the result of making the slot in the connecting rod, rather than in the table upon which the instrument rests.

Most of the correspondents who have mentioned this way of drawing ovals tell us that, so far as they know, the plan is original with them, and they also add that the machine is so bulky that for practical work they prefer to use the trammels or the pins and string. This probably arises from the fact that they are obliged to use such long connecting rods and small circles in order to obtain an approach to accuracy.

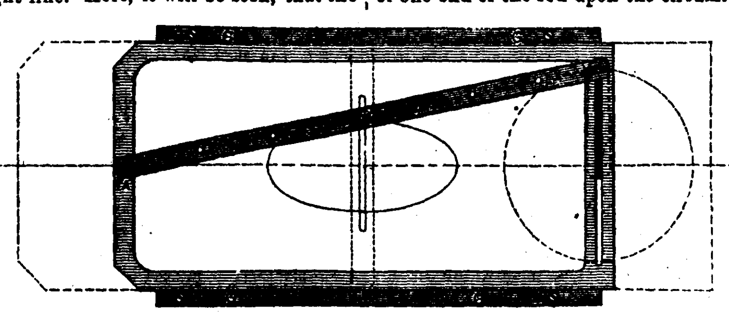
At first our readers may not see why the connecting rod draws a distorted figure. This can be easily shown when we consider that the widest point of the oval is in the middle of its length.



Ovals and Ellipses.—Fig. 5.—Diagram Illustrating the Relations of the Parts with a Rod One and a Half Times the Length of the Crank.

shows that while they are of equal length, as they must be from the very nature of the case, they are by no means equally spaced. Those marked 1, 2 and 3 are much further apart than 9, 10 and 11. In this case the connecting rod is less than three times the crank, or $1\frac{1}{2}$ times the diameter in the length.

In Fig. 4 we give a similar diagram, showing the figure produced by an instrument having a slotted connecting rod and a pin, instead of a fixed slot, by which the end of the rod is compelled to move in a straight line. Here, it will be seen, that the Now, when the back end of the connecting rod has just reached its half travel, the front end will be some distance from the center of the crank circle. In other words, the crank will not be at right angles to the center line of the instrument. When the connecting rod is very long this difference is slight. If the rod could be infinitely long the difference would disappear entirely by becoming infinitly small. Fig. 5 shows the relation of the parts with a rod of $1\frac{1}{2}$ times the length of crank. The lagging of one end of the rod upon the circumference of the circle is due



Ovals and Ellipses.—Fig. 6.—Suggestion of an Instrument, Working on the Principle of a Connecting Rod, which may be made to Produce Perfect Ellipses.

to what, in steam engine practice, is known as the "angularity of the connecting rod." The figure shows the crank and rod disconnected. The crank is exactly at right angles to the center line, having passed just half the distance from side to side, or one quarter of a revolution; the rod, too, is shown as having passed just half way along the slot, and while the rod, if running down, would touch the center of the circle, it will by no means reach the crank pin. This "angularity" makes a distortion in all parts of the figure.

The first thing that presents itself to the mind after a consideration of these points, is to devise some apparatus by which both ends of the connecting rod shall move at the same rate of speed, and where when one end is at half stroke the crank shall be at half stroke also. This may be done by an adaptation of what is called the slotted cross-head in combination with the connecting rod. The slotted cross-head is used upon steam engines to avoid the use of the connecting rod. It usually consists of a T-shaped piece, in the horizontal portion of which there is a slot in which the crank pin works. The upright portion travels in a slot to confine it to a straight line. By fastening a connecting rod upon the lower portion of the T and allowing the crank pin to pass through a slot in the the end of the rod, we have a machine which at first sight, appears to draw perfect ovals. For convenience of working, it is best made by using a square frame working in guides, with a slot for the crank pin in one end. The solid lines in Fig. 6 show an apparatus of this kind. When this instrument is made with a rod four or more diameters long, the figures drawn by any point upon the rod are so nearly accurate that they may be used as true ovals in all ordinary work.

Both ends of the rod have the required motions; when the crank pin is at right angles, the frame, and of course the back end of the rod, has moved through just half of its travel. Stopping here in our reasoning, we should at once be led to conclude that a true oval or ellipse was formed. Such, however, is not the case. The figure is an "egg oval," with the large end reversed and the point toward the crank. The reason for this is found in the fact that from the point A to B the rod introduces a small and independent angularity of its own, which, as the back end is moving with the crank, produces a reverse effect upon the figure which it draws. Even with this fault the instrument is a somewhat useful one, as it is much more easily made than a pair of trammels, and will do reasonably accurate work, as we have said.

The instrument, by the addition of another cross-head for the pencil to work in, can be made to draw perfect ellipses. It then becomes much more complex and difficult to make, as well as to manage, and it can hardly be said to be a practical machine. The dotted lines in Fig. 6 show how the extra cross-head may be applied. It is fastened across the frame at the middle point of any ellipse that may be desired, and the point of the pencil is compelled to travel in the slot. This cross-head may be made to fasten in any desired position upon the frame. With this arrangement the point which describes the ellipse has exactly the same longitudinal motion as the crank and the angularity due to its distance from A. If the guides G G G G are connected over the top of the machine and the crank attached to a cross-piece below it, it would not be an unhandy instrument, in either of the forms we have described, for drawing large ovals on working drawings, etc. It must be remembered, however, that in its first form it only produces a very close approximation to the ellipse.

THE PARIS INTERNATIONAL ELECTRIC EXHIBITION.

The plan of the forthcoming electrical exhibition at Paris is being rapidly matured by M. Berger and M. Cochery. There will be several electric railways, including a line starting from the Place de la Concorde, and traversing the Champs-Elysées on a viaduct, then entering the Palais de l'Industrie and terminating at the grand staircase in the western extremity of the nave. During part of its course it will also run through an artificial tunnel lighted by electric lamps. Messrs. Siemens Brothers will probably construct it, and the cost is expected to lie between 200,000 and 280,000 francs. The basement of the palace will be reserved for large machinery such as dynamo-electric machines and prime movers while the galleries of the first floor will be devoted to the innumerable applications of electricity which have been made in recent years to polite and common life. Apartments will be fitted up with call-bells, telephones, fire-alarms, etc., and illuminated by electric lamps, in such a manner as to display to best advantage the merits of these contrivances. For the electric light, provision has been made to supply 800 horse-power of energy, and it is estimated that this will enable no less than 600 lamps to be lighted simultaneously.

We observe that a proposal has been mooted in America to hold an international electrical exhibition there in 1882. Steam-power will be furnished at a fixed rate.

Applications for space by those intending to send objects to the Paris Exhibition will be received until March 31st. There will be no charge for space.—*London Engineering.*

THE ELECTRIC LIGHTING OF MINES.

At one of the sessions of the American Institute of Mining Engineers, in Philadelphia, the Edison system of electric lighting, as applied to mining, was described by Mr. A. O. Moses. The method adopted is very simple. Wires run direct from the dynamo-electric machine to the different workings, supplying light to the shaft on their way. Each lamp may, if desired, be immersed in water, or may be protected from fracture by a coarse wire screen; the connections can all be made under water, and thus lamps may be put in or out of circuit without the slightest danger from the electric spark.

Far too much importance, the speaker thought, has been attached to the consequences that may arise from leading wires into mines for conveying electricity, notably by such a high authority as Mr. Preece, the English telegraph engineer, but his deductions are not sustained by facts.

One of the most important advantages of the electric light in coal mines is in obviating the necessity of hermetically sealing up old or temporarily abandoned workings. Another is their prompt availability at times when light is of the most vital importance, when many lives may be in jeopardy after explosions, and dangers are multiplied on every hand, when everything depends upon immediate and vigorous action; then the weakness of all lamps that require to be fed with air asserts itself.

PHOTOGRAPHS IN NATURAL COLORS.

The announcement is again made that a process has been discovered for taking photographs possessing all the brilliancy and delicacy of the natural colors, and an exhibition of pictures thus naturally colored has just been held in London. According to the reports, the colors are produced by the action of light alone in the camera, and owe nothing whatever to the artist's brush. In the photographs exhibited, the coloring appeared to be quite true to nature, and delicate tones and shades were clear to the view. The flesh tint was exact to life, and full justice was done to gorgeous regimentals. The protruded tongue of a dog in one of the photographs possessed the exact color of nature. Some of the guests, says the *English Mechanic*, inspecting this collection, and not fully acquainted with the character of the latest invention, took it for granted that the work was done by skillful, artistic hands on ivory and other material, and could scarcely believe their eyes when informed that the color, as much as the form and outline, was produced by the light of day. Careful investigation, however, would then show that human handicraft was not in it; for there were touches and effects which nature's pencil of light could alone accomplish. The contention is that photographs colored by artists, however clever, must be more or less "monotonous, hard, untrue to nature, and to the originals."

The process was discovered, it is said, by a French scientist, but has since undergone improvement by the proprietor of the process in England. If the new system proves an unqualified success, the reward will not have been reaped without much labor in the past, for numerous attempts have been made to induce the sun-pencil to fix colors in the picture it draws in the camera; but chemical and mechanical difficulties have stood in the way. In the new process colors are said not only to be faithfully produced, but protected from the action of light by being passed through a boiling solution, of which gelatine forms the principal ingredient, and that some of the photographs so treated have been exposed for months to the sun without being in anywise affected by the ordeal. Unfortunately, the process is yet unknown, as it is likely to be for some time to come.—*Manufacturer and Builder.*

FREEING BENZINE FROM OFFENSIVE ODOR.—According to Mr. Fairthorne, benzine may be freed from all offensive odor by shaking it up well with quicklime—about 3 ounces to the gallon.

HOW OPIUM IS PRODUCED IN INDIA.

[CALCUTTA CORRESPONDENT OF SAN FRANCISCO *Chronicle*.]

Owing to the ever poverty-stricken state of the Indian *raiat*, or husbandman, the government advances the means whereby he can engage in poppy cultivation. The nature of their engagements is about as follows: The cultivator undertakes to sow a *bigka*, or about one-twentieth of an acre, with poppy seed. For this he is given the requisite amount of seed. If a well has to be dug, he is not only given a sum on loan, sufficient to carry out his purpose, but also money enough to buy bullocks in order to enable him to draw water from the well when it is finished. This is termed the first advance, and is simply given to prepare his land for the sowing of poppy seed. The second advance is given when the plant begins to shoot above the earth's surface, and the third, when the plant is about to mature. In January or February the plant comes to maturity; in that state the pods are lanced in the afternoon. The opium is allowed to exude till next morning, when it is carefully taken off by an iron scraper. At the same time precaution is exercised to close the incisions by running the finger over the cuts. About five to six incisions suffice for the drawing of the juice.

The opium is placed in brass vessels, slightly tilted, so as to drain off the dew or any other watery substance. It is then manipulated and placed in new earthen vessels, and is thus kept till it is brought to the weighing station. The cultivator of poppies does not employ labor. His holdings are mere garden patches; so all the aid he requires, from the sowing of the seed to the maturing of the plant and the gathering of the opium, can be had from the members of his family. The whole of this work is done by himself, his wife, and his little ones. Many of these opium garden plats, worked by the man and family, amount to only one-sixth or one-twelfth of an acre, perhaps; in a few isolated instances one man is wealthy enough to own half an acre.

There are many reasons which conduce to this. First and foremost is that the native does not like to lease more land than he himself can plow and work. Even with the growth of opium, where so many untold advantages are offered for extended enterprise, the Indian husbandman prefers to give his attention to a tiny garden rather than to be put to the expense of working, with paid help, a few acres. His outlay is nothing, and thus he is enabled, at tremendous profit, to grow opium for sale to the government. He does not pay for help; manure is always handy, as human excrement only is used, and nothing is cheaper and more effective. Irrigation is equally simple. A rude well is sunk; two posts and a cross beam, over which is placed a wheel, form the only apparatus for the drawing of water. A rope is passed over the wheel and attached to it a huge leathern bucket, which is let down and drawn up by bullocks. The water is emptied into a reservoir; running from this are numerous drains, which carry off the water and flush the lands requiring moisture. The stronger members of the family are engaged in this toil, while the children, who in other lands would be deemed infants, make themselves generally useful in picking weeds and many other duties necessitating light labor.

Before the sun gilds the horizon, and while the dew is yet fresh on the grass, the family are astir, and from early morning till evening their entire attention is bestowed upon their crop, either in weeding, watering, or picking during the day; and sometimes at night, in keeping wild animals from intruding and destroying in a single hour the labor of years.

The wants of the husbandman are but few. Four mud walls and a thatched roof compose the family mansion; and in such a hovel will he live for generations. A scant cloth tied round his loins serves for coat and pantaloons. When he desires to appear to advantage a huge cotton sheet, thrown in graceful folds around his body, serves as gala costume on occasions of great festivity. His little children are in a state of utter nudity, even in the coldest weather; and when it is borne in mind that from October till February the weather is a great deal colder than it is in San Francisco, some idea of the hardy nature of native children can be formed. The women are somewhat better clothed; a simple petticoat and a gray colored sheet has for the last three thousand years formed their attire. But, whatever, money the husbandman gains, he converts into jewelry, which forms the real wealth of the native landowner, and is regarded by natives much in the same way as a European looks upon a bank account. In times of acute distress he can always part, even at a premium, with his wife's ornaments. The Hindoo religion demands that certain ornaments must be worn by married women. When the contracting parties are poor they make them of lead, but directly fortune smiles favorably they are exchanged for gold and silver. The small farmer lives with but three objects, that is, to load his wife with ornaments, to eat off brass platters, and to be able, on the marriage of his son, to make a grand display. To attain this end he will suffer years of deprivation and inconvenience, and his many years' savings will be wasted in a single week of jollification.

We can imagine how glad must be the raiat when the poppy plant has begun to exude opium, and when his opium has all been gathered he waits patiently for the order to march, with the fruits of his labor, to the weighing station. It depends entirely upon the season as to when the cultivators can bring their opium to the government stations to be weighed.

DISPOSING OF THE CROP.

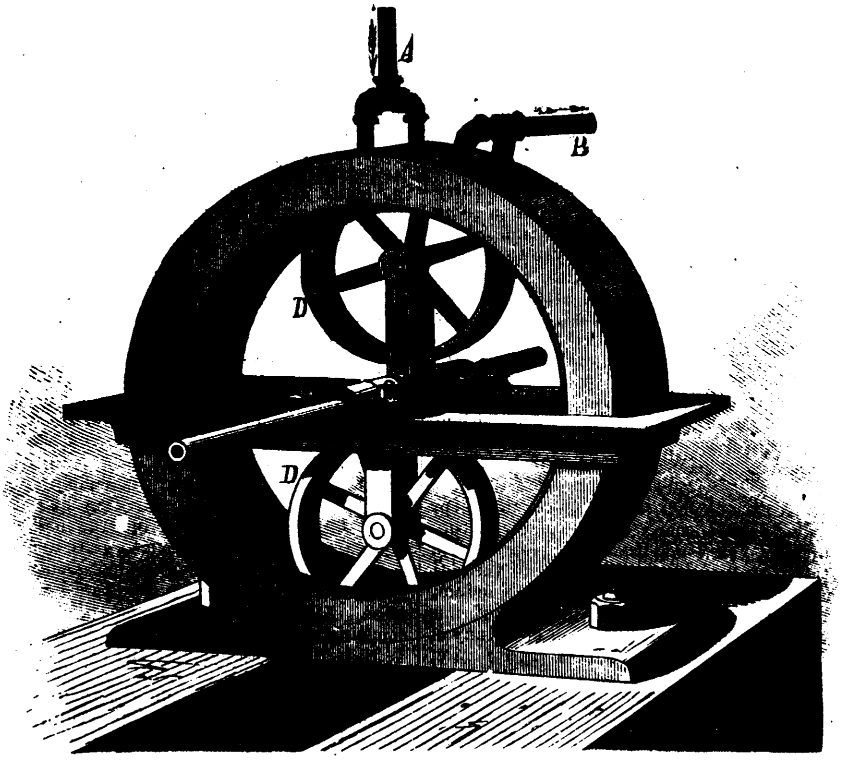
As a general rule, the month of April is the commencement of the weighing season. Intimation is then given to the opium cultivators that they must present themselves on a certain day with their opium, in order to have it tested and weighed. In the districts where the poppy plant is cultivated all are astir, and grand preparations are made for a general exodus. The opium is collected safely in red earthen pots, which are put in wicker crates, and the whole family, with burdens on their heads, make for the weighing stations. The picturesque Indian lanes are crowded with these men, marching like sheep to their destination. They only travel during the night. The sultry heat of midday forces them to seek the grateful shelter of the gardens and groves so liberally planted along the dusty highways. Directly a halt is called, and preparations are made for the daily meal. After this is finished some lively spirit starts a story, recounting the savage doings of the stranger who rules the land. With terrified countenances and anxious ears they listen to these fabulous tales; but inwardly they bless the "white face" as they think of the money he is soon to disburse.

Many of these ignorant cultivators have never seen, in their life, a European; and accept with easy credulity anything detrimental to the character of their governors. No wonder it is then that the native approaches the sahib or gentleman with the most abject fear painted on every limb. He holds his breath when he hears him speak, and is ready to faint at the slightest display of anger or impatience. These sensational stories are generally propagated by rascally natives, who profit by the credulity of their countrymen in order to extort money. These men represent that nothing can be done without the bakshish or blackmail present, and they are the agents for the sahib, sent by him to collect toll. If the ignorant wretch demurs, his torturer paints a picture to which the torments of hell are but a trifle. The poor fellow, anxious to escape such calamities as he is threatened, pays the demand, and further presents his friend with a trifle in order that nothing should go wrong.

WEIGHING AND TESTING.

Early in the morning the weighing and tests commence. Notice is given to the cultivators, and they proceed to the factory, ranging themselves in a long line before the examining officer. Some men connected with the department then mix up the opium and take out a small quantity for examination. The officer, after inspection, marks the quality on the side of the earthen basin in chalk. The samples are again mixed up and tested with a solution of tincture of iodine. If it happens that the cultivator has been attempting to adulterate his opium with farinaceous matter the solution will discover the deceit. Experienced officers are alone trusted with this important duty, and it is expected of them to be able to distinguish the class of the opium as much by the feel and sight as by a chemical analysis. The consistency of the opium is easily told by a man who has been long at the work by simply turning the opium over with his hand or with the aid of a knife. If the opium is of a first-class quality the color is a rich brown, and it is so stiff that there is some difficulty experienced in turning. The poorer the quality the blacker the color and the thinner the consistency.

After the opium has been weighed and filled into separate jars according to its quality, they are sealed up and dispatched to the factory, where all the opium is again mixed up to a certain consistency and made into balls ready for exportation and sale at Calcutta. After the opium has once been delivered into the hands of the government officer, the cultivator has nothing more to do. He is paid so much by the pound; his former advances are deducted, and the connection between the *raiat* and government closes. When the balls are made they are packed into boxes called "opium chests," and sent down to Calcutta.



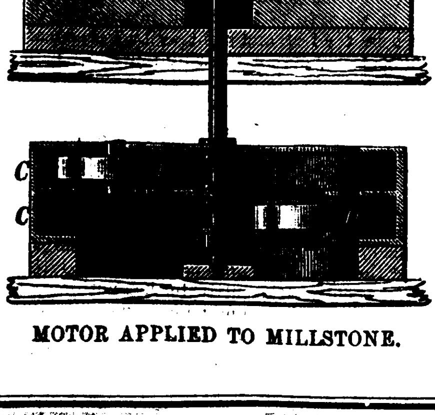
CONGER'S MOTOR.

A NOVEL MOTOR.

The engraving shows a means of imparting motion to vehicles and machinery by the employment of soft tubing beneath a flexible bearing surface for traction wheels. The tubing and flexible bearing, under the influence of steam, water, air, or other expansible or compressible fluid forced into it, will form a wedge-shaped or inclined wall or abutment in the rear of the tangential bearing of the wheel, and propel it with greater or less speed according to the pressure of the propelling medium.

Fig. 1 shows the application of the principle to a rotary steam or air engine. Fig. 2 shows the rotary engine in a horizontal position adapted to running a millstone. Fig. 3 shows the device applied to the propulsion of wagons or cars, and Figs. 4, 5 and 6 show the application of the motor to elevated railroads.

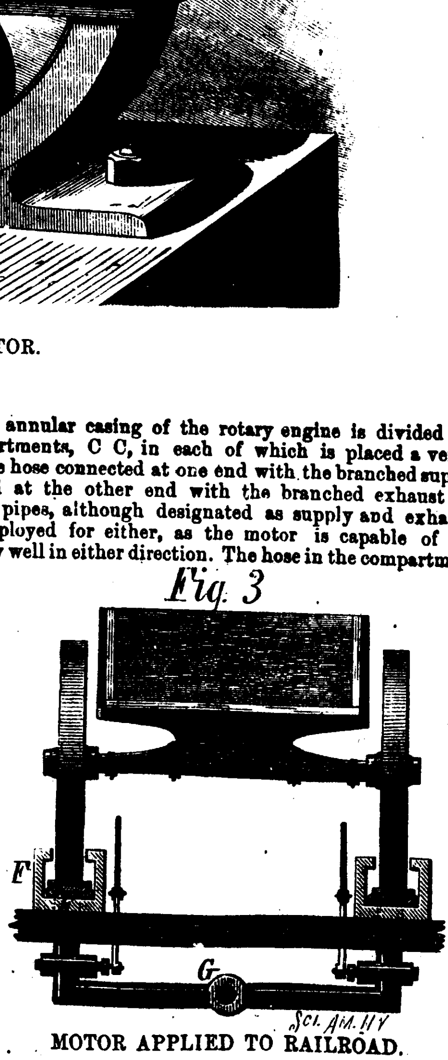
Fig. 2



MOTOR APPLIED TO MILLSTONE.

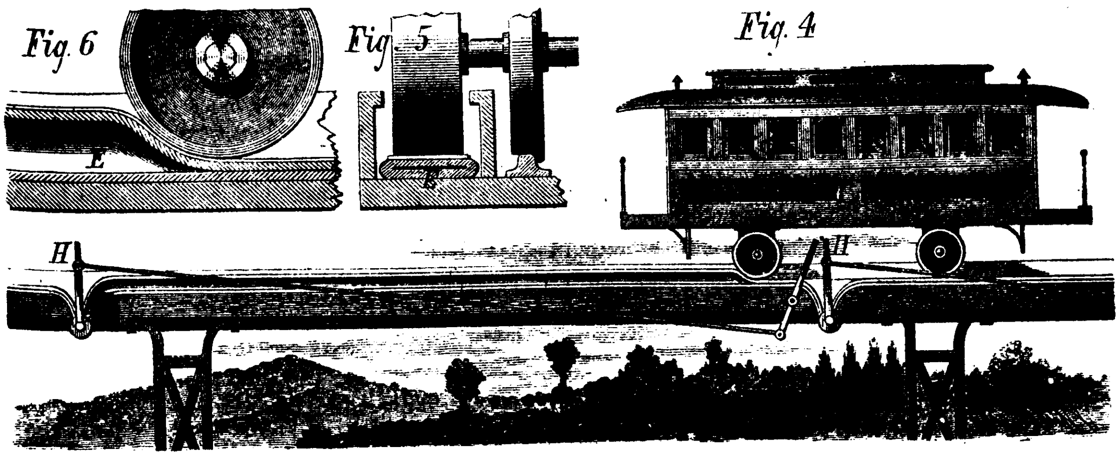
The annular casing of the rotary engine is divided into two compartments, C C, in each of which is placed a very strong flexible hose connected at one end with the branched supply pipe, A, and at the other end with the branched exhaust pipe, B. These pipes, although designated as supply and exhaust, may be employed for either, as the motor is capable of running equally well in either direction. The hose in the compartments C C,

Fig. 3



MOTOR APPLIED TO RAILROAD.

are provided with a flexible metallic bearing plate, which may be of steel or other suitable material, and upon these plates the wheels, D, press so as to bring the interior surfaces of the flexible hose into contact at that point. These wheels are supported by arms connected with the engine shaft, and when steam is admitted by either of the pipes, A B, and allowed to escape by the other, an inclined abutment is formed behind the wheels, which pushes them forward with greater or less force according to the pressure of the steam, air, or water used in the motor.



CONGER'S MOTOR APPLIED TO ELEVATED RAILROAD.

We are informed that these motors are capable of running at a very high velocity, and that they are efficient and may be applied to a large number of uses where the ordinary steam engine would be impracticable. Certainly nothing could be more simple, no piston, no valves, no stuffing boxes being required. The position in which this motor is placed is immaterial. It is shown in Fig. 2 placed in a horizontal position and adapted to the driving of millstones and vertical shafts. In this view the engine is shown in section, and the relative position of the flexible hose, C, its metallic covering, and the wheels, D, is clearly shown.

When the device is applied to railways the flexible tube or hose, E, is laid in a grooved track, F, and is protected by a straight ribbon of steel, upon which the wheels of the vehicle roll. This arrangement is adapted to light traffic, and for many purposes will answer admirably, but where the traffic is great the car is supported upon wheels running on an ordinary rail, while the driving wheel presses upon the hose with only enough force to bring the hose together, steam, water, or air tight, immediately beneath the driving wheel.

The hose is divided up into sections of fifty feet or more each, and each section is supplied by air from a main supply pipe, G, running below the track and connected with the air compressing station. At suitable intervals lateral pipes lead to valves at the side of the track, with which the hose is directly connected. At this point there is a valve connected with the lever, H, and and at the ends of the car there are levers which may be thrown out to engage the lever, H, and operate the valve to as to admit air to the section of hose upon which the car is just entering. The auxiliary lever at the side of the lever, H, is connected with the lever at the end of the filled section of hose, and as the driving wheel is leaving the filled section the lever carried by the car trips the auxiliary lever, moving the remote lever, H, and almost immediately touching the lever, H, of the section just entered.

It will be seen that by this arrangement collision is avoided, as the car on any particular section of the road has absolute control of that section. This system permits of running cars as frequently as may be desired, avoids all smoke and noise incident to steam propulsion, and is of necessity cheaper, both in respect to the road, propelling power, and rolling stock than any of the existing systems.

This invention was recently patented by Mr. M. M. Conger, of Wellsville, Mo. Further information may be obtained by addressing Messrs. Conger & Bro. as above.

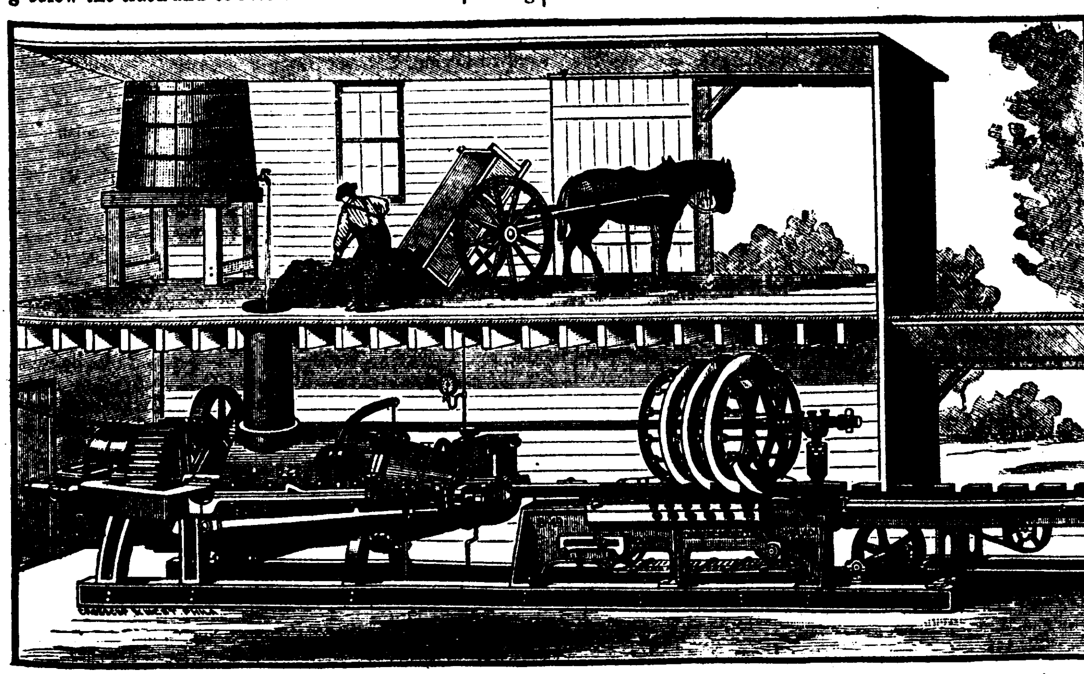


FIG. 1.—PERSPECTIVE VIEW OF THE CHAMBERS "B" BRICK MACHINE.—(SEE NEXT PAGE.)

CHAMBER'S IMPROVED BRICK MACHINE.

This simple and ingenious machine, of which we present herewith a perspective view, has acquired an extended reputation under the name of Chambers' "B" Brick machine. It belongs to the general division of "die" machines, as distinguished from "mold" machines, the former comprising such machines as form, by means of a die, or its equivalent, a continuous bar or slab of the clay or other plastic material operated upon, which is subsequently cut into blocks of proper lengths to form the brick. The "mould" machines, on the other hand, form each brick in a separate mould. The machine about to be described tempers its own clay with water, taking the clay as it comes from the bank, without any previous handling or preparation, and forms it into bricks, with sharp, well-defined corners and smooth, straight surfaces, at the rate of from 50 to 80 per minute, or from 25,000 to 35,000 per day of ten hours.

The essential parts of the Chambers "B" brick machines, are, the tempering mill, the impelling screw, the forming die, and the cutters. Their construction and operation will appear from the following description: A longitudinal section through the case of the machine is shown in Fig. 2, giving at a glance the disposition of the knives upon the shaft, the impelling screw, and the die. Fig. 3 is a transverse section, showing the disposition of the knives and the direction of their motion; while Figs. 4, 5, 6 and 7 show the several details relating to the forming die. The tempering mill is contained in the cylindrical portion of the machine, and consists of a strong iron case, in which revolves a horizontal shaft. To this shaft are attached a number of strong tempering knives, consisting of a series of blades of steel set spirally, the object of this arrangement being, that as they pass through the clay they shall at the same time move it forward towards the impelling screw. The clay is fed into the tempering portion of the machine through the hopper shown in the cut, and which, to avoid packing or clogging, is made somewhat larger at the bottom than at the top. The condition of the clay as fed into the tempering mill, as regards moisture, should of course be such as to leave it stiff, so that it shall not slip before the knives, but be cut through and through and thoroughly mixed. When it reaches the impelling screw, therefore, it will be ready to be formed into bricks.

The second portion of the machine is the screw, which is contained in the conical portion of the iron case. The interior of this portion of the case is ribbed, with the object of preventing, the clay from revolving in it, and is chilled to prevent wearing. Upon the smooth surface of this screw the tempered clay is impelled forward and forced in a continuous bar through the third portion of the machine—the forming die, which has an orifice corresponding to the transverse section of a brick.

As the clay issues from the orifice of the die, it is carried forward by a plate to the cutting device. This consists of a thin blade of steel, in the form of a spiral, the distance between the threads of the spiral being the exact length of a brick. This spiral knife runs perpendicularly in a flat endless chain, which supports the bar of clay at one edge and at the bottom, by which arrangement a smooth, square cut is insured, the equality of pitch in the spiral insuring equality of length in the bricks. An ingenious governor and frictional device is provided, by which the speed of the spiral cutter is made to depend on the speed of the issuing bar of clay, which will vary slightly, according to its stiffness. By these devices, the speed of the knives is directly proportioned to the speed of the issuing bar. To provide against the cutters being affected by the presence of stones in the clay, the wheel to which they are secured is held in position by means of gravity, which holds it with just sufficient force to compel it to pass through the bar of clay. Should the knife meet with any extra resistance, such as would be caused by the presence of stones, sticks, and the like, the weight yields and allows the knife to move up, and thus cuts around it, the knife immediately failing back to its original position, ready to cut through the bar further on. The bricks thus cut from the continuous bar are then separated and carried by an endless belt any distance convenient for off-bearing on cars or barrows. The bar is sanded with fine sand, which, adhering to the moist surface of the bricks, renders them better fitted for handling, and prevents them from sticking together on the barrows or in the hacks. In the machines at present built the dusting chamber is placed in the end of the case, directly in front of the die.

To secure sharp and hard edges to the issuing bar, and to the bricks made from it, Mr. Chambers has introduced an ingenious modification in his forming die, which makes with a varying cross section, giving it a peculiar enlargement at the corners at its commencement. Having thus placed an excess of clay at the corners, the gradual contraction of the die results in packing the clay hardest in the corners, and brings the bar out with the desired hard and sharp edges.

Should a stone or other obstruction too large to pass through the screw find its way to it, the flow of clay will be forced to issue at the safety valve provided for the purpose, and thus make known the presence of the obstruction, which may be removed. A smaller obstruction lodging in the die, will show itself by splitting the issuing bar of clay, and may be at once removed by swinging open the die, which is hinged to the case for this purpose.

The makers of this machine have overlooked nothing in their efforts to perfect it. It is because of their attention to many practical and seemingly unimportant details that much of the substantial success they have achieved must be ascribed. For example, all the main moving parts have their journals in one solid casting. The whole machine is self-contained—that is, all complete within itself. It cannot settle out of line; all wearing parts are easily removed. Each casting has a letter and number cast upon it, indicating the size of the machine and the particular piece. They are all fitted to standard gauges, so that by sending the letter and number, any piece can be duplicated at once, and fit guaranteed. The machine is replete with little conveniences and requirements for its easy care and durability. Each oil cup has a self-closing lid, so that it cannot carelessly be left open. Each journal has a dirt-band over it to prevent the dirt from working into it, and many of them are entirely closed at one end for protection.

It is attention to such matters are these, which many makers of really excellent machines frequently overlook, that often makes the difference between success and failure. The manufacturers of this brick machine are so well satisfied with its merits that they announce the standing offer to sell to any responsible brickmaker in the United States "subject to trial and approval."

For any further information desired, address Chambers, Brother & Co., Philadelphia, Pa.

TIMBER SUPPLY.

There are few questions more important to Western Ontario farmers than the question of timber culture for future use. Forests have been cut down with almost criminal waste and no new ones planted, and even in the Orillia districts ten years will use all lumber fit for the saw. While the future lumber supply has been much talked of, a few farmers in that neighborhood, show the question not so hard of solution. Having planted a few acres of poor land, they found it does not require many years to grow profitable timber, and that if its culture were properly understood there is little occasion to offer any inducement to plant beyond the self-interest involved in itself, just as there is in any other business pursuit. The man who plants an orchard does not expect to get any return until it is ten or fifteen years old. He knows that if he wants to sell his farm before the trees bear fruit, the statement on the sale-bills that it contains "an orchard of fruit trees just coming into bearing," will help the bidding wonderfully, and it would be the same with the trees if the timber question were properly understood. These parties state that a piece of woodland properly planted will come into use as quickly as an apple orchard will, and a farm of one hundred acres that had a few acres of young forest would bring far more than the additional cost of planting, should the farmer be forced to sell before the timber matured. All this implies that it be properly located. It would neither be prudent nor profitable to plant where a whole acre of timber could be bought for a few dollars any more than it would be wise to plant apple trees the fruit of which nobody would buy. There is, however no doubt that in fifteen or twenty years, over a large district of our Province, timber will be scarce and lumber high-priced, and that those who plant now will be well rewarded though the trees be not large enough for saw-logs then, yet the little plantation would come well into use for fuel and other purposes. Every one who owns a farm should look about him and see how the timber prospect is, and, if he sees a probable scarcity in the market or in his woodshed, plant a few acres to supply the deficiency.

—A correspondent writes that "Tar is instantaneously removed from hand and fingers by rubbing with the outside of fresh orange or lemon peel, and wiping dry immediately after. It is astonishing what a small piece will clean. The volatile oils in the skins dissolve the tar, and so it can be wiped off."

Mechanics.

THE MIGHTIEST LEVER IN THE WORLD.

The colossal crane at Woolwich, which has been upwards of four years in process of erection, recently assumed a definite shape in the operation of fixing the great girder, and the character of perhaps the most powerful piece of mechanism in existence can now for the first time be understood at a glance. The girder radicates upon a central pile, with the outer extremity of the arm supported upon a wheeled tower, travelling on a circular railway which encloses about a quarter of an acre of ground. The extent of the work is further illustrated by the weight of the iron employed in its construction, which in the aggregate exceeds 1,800 tons, while the brass bearings alone amount to more than three tons. When completed, the crane will be capable of lifting three or four 100-ton guns at once; but the purpose for which it has been provided is not to do work which other appliances could accomplish in detail, but rather to meet the probable necessity for dealing with specimens of ordnance so enormous as to defy all the means at present available for mounting them on their carriages. The motive power will be steam, supplied from the adjacent boiler-house, and working a pair of cylinders suspended from the central crown and revolving with it, but inside a group of eight columns, which support the structure. Along the upper surface of the girder the lifting carriage travels, bearing below the lifting blocks, the whole of the gear being put in action and controlled by one man at the central cylinders. The girder traverses at a height of 50 feet from the ground, and the carriage upon it makes the total height 70 feet. It is 75 feet long from the center to the revolving power, which consists, like the central group, of iron pillars firmly bound together. The carriage upon which the power rides is a double bogie truck, riding on rails, 12 inches in breath, with the ordinary gauge of 4 feet 8 inches. These rails run completely round the compass, making a circumference of about 430 feet, and the sweep can be made in either direction at a fair speed. Although calculated to raise 1,200 tons in case of need, the apparatus will also be fitted with a light gear for raising small weights at accelerated speed, and it is anticipated that even in the ordinary daily works of the Royal Gun Factories, to which department it belongs, it will prove a valuable auxilliary.—*Manufacturer and Builder.*

THE FARMER'S DEPENDENCE ON MACHINERY.

Following is an extract from a well thought article in *Capital and Labor* of London: which is well worthy the attention of farmers who are too short-sighted to move with the times.

The mechanical power of the age is like a series of concentric and eccentric circles, of which the farmer stands out in the principal center. These all revolve with and about agriculture, and the same force sets all in motion. It is the farmer's duty now to make the most of his opportunities. He should be the foremost man of the age. His influence should be felt everywhere. It is felt everywhere, for the wealthiest merchants and capitalists, and the most active politicians, all ask themselves how far the farmers can be depended upon before they make a movement in their special pursuits. But the farmer should feel this himself. It is one thing to have a power, and another thing to be cognizant of its possession. Let the farmers consider now their position, and as take a view of it let them consider what they owe to the power and influence of machinery. One most conspicuous example of the results pointed out may be noted. A few years ago Minnesota spring wheat was graded very low in the grain markets and brought a low price. Unfortunately for the Western farmers, this grade of spring wheat was the only one they could produce. A new process in milling was introduced. Elaborate machinery was invented to perfect the process. The best wheat by this process was the grade known as "Minnesota Spring," therefore despised and rejected—literally "rejected," in fact, in the markets. Afterward this grade became sought by millers, and the value advanced to a point equal to and sometimes more than that of the previously much-sought winter wheats. If Minnesota farmers produce forty million bushels of wheat annually, this advanced value, due to the new process, put several millions of dollars yearly into their pockets; and what a vast amount of comfort and happiness may be secured by the right use of so much money! This is but one instance of the vast concentration of circumstances which points out the moral here alluded to.

IMPROVED HYDRAULIC ELEVATORS.

Of late much attention has been directed to the improvement of hoisting apparatus, and the greatest amount of skill and ingenuity has been expended in increasing their safety and convenience. Much of the improvement in the character of this class of machinery is directly traceable to the constantly increasing introduction of elevators for passenger service. For this purpose the elevator has become absolutely indispensable, and it is fair to infer that the increasing concentration of business in certain quarters of our cities, which is accompanied with an increase in the value of land, and a correspondingly increasing tendency skyward of business houses, hotels, etc., will cause an increasing demand for machinery which saves so much time and muscular effort, and which materially enhances the value of the upper stories of high buildings by making them as readily accessible as the lower ones.

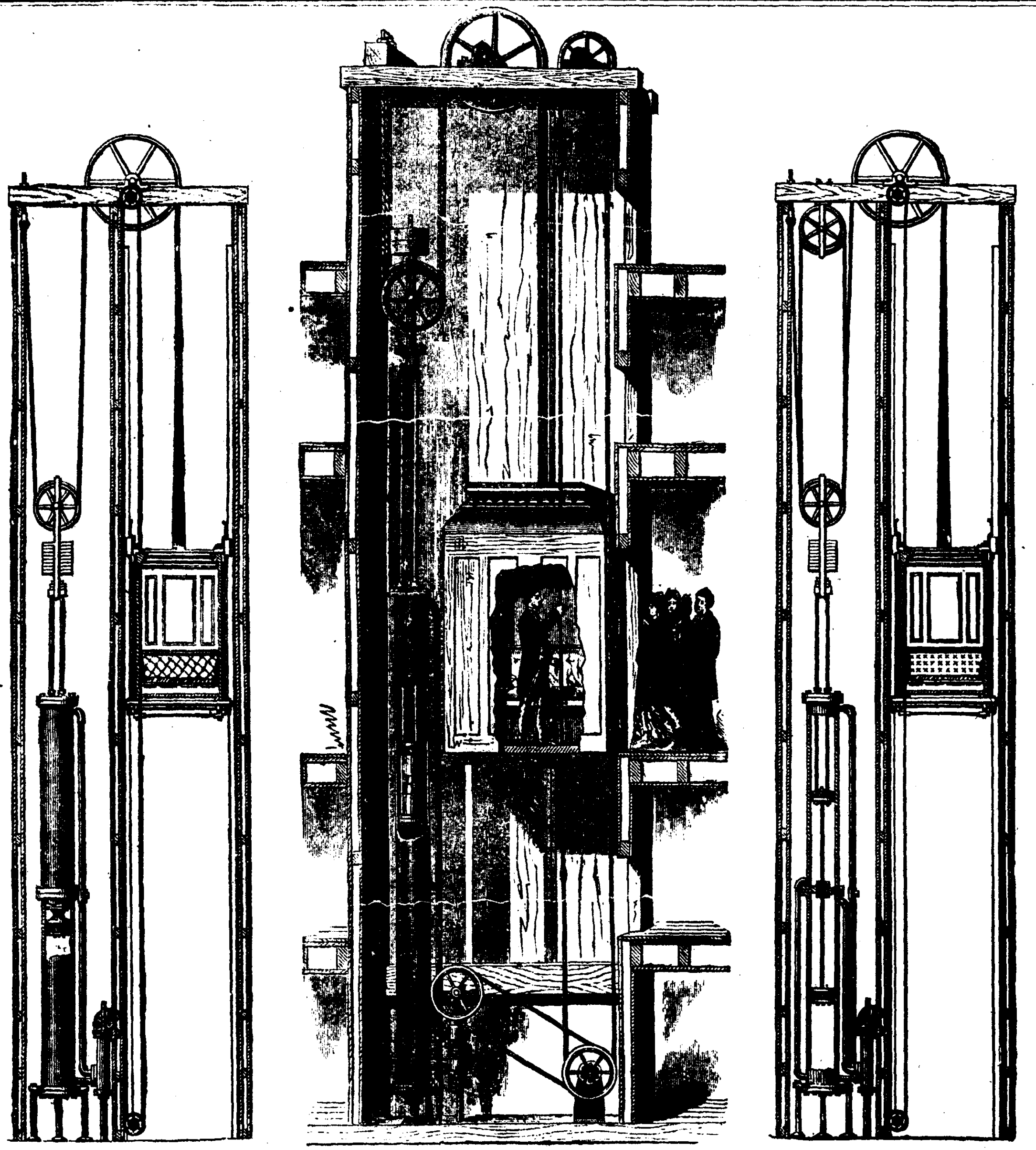
The first passenger elevators were simply improvements on the freight cages, but their liability to accidents did not recommend them to public favor. Safety appliances in the form of extra supporting ropes, clutches, catches, etc., were provided in time, and by doing away with many of the objections to this class of machinery, fairly inaugurated the era of passenger elevators, until to-day a large building without an elevator is regarded quite incomplete as though it lacked heating apparatus and similar indispensable conveniences.

An objection urged against the introduction of elevators, was the necessity of employing steam as the motive power, in the use of which it was impossible to avoid a certain amount of roughness of action. This objection, in turn, was happily overcome by the substitution of hydraulic power for steam, and in the improved hydraulic elevators generally in use to-day, we have an apparatus which very fully meets the public requirement of a smoothly operating and safe means of ascent and descent.

Otis Brothers & Co., of 348 Broadway, New York, have devoted much time and attention to the perfection of the hydraulic elevator for freight and passenger service, and having succeeded in securing for their apparatus an excellent reputation for convenience, simplicity and safety. We illustrate in the accompanying engravings the hydraulic elevator for passenger service made by this firm, accompanied with a brief description of its details.

The motive power for running this elevator is derived from the pressure or weight of water in a tank situated in the upper portion of the building, or from the water pipes of the city. This pressure is brought to bear upon the top of the piston B, while below it the normal pressure of the atmosphere is utilized. These forces are applied to raising the car, the water being also drawn from the cylinder below the piston. The car is connected with the piston by a number of wire ropes which are passed up over a fixed pully wheel, and thence to the traveling sheave A, and their standing parts are secured above, as shown in the cut. By a recent improvement, the counter-balance weights connected with the traveling sheave have been placed in the cylinder. The united weight of the sheave and the piston counter-balances that of the car. The piston is secured to the sheave, and works up and down in the cylinder C. When the piston reaches the upper extremity of the cylinder, the car is at the bottom of its route, and if the operator then desires to make the car ascend, he pulls the valve rope, which the cut shows him in the act of grasping; the valve D is then opened, which causes the water to enter the pipe E to the top of the piston, and at the same time F is also opened, which permits the water in the cylinder below the piston to escape. Our readers will observe that by discharging the water during the ascent of the car, the pressure of the atmosphere is utilized down to the level of the discharge, and thus the maximum of power is secured, while the water in the cylinder acts as a brake in lowering the car; and it is these features especially which give these machines a special advantage over others in the market.

The weight of the car is counter-balanced, as above mentioned, by that of the piston and sheave, and, therefore, the resistance to be overcome reduces itself to that of the load to be carried together with the inertia of the various parts. Opposed to this we have, first, the weight of the air, which is 15 pounds per square inch above the piston, which is obviously gained through the escape of the water below, the cylinder being always full; secondly, the absolute weight or pressure of the water itself acting on the piston which may be derived from the city mains, or may be due to a difference of level between the bottom of the cylinder and a tank located in the upper story of the building. The result will be the elevation of the car, and the water escaping may be raised to the tank in the upper story if desired, and used over again.

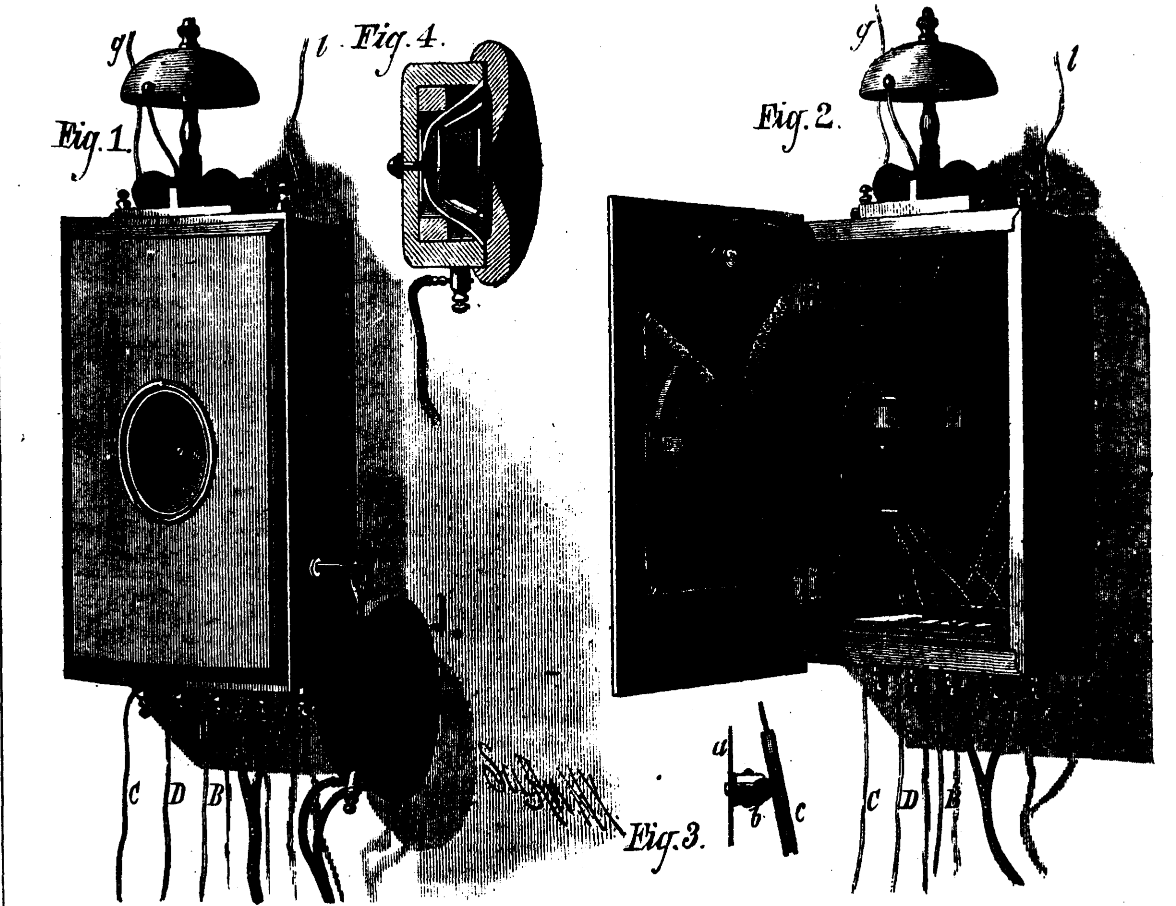


OTIS BROTHERS HYDRAULIC PASSENGER ELEVATORS.

No direct application of power is made to cause the car to descend, the valve-rope being pulled by the operator in the opposite direction to that described above, when the water above the piston passes out, and the piston ascends, being moved by the greater weight of the car, which sinks with a smooth and steady action, its speed being easily regulated by the operator by opening or closing the valve. A certain range of speed is allowed him, though there is a fixed maximum which cannot be exceeded. The car stops automatically at the top and bottom of its route, and it may be called by means of an operating rope. In these machines every probability and possibility of accident has been carefully considered and guarded against. All the parts of the machine are made not only strong enough for the work required, but many times stronger than extreme prudence would dictate, and the manufacturers have spared neither pains nor expense in the effort to make their elevator absolutely safe. All the moving shafts are of steel, and all the other parts, excepting the car, of iron.

The quantity of water required for running the Otis elevator, and the attendant expense, is reduced to a minimum, the friction to be overcome being materially lessened in comparison with that of other machines of the same class, by the careful attention given to the mechanical perfection of details of construction. They are ready for use at all times, day or night, and can be operated by any person of ordinary intelligence.

These elevators have so well demonstrated their adaptability for their intended uses, that they have come into very general use for freight and passenger service in all the large cities of the United States and Canada, in governments and other public buildings, hotels, manufactories, business houses, stores, and private dwellings ; and we are safe in making the statement that they realize most fully the desirable conditions of extreme simplicity, the highest economy, and safety in action. Among the many prominent buildings in New York in which these elevators are employed, we may mention the Morse Building, Borell Building, Post Office, United Bank Building, and the stores of Arnold, Constable & Co., and Stewart & Co.—*Manufacturer and Builder.*



SIMPLE TELEPHONE TRANSMITTER.

NEW TELEPHONE TRANSMITTER.

BY GEO. M. HOPKINS.

The microphone, with pendants, figured and described by the writer in the *Scientific American* of Nov. 16, 1878, was among the earliest of telephone transmitters, and although the device was crude in appearance and exceedingly simple in its construction, it contained the germ of a successful instrument, and was favourably noticed in the scientific papers of Europe.

The transmitter shown in the annexed engraving is based upon the same principle, and, so far as the devices for varying the currents go, it is even simpler than the original microphone. Fig. 1 shows the exterior of the instrument, Fig. 2 the interior, Fig. 3 a detail of the transmitter proper, Fig. 4 a sectional view of the receiver, and Fig. 5 is a diagram showing the battery and line connections. Everything, excepting the battery bell and receiver, is contained in the box. In the centre of the cover is formed the mouthpiece, behind which is placed the diaphragm, consisting of ordinary Russian iron of the thickness commonly used in stove-pipe. It is $2\frac{3}{4}$ inches in diameter, and is held in position in a circular cast iron frame by two springs attached to the frame and pressing the diaphragm. The edge of the diaphragm is bound with soft rubber or felt. This arrangement, however, is not essential to the successful working of the instrument, as equally good results may be obtained when the diaphragm is clamped tightly at the edges between two rings fastened with screws to the front of the box.

To the centre of the diaphragm *a* (see Fig. 3) is attached a metal clamp, *b*, which supports, in a horizontal position, a cylindrical pencil of hard electric-light carbon, $1\frac{1}{4}$ inch in diameter and 1 inch long. A disk, C, of battery carbon $1\frac{1}{4}$ inches in diameter and $\frac{1}{4}$ inch thick, is grooved around the edge and wound with fine copper wire, which terminates in a flexible spiral connected with the upper hinge of the box. The

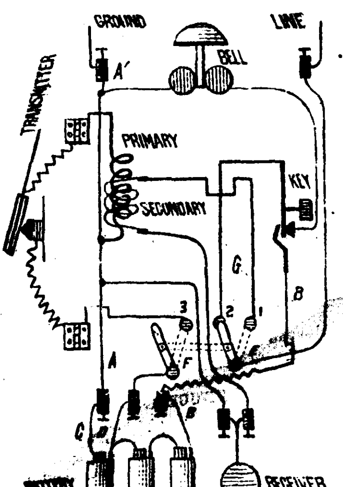


Fig. 5.–Telephone Connections.

carbon disk is suspended by a silk thread from a spool formed on the inner end of a screw extending through the box cover, and capable of being turned so as to raise or lower the carbon disk, as may be required. The disk is slightly inclined from the perpendicular, and the line of contact between it and the carbon pencil is a little above the center of gravity of the disk. This arrangement of the two carbons prevents any marked break in the local circuit, as the disk tends to rock on the carbon pencil rather than fly from it when the diaphragm is set in vibration. The carbon disk has been saturated with melted paraffine in some instances with beneficial results.

The clamp which holds the carbon pencil is electrically connected with the lower hinge of the box. From the hinges the connections may be more easily traced in Fig. 5 than in the perspective views.

This diagram shows all of the connections for one end of the line, both ends being alike. The connections are shown in condition to call or receive a call. When a call is received the current passes from the line through the switch, E, button 2, key, bottom or outer contact of the key, bell-magnet, and ground wire, A, to the ground. When the key is depressed to call a distant station, the key touches the inner or top contact, on the battery wire, B, sending the current through the button 2, switch, E, and line to the bell and ground of the distant station. The current returns by the ground and wire A, to the battery. After calling, the switch E, is moved to button 1, and the switch F, being connected with the switch E, by an insulating connection, is at the same time moved to button 3, as shown in dotted lines. Now the line connection is through the switch E, button 1, wire G, secondary wire of the induction coil, and receiver to the ground. The switch F, when turned as described, completes the local circuit, the current passing from one cell of the battery through the wire D, switch F, button 3, transmitter, primary of the induction coil, ground wire A, and wire C. The connections are now correct for talking. The diagram shows the connections adapted to the class of transmitters employing but a single battery element, and to a line requiring several cells of battery to call. If a single cell of battery is sufficient to call, the posts of the wires B D, will be connected together.

The button which moves the switch extends through the side of the box below the hook upon which the receiving instrument is hung. This arrangement insures the readjustment of the switch after talking, as the receiver cannot be hung up until the witch is pushed in.

Three layers of No. 18 silk covered wire form the primary of the induction coil, and the secondary consists of some ten or twelve layers of No. 36 silk covered wire.

The receiver, shown in section in Fig. 4, has a diaphragm of the usual size mounted in a hard rubber case 2⅛ inches in internal diameter and 1 inch deep. The bobbin of the usual style is placed on a soft iron core having a large convex head, and held in place by a screw extending through the bottom of the case. A soft rubber button is placed between the casing and the convex end of the core, and eight curved permanent magnets, one-eighth inch thick and one-quarter inch wide, touch the convex end of the bobbin core and are pressed upward into contact with the diaphragm by a rubber ring at the bottom of the case. The diaphragm at its points of contact with the magnets is freed from japan or oxide, and the ends of the magnets are let into notches cut in the case, so that when they press upon the diaphragm the latter is backed by the mouthpiece.

This receiver is very compact and light, and as to efficiency it is all that can be desired.

The transmitter works well, is perfectly simple, requires no particular care in its manufacture, and never gets out of adjustment.

Mining, Metallurgy, Mineralogy.

REDUCING ORES.

Levi Stevens, of Washington, D.C., who, it will be recollected, was in San Francisco some years ago with a patent furnace for smelting ores by petroleum, has devised another process of reducing ores. There was considerable excitement at the time of his visit here, on the subject of low grade ores, and he sold rights to use his furnace, for an aggregate sum of $40,000 or $50,000, though it never came to anything.

His new furnace is triple in its character, by which it performs the threefold office of smelting, matting and roasting in one continuous operation. The products of combustion, after performing their function of smelting the ores, operate further summarily to mat and roast them.

In connection with this furnace he has a process of reducing ores by forcing superheated steam together with air through incandescent coal in a gas generator, thereby producing rapidly a large quantity of gas of high heating quality. This inflamed gas is conveyed in its highly heated condition immediately onto the ore.

A hot air chamber is placed in the top of the gas generator, and in connection with an air jacket, covering, or partly covering, the top of the furnace. Through the air jacket is forced atmospheric air, which serves to absorb the heat that would otherwise be radiated from the top of the furnace, and conveys it to the hot air chamber, from which it is discharged in the form of a hot blast, to perfect the combustion of the gases as they pass the bridge wall. The body of the furnace is made in the form of an inclined shaft, comprising, in sequence, a smelting, a matting, and a roasting chamber. The bed of each of a series of shelves above the matting furnace is formed with openings, through which air is admitted, and through which, also, the ores can be moved from any shelf to the one below, and so on down, exposing the said ore to the action of the heat from within the furnace, and also to air drawn in through the openings, as they are moved from the upper to the lower shelves; and keeping each charge of ore separate from the more thoroughly roasted ore below, and the less thoroughly roasted ore above, until moved into the matting furnaces from the lowest shelf.

After the fire had been built in the gas generator or fire box, and the fuel is incandescent, ore is put in through a hopper. Superheated steam is injected into the ash-pit. This produces a powerful blast through certain parts, and the dry steam and air are forced up through the incandescent fuel. The steam is decomposed into its elements, thus aiding combustion. The hot products of combustion, at a turning point provided by the construction of the furnace, are met by a current of hot air. These joint currents, producing almost absolute combustion of the fuel, and multiplying the quantity of inflammable material by reason of the additional hydrogen, or carbureted hydrogen, derived from the injected steam, thereby, the inventor says, giving to the incandescent gases, which are finally deflected upon the matted ore on the bed of the melting chamber, an intensity of heat, which only the most refractory substances can resist.

The products of combustion, having thus operated to melt the ore, continue on through a chamber where they mat the ore still on its way to the melting chamber, and next through another chamber, where they encounter air entering through other openings, which serves to ignite them afresh, thus aiding the operation of roasting. This accomplished, the gases pass into the chimney and escape, the inventor having done about as much with them as could be expected.—*Mining and Scientific Press.*

THE ALASKA MINES.

DESCRIPTION OF THE NEWLY DISCOVERED DISTRICT.

While the southern Territories of the United States are just now attracting a large share of attention from the mining community, the northern Territory of Alaska is also putting forth its claims as a mining region; and it is probable that the coming summer will see many prospecting parties in the field. Last year there was considerable prospecting done, but the winter of course, stopped work generally. It has been somewhat difficult to get any reliable news from the various camps which are being opened, and reports have been somewhat conflicting. Mr. Geo. E. Bilz, who is now at Sitka, writes, however, to the *Mining and Scientific Press*, a letter in which he communicates considerable information of interest concerning the mines; and as he has evidently personal knowledge of the matter, his statements are more direct than any before received. Mr. Bilz's letter is as follows:

EDITOR *Press*:—I think it probable that as you have not heard for a long time from this part of the coast (Sitka), a few notes in regard to certain newspaper reports may be of advantage to the readers of the *Mining and Scientific Press*. During the past summer, feeling confident of the mineral wealth of Alaska, I fitted out seven different parties to prospect, each with six months' provisions and equipments. I also paid each party, which consisted of five or six men, regular wages; as otherwise I could not expect to have the prospecting of the country done to my own satisfaction.

The last of the seven parties returned in the latter part of

November, and brought here to Sitka, on a canoe, about two tons of the richest quartz I ever saw in any country. I went up to this new El Dorado, leaving here on the 25th of November, and arrived there, on a canoe, on the 29th of the same month.

The district is called after the discoverer, "Harris district," and is situated on the main land of Alaska, between the Takou and Chilcat river, in 58° 28' north latitude and longitude 134° 10', within four miles of Stephenson's straits, opposite Douglas Island, on the northern end of Admiralty Island.

The discoveries of the ledges and placers were first made on Gold creek, but since traced and found in Salmon creek and Glacier creek, five and seven miles northwest respectively, and in Sheep creek, three miles southeast. The same ledges and ores were found 30 miles southeast, and in Windham, Spruce and Sehug creeks, where, for the last five years, the placers have been paying well to a small lot of men. In Gold creek and its tributaries some 60 claims are now already taken up and staked out, and on all very encouraging prospects have been found. They may be called $5 to $20 diggings. But very little can be done there before April or May, as the men are not prepared to work yet, and are only getting ready and prospecting their grounds.

THE LEDGES.

The ledges which made these placers are at the head of the creek, and cross the creek twice in a distance of about two miles. There is but one belt of them, which is about 3,000 ft. wide, and in it the six main ledges run parallel to each other, besides a number of smaller veins, but which are taken in by the main locations, as those are only about 300 to 500 ft. apart, and are from 6 to 30 ft. in width. These lodes, which show bold cropping for over three inches (so far as I have been on them), hold very regular in size and distance apart, and the whole length show the richest kind of ore. The quartz is imbedded in soft slate, and is quite decomposed and brittle. The gold is mostly free in the quartz, but the richest ore is in the galena, which is the only disadvantage of the ore, as I expect it will interfere with the amalgamation; yet the gold is quite coarse and very heavy, so that it will readily concentrate with the galena to be smelted there. I have made upward of a hundred assays, both fire and wet, and the lowest assay out of the very poorest piece of quartz yielded $33 per ton, while the average of my assays which might be also called average of the ledges, are 285 per ton, and run from $100 to $5,000 per ton; and then I have never yet assayed any specimens.

The ledges were respectively called the Jamestown, Takou, Pilz, North Star, Montana, California lodes, and on each there are claimed already six locations of 1,500 ft. each, with plenty of ore on all of them. In the creeks lie thousands of tons of the richest kind of ore, every piece of which shows the gold plainly, and a good many of the placer claims are vaulable for the quartz which lies on them.

WATER IN THE CREEKS.

There is an abundance of water in the creeks as they are fed from eternal snow banks high up in the mountains, and there were on the 15th of December, all of 3,000 inches running, which is the lowest water of the year. There is nothing to prevent working these mines the year around. As far on as this (January 18th), in the season, we have had only six days of frost, and now there is no snow as far as 1,000 ft. above sea, and it rains a good deal, of course, in the high mountains. It snows in the higher mountains.

The country is thickly timbered with red and black spruce, black pine, hemlock, alder and red birch, not so tremendously thick as on the island, as there is 100% more moisture on the archipelago than on the main-land.

The way to it is very easy and any large vessel can sail to the mouth of the creeks and anchor within 200 ft. of the shore. Already I have had a 150 ton steamer up there, taking up my men supplies, and by the middle of February, I expect to have the mail steamer *California* running up there with lumber and supplies. Outside of this district one of my parties found

A SILVER ORE DISTRICT.

Between Lynn canal and Youiatate and Hoonah Island. The ore they brought from there is most encouraging. They brought some chloride and some bromide silver ore which is quite high grade, and they claim to have plenty of it. They also bring samples of argentiferous galena, from a whole mountain of the kind, which yields 40 per cent. lead, and $25 to $60 per ton in silver.

Another ledge they report quite large, the samples yielding from $30 to $120 in silver and $60 to $100 in gold. They report also and bring fine samples of copper-silver glance, antimonial silver, and sulphurets of copper, in large quantities. This is called Morrisana district, and I shall visit it early in the spring in the U. S. N. steam launches. I must not forget to give due credit to Commander Glass and the other officers of the U. S. ship *Jamestown*, for their ready assistance to us prospectors, they having done everything in their power to further our efforts. You will please continue to send me the *Press*, and send me also a set of back numbers from July last.

Yours Respectfully, GEO. E. BILZ.

Sitka, Alaska, Jan. 25, 1881.

Carriage Maker's Work.

BRISTOL LIGHT SPRING MARKET CART.

(See Illustration.)

For agricultural, farming and dairy purposes two-wheeled vehicles are very extensively used in England and France, and late statistics show that in the latter country 75 per cent. of the vehicles used for transportation outside of the cities are two-wheelers.

We have not the least doubt but that the advantages of two-wheel wagons for almost any purpose will be recognized all over the country at no distant day, the same as has been the case with carriages (or so-called village-carts) and delivery wagons.

Our present design is a Light English Market Cart, built by the Bristol Wagon Works Company (Limited), Bristol, England, who are supplying most of the wagons and carts for the Prince of Wales' estates.

The body is suspended on three springs, namely, two half elliptics on the sides and a half-elliptic cross-spring, an arrangement which, for a two-wheeled vehicle is, we believe, not unjustly considered to do the same service as platform springs on a four-wheeled wagon.

This will form an interesting and timely subject for further discussion at an early day.

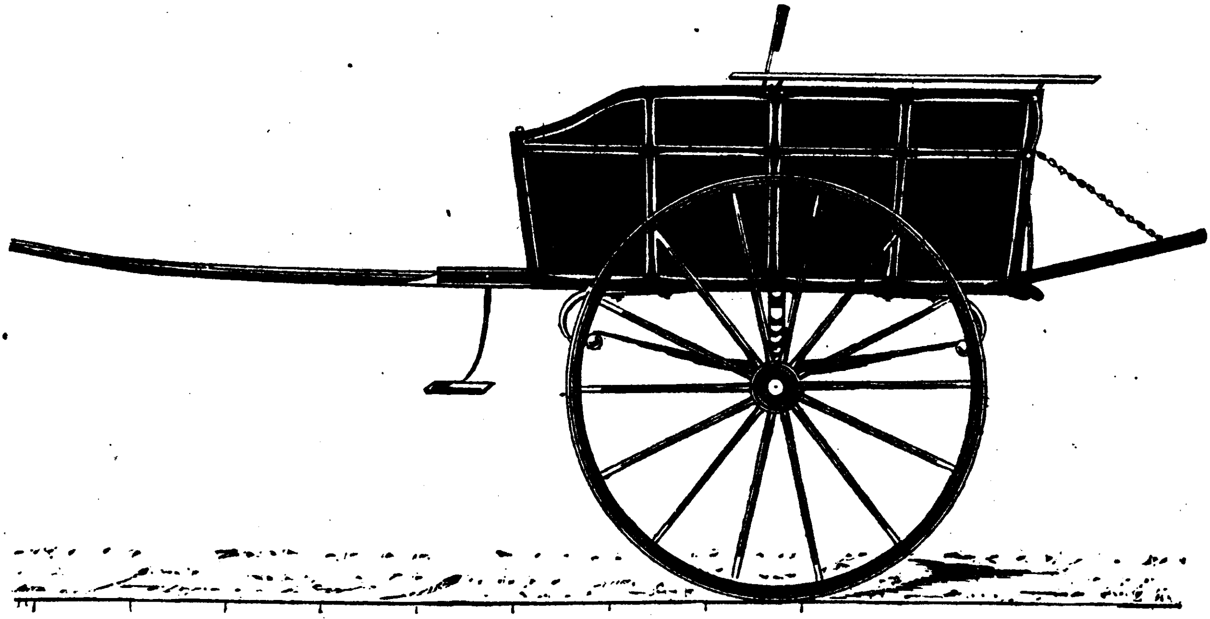
Our design shows the tail-board down and also the lazy back of the driver's seat. The latter can be slid forward if the load requires it, and in this case the front panel of the body is also made to drop, forming what is called a "bracket front."

This cart is fitted with a patent axle; the seat board is portable, making the vehicle adapted for general market purposes and also for conveying boxes or baggage.

Three sizes of this cart are made, viz.: No. 1 pony size, to carry 10 cwt., wheels $1\frac{1}{2}$ in.; No. 2 cob size, to carry 15 cwt., wheels $1\frac{5}{8}$ in.; No. 3 full size (our illustration), 20 cwt., wheels $1\frac{3}{4}$ in. Prices in England respectively £16 10s., £18 10s., and £20.

THE LUDLOW IMPROVED GEAR.

Since the days of Egypt's glory, when the nations of the earth flocked to her granaries for food, and the patriarch Jacob wended his way through the scorched and barren plains of Palestine to the well-stocked storehouses of his long lost son, in a wagon of clumsy build, having revolving axles and solid wooden wheels, without springs, to this, the 19th century, has the skill and ingenuity of man been taxed to produce a perfect wagon. History is almost silent as to the details of improvements made by each century, but from time to time a point was gained. The wheels were made lighter and neater, and revolved on the axle instead of with it. The hub, felloes, spokes and tire followed, heavy, to be sure, but they were in the line of progress. The chariot and cart, with single axles, were followed by the wagon with a double axle, and finally the circle or fifth wheel became necessary. The rich called for an easy riding vehicle, and were supplied with first wooden, then leather, and finally with steel springs. After these points had been gained, it became but a matter of skill in construction, as tools were invented and workmen instructed in their use, to produce the beautiful and symmetrical carriage of to-day. As steel became cheaper and better, all passenger vehicles were fitted with steel springs, removing the jar caused by rough roads from the passenger and adding great durability to the running gear of the vehicle. The form of spring in general use formerly was the elliptic, which is by no means a perfect spring, hence the increasing effort of inventors to improve upon it. First we had the side or Concord spring for light vehicles, the chief fault of which was its rocking and unsteady motion. Finally this defect was entirely overcome in



BRISTOL LIGHT SPRING MARKET CART.—(SEE PRECEDING PAGE.)

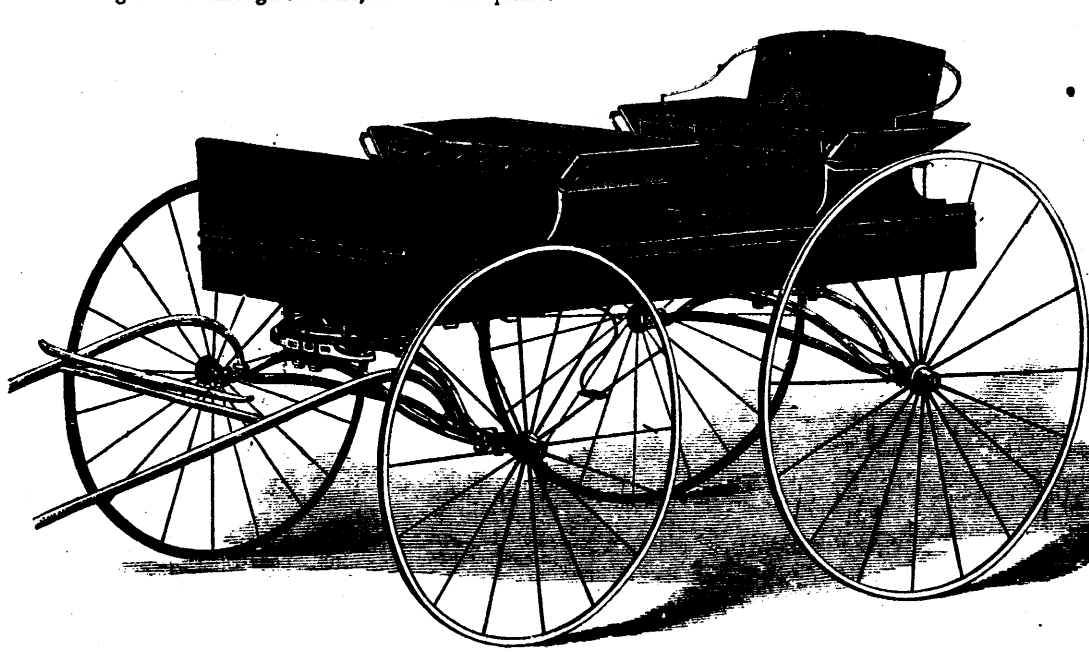
the light, airy, graceful and serviceable Dexter Queen, which has only enough side motion to make it easy riding, while the springs are of such fine temper and quality and so much lighter for their length than ordinary springs that the jolts from uneven roads are thoroughly dissipated before reaching the passenger.

For heavy service the platform spring is very popular. But a rival to both elliptic and platform springs, especially for light wagon service, has recently appeared, and gives promise of meeting with general favor. It is known as the Ludlow Gear, and is the invention of Mr. S. W. Ludlow. It is of peculiar construction and very neat in appearance, as will be seen by our illustrations, and promises to be very durable. The springs are hung to links at each side of the axle, close to the hub. They are uniformly curved both up and outwardly, being at their centre bearing 14 inches apart, and 6 to 8 inches above the axle. In front the springs are attached to the circle, as in the platform wagon, and the rear gear directly to the body. The ends of the springs are hung on links. The top part of the link has a shoulder which goes half through the axle, and makes a perfect journal for the link to vibrate on, taking all strain from the bolt. As the spring is depressed by the load the shackles very freely yield and an easy motion is secured to the body. The Ludlow makes a pretty wagon of light appearance, and hangs very low.

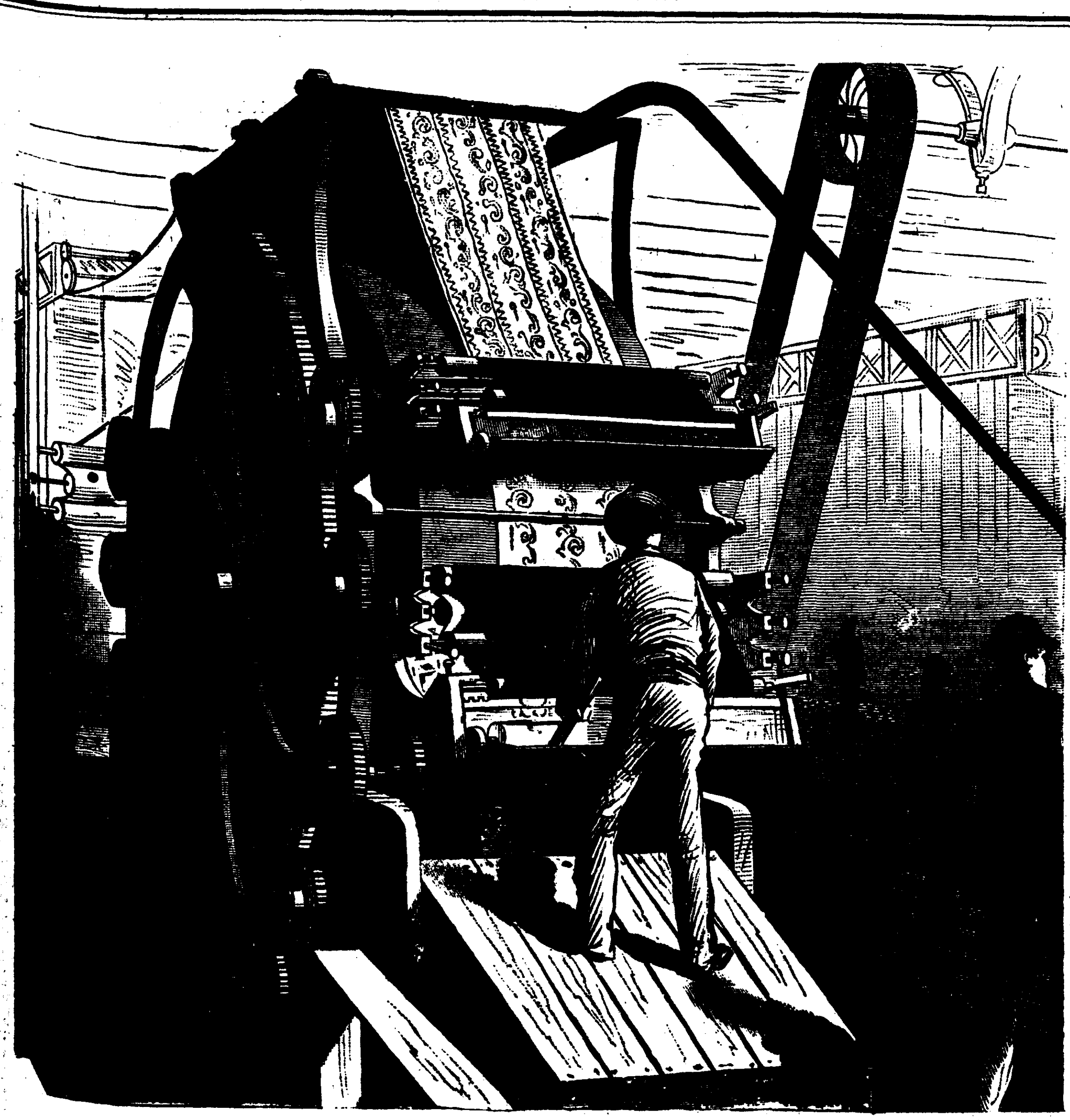
For delivery, depot, sewing machine, or a 4 or 6 passenger democratic wagon it is a decided success.

A recent improvement on the Ludlow shackle is the invention of Mr. A. Warnock, of Galt, Ont., which increases the value of the Ludlow invention very much, as by it a solid boss is forged on the axle, simplifying the parts and substituting wrought-iron for malleable-iron shaft shackles.

The Dexter Spring Co., of Hulton, Pa., holds the exclusive right to build Ludlow Gears in the United States, as also the exclusive use of Warnock Improved Ludlow axle and gear in the United States. Warnock & Co., we are informed, hold the same rights for Canada in both the "Ludlow" and "Dexter Queen" Gears.



WAGON WITH LUDLOW SPRINGS.—(SEE DESCRIPTION.)

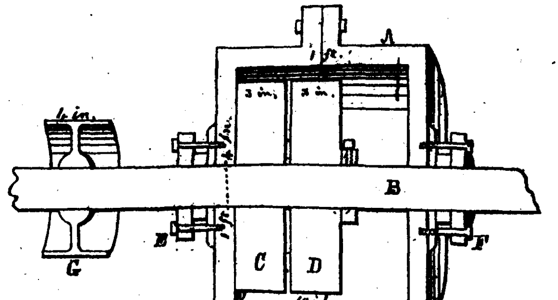


THE MANUFACTURE OF WALL PAPER.—THE PRINTING MACHINE. (See page 83.)

HEAT FROM FRICTION.

That friction will develop heat is often used to demonstrate the familiar law that heat is a mode of motion, and that one may be turned into the other. In mechanical work, the heat springing from friction is regarded as a loss, to be saved, as far as possible, by the use of lubricants, and little practical use has been made of the transformation of motion into heat by friction, except in the common lucifer match. Recently two inventions, originating in this country and differing widely in their objects, have been introduced, with a view to utilize the heat that springs from friction. One of these is the fusing disk, already in use in several iron-works, and the other is a novel system of obtaining sensible heat from friction, for the purpose of warming buildings and railroad cars. The aim of this invention is to transform the motion of a steam-engine, wind or tide mill, or other motor, into heat for warming inclosed air. It consists essentially of two disks of iron, arranged to rub against each other when in motion, and a water-circulating system for conveying the heat developed to the room or car to be warmed.

The accompanying diagram gives a section of the movable parts of this machine. An iron cylinder A, made in two parts, is bolted together, inclosing two iron disks C D. One of these is fastened to the end of the cylinder, and the other is placed on the shaft B that passes through the centre of the cylinder. The disks are designed to be placed together, provision being made for regulating the pressure of one against the other. The shaft



is turned by means of a belt on the pulley G seen in the drawing, and when ready for work the cylinder is connected by pipes (not shown in the drawing) with overflow and return of a common hot water system, such as may be seen in any greenhouse. Stuffing boxes E F are provided for the shaft, to prevent leakage, and when the pipe-system and cylinder have been filled with water (through the usual expansion stand-pipe), power is applied to the pulley. The rubbing or friction between the two disks heats the water in the cylinder, and it expands and circulates through the pipes, heating and warming the room in which they are placed. The amount of heat obtained depends on the amount of friction between the two disks and the power expended in overcoming it. No doubt the water surrounding the disks in a measure reduces the friction by acting as a lubricant, and that in a dry air the heat obtained by friction would be greater, but much of the novelty of the invention consists in the use of the water-circulation to take up the heat and convey it where it is needed. Machines constructed on this plan, having a cylinder 30.5 centimeters (12 inches in diameter, 61 centimeters (2 feet) long, and absorbing the energy of some motor represented by one horse-power, are reported to thoroughly heat 61 meters (200 feet) of water-pipe, or sufficient heating surface to warm a room 9.15 by 12.20 meters (30 by 40 feet). A larger machine, absorbing four horse-power is said to be sufficient to warm a room 18.30 by 61 meters. The horse-power quoted is presumed to mean horse-power per hour, and calling this a consumption of three pounds of coal burned in the boiler, it would seem the larger room is warmed at a cost of 12 pounds of coal per hour. While this interesting invention is reported to be a practical success, it must be observed that it is essentially wasteful. The coal under the boiler supplies heat to turn water into steam, and this in expanding develops energy in the engine, and the friction of the rubbing-disks turns the energy of the engine into heat. Each transformation is accompanied by loss, particularly in the first, for only a small fraction of the heat in the coal is utilized. It would seem better to burn the coal directly in a stove in heating the room. However, power in certain places is cheap, as at a waterfall, tide or windmill, and by such a device as this it may be used to develop sufficient heat to warm shops or dwellings. It can also be used on railway cars, by taking the power from the axles of the moving car, and it has the undoubted merit of freedom from danger by fire or explosion.

The second invention for utilizing the heat of friction is so radically different that there does not at first seem to be any connection between the two. From experiments made within the last year or two, it was found that if a bar of steel was brought close to the edge of a thin disk of metal driven at a high speed, it could be cut, or apparently sawn apart. The action of such a disk was not at first understood, but the invention has been improved, and is now in use in a number of machine shops under the name of the fusing-disk. The name rightly describes the peculiar action of the apparatus. The revolving disk is now made of soft steel, 5 millimeters (3-16 inch) thick at the edge and 106.7 centimeters (42 inches in diameter. This is mounted vertically on a shaft, supported by a strong frame, and driven by steam-power at a speed of 230 revolutions a minute. In front of the disk is placed a lathe chuck for carrying the steel bars to be cut. A round bar, 4 centimeters (1⅝ inches) in diameter, placed in the chuck and turned in the same direction as the disk at a speed of 200 revolutions, and slowly brought in contact with the disk, is cut or fused in two in from two to ten seconds. In examining such a bar when partly cut in two, it is found that the cut portion is wider than the disk, there being a free play or narrow space between the sides of the disk and the sides of the cut, showing that in cutting the bar the disk does not touch it anywhere. It is thought from this that the cutting is really a fusing or melting of the bar, due to the heat developed by friction. The particles of air next the edge of the disk are swept around by its motion and thrown against the bar, and the friction of the air develops the heat that fuses the bar. The bar is clearly melted off, and the explanation offered appears to be reasonable. The fusing disk is reported to be a practical and useful tool, and it will no doubt lead to other interesting and valuable inventions based upon the same principles.

In December last Messrs. Yarrow and Co., of Poplar, received an order for six of their improved first-class, torpedo boats of the "Batoum" type, 100 ft. in length, from the Greek Government, and on the 24th ult. the trial of the first one took place, this boat having been completed in the short period of a little over two months. The remaining five vessels of the same class will, it is understood, be finished in rapid succession.

Cabinet Making.

PRACTICAL HINTS.

Repolishing Old Mahogany Work.—We gather from an authority that the best plan to pursue is to put into a bottle half a pint of alcohol, quarter of a pint of vinegar, quarter of a pint of linseed oil, and one ounce of butter of antimony ; shake them well together. Wash the work well with warm water in which a little soda has been dissolved, and thoroughly dry it. Now roll up a piece of cotton wool into a rubber, moisten it well with the mixture, and rub this briskly over the work until dry. This is a French-polish reviver, and may be used by any one with good effect where there is a moderate body of polish still remaining on the furniture.

Transferring Prints to Glass—Is one of those arts that requires patience and practice. Much depends upon the skill of the transferer in repainting and mending up a print if it is at all broken in removing, and, of course, transparent colors must be used in the painting. These are scarlet, lake, Prussian blue, gamboge, burnt umber and sienna, lamp black ; it is best to have them in powder, and mix them together with equal quantities of Canada balsam and turpentine, and each put, as ready, into a kettle. It soon dries, therefore only a little is taken out at once ; dilute, and work with turpentine, not water. The best varnish to use is shellac. It must be used warm, not hot ; the glass, too, should be warm. The best way is when the varnish is well heated—that is, it must be a little above summer heat—to keep it in the fender before the fire ; have your work there, too, for a few minutes, and finish it there, using a large brush. If the varnish is too cold it will be streaky, thick, and white ; if too hot—a very usual thing—it will rise in bubbles ; it should look like glass. Prints are transferred to wood in the same manner, with the one difference, that wood requires a coat of varnish first, and the prints should have a coat of spirits of wine on the print, and lay it at once on the varnish before it sets. The French use what is called " Mordant " for their transfer.

Preparing Floor for Dancing.—If planed well, paper the floor with sand paper, then wax it with bees wax and turpentine. To prepare it, melt in an iron pot two or three pounds of common yellow wax ; when melted, take the pot off the fire and allow the wax to cool a little, then add one pint of turpentine for each pound of wax, well mix and wash the boards with the mixture, using a large paint brush ; the wax must now be well worked in the boards by friction. The surplus wax may be wiped off with a stiff cloth ; beeswax and turpentine, with friction, is the best plan extant ; in fact, at the present day is still in vogue in many of the chateaux in the south of France.

French Polishing in the Lathe.—You cannot go too fast so long as you do not fire it ; for polish, take 2 oz. shellac, ½ oz. sandarac, and put into half-pint alcohol, and shake it up now and then until dissolved ; use with a rubber of list, flannel, or cotton wadding ; cover with a piece of soft cotton material ; to use, wet the rubber with the polish, cover with rags, and with the finger dab a little linseed oil on it, and apply to the job lightly at first, until the polish is well distributed ; afterwards heavier, and continue until you get what you desire. It requires practice.

Applying Gold Leaf.—Paint the article to be gilded with gold size ; when nearly dry apply the gold leaf, press flat with cotton wool ; when dry, burnish with an ivory paper knife, placing a piece of tissue paper between the leaf and knife.

DIAMOND INK FOR WRITING ON GLASS.

A mixture for writing on glass has lately been put on the market, under the name of " diamond ink," which is pronounced to be a very useful article for druggists and others for labelling bottles containing substances which would destroy ordinary labels. It has been examined and found to consist of a mixture of ammonium fluoride, barium sulphate and sulphuric acid ; the proportions for its manufacture being barium sulphate, 3 parts ; ammonium fluoride, 1 part ; and sulphuric acid enough to decompose the fluoride and make a mixture of semi-fluid consistency. This mixture, when brought in contact with a glass surface with a common pen, at once etches a rough surface on the part it comes in contact with. The philosophy of the action is the decomposition of the ammonium fluoride by the acid, which disengages hydrofluoric acid, which attacks the glass ; the barium sulphate is inert and is simply used to prevent the spreading of the markings. The mixture must be kept in bottles coated on the inside with paraffine or wax.

Trade Industries.

THE PAPER TRADE OF IRELAND.

Our woollen manufacture has well-nigh disappeared, and as for our cotton trade the less said about its prospects the better. We had, however, twenty-five years ago an Irish manufacture which was a credit to the country, and which, with energy, would have been still retained for us. We allude to the paper manufacture of Ireland, which, at the period we refer to, was chiefly centred in Dublin, where no less than fourteen mills were busily engaged at work, employing on an average 2,400 hands, a considerable number of whom were girls. Now we have two of moderately decent dimensions, manufacturing white paper for other purposes than newspapers, and some four or five doing a not very extensive business in browns, of qualities more or less coarse.

More paper is now consumed in Ireland than at any former period, and yet scarcely a single Irish journal is produed from Irish-made paper. English and Scottish industry has managed to take the trade from us, and there seems to be no help for the matter. Indeed, it would appear idle to expect that in the manufacture of paper we could at all compete with the huge concerns across the water. There everything is in their favor, while here the obstacles to its revival seem insurmountable.

Almost all the great mills of Great Britain are either in the very centres of the coal fields, or in such close proximity to them as to reduce cost of fuel to the lowest point. In this respect the mill-owners of Lancashire and Lanarkshire enjoy an advantage denied to capitalists here. Coal can be delivered to the Lancashire and Derbyshire mills for about six shillings per ton for cartage to the Dublin concerns in the suburbs. This of itself would seem fatal to an extension of the work in Ireland; but when to the low price of coal at the other side is added the superior machinery engaged, the case seems, indeed, a hopeless one. So complete is their system of generating steam by which not a particle of carbon is allowed to go to waste, and so perfect and powerful are their compound engines, that a single ton of coal will now give as much horse-power as a couple of tons did twenty-five years ago. In her paper manufacture England possesses another enormous advantage, in the presence of her numerous cotton mills the refuse of which enters largely into the material of which the pulp is composed, though straw is used more extensively than ever, and a large variety of vegetables is also brought into requisition.

It will thus be seen that the secret of Great Britain's superiority in the making of paper arises from three causes—cheaper coal, the employment of the most powerful and finished machinery, and the possession of an unlimited supply of cotton refuse.

It might then be worth while to consider whether Ireland is so completely out of the running in this respect as to render a revival hopeless. We hold she is not, and that if practical Irishmen with the requisite capital would only take the matter earnestly in hand, the difficulties would disappear. Twenty-five years ago the paper mills of Dublin were capable, not alone of supplying the wants of Ireland, the literature of which was much more contracted than it is at present, but of invading, in some instances, the English markets. We have even sent paper to Belgium and France, where the Irish article, made purely from rags, always commanded a ready market and a higher price than that of the production of any other nation. We are now largely reduced to the necessity of providing for our everyday wants from the mills of Great Britain, while every accessory of a prosperous national trade stands idly disregarded.

Why should not paper mills be erected on the banks of the Liffey—in the neighbourhood of Ringsend, for instance, thus doing away with the heavy cost of cartage to such remote districts as Tallaght, Rathfarnham, and Clondalkin? The lower cost of labour in Ireland, as compared with the wages paid in England and Scotland, should also count for something as against the price of coal. Rags, we unfortunately have in abundance; straw is as plentiful as ever; no country in the world of the same area produces greater quantities of vegetables, so many of which are used in the manufacture of paper; and if our cotton mills are few in number (there being, we believe, three at work in Ireland), their united refuse would add largely to the raw material stock of the paper mills.

But even cotton refuse is not a necessity. As we have said, straw and the various vegetables are with us in profusion; and a cargo of Esparto grass, which makes paper of the finest quality could be had as cheaply in Dublin as in Liverpool or Glasgow. The strong alkalies and other chemicals necessary in the manufacture of paper come almost entirely from North Wales; and surely their transmission to the Liffey would not be a much more costly proceeding than the forwarding of them to Lancashire or Derbyshire or distant Kent, while it should be much less than the rate at which they could be delivered in Glasgow. One other feature might be mentioned in favour of the Irish trade, and as tending still further to equalize the disproportion in the relative prices of coal in the two countries—the freight of the manufactured article from England and Scotland to Ireland.

Water carriage is, of course, the cheapest mode of transmit known, and a ton of paper from Lancashire or Lanarkshire costs a wonderfully small sum to have landed in Dublin: but still it is an item to be taken into the account. We have, then, arrived at this position, that Glasgow, Aberdeen, various towns in Lancashire, Kent, and Derbyshire supply nearly the whole of Ireland's wants in this respect, while our own country remains apparently helpless either to assist herself or to compete in the market of the world. Great Britain gives us the article we require at a cheaper rate than it can be produced for here; and this is largely, if not entirely owing to the absence of the requisite machinery and enterprise.

The North of Ireland has one considerable paper manufactory at Ballyclare, in County Antrim—a limited liability concern, which, we are glad to know, is doing very respectable trade with England. They are altogether in what is known as the "news" trade. There are those, however, who say that if this firm were alive to the situation—if a little more energy were infused into their operations—they might become largely instrumental in restoring the former prestige of the paper industry of Ireland. They give very considerable employment in the little Antrim town in which their premises are located—more than a hundred hands being employed—and certainly every one desirous of seeing Irish industries flourish would wish the Ballyclare company success.

In Dublin, one might count our paper manufacturers on the fingers of a single hand. We have the Newbrook Mills at Rathfarnham (Messrs. Macdonough & Sons), principally devoted to white paper, though not of the newspaper class, and the Swiftbrook Mills at Saggart, Rathcoole, which also make moderately large in whites, but not, we are sure, so extensively as their proprietors, Messrs. John McDonnell & Co., would desire. The smaller owners, who work chiefly in browns, scarcely require reference. They don't extend beyond half a dozen, where quarter of a century ago they were forty.

There was really nothing to prevent an unlimited exten ion of this trade in Ireland, if capital were only applied, and a widely directed energy guiding it. Cannot our capitalists, who seeking investments in foreign securities, many of which might be reasonably regarded as risky, turn their attention to this neglected field of Irish enterprise, benefiting our working population, enriching the country, and securing for themselves remunerative return for their outlay?—*Irish Times, Dublin.*

A Walnut Stain to be Used on Pine and Whitewood.—Take 1 gallon of very thin sized shellac; add 1 lb. of dry burnt umber, 1 lb. of dry burnt sienna, and ¼ lb. of lampblack. Put these articles into a jug and shake frequently until they are mixed. Apply one coat with a brush. When the work is dry, sand-paper down with fine paper, and apply one coat of shellac or cheap varnish. This will give a good imitation of solid walnut. —*American Cabinet Maker.*

THE MANUFACTURE OF WALL PAPER

The use of paper as a covering for walls originated in China. It was introduced in Europe as a substitute for tapestry hangings—whence the term paper hangings—by the French. At the present time, owing to the improvements which have been effected in printing, and the wide range of colors open to the artist designer, it offers probably the cheapest and most ornate means of mural decoration.

The blank paper is received by the manufacturer in the long rolls made by the Fourdrinier machine, and weighing from 80 to 85 lbs. to the roll. It varies in quality according to the printing and finishing which it is to receive—weighing 9, 10, 12, and 14 ounces to the length of eight yards, which constitutes the usual length of the roll as sold at retail. The first process undergone is termed

"GROUNDING,"

and the object is to give the paper the requisite body to enable it to receive the colored pattern. The grounding machine is represented in Fig. 1. While passing over a roller the paper is covered with a mixture of so-called Jersey clay, which contains some 18 per cent of alumina, glue, and water, and if the surface is to be finally polished—or satin finished—a percentage of lard oil is added. After the mixture is applied it is evenly distributed over the paper, first by two reciprocating brushes, then by a rotating brush roller, and lastly by two brushes like the first. It then is conducted up between endless belts across which sticks are laid, and over which sticks the paper is suspended in festoons. The sticks are so placed that a length of paper measuring just four yards ing into the design must be printed separately, so that there must necessarily be as many blocks or types prepared as there are tints in the pattern. The blocks are constructed of two layers of wood, a thin piece of maple fastened to a thicker backing of pine board. Each block is about 26 inches wide, two feet long, and an inch and a half to two inches in thickness. On the maple all of the design to be printed in a single color is drawn and afterward cut out by engravers, so that the lines are in high relief. The more delicate figuring is not made in the wood, but is supplied by the insertion of bent pieces of brass, as we shall explain more fully in referring to the manufacture of the printing rollers further on.

MANUFACTURE OF WALL PAPER.—A HAND PRINTING MACHINE.

hangs between any two. The belts are kept in constant motion, and the paper is thus conducted along the loft, which measures some 160 feet in length. Steam coils are placed beneath the belts and a temperature of 120° maintained. About nine minutes are occupied by any one festoon of paper in making the journey from grounding machine to the point where it is again made into a roll, and during this period it becomes thoroughly dried. Frequently coloring matter is mixed with the ground paint, and the paper is thus given a flat tint, which forms a background for the pattern, or which is left unaltered when the paper is meant to be perfectly plain.

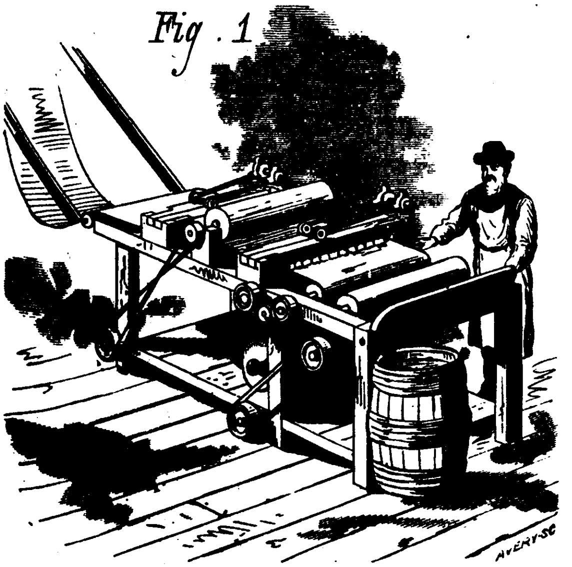
IMPRINTING THE PATTERN BY BLOCKS

Is done in two ways, either by the block or old process, or by the roller or improved process. In either case each color enter-

When the wood carving is completed, the work is brushed over with boiled oil, and when dry sent to the printer for use. The workman stands before a table, Fig. 2, over which passes the paper.

Hanging above the table, supported by an India-rubber cord, is the block. The upper end of the cord is attached to a small wheel traveling on an iron guide, so that the block may be swung from the table over to the place where it receives its covering of color. This last is obtained from what is termed the "slush box," which consists of a shallow box, the bottom of which is covered with painted ticking. This box floats on a mixture of water and paper pulp contained in a larger box, so that its bottom is always perfectly level. The workman first places the paper across his table, then swings the block over to the slush box and brings its carved side down on the paint. Next he carries the block back again and places it on the paper, of course using great care in the registering, so that the impression may fall exactly on the right place. A vertical movable arm attached to a frame above is now rested upon the back of the block, and forced down by a lever worked by the foot of the operator. This

Fig. 1



WALL PAPER.—THE GROUNDING MACHINE.

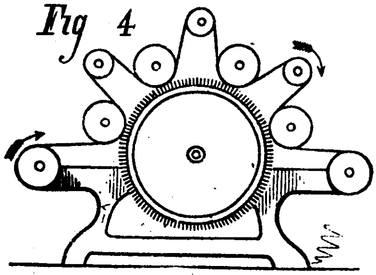
process is repeated until the whole piece is covered with the pattern, when it is hung up until perfectly dry.

Hand printing is now used on borders where there are many colors, and in the finer qualities of decorated paper, where the care requisite for printing the numerous tints can scarcely be exercised during the motion of the rapid working cylinder machines. In

ROLLER PRINTING

the impression is obtained from a series of rollers, on the surface of which the design is raised. This process is used for all the cheaper grades, and hence for very much the greater proportion of all the wall paper manufactured. The rollers

Fig 4



POLISHING MACHINE.

are of maple lined interiorly with brass Four different sizes are used, measuring respectively 13, 16, 18½, and 22 inches in circumference. Their width in all cases is 18½ inches. The pattern of the design is first drawn on paper and colored, and then the outlines of the various parts are transferred upon the rollers, each roller printing, as before stated, only such portions as are of one particular hue. Unlike that of the blocks described above, the surface of the roller is not engraved away, but the pattern is made by driving in pieces of thin brass, which the workman, Fig. 3, bends in a vise so as to correspond with the lines of the pattern. Where there is a considerable area to be printed "solid," its outlines are raised in brass, and inside the metal boundaries thus made is packed glued felt. In some cases where the

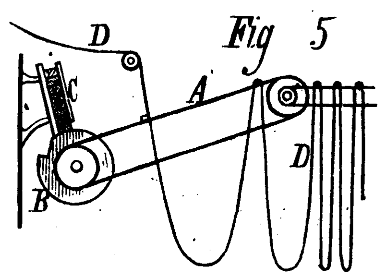
Fig. 3.

MAKING PRINTING ROLLERS FOR WALL PAPER.

paper is not grounded rollers are covered entirely with felt with the exception of such portions representing the pattern as are intended to be left white. After the design is thus produced the roller is placed in a lathe, fixed in the slide rest of which is a vertical file which smooths the surface, or if the roller be entirely felted it is submitted, when the glue in the felt is dry, to the action of an emery wheel.

The printing machine consists of a large cylinder or drum around which the paper passes. While being thus carried the paper receives an impression from each roller in turn, the rollers being disposed around the periphery of the cylinder. Each roller is supplied with color by an endless belt

Fig 5



DRYING THE PAPER.

of felt, which passes down into a receptacle filled with the paint. If the paper is striped the colors are blended by dry paint brushes held in contact with the surface as the cylinder rotates. In the large illustration on page 81 a 12 roller machine is represented. This prints therefore twelve colors at once.

If, however, the paper is to be satin finished, before the above operation takes place it is put through a polishing machine shown in section in Fig. 4. This consists of a central rotating brush against which the paper is carried by several metal cylinders. The alumina and oil in the ground-work admit of its being finely polished. The printed pattern is, however, in dead color, so that when the paper is finished some portions have a luster while others do not, thus adding to the detail of the ornamentation.

As the printed sheet emerges from the machine, it is led over sticks on endless belts the same as before described during the grounding process. An ingenious device is employed for placing the sticks under the paper, which is represented in Fig. 5. At the ends of the roller over which the endless belt, A, passes, are two cams, one of which is shown at B. Above the cams and resting on their periphery is a pile of sticks, C. The cam shoulder equals in height the thickness of one stick. Hence at each revolution of the cam a stick is moved from the bottom of the pile and carried down on and across the belts. Between the latter comes the paper, D, which thus falls in folds over the sticks as they are laid in place.

After the paper has been carried on the belts to the end of the loft (becoming dried meanwhile) its end is connected to a swiftly rotating horizontal spindle which winds it into tight rolls. These measure but 8 yards in length, the sheet being cut by the attendant as soon as a mark placed by the printing machine comes to the spindle. If the paper is to be embossed this is now done by passing it between engraved metal rollers. Nothing further then remains but to send it to the markets.

THE COLORING MATERIAL

is made of ordinary dry pigments combined with the Jersey clay and gum substitute. This last is produced from potatoes, large quantities of which are raised for this especial purpose. The tubers are simply dried and ground, the powder forming when mixed with water an extremely adhesive size. Sometimes ordinary glue size is employed. Paris green and the arsenical colors are now rapidly going out of use in paper coloring, chrome green being utilized in preference to the former.

We have obtained the material for this article and the annexed engravings from Messrs. Christy, Shepherd & Garrett, the proprietors of one of the largest wall paper factories in the country. The establishment is located at No. 510 West 23rd Street, New York City; 125 workmen and 13 large printing machines are here employed, producing six million rolls of paper per year.

TYPE SETTING BY MACHINERY.

The Chicago *Times* says: The *Times* has lately ordered from the Kastenbein Type Setting Machine Company several of their type-setting machines, which, when received, will be set up and put in operation in the *Times* printing house. These machines will enable the *Times* to do what has never been done in this country before—set the principal part of its type by machinery. It can accomplish this at a speed hitherto unknown in the world, and with immense advantages over the old method.

The machine was invented in Brussels, Europe. The principal house for their manufacture is about to be established in Chicago, of which John Marder is president, Ernst Schonrock, secretary, and Charles Kastenbein, superintendent of construction. Thus Chicago is about to acquire a new and very important industry.

The *Times* will be first in this country to introduce this improvement, which will be a stride of very great dimensions in newspaper making.

A NEW PROCESS OF TANNING, in which mineral compounds alone are employed, and bark entirely dispensed with, is said to have been extensively introduced in Germany. It has lately been experimentally tried in Glasgow (Scotland), and, it is said with favourable results. The principle of the new process appears to be based on the well-known action of chromic acid in rendering gelatine insoluble; and the process involves the employment of a number of substances, all soluble in water, which have the power to effect the decomposition of bichromate of potassa, with the liberation of chromic acid. Specific details are wanting. The new process, it is further asserted, requires only from four to six weeks for its completion, as compared with the several months required by the usual process with bark. A number of processes for tanning with mineral substances have been suggested and employed, but none thus far have proven fully satisfactory. The above named procedure may possibly meet the requirements of the art more satisfactorily than its predecessors.

RICHARD ARKWRIGHT.

THE BARBER'S APPRENTICE.

A poor boy in a poor barber's shop at Preston, somewhere about the year 1744, learning the art and mystery of razor-stropping and clean shaving! This is the opening scene in the life of one of the most brilliant examples on record of what patient industry can and will accomplish in the face of every difficulty.

In all England I defy you to produce a more unpromising specimen of a genuine young dunce. He has never been to school, for his parents are too poor, and he is the youngest of thirteen children. The barber's shop was the first employment that offered, and, since beggars must not be choosers, he gladly accepts it. He can neither read nor write. If he has any ideas floating through his brain they are wild and profitless—certainly useless in the business of shaving. He has a determined will of his own, however, and is not easily turned from any purpose.

Now, suppose we allow our imaginations to run riot, and that we attempt to forecast this lads future. He will in due time learn how to shave, and will become a barber himself. Yes! Further, he will plod on at his business like his master before him, and grow old, and feeble, and die, a worn-out barber, whom nobody knows. No! He will, on the contrary, become a man of much consequence, a High Sheriff of Derbyshire. He will be knighted by his sovereign, and dying, leave a name which all men will honor. Then, to do this he must have some extraordinary good fortune, perhaps some powerful friend. His greatest good fortune was his own industry, and his best friend his own stout heart, which never failed him, but carried him through many and amazing difficulties. Having said so much by way of introduction, we will now trace briefly the career of one who did much to promote the well-being of his country, and whose labours were carried on under the greatest disadvantages.

Richard Arkwright was born at Preston on 23rd December, 1732. He received positively no education. He never went to school, and to the end of his life he could not master the difficulties of writing. When he had served his time to the barber, he started on his own account in Bolton. He began low—in a cellar! "Come to the subterraneous barber; he shaves for a penny!" was the invitation which he hung in the upper regions in sight of the unshorn public, and customers came to him in fair numbers. "Competition is the life of trade." The other barbers reduced their charge to Arkwright's upon which he announced that he would give a "clean shave for a halfpenny."

He found, after twelve months' experience, that he could do better as a dealer in hair, wandering over the country and purchasing material for wigs, which were then much worn. His custom was to attend the Lancashire hiring fairs and buy the long tresses of those young women who were willing to part with them for gold. He had also a secret process for dyeing hair, which brought him in a little—it cannot have been much, for with all his efforts he was only able to subsist. The wig business declined throughout the country, owing to a change in the fashions, and Arkwright had serious thoughts of giving up the business altogether. He had been gradually led to little mechanical experiments, and became bitten with the "Perpetual Motion" craze, which has done for mechanics what the "Philosopher's Stone" has done for chemistry. Many a mind whilst searching for the impossible, has found the practicable. It has been like the treasure which a man said lay in his field, and would yield to the laborious efforts of his sons. The gold they never found, but the produce of their husbandry brought them honourable wealth. Arkwright began with little models of what he hoped might prove the solution of perpetual motion. He ended by bestowing upon his country the spinning machine! But the path of the inventor is always a thorny one. Too frequently it ends in poverty and death. We know very little of his life during this period, but we do catch an occasional glimpse of him, which lets in much light upon his character and difficulties. One will suffice.

In a large old-fashioned farmhouse in the county of Lancashire, on a summer evening in 1763, a group of the farmer's family and farm servants sits in the best kitchen gossiping in the good old style. One of the farmer's sons has come up from Manchester, and is bemoaning the loss which his uncle there must suffer owing to the want of yarn for his looms. A young wig-maker and hair-dealer, known as "Travelling Dick," who has come in to share the gossip and seek for a job at wig-mending, astonishes the company by taking from his pocket a few small sticks and bobbins, and by modestly saying that he believes he could make a machine to spin the yarn if he had the money.

When he had put his rough model together, he explained as best he could the way it was to work, and what marvels it would bring about in the cheapening of calico. He was listened to patiently until he talked of building great mills for his machine, and driving the engine by water-power like a corn mill, and then, one by one, they all began to laugh and jeer, until poor Dick thrust his model hastily into his pocket and went out crestfallen and disheartened.

Perhaps to console himself for these and other trials, he married a wife, but soon found that, instead of improving his position, he made matters worse. The absorbing employment of invention drew off his mind from his business, and he soon began to feel the pressure of poverty. Not that he cared very much for that; but his wife did, and she, perhaps naturally, concluding that a good wig-maker was better than a bad machine-planner, in a fit of passion destroyed all his models. He was by no means the first inventor who had to combat difficulties at home as well as abroad. Nor must we look with too severe an eye upon the anxious wife, who fears that her husband's strange infatuation may beggar them both, and that hopelessly. But she was unwise in her mode of treatment. Love might lead, but anger could never drive, and being provoked beyond measure by the loss of his priceless models, he separated from his wife, determined to go his way and beggar himself unhindered if he chose, which he did most effectually. Happening one day to see a piece of red-hot iron passed between rollers for the purpose of drawing it out, it occurred to him that he could use the idea in making a machine for the spinning of cotton thread. He had made the acquaintance of a clockmaker at Warrington, one Kay by name, who had been useful to him in constructing wheels for his perpetual motion machine, and to him he went, brimful of his new idea. But the watchmaker could not help him, and so he gave up his business altogether, determined to carry out his idea at any cost. Indeed his mind was in some degree strengthened by a feeling of confidence in his own powers. He saw that a great need existed for a machine such as he had in his mind, and he believed that he was the man to make it. As to difficulties in the way—well, they were made to be overcome, and he was the man to overcome them.

What was this new machine to do? It was to spin a thread of cotton long enough to enable the weavers to use it as warp, the thread that runs lengthwise in the cloth. Calicoes were, up to this time, a mixture of linen and cotton. The warp was linen because no means had as yet been devised of making cotton threads long enough. The demand for calicoes grew, although they cost more than silk does now, and in the manufacturing districts the weavers had sometimes to scour the country in order that they might collect from the women who carded and spun sufficient weft to serve them for the remainder of the day. So undesirable had this state of things become that, as early as 1738, a Mr. Wyatt, of Birmingham, had taken out a patent for spinning by means of rollers, and his machine had been tried both at Birmingham and Northampton, but without success, and it was at length broken up as a failure. Just thirty years after Wyatt's patent was taken out Arkwright modestly produced the first result of his labours, being the model of a machine constructed by Kay, the watchmaker, under his guidance. This he exhibited in the parlour of the Free Grammer School at Preston, but the exhibition was not as agreeable to the townspeople as to him.

We find his condition at this time low in the extreme. His clothes were so tattered that when he desired to vote as a burgess of Preston at a contested election, some kind friends were moved with compassion, and subscribed money enough to make him presentable when he went to the poll.

But his spinning machine—upon which he had spent so much precious time and money—instead of awakening curiosity and wonder excited only suspicion and strife. When he went abroad he heard ominous whisperings, and even outside the schoolroom angry groups of workpeople discussed the merits of the labour-saving apparatus with no pleasant words. In fact, it was plain that if he wanted to escape a mobbing he must take his model and fly. Other inventors had been treated with scant ceremony. Kay's fly-shuttle and Hargreaves spinning-jenny had both called forth violent opposition, for the ignorant workpeople believed that the world's progress could be stopped by breaking up the models of the inventors, and pelting those unhappy men with stones.

He took his model to Nottingham, where he found friends with money and influence, who gave him a helping hand. Mr. Strutt, who was a man of great perception, and himself an inventor, having been introduced to Arkwright, was much struck with the model, and offered terms of partnership. These having been accepted, a patent was taken out in the same memorable year in which Watt secured the patent for the steam-engine. The new firm set heartily to work, and a cotton-mill was erected at Nottingham driven by horses. Another mill, considerably larger and driven by water, was built at Cromfort, in Derbyshire, and this was called the water-frame mill.

To the genuine inventor there is no such thing as idle satisfaction. Although Arkwright had done so much he was by no means satisfied with his efforts, and, although it seemed at first as if he was on the road to fortune, he soon discoved to his cost that much of his labour was profitless and useless. The cost of building the mill was very great, but the profits from the manufacture of the cotton-thread were *nil*, and so they remained for years.

Nothing could resist the patient industry of the zealous inventor. Step by step he overcame all his difficulties, and the mills proved successful. Now, surely his reward must be near! But no! As soon as the Lancashire manufacturers found that the mills were likely to prove injurious to their interests they set to work to ruin them. A mill near Chorley was wrecked by a mob in the presence of a force composed of military and police. Arkwright was the working-man's enemy and should be suppressed. The material manufactured at the mills must not be purchased. His patent must be questioned in the courts, and, having been questioned, the courts decided against him.

"Well! we have done the old shaver at last!" cried some one, loud enough for Arkwright to hear the remark, as he walked away from the court-house.

"Never mind; I've a razor left that will shave you all," answered the old barber, fearlessly.

And he did it! His mills rose in different parts of the country, and the excellence of his manufactures carried the market with him, until he became the recognized head of the cotton-spinners. Indeed the very opposition he met with seemed to increase his wealth. The employment of the yarn produced by his mills was discouraged by the other mill-owners, who clubbed together to prevent the use of cotton warp, and thus to throw an enormous quantity of useless stock upon the inventor's hands. Arkwright and his partner took counsel together, and decided upon manufacturing the yarn into stockings. The attempt was successful, and they then set to work to make cotton calicoes, such as are used so extensively to this day.

But even here fresh difficulties presented themselves. Every step of the way was bristling with obstacles. The revenue officers discovered, as they thought, reasons for charging the firm twice as much duty as other as other manufacturers paid. It was so evident that a plot was on foot to crush him that Arkwright appealed to Parliament, and had the good fortune to obtain a declaratory Act, authorising the excise to charge him only the ordinary rate. This seemed to be the turning-point in his history. Such persistent effort as his could not fail to overcome prejudices, difficulties, fears, and factions. He outlived them all, and the tide of wealth so long delayed and so richly earned flowed in upon him at last. The man was thorough. We see him toiling in his mills, organising and directing often from four in the morning till nine at night. At the age of fifty he snatches a little time each day to learn English grammar and writing. Eighteen years after he first showed his model in Preston he was made High Sheriff of the county of Derbyshire. And among the numerous applicants for his new spinning frame was one who twenty years before had laughed at "Travelling Dick Arkwright', and his few sticks and bobbins in the farmer's kitchen in Lancashire. In 1786 he presented a congratulatory address to George III., and received the honour of knighthood.

Sir Richard Arkwright was a man of whom any country might well be proud. Even in this brief sketch we cannot fail to see the secret of his strength and success. It was his courageous perseverance—his dauntless energy. No obstacle could frighten him from his purpose; no opposition could turn him. Between the barber's apprentice of Preston and the High Sheriff of Derbyshire there is a wide gulf, but it was no magician's wand that changed the pauper into the knight. It was that noble industry which has so enriched our land, and has brought so many of England's poorest sons from obscurity to sit among princes, and to receive the homage of the civilized world as its truest benefactors.

From his youth he had been a sufferer from asthma, and his sedentary life, the result of overwelming business, brought on complications that proved fatal at the comparatively early age of sixty. He died in 1792, leaving behind him for all time an example of industry and courageous perseverance which the poorest may follow with the certainty of benefit to themselves and their generation.

RICHARD ARKWRIGHT.

COZY-CORNERS.

A room without a cozy-corner lacks the prime characteristic of a home. However much money may be spent in furniture and artistic decorations, in elaborate draperies and other embellishments, it will retain a cold and formal appearance not the least inviting to those who, wearied in mind and body, long for a cozy corner in which to rest. We have been in houses where the parlors were palatial, the dining-rooms stately, with meals to correspond, the bed-rooms elegantly upholstered, and the "sitting-room" giving a standing invitation not to sit down, and have felt a sensation of dignified dulness owing to the absence of cozy-corners.

There is a cordial greeting in the out-spread arms of the easy-chair, a friendly salutation in the comfortable lounge, if it happens to set in just the right place, and an appeal to the domestic side of one's nature in the home-like arrangement of inanimate things which affect us far more than many of us realize.

The poor woman mentioned in Scripture swept the corners of her house in the search for a lost piece of money, and it may be that the corners of modern houses are responsible for much lost treasure. An open fire and a cozy-corner where the boy can settle himself to his books or games, and the girl can yield to her dreams and relax the tense strain upon the nerves, do much toward keeping families together and preventing the entire disruption of home and home ties.

Our Puritan ancestors, who disciplined the mind and body with as much severity as did any of the monks from whose practices they revolted, spent no time in making soft cushions or cozy-corners. They landed on a rock, and scorned to rock themselves in cradles of luxurious ease. How those old straight-backed, hard, and uncompromising chairs protest against the sensuous surroundings of these modern days! But had we inherited the Puritan back-bone we might have adapted ourselves to their rigid style of architecture, and so the infirmities of the body furnish a sufficient excuse for non-conformity to ancient customs.

A COZY CORNER.

There is something doleful about the high-post bedstead and the hard-back chair, to say nothing of the church-pew that was made so uncomfortable that the worship of God was flavored more with the spirit of penance than that of praise. The character of the age is shown in its fashions and furniture. "Moral epochs," says Goethe, "have their course as well as the seasons"; and the increase in the manufacture of lounges, reclining chairs, and "flowery beds of ease" is an indication that in this day and generation mortification of the flesh is not held in very high esteem as a means of spiritual advancement.

Well do we recall the cozy-corner where a dear invalid spent the most of her time. The easy-chair with writing-desk attachment, the stand on which were flowers and books, and fruits in season; the window which furnished an outlook for eye-vision and soul-vision, the work that lay near the busy fingers and relieved the active brain, are pictured upon the memory in colors that cannot fade. Even when death has broken the circle and destroyed the home, the thought of that cozy-corner awakens pleasant recollections, angel forms and faces gather there, delightful intercourse is renewed, and the lost days of youth are restored. The coziness of a corner depends more on who occupies it than on the placing of the furniture therein. The impressions made by animated nature are far more lasting and satisfactory than those received from inanimate things, although the latter may do much toward rounding angles and changing outlines. A cross, ill-natured person changes a cozy-corner into a growlery. A sulky person may "stand in the corner and pout" and have no one to help him out with a kiss, as was the rule in our childish game. Therefore a cozy-corner offers no invitation to those whose spirits are not in harmony with the place, and it is easy to perceive that our artist has drawn an actual picture, full of homely suggestions. We can almost imagine the personal appearance of the late occupant of the easy-chair, with its tasteful back-ground, and need not to be told that she is neat, industrious and ingenious. Let us have more cozy-corners in our homes, and we will have more comfort and sociability, less club-life and intemperance.

Though others choose to linger
Amid the halls of state,
Charmed by the splendor that surrounds
The dwellings of the great;
Give me the cozy-corner
By the cheerful ingle-side,
Where evil spirits ne'er intrude,
And peaceful ones abide.

Sanitary and Plumbing.

THE theory that the frequency and persistency of London fogs have been increased by the increase in the consumption of coal within the metropolitan area is not regarded approvingly by the *Lancet*, which declares that even in the worst fogs of recent date there has been nothing to compare with those of forty years ago. They were distinctively yellow, and coated window glass with a layer so opaque that the outer sill was often indisguishable through it. This yellowness has almost faded out of the fogs since the embankment of the Thames, a change probably attributed to the covering of large surfaces of yellow clay by buildings. The suggestion is made that the character of fogs may be determined by emanations from the soil, and that coal vapors in the atmosphere may not be the chief source of fog production even in smoky London. That they must, however, bear a fair proportion of the blame seems unquestionable, as any one will say who has sailed from London to New York and been struck by the first appearance of a city heated for the most part by anthracite in place of soft coal.

A SCHOOL FOR PLUMBERS TO BE OPENED IN NEW YORK.

The popular interest now prevailing in the subject of domestic drainage has led to the inception of a course of technical instruction in plumbing and sanitary engineering, which will be given at the rooms of the Metropolitan Museum of Art, New York. The course of lectures, which will be given on Monday and Wednesday evenings, will cover a period of two months. The course will embrace lectures by Prof. Chas. F. Chandler, on the "Chemistry of Sewer Gas, Disinfectants," etc.; by Mr. C. F. Wingate, of the *Sanitary Engineer*, on "Plumbing," and by Mr. John Buckingham, on "Mechanical Drawing." The following list of subjects will give an idea of the value of this course to practical plumbers: "Sources of Water Supply and Means of Conveyance," "Systems of Sewerage and Sewage Disposal," "Laws of Physics and Hydrostatics," "Chemistry of Sewer Gas," "Disinfectants and Deodorizers," "Water Pollution and Water Analysis," "Plumbing Materials," "Proper and Defective Methods of Plumbing," "Various Apparatus and Appliances Used in House Drainage." The lectures will be illustrated by models of various plumbing appliances and apparatus, loaned or presented by the manufacturers of such articles, and by sketches of proper and defective methods of plumbing. Professor Chandler's lectures will be illustrated by the magic lantern and electric light.

CISTERNS.

A lively controversy has been carried on for some years past upon the merits of the constant service in the supply of water for domestic use in the metropolis and other large towns; and this question, though considered by some to have been finally disposed of, is still under discussion. The cistern system certainly requires reform. Domestic cisterns frequently render the water unfit to drink, and they not only are attended by extravagant waste, but by percolation injure property and destroy health. Whether or not the constant service will eventually fulfil all the anticipations of its advocates, it is probably an advance in the right direction. The cistern cannot however be entirely abolished; it is at any rate necessary for the feed of the closets, even if avoided for culinary purposes. But for the latter object, supposing the water was liable to be charged even in a small degree with suspended matter, the precipitation and interception of the sediment by the cistern is a benefit which is worth consideration. This benefit is very commonly lost by the "draw-off" being inserted too near the bottom, and by the ball-tap service being allowed to fall directly down into the cistern, thus stirring up the whole of the sediment every time the water is turned on, instead of the water being led by a piece of slate, or by other means, to fall against the side of the cistern.

Cisterns are constructed of various materials, the chief being wood, stone, slate, lead, and iron, Wooden cisterns are clearly open to many objections and are not frequently used. Stone cisterns are too heavy for use in any other situation than in the basement of a house, and though they are excellent cisterns they are useless for general purposes above the ground floor. Slate cisterns are frequently used, and have been much recommended from time to time. Both stone and slate have their drawbacks, the first being their weight, and the second that the joints are apt to become leaky. When this happens the man sent for is the plumber, and he very naturally empties the cistern, gets into it and fills up the joints with red lead, about the worst material he could possibly use. Stoneware cisterns are now made, and are admirably suited for cottages and for use in basement floors.

Lead and zinc are generally believed to be open to the gravest objections as materials for cisterns, from the danger of poisoning. An old lead or zinc cistern can be rendered innocuous by lining it with tile and cement. Zinc is destroyed even faster than lead, although this latter metal does not contaminate running water. When pure water is allowed to stand over lead, whether in the pipe or in the cistern, contamination begins, but this danger is very much reduced by the presence of alkaline salts, which always occur in natural waters.

A material now replacing lead for the purpose of cisterns and pipes is wrought iron. It has the advantage of being much cheaper than lead, and is very durable. Against this is the fact that the iron is not so easily jointed, therefore necessitating screwed bends to be specially made of every possible kind. In some cases, too, it is an objection that large quantities of rust separate from the internal surface of iron pipes and discolor the water, besides imparting an unpleasant taste.

Assuming that it is neccessary to have a cistern in a dwelling, the first thing to be careful about is that the cistern must not be used for any other purpose than to supply drinking water. It is highly essential that a single cistern should not be used as the source of water for every purpose. If the same cistern is use for closets as well as for drinking purposes, the water may get contaminated, and so become unfit to drink. Water-closets may be supplied by subsidiary cisterns, fed from the one main cistern, and if the connections are properly made, no evil effects need result.

VENTILATION AND HEATING.

BY JOHN S. BILLINGS, SURGEON, U.S.A.

The new building of the Union League Club, corner of Fifth Avenue and Thirty-ninth street, New York city, which is now just being completed, presents some peculiarities in the arrangement of its heating and ventilation which are worthy of notice. Through the courtesy of Mr. Tudor, who furnished the apparatus for this purpose, I am able to give the following diagrams and description, the latter being derived also in part from a personal examination.

This is a five story brick building, about 150 by 85 feet and containing 932,000 cubic feet of space to be warmed and ventilated. The apparatus used for this purpose consists of steam coils and radiators to furnish heat, and to some extent motive power in exhaust flues, and a fan, 10 feet in diameter, to produce and control the necessary influx of air.

The general arrangement is shown in the diagrams, Figures 1 and 2:

The fresh air taken from the street level is drawn through a chamber so arranged that it may either be all forced through a steam coil, or a part of it may be allowed to pass below the coil. The layers of cold and warm air thus produced will be thoroughly mixed by the fan, and pass into the space *F*, which is about four feet high, and extends under the whole building, forming a large common air chamber whence all the flues obtain their supply. The bottom of this chamber is concrete, resting on hard, blue clay, and it is intended that the temperature in it shall be from 70° to 80° F. The fresh air flues connect with it as shown at *G*, being wide enough below to permit the insertion of a small supplementary heating coil, as shown at *H*. The valve *C* shown, connected with the upper corner of *H*, is controlled by a rod passing to the room to which the flue leads, and it will be seen that the occupant of the room can thus regulate the temperature of the incoming air to suit himself without diminishing the quantity. The movable arm on the register which regulates this valve is shown in Fig. 2, which is a section through one of the conversation rooms of the club, indicating postions of outlets and inlets.

I shall probably have occasion to comment hereafter upon the arrangement of the fan in this building, and will only say now that there is great loss of power from contracted inlet and from the arrangement of the air chamber, which virtually forms a sudden expansion to the delivery duct. With the fan making 130 revolutions per minute, Mr. Tudor informs me that he obtained a movement of 33,000 cubic feet per minute, which is slightly in excess of his calculation as to what is required.

Certain rooms, such as water closets, servants' rooms, etc., obtain their whole supply of air from the corridors, and have outlet flues specially heated, the intention being to secure a constant flow of air from the halls into the rooms. They are, in fact, the only outlets for the large supply of air which is furnished to the stair-case halls.

The amount of air supply and heating surface have been calculated on the assumption that 3,000 cubic feet of air per hour per person shall be allowed, except in the audience hall, where about 1,000 cubic feet per head per hour is provided for.

It is also assumed that during the day—that is, until 5 p.m. —about 100 persons will be in the building, and that in the evening 1,000 persons may be present, although from 500 to 600 will be the usual number.

The fan is intended to have a capacity of about 2,000,000 cubic feet per hour. To heat this air, about 9,000 square feet of radiating surface are provided, one half being in the large steam coil between the fan and the street. This coil will be heated by steam at about 60 pounds pressure, and will therefore be of much higher temperature than an ordinary steam radiator.

This high temperature, which will probably be over 280° F., is relied upon to make up what would otherwise be a deficiency in heating surface. The exhaust steam from the engine which runs the fan and the elevator is turned into the heating apparatus, causing a back pressure of about 10 pounds.

One of the special difficulties in this building is to provide a a sufficiency of fresh air for the audience hall or theatre. The method adopted, with the necessary illustrations, will be described in our next.

BRITISH ARCHITECTS ON VENTILATING DRAINS.

At a recent meeting of the Royal Institute of British Architects, the question of ventilating house and city drains was discussed. Mr. Rogers Field, speaking of theoretically complete ventilation in London, said that they would have a million-and-a-half of ventilating pipes emitting foul emanations and poisoning the air. As had been hinted, that was not and could not be the be-all and end-all of sanitary science; some means must be found for preventing the existence of foul gases themselves. A little consideration of the subject would show that it was not only possible, but quite easy to prevent such foul emanations. What did they come from? From the decomposition of organic matter. Wherever oganic matter was allowed to rest, so as to decompose, there would foul gases be formed. All, then, that had to be done to prevent the formation of such gases was to prevent any accumulation of organic matter by arranging the sewers and drains so that such matter was immediately carried away. This requirement was so extremely simple that there was great danger that its simplicity would cause it to be overlooked. Above all things, it was necessary to make the house-drains self-cleansing, and in order to be so it was necessary that they should be of proper size, truly-formed, and truly-laid. It was a great mistake to make them too large, because large drains and traps retained foul matter when small ones would not. In a house at the West End, where he was called to see the drains, he found a 9-in. pipe laid, with a 9-inch syphon trap. The trap was choke full of foul matter, and he at once saw that it and the pipe were too large. Prior to substituting a smaller pipe and trap—for the house could not then be handed over to the workmen—he, as a tentative measure, had the trap cleared out, but he found, a month afterwards, when the workmen got possession of the place, that the trap was nearly as choked up as before. For the 9-inch pipe and trap he substituted 4-inch ones, and there has since been no stoppage or foul smell. He did not mean to imply that 4-inch pipes were of the proper size to use in all cases. Then, again, it was necessary that the drain-pipes should have a sufficient fall—at any rate, a better fall, than that which seemed to be so favoured by some builders, and even architects, viz., 1½ inch in 10 feet, which was not sufficient. The fall ought to be at least double that—say 1 in 30 or 1 in 40, except where there are self-acting means of flushing. Drains should not be laid, as they too commonly were, in curves, for then it was impossible to ensure their being truly laid. They should be laid in straight lines from point to point, as recommended by Mr. Rawlinson, with means of inspection wherever possible at points of junction or differeuce of level. If all these points were attended to, house-drains would be practically perfect, and incapable of retaining foul matter.

CHEMICAL VENTILATION.

Dr. Richard Neale, of London, is urging a scheme for purifying the foul air of tunnels, mines, theatres, hospitals, etc., by chemicals means. According to the *Lancet:*

As the lungs of living beings appropriate oxygen and give off carbonic-acid gas, Dr. Neale proposes to make a "chemical lung," which will appropriate carbonic acid and sulphurous gases from the air containing them, without yielding any products in exchange. In the air in the tunnels of the underground railway the principal deleterious gases are carbonic acid and sulphurous gases and carbonic oxide. All these, but especially the two former, may, Dr. Neale maintains, be easily got rid of by chemical means. By mixing a solution of sulphurous acid and water in a flask, Dr. Neale made an excellent imitation of the air at the Baker Street or Portland Road Station. He then added a small quantity of solution of caustic soda, and agitated the flask briskly for a few seconds, and immediately the sulphurous smell was abolished. Into the same flask a current of carbonic-acid gas was next passed, so that a lighted taper introduced into the flask was at once extinguished. After a few shakings, the lighted taper was again introduced, and burnt with a bright steady flame, showing that soda had taken up the acid. Similar experiments were made with solutions of caustic lime. As regards the Metropolitan and other underground railways, the locomotives might, Dr. Neale said, be supplied with a tank containing a strong solution of caustic soda or lime, through which the smoke should be made to pass before being discharged into the outer air. By this means the carbonic acid gas and the sulphur would be eliminated. The carbonic oxide would require to be dealt with in another way. In order to attain further purification of the air in the tunnel, each train might be furnished with a truck open at both ends, and appropriately fitted with trays or other contrivances for holding solutions of lime or soda. As the train progressed, air would rush through the tanks or trays, and be robbed of its carbolic acid and sulphur in its course. The proposal is both happy and ingenious, and it commends itself on account of its simplicity and cheapness. We trust the directors of the underground railway and the managers of theatres, etc., will at once fairly test its practicability.

A correspondent informs us that the happy conception of Dr. Neale is about to be reduced to practice. In the London theatres the audience will be provided with alkili-proof umbrellas and overalls, and so soon as the vitiation of the air reaches a point to be ascertained by an analytical instrument, a rain of caustic soda will be set up to purify the atmosphere. The Metropolitan Railways have under consideration methods of shaking up the trains from time to time for the restoration of the air in the carriages, at the bottoms of which will be tanks of four or five inches deep, to hold the liquor. It is estimated that the by-products of the operation, carbonate and sulphate of soda, will fully remunerate the companies. Seriously, there is no doubt but chemical purification and revivication of air in a diving bell is practicable and advantageous, but the offensive and dangerous substance in theatres, hospitals, etc., is organic matter, which Dr. Neale's method is incompetent to deal with.

Natural History.

THE PARASITES OF A MONSTER JELLY FISH.

BY C. F. HOLDER.

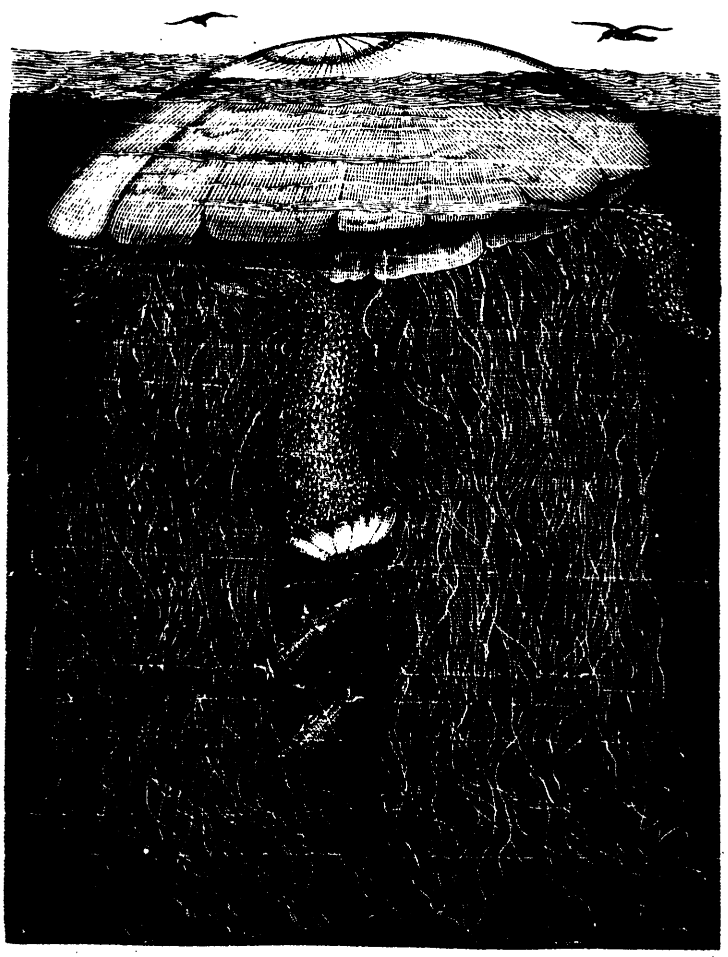
The discophore known as the *Cyanea artica* is familiar to every frequenter of the sea shore, where their stranded jelly-like forms can be found after every tide evaporating, as it were, in the summer sun. While afloat and active in the water they afford protection to several parasites that are figured in the accompanying engraving. The large creature hanging from the inner lobe of the jelly fish is a parasitic sea anemone called the *Becidium parasiticum*. In the engraving it is life size, while the *Cyanea* is reduced greatly. The *Actinia* is generally found in the larger specimens concealed in the mouth folds, where it shares the food brought up by the tentacles of its protector. In appearance it resembles an elongated cone strongly ribbed along its sides; around its mouth a few short tentacles. The body is covered with innumerable wrinkles, with which it attaches itself to its post, and to which it is a strong contrast, being violet or brownish-red in colour. Two or three can generally be found on them.

The little worm-like creature shown on the outer edge of the *Cyanea* is a true parasitic worm, the *Monopus medusicola*—with a depressed subcylindrical body armed with two suckers. The fore one, strange to say, is imperfect, while the latter—one third the total length from the tail—is columner and truncate. In the engraving it is magnified twelve fold.

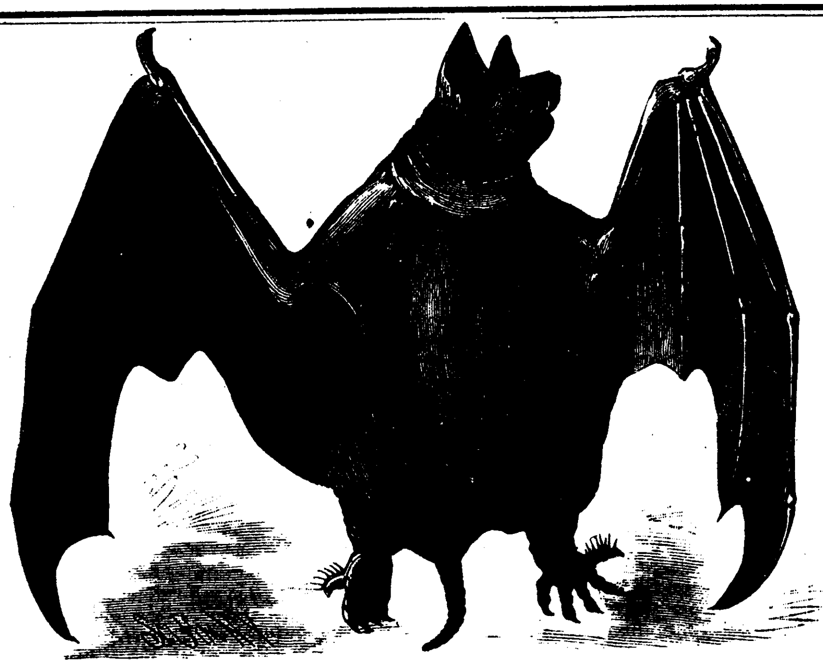
Besides these, numerous little fishes are found up under the tentacles, that with their terrible lasso cells would seem the last place for a fish to choose as a home, but here we find them, darting in and out among the treacherous tentacles, perfectly at their ease.

The *Cyanea* is a giant among its fellows and attains a diameter of seven feet, with tentacles two hundred feet long. Mrs. Agassiz thus speaks of one: "He was quietly lying near the surface, and did not seem in the least disturbed by the proceeding, but allowed the oar, eight feet in length, to be laid across the disk, which proved to be about seven feet in diameter. Backing the boat slowly along the line of the tentacles, which were floating at their utmost extension behind him, we then measured these in the same manner, and found them to be rather more than fourteen times the length of the oar, thus covering a space of some hundred and twelve feet. This sounds so marvelous that it may be taken as an exaggeration; but though such an estimate could not, of course, be absolutely accurate, yet the facts are rather understated than overstated in the dimensions here given. And, indeed, the observation was more careful and precise than the circumstances would lead one to suppose, for the creature lay as quietly, while his measure was taken, as if he had intended to give every facility for the operation."

The different stages of the young of this animal are so totally different that they have been described as separate animals, namely *Scyphistoma*, *Strobila*, and *Ephyra*. This enormous creature is produced by a hydroid measuring about half an inch in height. The eggs are laid in the autumn, and the young, when first hatched, are oval, soon they become pear-shaped and attach themselves to the bottom. Now minute tentacles (never over sixteen) appear, and the creature resembles a simple polyp. It grows rapidly, constriction taking place along its entire length, each one being lobed around its margin, until it finally looks like a pile of inverted scalloped saucers. The top one dies and falls off, and the others soon separate by the deepening of the constrictions, and swims on, perfect infantile cyaneas, that soon reach a large size, and in turn deposit eggs.



THE PARASITES OF A MONSTER JELLY FISH.



CHEIROMELES TORQUATUS.

THE HORNED SCREAMER.—(*Palamedea Cornuta.*)

THE CHEIROMELES.

BY FREDERICK A. LUCAS.

If the curious bat (*Cheiromeles Torquatus*) shown in the accompanying engraving is not the most singular member of the order cheiroptera, it certainly has very few rivals. The skin is thick, almost naked, and marked with deep wringles, so that the animal has something the appearance of a diminutive pachyderm. Like the other members of the small sub-family to which it belongs, the cheiromeles has long, narrow wings which fold compactly up, very little membrane in front of the fore arm, and feet entirely free from the wing membrane. It thus has greater freedom of movement than bats usually possess, and the creature can crawl so rapidly over the ground that it is not an easy matter to pick it up. The first toe is quite separate from the others, and is furnished with stiff hairs along the outer edge. The thick round tail is free for more than half its length, and the interfemoral membrane is movable upon it, thus allowing the extent surface exposed to the air to be increased or diminished at will, and probably aiding the animal in its rapid turns while in pursuit of the insects on which it lives. The lips are thick and extensible, and the teeth sufficiently large and sharp to crush with ease the hardest beetles. Beneath the neck, running from shoulder to shoulder, is a deep fold or sac, which receives an oily secretion from glands situated in the upper pectoral muscles. But the most peculiar feature of the cheiromeles, and one not fonnd in any other species of bat, is a sort of inverted pocket situated beneath either arm pit, formed by a fold of skin running obliquely downward and inward from the elbow. Dr. Dobson suggests that these pouches are to support the young, which otherwise would be unable to maintain a hold on the naked body of their mother during flight. The mammæ are situated at the upper end of these "nurse pouches." As both male and female have these pockets it is probable that when two young are born the male takes charge of one. This bat is nearly eight inches in length from nose to tip of tail, and twenty-two inches across the wings. It is of a dingy lead color, and dwells in holes in trees. Although not at all common, the cheiromeles has quite an extensive range, being found in Java, Borneo, Sumatra, and the Malay Peninsula.

THE HORNED SCREAMER.

The horned screamer (*Palamedea cornuta*) is found in Central Brazil and northward in Guinea and Columbia. On account of the horn on the crown of its head, the thickly feathered wings, short head, and neck feathers, it will be recognized as a representative of the family of horned birds.

The horn, fastened only in the skin, rises from the brow about five-eighths of an inch from the root of the bill. It is slender and from four to six inches long, standing nearly erect, but slightly curved toward the front. Its diameter at the root is one-eighth of an inch, and it may properly be compared to a catgut string.

The horned screamer is armed with two spurs on each wing; the upper one on the bend of the wing is triangular and very pointed. It is about nine-sixteenths of an inch long and almost imperceptibly curved outward. The lower one is only five-sixteenths of an inch long, almost straight, and very strong.

The soft velvety feathers of the upper part of the head are of a light gray, black toward the tip. The throat, neck, back, breast, and tail are blackish brown, the shoulders and large wing coverts are of a glistening metallic green, the lesser wing coverts a muddy yellow at the roots, the upper half and the upper part of the breast are a clear silver gray with a broad edge of black, the rump and belly are pure white. The eye is orange colored, the bill blackish brown, white at the tip. The horn is light gray, the feet a darker gray.

The horned screamer is a large and beautiful bird, about the size of a common turkey, and is an ornament to the primeval forests of Brazil. In traveling from the south to the north it is not generally found until the sixteenth degree of south latitude is reached, where it may be seen in large numbers.

It lives only in wilds far from the habitations of men, where its peculiar voice may be frequently heard; it has some similarity to the notes of the wild wood-pigeon, but is far louder and accompanied with guttural tones, and is uttered so suddenly and with such vehemence that it has a very startling effect. Sometimes one can catch a glimpse of these birds as they walk proudly upon the sand banks near the rivers. If they are approached they fly up and resemble in the broad surface of their wings, their coloring, and flapping, the urubu, or black vulture. They perch upon the top of thickly foliaged forest trees, and though they can seldom be seen, their loud, shrill voices indicate their whereabouts. In the breeding time they are found in pairs, sometimes four or six individuals joining together. The food of the horned screamers consists chiefly of vegetable substances, such as the leaves and seeds of aquatic plants, in search of which they wade through the morasses. Their flight is strong and easy, their walk erect and bold, and their mien lofty like that of the eagle. Their nests are found upon the ground in the forest marshes not far from rivers; they contain two large white eggs, and consist only of a few twigs. The young fellow their parents almost as soon as hatched. Their flesh is not edible. Their quills are often used for pens.

The horned screamers when domesticated are confiding and obedient, associate with fowls, and are peaceable when unmolested. They always place themselves on the defensive toward dogs, and know how to use the spurs on their wings to such purpose that they put them to flight with a single blow.

GIGANTIC SEA-WORMS.—A gigantic sea-worm has been taken by long-line fishermen, among some sea-wrack, on one of their cod hooks off Dunrobin Castle, Golspie, N.B. This worm, whose existence is known to scientific naturalists is but very seldom heard of by the general public. This specimen, now alive in the aquarium in the Duke of Sutherland's museum in Dunrobin Castle, is only about five feet long. It is probable that he has not uncoiled himself to his full length. In shape he is flat, like a ribbon, and only five or six lines in width, of a brown violet color, smooth and shining like varnished leather. When full grown this remarkable worm is stated, on excellent authority, to attain the length of from forty to ninety feet. Fishermen not unfrequently haul in as much as thirty fathoms in length, but it is very rare to see him extended his whole dimensions, as his habit is to coil himself up into a heap of knots, and when in this ball to take up his habitation under stones and hollows of rocks. In this position he attracts attention by the continual tightening and loosening of his complicated knotted body. When he wishes to shift his quarters he has the power of unknotting himself and gliding in a graceful manner through the water, propelled by ciliæ which run the length of the body. As regards his habits and food, nothing whatever is known for certain. It is, in fact, a sea form of the fresh water "hair-worm," found in stagnant ponds and ditches—viz., the "gordius acquaticus"—and which our ancestors used to say were horse-hairs in the process of transformation into eels. The scientific name of this curious seaworm is "Liæus marinus longissimus."—*Exchange.*

THERMOMETERS.

The word thermometer means a heat measure, hence any instrument employed to measure heat should be called a thermometer. When very high temperatures are to be measured, the instruments employed are called pyrometers, or measures of fire. Thermometers do not, of course, measure the quantity of heat in a body, but only tell us the relative temperature. There are several forms of thermometers, all based upon the principle that "heat expands, while cold contracts." Some substances expand unequally for equal increments of temperature, others expand so slightly that they fail to indicate small changes of temperature; both are unfitted for thermometers. It is believed that air expands equally for equal changes of temperature, and as this expansion is quite considerable (1.273d part for each degree centigrade), and as it does not become either liquid or solid under ordinary pressure, at any temperature which we can produce, it is the substance employed for the most accurate measurements of temperature. Any of the difficultly condensible gases, oxygen, hydrogen, marsh gas, might be employed instead of air, but with no advantage, and with much inconvenience in their manufacture. Next to air, the best material we have is mercury, which expands very evenly, does not freeze readily, and boils at a comparatively high temperature. For temperatures below 40° alcohol is generally employed, although it is claimed that glycerine could be used. For temperatures above 300° C., air thermometers alone are admissible, and for very high temperatures, where glass begins to soften, they are made of platinum.

The mercury thermometer, being the one usually employed in the arts, meteorology, in medicine, and in other sciences, a few words in regard to the manner of making one may be of interest.

A glass tube with a very fine bore has a suitable bulb, of any desired form, blown upon one end. At the other end may be a bulb of larger size, blown merely for convenience in filling. Neither bulb can be blown with the mouth, but with a bellows, containing pure, dry air. A small capsule is filled with pure mercury, which is heated to boiling to expel both air and moisture. While still hot the second or temporary bulb is warmed to expel a portion of the air therein ; the open end is placed in the mercury, which ascends into the bulb because the air contracts on cooling. When a sufficient quantity of the hot mercury has been introduced into this bulb, the tube and the other bulb are heated to expel a part of the air, and some of the mercury, which must always be kept hot to prevent its chilling and thus breaking the hot glass, enters the real bulb. By repeating the operation the bulb and stem are completely filled with mercury, which is then boiled to expel every trace of air. The tube is now drawn out close beneath the auxiliary bulb to a fine thread and cut off ; the thermometer is placed in a bath heated a few degrees higher than the highest temperature which the thermometer is to show ; the excess of mercury flows out, and the point is closed with a fine blow-pipe flame. As the mercury contracts on cooling it leaves a perfect vacuum above it.

The graduation is effected by putting it into ice or snow, then in the steam from boiling water, marking each of these points, dividing the space between into 100 parts if it is to have a Celsius or centigrade scale, into 80 if a Reaumur, or 180 if a fahrenheit. The graduation is carried on in each direction to the end of the stem. On the Fahrenheit scale the freezing point is marked 32, on each of the other scales it is marked zero.

Absolute zero is a term applied to a temperature 273° below zero on the centigrade scale, or—460° Fah. If we take 273 cubic inches of air, or any gas measured at 0° C., it will become 274 at +1° C., or 283 at +10° C. or 373 at 100° C., and at—10° C. it is only 263, at—49° it is only 233, and, at this rate it should become only 1 cubic inch at—272° and at—273° it should occupy no space at all, or at least not be gas any longer. As this temperature is not yet attainable, we can not positively assert that such would really be the case.

Maximum thermometers are made by placing a little float of steel upon the mercury, and the thermometer placed horizontally or nearly so. As the mercury expands it pushes along the float, which does not, however, follow the mercury when it contracts ; hence we are able to ascertain the highest temperature reached during any given interval. To reset the thermometer, it is raised to a vertical position and a slight tap given to it, which causes the float to drop down on the mercury again.

A simple and more accurate form of maximum thermometer, employed by Bunsen in measuring the temperature of the Geysers, consisted of an ungraduated thermometer open at the top, such as could easily be made by a person of but little experience. When placed in the spring, of course a portion of the mercury would flow out and escape. At any subsequent time the thermometer could be placed in an oil bath beside a standard thermometer, and heated until the mercury had entirely filled the tube and was about to flow over ; at this moment the standard thermometer is read, and shows the temperature to which the other thermometer had been exposed. The ordinary minimum thermometer contains alcohol instead of mercury, and the float is either of glass or of steel covered with enamel, so that it is drawn back by adhesion, but can not be pushed forward.

The most reliable form of self-registering thermometer is an upright mercurial thermometer, behind which is passed by clock-work a strip of sensitized paper. In front of it is placed a light of sufficient actinic power to blacken the paper above the mercury column. This gives not merely the maxima and minima, but all variations of temperature.

Metallic thermometers may be constructed by combining two metals which expand unequally into a spiral, which winds up when heated and unwinds when cooled. One end of the spiral being attached to an index which passes along a graduated arc. the slight motions are magnified so as to be distinctly visible. It is graduated by comparison with a good mercurial thermometer.

For measuring slight changes in temperature a thermo-electric pile, connected with a galvanometer needle, is employed. This is only applicable within very narrow limits, and requires great care to obtain satisfactory results.—*Scientific American.*

GARDENING.

March, the first spring month, will appear to our readers in widely different forms. In some parts of our country the essential signs of spring are plainly manifested ; the buds are swelling upon the trees—some even are in full flower ; in sunny, well-protected corners the Crocus and Snowdrops are contrasting their beautiful forms and colors, and the "busy bee" is gathering from these flowers its first crop of the season. In other parts of our country the snow-banks completely hide from our view every appearance of early spring flowers.

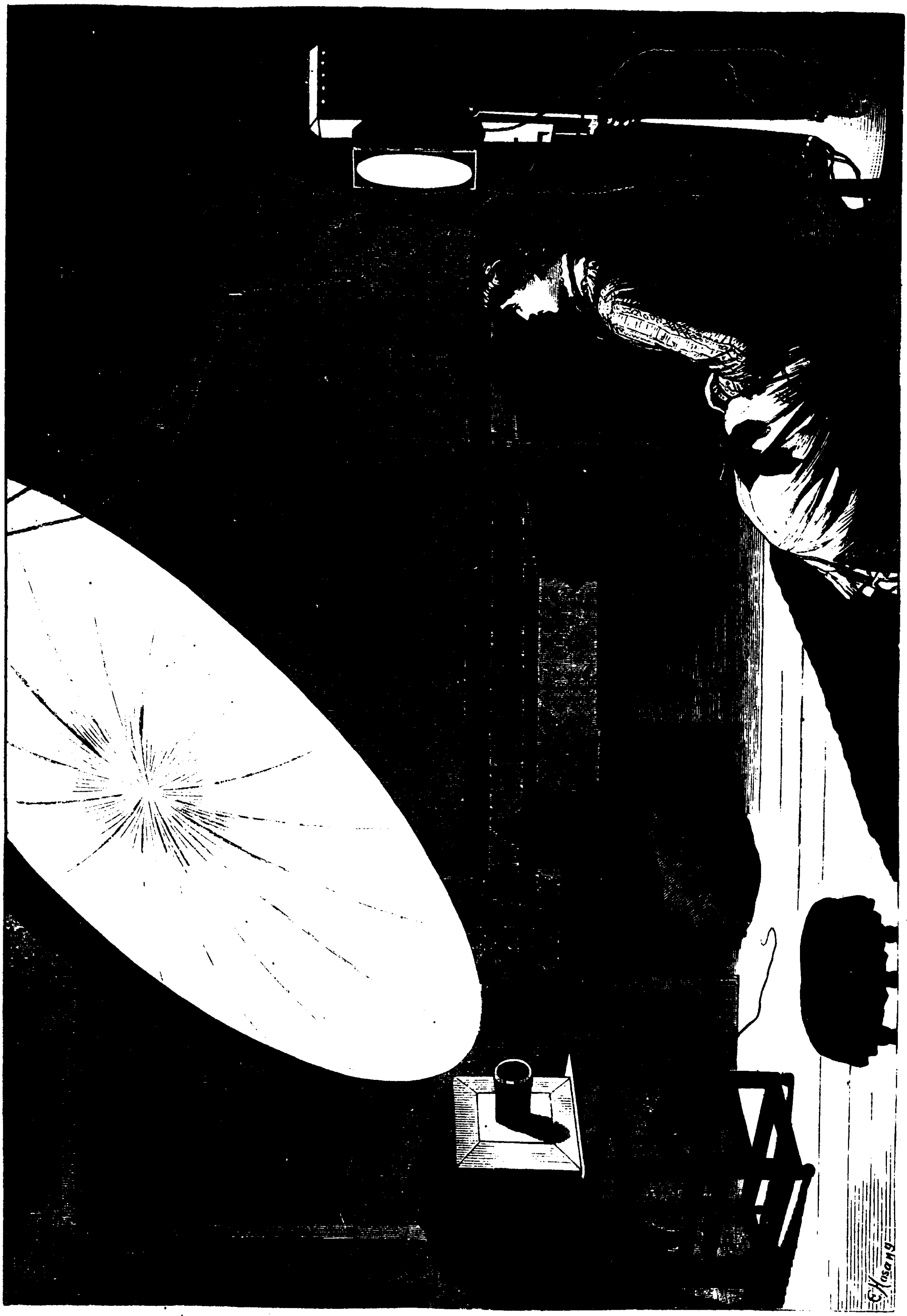
In this section, March is the most remarkable month of the year, and it is not uncommon to have the weather of the four season crowded into a single day. Winter, though it may return now and then in bitter nights, may be considered gone, and is rarely felt injuriously during the day. The cold winds, it is true, blacken and destroy our early flowers and try our tempers, but spring, in defiance of all hindrances, pursues its way steadily and with success. Nowhere is this more beautifully shown than in the vegetation of seeds bequeathed to the soil in the p evious autumn, and which, after lying in the earth apparently dead for many months, now assert their vitality and lift their green blades into the air. These delicate little forms, scarcely perceptible to the naked eye, are full of promise, and fill us with hope and confidence. The love of flowers of all kinds is naturally implanted in man but the early flowers of spring always bring with them the greatest degree of pleasure. The Crocus bursting through the ground is the harbinger of sunny days, and when we first meet with it in spring it is like greeting a long-absent friend. We live with summer flowers as with our neighbours, in harmony and good-will, but for the early flowers we have the most endearing affection.

Preparation for spring and summer work now begins. Should cleaning up and pruning have been neglected, defer that important work no longer than the weather compels you to. As soon as the ground is fit to work, attend to the removal and the dividing of all herbacious plants that need to be removed or increased by division. Herbacious plants have all *their* preparation for spring work completed and commence growth as soon as the frost is out of the ground ; therefore remove early, in order that their first new roots may not be destroyed in removal and the plants remain worse than idle while new roots are being formed. Lilies, in particular, that have been in the border during the winter should be removed early. In planting out again select a partially shaded situation, the shrubbery border being preferable. To have Lilies in perfection the soil must be kept moist and cool ; if planted in low-growing shrubbery this necessity is provided for in the most natural way. If the Lily-bed is in an exposed situation, mulch with newly-cut grass as soon as the weather becomes hot and dry.

Hot beds should now be in readiness for the sowing of seeds for early flowering plants. It should ever be borne in mind that seeds of annual plants of every description, if sown at this period, ought not to be rapidly excited by too powerful heat. Errors of this kind are very common, and the many losses of plants from this cause tend to discourage the amateur in the laudable effect to prolong the flowering season. Where any artificial heat is employed, it should be of a very gentle nature. and, with the exception of extremely tender species, the more it is dispensed with the greater will be the luxuriance, beauty, and hardiness of the plants.

As a rule, amateurs will be more benefited by a cold-frame for bringing forward plants such as Asters, Balsams, Zinnias, Petunias and Antirrhinums, etc., etc., than by a hot bed. Our custom is to sow seeds of annual, six weeks earlier than tender plants can be transferred to the open border. This should be done in a common cold-frame covered with hotbed sash. The result will be good, strong plants about six inches high at the same time that seeds sown in the open border are just breaking ground. These plants, having been grown cool, are vigorous and healthy, and can be transplanted into the flower-border without danger of loss.

House plants will now require much care and attention. The sunshine on clear days will excite a rapid growth ; consequently the plants will require a corresponding amount of air and moisture. Insect life is now quite as active as plant life, and the two cannot live long together. Destroy the insects, or they will destroy your plants. Geranium-cuttings may now be struck, and the young plants grown on for the conservatory the coming winter. Young plants from seed sown in boxes should be pricked out into small pots and brought forward as rapidly as possible, but do not suffer them to grow weak and spindling. Always remember that one good, strong, healthy plant will produce more flowers than a score of puny, weak ones. Hyacinths in pots should be in perfection of bloom this month. When the flower-spike is well developed and the first flowerets begin to open, place the plants in a cool, light room. This will materially prolong their season of bloom. After flowering allow the bulbs to dry off gradually, and they will be worth preserving for planting in the border the coming autumn. Hyacinths that have once been forced are in future useless for pot-culture. —*Floral Cabinets.*



THE ELECTRIC LIGHT APPLIED TO PHOTOGRAPHY.—(SEE EDITORIAL.)