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## ELECTRICAL HUMBUG.

THE old song which dealt with the marvels and deceptions of London trade, and complained pathetically of the metropolis that

"Humbug has here got the snuggest of monopolies
And everything is anything but what it seems."

needs an additional verse to-day to describe the prodigies of humbug which the spread of electrical knowledge has called into being. Upon the heels of every great discovery there follow adventurers who use the new name to palm off worthless objects upon their dupes, but electricity has probably more to answer for than others in this particular. There is probably no limit to the uses to which electricity will be ultimately put for the benefit of mind; but what is even more certain than this is that the majority of so called electrical appliances sold at the present day owe their electricity to the imagination and their efficacy to the superstition of the purchaser. Electricity may be, when properly applied, a specific for some nervous diseases, but what connection a copper and zinc medal hung round the throat can have either with electricity or rheumatism we have yet to discover. That these things meet with a ready sale seems certain from the flood of hand-bills and advertisements of every kind which deluge the country and litter the counter of every drug store. Electric belts, electric pads, electric brushes, not to speak of electric pills and potions and powders which contain about as much electricity as their purchasers heads do sense. How for example can a brush composed of ordinary bristles, even if the back do contain a magnet, to keep up the delusion as to its electrical power, how, we repeat, can such a brush exercise any other effect upon the head than the ordinary hair brush composed of the same materials and applied in the same way. And if the brush contain wires, introduced among the bristles to heighten the delusion, the friction of these, so far from being a benefit, is productive in many cases of injury to the scalp, while the electric effect is as far to seek as ever. This is not to say of course that there are not galvanic remedies which really do set up a current, and produce an effect upon the surface exposed to them, which may or may not be beneficial. It is not for us to discuss the genuine use of such appliances; all we war against is humbug in whatever form; all we want to do is to warn those who want or think they want electricity, pay for electricity, and don't get electricity after all.

## THE ORIGIN OF MAN.

The latest contributor to Darwinian, or rather anti-Darwinian literature is Mr. WM. DENTON. To begin with the praise that is legitimately due to him at the outset, Mr. DENTON has succeeded, as it seems to us, in avoiding the Scylla of dry physiological investigation without getting into the Charybdis of unscientific over-popularity. The book is easily to be "understanded of the people," but is none the less on that account the result of accurate scientific study. Starting from the now acknowledged facts as to the earth's origin, and going as far with DARWIN as to refer the appearance of man to evolution from the lower animals, Mr. DENTON finds his first point of difference in the unqualified adhesion which he gives to the theory of spontaneous generation. Apart from the known facts, we have ever considered that this is the only logical end, or rather beginning, of the doctrines of evolution. If man by a series of natural operations is the legitimate descendant of the *protozoa*, from what came these *protozoa* themselves? And conversely, if an external power (call it what you please) created the *protozoa*, how is it more unreasonable to suppose that the same power was capable of creating, or did, in fact, create man?

But unfortunately it does not seem within the province of physiologists to be logical. Of Mr. DENTON's failure in this respect, more hereafter. Meanwhile, those who deny the possibility of spontaneous generation find a strong support in the experiments of Professor TYNDALL, which, viewed by the rules of strict evidence, seem to outweigh those of WYMAN and others, and for this reason. Granting that the conditions in both cases were equally perfect, it is yet more reasonable to suppose that an accident may have introduced the germs of life into a sealed flask, or preserved them from destruction in the preparation of it, than to conceive it possible that life, if really capable of producing itself spontaneously, should have remained inert under any circumstances. To continne, Mr. DENTON traces the similarity in early forms of being, and points to the close resemblanee of the *embryos* of man and the animals to support the theory of evolution. Evolution admitted, the question remains, then, of cause, and it is here that his theory branches from the doctrines generally propounded Mr. DENTON sets aside natural selection, and for the most part sexual selection, as inadequate, in his opinion, to account for the changes. After tracing with painstaking care the various operations of variation, tendency, modification, hereditary transmission and natural selection in a modified form, he proceeds to account for their systematic action in the production of man. Man's origin is undoubtedly natural in the sense of owing its development to the operation of natural laws, but it is also—and here is, we take it, the new point of Mr. DENTON'S theory—spiritual. The operation of building up from the first beginnings of life the most perfect expression of it which we have on earth, has been presided over by a Nature which has, we submit, all the characteristics of a God, and which may be readily exchanged for Him, by those of us as are not yet ready to give up our old-world associations.

This theory, it seems needless to say, involves the future life of the soul.

"Why should millions of ages have been spent to produce a being to whom future existence is so desirable, and then deny him what he of all the world only craves? There is a life after death; the past teaches it, the present declares it."

Nature then, during the millions of years she has required to produce the present generation, has been striving after perfection. The result of those struggles is man as we find him to-day. The future is to bring infinite happiness not only to the race, but to each member of it.

"And what (Nature) has done for the race is an indication of what she will do for the individual."

Here, then, is the theory in a nutshell; and here, we conceive, the grand objection. Follow the argument to its legitimate conclusion. Putting aside the question, which naturally arises, of where the line of the future existence is to be drawn between man and his ancestors (for why the first man should be worthy of Heaven and his immediate progenitor, the last ape, end his existence on earth is not at all clear, nor does Mr. DENTON seem to insist upon it) granting that it is only men who are to have a future, we may ask, Are all men of all ages included in this grand promise? Are the gentlemen who dined off Captain Cook equally deserving of the exertions of Nature on their behalf with Mr. Disraeli or Cardinal Newman? There can be but one answer. They are alike men, they must alike be admitted to immortality. Well, then, Mr. DENTON, is it not all a failure? Here has Nature been for millions of years struggling after perfection. She has partially attained her aim in the nineteenth century, will, no doubt, attain to it more perfectly in the odd millions of years left her for her operations on this planet; and then this done, will she not have to begin all over again with Heaven? It has taken millions of years to fashion out of the primeval man a Huxley or a Lyell. And lo! this life ended, and the primeval man is back again in his original simplicity (for remember the future is for individuals), and it may be expected that Mr. Lyell will have to complete the course of instruction which Nature has failed to bestow.

Such is, we take it, the objection to the new system. That such an objection does not hold to the Christian doctrines of a future life, might be shown readily, though our space is too limited for present discussion of the subject. Meanwhile, in the general acceptance of the doctrine of a future life amongst our leading scientists is reason for congratulation amongst those of us who recognize in science the handmaid and not the mistress of revealed-religion.

## Chemistry, Physics, Technology.

### CHEMISTRY AND PRODUCTION OF GUN COTTON AND NITRO-GLYCERINE.

BY E. M. EISSLER.

All the organic nitro compounds bear in their production from certain organic bodies the same characters—namely, all these nitro combinations are produced from the original body by the exchange of a certain number of equivalents of hydrogen against an equal number of hyponitric acid. For instance:

Cellulose (cotton) $C^{12} H^{10} O^{10}$ or $C^{12} H_7 O^{10} H_3$ changes into nitro-cellulose or gun cotton, $C^{12} H_7 O^{10} (NO_4)_3$ or $G^{12} H_7 O^{22} N_3$

Glycerine $= C^6 H^8 O^6 = C_6 H_5 O^6 H_3$ changes into nitro-glycerine $= C_6 H_5 O_6 (NO_4)_3 = C^6 H_5 O^{18} N_3$

Carbolic acid $= C^{12} H_6 O_2 = C^{12} H_3 O^2 H_3$ changes into picric acid $= C^{12} H_3 O_2 (NO_4)_3 = C^{12} H_3 O^{14} N_3$

Mannite $= C^{12} H^{14} O^{12} = C^{12} H_8 O^{12} H_6$ changes into nitro-mannite $= C^{12} H_8 O^{12} (NO_4)_6 = C^{12} H^8 O^{36} N^6$

Here we have four of the well-known high explosive bodies, and in each case we find three equivalents (or the multiple of three) of hydrogen replaced by three equivalents of hyponitric acid.

Gun cotton looks like ordinary cotton, nitro-glycerine looks like glycerine, and nitro-mannite like mannite, but their chemical properties are vastly different. We shall speak in this chapter of the properties of nitro-glycerine. The nitro-glycerine is produced by the action of concentrated nitric acid on glycerine, during which action the glycerine takes up the nitric acid, and water is eliminated. The chemical reaction is as follows:

$$C^6 H^8 O^6 + 3(NO_5) = C_6 H_5 O_3 (NO_5)_3 + 3(HO).$$

Glycerine. Nitric Acid. Nitro-Glycerine. Water.

It is eminently necessary that the nitric acid should be employed in a very concentrated state. In the process of manufacture it is necessary to have the water which is produced in the above re-action absorbed, and that is accomplished by mixing the nitric acid with sulphuric acid.

The practical production of the nitro-glycerine therefore is accomplished by the treatment of glycerine with a mixture of concentrated nitric and sulphuric acid, in which treatment the sulphuric acid plays a secondary role, while by the absorption of the eliminated water it maintains the surplus of the nitric acid in a concentrated condition.

Different chemists employ different proportions in their mixtures of nitric and sulphuric acids, and also in adding the glycerine.

In the production of nitro-glycerine there is a very strong elevation of temperature, which must be avoided, as it may lead to explosions. There are also different methods employed to avoid this elevation of temperature.

According to Sobrero, 2 volumes of sulphuric acid of 1.831 specific gravity, and 1 volume of nitric acid of 1.525 specific gravity, are mixed, permitted to cool, and into this mixture half a volume of glycerine, of a very syrupy consistency, is introduced with constant stirring. The mixture is again cooled, and after having become turbid and been separated into two layers, poured into 15 or 20 times its bulk of cold water. The oily nitro compound sinks quickly to the bottom, is freed from unchanged acid and glycerine through repeated washing with water, and hastily dried in vacuo.

Praeger & Bertram add 1 part by weight of glycerine to 8 parts of a mixture of 1 part of concentrated nitric acid and 2 parts of fuming sulphuric acid.

Liebe recommends to pour 1 part by weight of glycerine into a mixture of 2 parts of nitric acid of 1.525 specific gravity, and 4 parts of concentrated sulphuric acid, to keep the mixture below 75° F., and to dry the washed nitro-glycerine in the steam bath. There are various methods proposed, but on working on a large scale, the process is carried on as follows:

The manufacture of nitro-glycerine usually takes place in three wooden sheds of light structure, separated from one another by strong earth banks of 25 to 30 ft. in thickness at theis base. The walls and roof are lined with straw, and the temperature, by means of hot-water pipes, is kept day and night at about 60° Fahr.

In the one shed the glycerine is brought together with the mixture of acids; in the second shed the nitro-glycerine is poured into the water, and otherwise washed; in the third shed the complete elimination of acid from the oily compound is effected, and eventually the nitro-glycerine is worked up into dynamite.

These sheds are sunk into the ground, so that their flat roofs are barely above the level of the ground, they are lit up by reflecting lamps placed outside on the roofs; the floor is covered with fine sand. At some distance from these sheds are the huts in which the cartridges are made. They, too, are separated from one another through earth banks, and so is another shed, in which the packing takes place. Quite away from all these buildings are the store-houses, sunk into the ground. There are usually also cellars for keeping the ice, which latter serves for cooling the wash water. The storing of the raw glycerine and the sulphuric acid requires no special precaution.

Nobel's arrangement for making nitro-glycerine is very perfect, as large quantities can be produced by it at a time, as much as 3,500 lbs. in one operation, and to accomplish it, only a few hours are required, and under the supervision of an able man the operation can be considered comparatively safe, as he keeps his mixture cool, and avoids in this way the great danger of the nitro-glycerine igniting and causing explosions. I shall enumerate the way the nitro-glycerine is manufactured in some large establishments on the Continent.

In one of the largest dynamite factories in Europe, where the daily production is over two tons, the nitro-glycerine is prepared in the following manner: 1,300 lbs. of nitric acid of the specific gravity 1.48 are mixed in four cast iron pans with 2,600 lbs. of sulphuric acid; this mixture, which is left to cool for a day, serves for the treatment of 630 lbs. of glycerine. The acid is drawn from the pans into a wooden cylindrical vat, of about six ft. high and three and one-half ft. in diameter, lined inside with thick lead and containing along its lining two spiral lead pipes of about one inch diameter, which reach from the bottom to the top. Each of these spirals, or worms, forms a system by itself through which cold water circulates, and one may serve as substitute for the other in case one gets out of order. The mixture of acids is stirred first by itself in this vat; the stirring is effected by two iron disks covered with lead, disk and covering being perforated, which glide up and down on a vertical iron shaft, the gliding motion being effected by pulling the rope attached to the disks over a pulley; the two or three workmen who perform this task stand at a distance of 30 or 40 ft. from the vat, behind a strong earth bank. When the acids have been introduced into the vessel, and the agitation has commenced, water of the temperature of about 25° F. is let into the worms, the temperature of the acid can in this way be maintained at about 50° F., as may be ascertained from a thermometer which reaches through the lead cover of the vessel into the acid. The glycerine, which is kept in a zinc tank on the roof of the shed in which the mixing vat is, is now allowed to run into the latter vessel. The flow is regulated by means of a tap, and also by letting the glycerine first run into perforated zinc boxes, placed on the lid of the mixing vat, and corking up, if occasion requires, some of the perforations. As soon as the glycerine falls into the acid the temperature rises at once, but by carefully regulating the supply of glycerine it may be kept at about 60° Fahr.

It is advisable not to allow the temperature to rise above that degree, though experience shows that a higher temperature yields a larger quantity of nitro-glycerine. It requires, according to the season and the temperature of the cooling water, two to three hours for 630 lbs. of glycerine to pass into the mixing vat; the stirring must not be stopped for a moment during the process. When all the glycerine has been added to the acids, the mixture is at once drawn off through a leaden pipe to the so-called wash shed, where it passes into a tank about eight ft. high and 12 ft. in diameter, which is half filled with cold water. The inlet tube carries a sieve, to retain lead sulphate that may have been brought from the mixing vat. Whilst the nitro-glycerine flows in, stirring with wooden poles is begun, and continued until the nitro-compound has settled below the dilute acid. The bottom of the wash tank is slightly inclined, so as to allow a complete drawing off of the nitro-glycerine. The outlet taps are of stoneware. The nitro-glycerine is now twice washed with water, freed from acid and lead sulphate, and finally washed with water, to which sodium carbonate has been added to neutralize free acid which may be present.

But even after this purifying process there remain traces of acid; to eliminate these the nitro-glycerine is transferred to a third shed, where it is agitated for about an hour in a rotating vessel called a butter machine, with about 50 lbs. of a concentrated solution of a sodium carbonate; after this time it will no more redden litmus paper. It is now separated from the alkaline solution, filtered through felt, and collected for further use in leaden reservoirs.

The yield differs greatly, according to the conditions of the raw glycerine, the concentration of the acids, and the temperature. The yield of nitro-glycerine falls generally below the theoretically calculated quantity. This short-coming is due to the formation of a glycerides, which dissolve in the wash water. As a rule, the yield in winter is greater than that in summer.

The above is a system employed by some continental manufacturers, and, notwithstanding the precautions taken against the accidental rise of temperature during the production and washing of the nitro-glycerine, some very serious explosions during its manufacture have not been unfrequent; but Nobel has adopted a method of operation which, so far as experience goes, appears not to involve any special elements of danger if properly applied, and also presents advantages from an economical point of view, besides promoting the attainment of uniform results; and to his credit it must be said that when he made his first trial with his new apparatus he certainly exhibited a great deal of boldness and pluck, as it was a question of converting several hundred weight of glycerine into the explosive compound in a single operation. His mode of operation is successfully carried out by the Giant Powder Co., of San Francisco. The plan pursued by some of the other companies established near this city differs somewhat in its arrangement.

A series of small iron kettles, or pots, are arranged in a trough, each provided with a stirrer, which receive their movement from a common shaft which is revolved by a man stationed outside of the building. The pots are charged with the acids, and the glycerine is supplied either from a common reservoir by small outlet pipes, or above each pot is a small vessel containing glycerine, from which the same runs in a small stream into the acid mixture.

The iron pots are surrounded by a running stream of cold water while the reaction is going on and stirring has to be constantly kept up. After the reaction is complete the pots are taken up and their contents dumped into large tanks filled with water, where the nitro-glycerine separates and is afterwards washed

As simple as this operation may appear, the writer earnestly warns anybody who is not experienced in the matter not to undertake any trials, as there are points connected with the manufacture of nitro-glycerine which can only be acquired by practical experience, and even then it is fraught with danger.

In the next issue, Mr. Mowbrey's of Mass., process of manufacture will be given, as it has certain features worthy of note. —*Mining and Scientific Press.*

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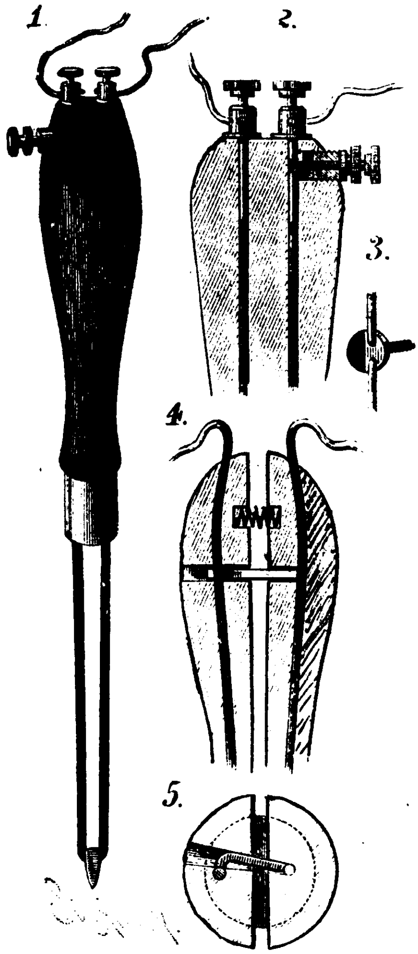
Two ingenious pieces of electrical apparatus for lighting and extinguishing lamps have recently appeared. In one of them (M. Margret's system) the oil lamp stands on a base in which is a horizontal electro-magnet. From the armature of this rise two parallel curved rods of copper, joined at the top by a platinum spiral, which is rendered incandescent by a battery current and brought in that state to the wick, when the armature is attracted. In this movement towards the wick, a small bellows is compressed, giving a puff of air through a tube rebounding on the wick. In the case of lighting the lamp, this puff has no effect, but when the lamp has been burning, and is to be extinguished, the puff produced by a momentary passage of the current blows the flame out, and there is not time for the spiral to relight the lamp. In the other system (that of M. Ranque), a platinum spiral is brought to the wick, much in the same way, but the lamp is put out by an extinguisher at the end of a curved and pivoted wire. The contrivance is such that the extinguisher is brought down to the wick, or raised from it (through attraction of the armature) according as the flame is to be put out or lit. (Both lamps are figured in *La Nature*, No. 404.)

## SOLDERING BY ELECTRICITY.

The engraving shows a soldering iron heated by the electric current, and capable of melting all kinds of solders, such as gold and silver solder, which have heretofore required a blowpipe to melt them. It may also be used for the more fusible solders employed in making tin ware. Now that the electric current is distributed so generally and is used for all manner of purposes it seems quite practicable to employ it for soldering.




ELECTRIC SOLDERING IRON.

Figs. 1, 2, and 3 show one form of electric soldering iron, Fig. 1 being a perspective view, Fig. 2 a section showing the switch for controlling the current, and Fig. 3 a detail view of the switch button. Figs. 4 and 5 are views of a modified form of the device. In Figs. 1 and 2 the electric conductors extend through and project beyond the handle, and embrace a piece of platinum or other material offering sufficient resistance to the passage of the electric current to become heated more or less according to the strength of the current. One of the conductors is separated near the upper end of the handle, and bridged by a button made partly of electrical conducting material and partly of insulating material, so that by turning the button the circuit may be completed or broken as circumstances may require. The device shown in Figs. 4 and 5 is on the same general principle, the only difference being that the handle is split lengthwise and the two portions are pressed apart by a spring When apart to their fullest extent a hook attached to one of the conductors touches the other conductor and short circuits the current in the handle. When the two halves of the handle are pressed together the current passes through the refractory point. When the point is heated to incandescence the tool may be used for melting either silver or gold solder. For melting soft solder the heat may be less intense.

This invention was recently patented by Mr. C. E. Ball, of Philadelphia, Pa.

## THE STONE FACE OF STATEN ISLAND.

A few weeks ago, while two brothers named Hall were at work at Silver Lake, Staten Island, digging up a small tree for transplanting, they uncovered a stone of slaty rock, irregular in form, some two feet long by twenty inches wide, and about eight inches thick. The upper half had a human face, life-size, cut so sharp and natural as to be almost startling at first. The face was oval, of the old Huguenot type, with low cheek bones, fat, full cheeks, a sharp, clear-cut chin, full eyes and parted lips. Of course all sorts of stories are rife of its origin and history, some people believing it marked the burial-place of ill-gotten treasure, others that it is a stolen art gem, and others again that it is a relative of the Cardiff Giant. Whatever it may be, it is certain that it has excited considerable interest, and for this reason we give a sketch of it.

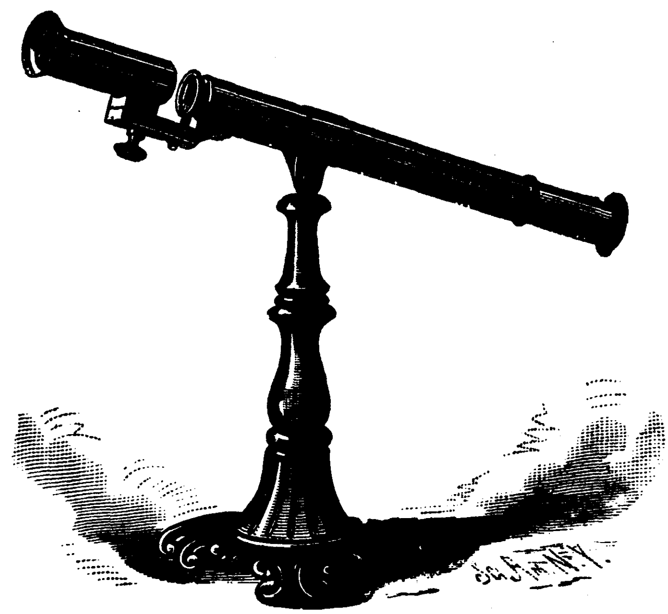
STONE FACE RECENTLY FOUND ON STATEN ISLAND.

## IMPROVED OPTOMETER.

We give an engraving of a novel instrument for measuring the focal lengths of lenses, which is capable of measuring the focus of any lens from three inches to seventy-two inches, while the length of the instrument is only thirteen inches. This is effected by the employment of a convex lens of short focus which shortens the focus of the lens under test. The instrument is in some respects similar to a camera, the object being held in the short detached tube, the lens to be tested being placed between the two tubes; the image of the object is formed on a ground glass carried by the movable tube. There is a scale on the movable tube, and when the image on the ground glass is sharp, the scale indicates the focal length of the lens.

The great utility of this instrument will be understood when it is known that scarcely any spectacle or eyeglass has the correct focus marked upon it; and it is often very essential that the exact focus of a lens be known, for example, in matching a glass when its mate is broken, or in supplying spectacles which are but very little different from those already worn.

This instrument is as well adapted to testing concave as convex lenses, and it may be used by any light. It is an ornament to the show case of a dealer, and will be found very useful by any one dealing in spectacles as well as the regular optician.
*Scientific American.*



NEW OPTOMETER.

## COMBUSTION AND VENTILATION.

Although the discovery and use of anthracite coal dates back about ninety years, there is something yet to be learned about its management, at least in our dwellings, judging by the construction of our cooking stoves, ranges, and heating furnaces and parlor stoves. Invariably the fire-box is improperly proportioned, the object appearing to be to get a deep mass of coal on fire at one time. The slightest knowledge of the process we call combustion would show that the present plan of deep fire-boxes in stoves, ranges and domestic furnaces is radically wrong. Why do not the builders of steam boilers construct their furnaces in similar manner? If they did, the fire-box for a boiler fifty inches diameter and fourteen feet long would be about six feet deep, and all the air that was allowed to enter the mass would be forced to come in at the bottom of this pile of coal. Now, nothing of the sort is attempted under steam boilers. There is a large grate-surface extending the entire width of the full diameter of the boiler, and it is so contrived that the fireman cannot possibly get over four inches thickness of coal; and he is the better fireman who runs with three inches or even less. Then the air—the outer atmospheric air—is admitted to the entire under side of the grate, and also over the fire itself, Sometimes the upper or surface draught is admitted by the doors themselves, and sometimes by openings in the sides on the fire-box, back of the doors, and sometimes by perforated pipes open at the ends, and allowing and inducing atmospheric air from outside to the top of the fire inside. This surface draught is worthy of notice. Properly managed, it does not deaden the incandescent coal nor diminish the combustion. Of course, it is acknowledged that a favorite mode of cooling down a kitchen fire is to uncover the fire,—that is, remove the covers and saddle, allowing the entire atmosphere of the room to enter the stove at the top of the fire. But if only a proper proportion of air was admitted to the top of the fire, the combustion of the coal would be hastened, and, what is equally important, the unconsumed carbonized gazes would be burned, adding greatly to the effective value of the coal consumed—the coal coaked and wasted rather.

This is the system pursued by boiler-makers; and this is the foundation of all the attempts and successful results of improving the fuel service of steam boilers. The justly celebrated Jarvis furnace is based on giving the fuel and its liberated products sufficient oxygen to consume them. It is the basis of all the improvements reached within the last twenty-five years in the production of heat force from carbon. If half as much sense were shown by our stove builders as by our boiler makers, very heavy reductions might be made in our domestic coal bills. Of course, their fires require attention. So does anything that is of present value. But, while a pot of green coal ten inches deep and eight by twelve square may live unattended for twelve hours, it will give out but little heat. The coal cokes, gradually disintegrates, turns to unburned coal in small particles, some of them flying off into the outer air on the wings of the upward draught, and others falling into the ash-pan, or clogging the interstices of the uncracked coal. All the visible *débris* is called ashes, and thrown away; and all the flyaway fuel is not called— it is lost as much as the "ashes." This present method of coal burning is illustrated every day—or every night. Fill the cylindrical or oval or rectangular receptacle of the stove or furnace to the top at bed-time. Next morning the room is not overwarm. Everybody knows how chill it seems in the morning, and how cheerful it is to "start the fire up." Yet when the attempt is made to start up the fire, it is found that the coal is all gone. Sometimes kindling fuel is necessary. Now, if that coal has been burned, why is not the room warm. A similar amount of coal in the day, when it received occasional attention, was sufficient to keep the room even uncomfortably warm? The facts are that the coal was not burned and the heat was not evolved. There is little warmth in the room, but a feeling of unpleasant atmosphere, too much carbonic acid gas for comfort.

This sketch is a common case, and it shows plainly that our present methods of burning—or rather using—anthracite coal are wrong. We do not *burn* the fuel. We simply get rid of it. We do not get the heat, the flame, the genial warmth; but we use the heat to coke, and disintegrate and use up the coal, permitting the gases to go unconsumed up the chimney, and relentlessly shovelling out upon the ash-heap our true solid fuel.

One of the biggest swindles in domestic stoves is that of the self-feeding parlor stove. It is a device to encourage laziness and the coal-dealer's business. Not one-tenth of the coal poured into the top of these gas-furnaces is ever used as heat in our dwellings. Most of the heat is used up in coking the coal in the open funnel, and then the resultant fine fuel is carted off as ashes. In some of these self-feeding heaters, the combustion and the resultant heat is so confined that what does not go unconsumed up the chimney is expended in coking and destroying the coal. The process is simply that pursued by our gas-men with bituminous coal; only our gas-men are sensible enough to collect and purify the gas, and use it again for light and heat. We, in our houses, waste the gases and throw away the coke. Proper combustion of fuel and good ventilation are closely allied, and—but the ventilation must wait for another article. This is sufficiently long—*Journal of Commerce.*

## ELECTRIC LIGHTING IN LONDON.

The city of London has at last fairly started upon a grand experiment in the way of lighting by electricity, and the arc of light now stretching across the metropolis, from Westminster to London Bridge, has no rival in the civilised world. It may, however, be considered as somewhat of a reproach to Britain that much as she contributed to the early development of electrical science, these latest practical illustrations have been mainly worked out by foreigners. So much is this the case that English firms have avowedly abstained from assisting at the present Electrical Exhibition at Paris, on the ground that they draw their own supplies from that city. It is greatly to be feared that the monopoly in use claimed by the Telegraph department of our own Post Office has done much to retard invention and improvement here in one important application of electrical science, and that naturally reacts on the rest. Be this as it may, the fact remains that for the electric lighting of London recourse is had to Jablochkoff, a Russian; Siemens, a German; Brush, an American; and Lontin, a Frenchman.

The Jablochkoff system is the one which was first introduced into this country by Messrs. Wells, of Shoreditch, whose stand at the Building Exhibition is now lighted up by it. Subsequently it has been "exploited" by one if not two companies, and it appears to be temporarily in abeyance, since the district of the city apportioned to it has been turned over to the Lontin company. The Metropolitan Board of Works has, however, for the past two years maintained a row of Jablochkoff lamps on the Victoria Embankment, and this system is therefore pretty well known to Londoners. The Lontin system is to be adopted in Queen Victoria street, but owing to the short notice at which the contract was taken up, it will not be in operation till the 1st of May, though a few lamps are to be seen in a shop on Ludgate Hill. Consequently the two systems of Siemens and Brush mainly require our present attention.

The first point we have to note is as to the money cost of the experiment, which will be for plant and maintenance 1,410*l.* for the 32 Brush lights, 3,725*l.* for the 34 Siemens' lights, and 2,930 for the district allotted to the Lontin light. The discrepancy between the cost of the two first systems is most remarkable. The Brush Company has taken the contract at the price of gas, and astonishing as it seems, its managers assure us that they expect to make a profit out of the contract. Deducting the expense of plant, the maintenance of 32 Brush lights will be 660*l.* for a year, that is about 21*l.* per lamp. Calculating the Siemens' light in a similar manner, and allowing the larger lights to cost twice as much as the small ones, we find that they cost 2,270*l.* for the district, an average of 57*l.* for the lower lights, and 114*l.* for the high ones. The contractors may all be supposed to know their own business best, and it is impossible for anyone to criticise their prices until experience furnishes the necessary facts, but the proportion between their charges is a thing well deserving of being borne in mind.

As to the quality of the light supplied by the competitors, it will probably be admitted that for whiteness and steadiness the Brush bears off the palm. At King street, where it can be seen in contiguity with Siemens' light, the latter seems to have a pink tint, while the Jablochkoff at its point of contact with the Brush at Blackfriars Bridge, appears even bluer than at Waterloo. The intensity of the light is of course great, but although attempts are made to express it in figures our readers must bear in mind that these are only estimates, and that no trustworthy mode of measurement has yet been applied to the electic light.

We now come to the mechanical details by which the light is produced and distributed. The Siemens' plan of illumination differs from any so far tried in London for street-lighting, and shows what can be effected in the illumination of a town by placing a few powerful lamps at a considerable elevation, so that the light shall be diffused, and but little shadow be cast by persons and vehicles. For this purpose six powerful lights are employed, each approximately equal to 4,000 candles, and twenty-eight smaller ones of 300 candle power each. The six powerful lamps are about 80 ft. above the level of the street, and are placed on latticed iron poles like those used for signal-posts, made by Messrs. Stevens & Son, of Southwark. The furthest of these lights from the source of power is about three-quarters of a mile from the dynamo-machines. The twenty-eight smaller lights employed are placed on iron posts resembling ordinary lamp-posts, but higher, the light being about 20 ft. from the ground, or more than 8 ft. higher than the gaslights. The additional height at which the light is placed brings a larger field under the illumination of each, and aids the diffusion of the light. The electrical generators and their steam motors are in Old Swan lane, Upper Thames street. Each of the large lights is fed by its own dynamo-electric machine, separate conductors being led from the dynamo-machine to each lamp. The twenty-eight smaller lights are treated as if in four groups of seven lights each. To feed them two alternate-current machines are used, each machine supplying two groups, or fourteen lights. This method of subdivision has been adopted, not because all the small lamps could not be supplied by one machine, but for convenience in working, and with a view to prevent the danger of the streets in the district being left for a short time in darkness should any accident happen to the machinery. The generators, again, are dealt with in two equal groups, each of which is driven by a steam engine of ten-horse power nominal, supplied by Messrs. Marshall, Sons & Co., of Gainsborough. A third steam engine of the same power stands as a reserve between the two, so that it may be used to drive either set of generators when their own engine needs to be cleaned. The "leading" wires which convey the current from the dynamo-machines to the lamp consists of strands of copper wire coated with gutta-percha. Except over London Bridge, the conducting wires are laid in the ground, enclosed in cast-iron pipes. Those supplying the lamps on London Bridge are carried along the broad ledge outside the parapet, and are protected by a sheathing of iron wire. In the side of each lamp-post is a door opening to an iron box, within which the conducting wires from the lamp join those which come from the machine. The lamp, or "regulators," are fitted with one pair of carbon cylinders, the carbons being placed vertically one above the other. In those used for giving the lights of high power the upper one is 2 ft. long and 20 millimetres or a little more than three quarters of an inch in diameter, the lower one 1 ft. 8 in. long and 15 millimetres or nearly 6-10ths of an inch in diameter. The pair will last for about 18 hours without renewal. For the smaller lamps the carbons are 16 in. long and 12 millimetres or rather less than half an inch in diameter. Those in use are partly from the works of Messrs. Siemens Brothers, at Charlton, and partly from the works of Messrs. Siemens, at Berlin. The globes on the smaller lamps, of a material called alabaster, and of a quality made exclusively by Mr. Frederic Siemens, of Dresden, are estimated to absorb only about 20 per cent. of the light. Those on the high lamps are of clear glass. The high lamps which are fitted with reflectors above to intercept the upward and horizontal rays are suspended from iron brackets fixed at the top of the latticed iron pole. Guide wires passing through the reflectors steady the lamp when it is being drawn up and down to be cleaned and to have the carbons renewed. Such work is done on a platform, placed about 16 ft. from the street. The street work, the laying of the leading wires, and the erection of the posts, which was done by Messrs. Docwra & Sons, proved very costly, the difficulty of breaking up the asphalte and the interference with gas and water pipes adding materially to the expense.

The apparatus of the Brush light, which was fitted up by the Anglo-American Electric Light Company, is of a much simpler character than the foregoing. The nearly constant purity of colour and the steadiness of the Brush light already alluded to have been obtained partly by the improvement of the mechanical contrivances for regulating the current, and partly by the homogeneity of the carbons, analysis showing, it is said, but a-half of one per cent. of impurity in the manufactured carbons. The whole of the 32 Brush lamps are fed through a single leading wire from the works of the Company, which are in Vine street, near Waterloo Railway Station. The circuit is about 3¾ miles in length, over 20,000 ft. of wire being required to complete the round of the district. The conducting wire, one-eighth of an inch in diameter, is made like a wire rope for the sake of getting pliability of seven fine copper strands, and by thus using what is practically but one wire there is, it will be readily understood, a saving in the first outlay and afterwards in the cost of maintenance. The view with which the inventor of the system has worked is that he has to multiply and not to subdivide the electric light, assuming that, instead of dividing a large light into a number of small units, with a loss in the total light by the subdivision, he should rather multiply one ordinary-sized light, of say 1,000 to 2,000 candle power, into a greater number of lights of the same size, absorbing energy proportionately to the increase in the number of lights. This result he obtained by increasing the speed at which the armature wheel revolves in the magnetic field. The current obtained is continuous. By the use of an appliance the inventor calls the regulator, the number of lights worked by a machine can be increased from one up to the highest number the machine is capable of feeding. The 32 lights in the district under experiment will be worked by one machine, absorbing for the entire circuit about 28 horse-power indicated—work which can be obtained from an ordinary engine of 12 or 14 nominal horse-power. At present, as a matter of fact, the machine is worked by the large Galloway engine which is employed to run the machines supplying the lights at Charing Cross (South-Eastern), and Waterloo Stations. A Brotherhood engine is at hand with which to provide against the contingency of an accident to the ordinary driving engine, and there other dynamo machines in the works which could be instantly substituted, if necessary, for those in nightly use. One point which should be noticed in the arrangements in this district is that use has been made of gas lamp-posts with a view to show at how small a cost a change might be made from gas to electricity. A pipe 2½ ft. in length has been fastened to the top of each lamp-post used, and above this the electric lamp is fixed. The alabastrine globes used are of almost porcelain-like whiteness, and denser than those in the Siemens' district, absorbing, it is computed, from 40 to 50 per cent. of the light, but yielding a pleasantly soft and diffused colourless light which, although estimated as of 1,000 candle power, can be looked at without pain to the eyes. The light within is considered equal to the light of 2,000 candles. The carbons, of which there are two pairs in each lamp, are made to burn for about 16 hours without attention, the change from the burnt-out pair to the second pair taking place by the intervention of self-acting apparatus. There is no clock-work used for the adjustment of the carbons, the movement of these necessary to keep the points at a proper distance being effected by automatic electro-magnetic apparatus of a simple kind. The extinguishing of a light in the circuit is provided for by an automatic "cut-off," and the light of the other lamps is not thereby appreciably increased. The carbons, which are coated with copper, are 12 in. long, and a little over three-eighths of an inch (11 millimetres) in diameter. Above the lamps is a little shelter-roof of metal, not unlike the covering of a lych-gate, which acts to some extent as a reflector.

So far as it has gone the experiment appears perfectly satisfactory, except to some who object to the display of this magnificent light to the "few old housekeepers and numberless cats" which they say constitute the night population of the city. It is of course too early to say anything definite about it, but there seems little doubt that the action of the civic authorities has given an impetus to the progress of electric lighting, which, if not leading to its speedy adoption will certainly tend to a final decision on its merits. For ourselves we do not despair of seeing the day when an electric lamp will be as necessary to the plant of a builder or contractor as a steam engine or a ladder.—*Building and Engineering Times.*

## THE FORTHCOMING INTERNATIONAL EXHIBITION OF ELECTRICITY AT PARIS.

From the "English Mechanic."

The exhibition to be held in Paris, in the Palais des Champs-Elysées, formerly called the Palais de l'Industrie, which is to be opened to the public on the 1st August next, promises already to be one of very great importance, and will doubtless make an era in the history of electricity and its application to the useful arts. The formation of the proposed Exhibition has been intrusted to the Minister of Posts and Telegraphs, who occupies the corresponding position to that of Postmaster-General in this country, and it was authorised by a decree of the President of the French Republic, dated October 23rd, 1880. A very influential and representative commision, which includes the names of all the most eminent scientific men in France, has been nominated, and a technical committee has beeen appointed to concert measures for a comprehensive and complete series of trials of the apparatus and inventions forwarded for exhibition. The different European nations, with the marked exception of England, have nearly all of them already expressed their willingness to take part in the exhibition, and the commissioners nominated by Belgium, Austria, and several other countries are making preparations for bringing the objects of the French Government before their countrymen. It will be fresh in the memories of our readers that, in reply to a question put by Sir Henry Tyler in the House of Commons a few days back, Lord F. Cavendish declared that it will be impossible to appoint a commissioner for England, nor can our Government take part officially in the forthcoming exhibition. The determination arrived at by our Government has caused much surprise and vexation in Paris, where our cordial co-operation and prompt and willing assistance in 1878 produced so much satisfaction and friendly feeling. The French themselves look forward to the exhibition for the settlement of many doubtful points and disputed claims in the application of electricity, and, failing all other participation, we may hope at least to have some independent and authoritative reports from experts in this country on the results of the various trials and competitions.

With respect to dates for sending in applications for space, and the nature of the objects to be exhibited, the following particulars may be of service to English exhibitors, who, in the absence of any official representative, may make their applications direct to M. Georges Berger, at the Palais des Champs-Elysées, Porte No. 4. Such applications, on forms which must be obtained from the Commissioner, must be forwarded not later than the 31st instant. The exhibitors will, on or before the 15th May, receive notice of their admission or otherwise, and of the space which has been allotted to them. All objects intended for exhibition may be sent in on and after July 1st. The packing-cases must bear special distinctive labels, and the Railway Companies have agreed to reduce to a very considerable extent their through rates to the Exhibition. There will be no charge for space, and the general decoration of the building will be undertaken by the French Commissioners, who reserve a right of supervision over the special decorations of individual exhibitors. Motive power will be provided at a reduced rate to all exhibitors, and for the trials and competitions the necessary power will be furnished free of cost. There will be a congress of electricians during the Exhibition. The usual regulations concerning the labelling of objects, right of free admission to exhibitors and their attendents, police arrangements, maintenance, etc., are included in the programme.

Empty cases will be warehoused by the French authorities at the rate of 6 francs per cubic meter. Special protection will be afforded to new inventions during the period of the Exhibition, until three months after its close, in accordance with the law of May 23, 1868. A catalogue will be published by the French authorities, and diplomas and medals, to be adjudged by a jury of experts, will be awarded to successful exhibitors. The exhibition will be divided into six groups, comprising in all sixteen classes.

Group I. Production of electricity:—Class 1. Static electricity; class 2, batteries and other accessories; class 3, magneto and dynamo-electric machines.

Group II. Transmission of electricity:—Class 4. Cables, wires, and accessories; lightning conductors.

Group III. Electrometry:—Class 5. Apparatus for the measurement of electricity.

Group IV. Application of electricity:—Class 6. Telegraphy, signalling; class 7, telephones, microphones, photophones; class 8, electric lighting; class 9, electro-motors, transmitters of electric force; class 10, medical electricity; class 11, electro-chemistry; class 12, instruments of precision, electro-magnets, magnets, compasses, electro-horology; class 13, miscellaneous apparatus.

Group V. General machinery:—Class 14. Generaters, steam motors, gas motors, hydraulic motors, shafting suitable for trades employing electric force.

Group VI. Bibliography. History of electricity:—Class 15. Bibliographical collections of works concerning the science and the industrial employment of electricity, plans, diagrams, etc.; class 16, retrospective collections of apparatus connected with the first study of electricity and its early application.

This classification is simple and good, and if the various groups are well represented. the display can scarcely fail to be one of great interest; but the commissioners look forward to the trials which are to take place during the meeting of the Congress as the most important feature of the exhibition. The display will remain open to the public until the 15th of November.

The funds for the exhibition will be obtained partly from a State subsidy and partly by public guarantee. The guarantors can in no case, however, receive more than four per cent. interest on their investment. It is intended to light up the building by night by means of the various electric lamps, which may be exhibited, and the Palace will be opened each evening from 8 till 11 p.m. All the details appear to us to have been most carefully considered by M. Georges Berger, who has had great experience in such matters.

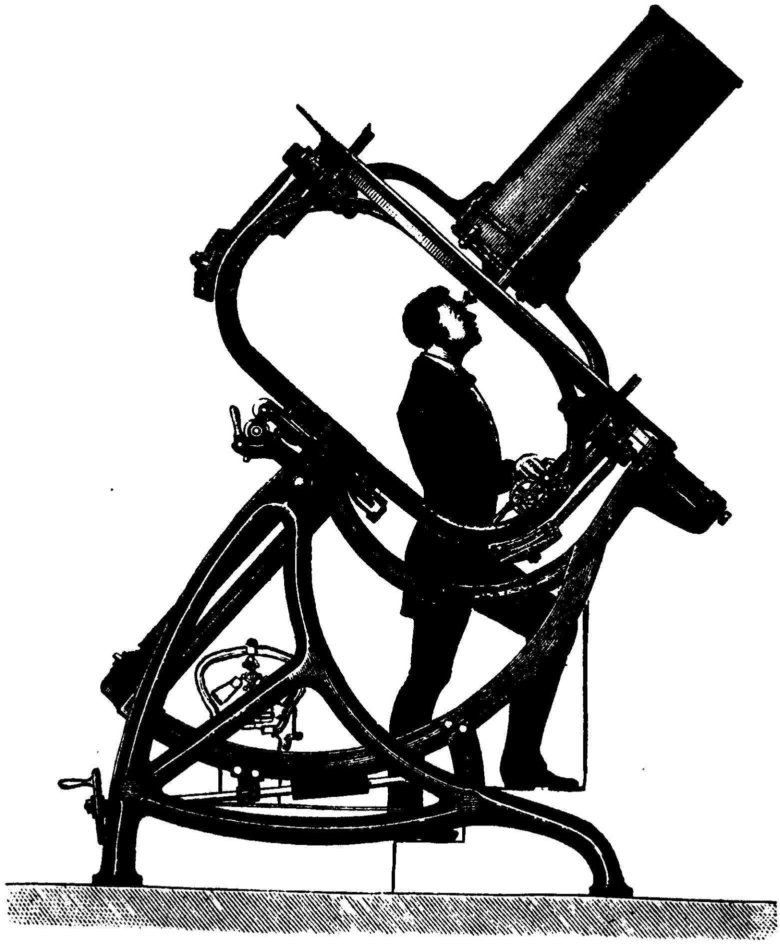
The Tides of Electricity.—Mr. Alex. Adams, one of the officers of the British Post-office Telegraph Department, has discovered the existence of electric tides in telegraph circuits. By long continued and careful observations he has determined distinct variations of strength in those earth currents, which are invariably present on all telegraphic wires, following the different diurnal positions of the moon with respect to the earth.

## NEW TELESCOPE OF SHORT FOCUS.

We give herewith a telescope devised by M. Leon Jobert, director of the Popular Observatory at the Trocadero, Paris.

This instrument is like the Cassegrainian telescope in form, and is of short focus, its parabolic reflector being only half the focal length of those of Foucault. It is of variable latitude, or, in other words, may serve for all points of the globe. In order that the observer may, without changing his position, be able to sweep the whole heavens above the horizon, the ocular is located at the intersection of the polar axis with the axis of declination. The sides of the tube are furnished with two supports, which are jointed around the horary axis, and pass through two other large supports that form a part of the last-named axis, and that are connected with each other by a turned circle moving over two large rollers. This circle is made very solid by a wide open-work backing, and both the latter and the circle are open in such a way as to allow the body of the telescope to pass when the instrument is directed toward stars which are at the celestial equator or near the southern horizon. The body of the telescope is balanced by two weights whose supports are fastened to the axis of declination. The polar axis passes through a journal box, whose two extremities are held in the upper ends of the two large cast iron sides forming the main frame. The cast iron cross-stays which connect the two sides of the frame are provided with a couple of projections which carry an arc, against which the large arc may slide with slight friction. The latter is firmly united at one of its extremities with an arm which descends from the journal box and supports the bed plate, on which rests the lower end of the polar axis; and its other extremity is connected with another arm, which likewise starts from the journal box and forms, by branching laterally, the bearings which carry the two rollers on which the turned circle revolves through the action of the clock which causes the diurnal motion. The clock is regulated by a regulator which is plainly visible in the annexed figure.

By means of a hand wheel the instrument may be fixed at the latitude of the locality where it happens to be placed, in such a way that the prolonged polar axis is parallel with the axis of the earth and points to the celestial pole. The instrument is furnished with a polar circle and a circle of declination with verniers that are moved by endless screws. In the figure the observer is represented with his hand on the hand wheel, which actuates at the operator's will, either rapidly or very slowly, the axis of declination. The clockwork movement is transmitted by bevel wheels and an axle, to a wheel which revolves loosely on the axis of latitude formed by the bearings of the large arc; and from this point motion is transmitted to the axis of the endless screw, and from thence to the endless screw which actuates the polar axis. With this instrument the observer can sweep every point in the heavens without changing his position, the only change he makes in the latter being that of moving with the instrument, which makes one complete revolution every twenty-four hours.—*La Nature.*



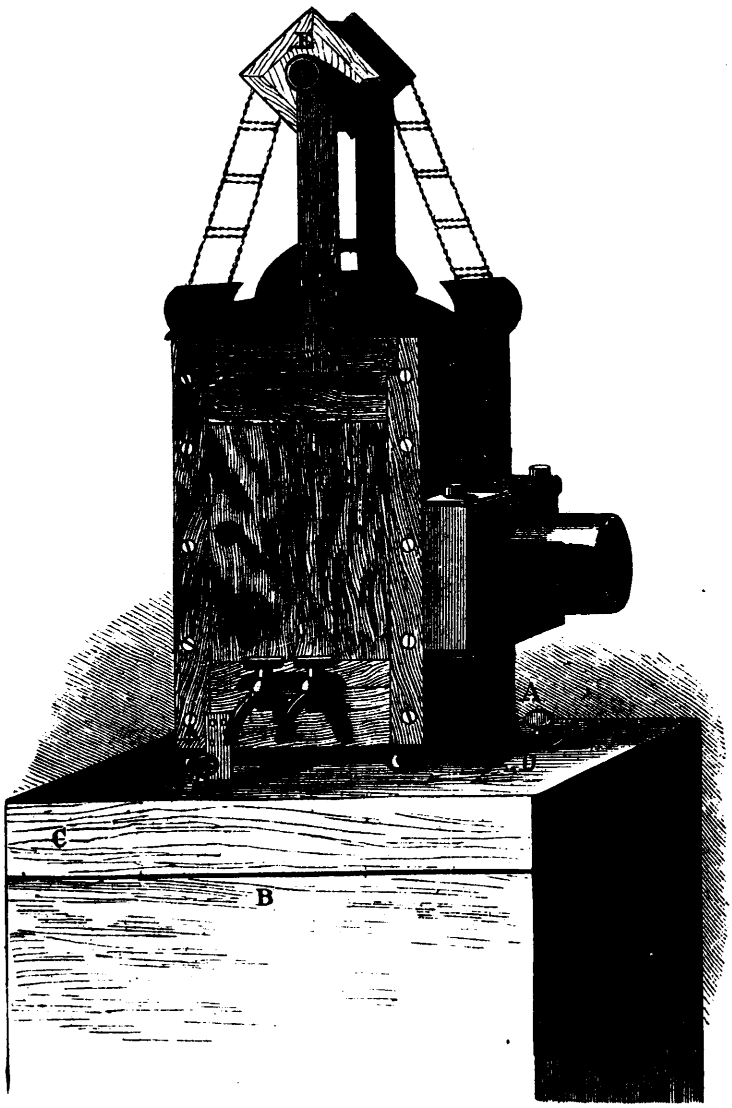
TELESCOPE OF SHORT FOCUS.

### CONTINUOUS-SLIDE LANTERN.

The engraving shows a lantern which possesses certain advantages, and is specially adapted for lectures where the subjects follow each other in an unbroken series. Mistakes arising from the insertion of a wrong slide, or an inverted subject, are apt to mar an evening's entertainment. But, as will be seen, errors of this nature are altogether avoided, and by a simple mechanical arrangement, the slides present themselves in perfect order and at their allotted times.

cube turns on its axis, E, to which is attached a milled head. The band is made so that the slides can be detached and replaced by a new series at will.

The advantages of this simple arrangement are so obvious as hardly to require further comment. The operator has only to turn the milled head of the cube in order to bring his subjects, one after the other, into position. This system might be applied also to the dissolving view apparatus. The heat from the chimney is never so intense as to interfere in any way with the slides, while it clears them of surface




CONTINUOUS-SLIDE LANTERN.

The instrument is fixed to the top of the packing case, B, by the screws, A A; the lid of the case, C, serves to elevate or depress the lantern, which may be fixed in position at any angle. Reared above the chimney are two metal uprights, secured to the sides of the lantern. These carry at their apex a wooden cube covered with fine leather; each side of this cube corresponds with the size of the slides. But, by the aid of strong ribbon binding, the slides are so united as to form a flexible band which traverses the cube and descends into the case, B, through slots, D D. The

moisture, by which they might be obscured during cold weather.

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**Preservation of the Colors of Dried Plants.**—According to M. Storbzl the slow immersion of the fresh plant in a boiling solution of one part of salicylic acid in six hundred parts of alcohol, and then shaking off superfluous moisture, previous to pressing in the usual way between blotting paper, will more nearly preserve the natural color than any other method.

## Astronomy and Geology.

### THE COLORS OF THE STARS.

The constellated regions of the heavens, says the astronomer Niesten, in *Ciel et Terre*, offer an exceedingly vast field for the investigation of all those who desire to see progress made in astronomical science; and the most varied and interesting questions crown themselves upon observers for examination. Among these the study of the coloration of the stars holds one of the most important places, not only for the attraction that it offers because of its novelty, but for the facility with which it may be pursued, and for the importance, especially, of the scientific questions connected with it.

If, on a fine evening, we raise our eyes toward the starry vault, we are immediately struck with the diversity of size, or rather with the brilliancy, which the stars exhibit. If we bestow a little attention on the subject we shall be readily convinced that these worlds or unknown suns, which are commonly said to shine with a whitish light, emit rays of the most varied colors. If the observer compares with each other the most brilliant stars—those of the first magnitude—*Procyon* and *Altair* will appear to him of a dazzling white; *Sirius*, *Vega*, *Castor*, and *Regulus*, of a white slightly tinged with blue; *Aldebaran*, *Betelgeuse*, and *Arcturus* will be orange; *Pollux* and *Alpha* of Cetus will appear yellow; and *Antares* and *Alpha* of Hercules will be orange red. Among the stars of the second magnitude *Epsilon*, *Zeta*, and *Eta* of Ursa Major will appear white, while *Alpha* will be distinguished by its yellowish color. In Ursa Minor, *Alpha* or the Polar Star will be seen to be yellow, and *Beta* yet more so. Castor will be found to emit greenish-white rays, while those of *Eta* are of a pronounced blue. Finally, if the observer makes use of a telescope, there will be seen thousands of stars exhibiting to him the same diversity of color.

According to Sir John Herschel, there is, near *Kappa* of the Southern Cross, a remarkable group formed of one hundred and ten stars, the principal ones of which, scarcely of the eighth magnitude, exhibit the greatest diversity of colors; one is of a bluish-white, two are red, two are green, and the three others are of a pale blue. It is an extremely brilliant and beautiful object, says Sir John, and the stars which compose it, when viewed through a telescope of sufficient power to distinguish their colors, have the aspect of most exquisite jewels.

These different colorings are not limited to certain particular stars, but we may observe in certain constellations nearly all the stars having the same tint. Libra and Eriadnus contain a large number of stars which are yellow. The principal stars of the beautiful constellation of Orion exhibit a color of a decided green, while the majority of the smaller ones are of a blood-red. Dunlop, in his catalogue of southern stars, refers to an extensive group, all of whose stars are blue.

By using a sufficiently powerful telescope, the observer will be enabled to separate certain stars which to the naked eye appear single, and he will then be struck with the richness of the coloring, and especially with the notable difference of color which in most cases exist between them. Some, and indeed the majority of them, will show him the principal star colored either yellow or white, while its companion is one of the shades of white, yellow, or red, or else is tinged with purple, as in *Eta* of Cassiope, or with sapphire-blue, as in *Beta* of Cygnus. In others the two components are orange, or else one is orange and the other blue, as in *Theta* of Centaurus, or green, as in *Epsilon* of Bootes and *Gamma* of Andromeda.

In some stellar systems we find white contrasted either with purple, as *Delta* of Orion; or with green, as in *Zeta* of Corona Borealis; or with blue, as in *Pi* of Andromeda, *Lambda* of Ophiucus, *Psi* of Cygnus, and *Delta* of Bootes; or with yellow, as in *Gamma* of Delphinus: or with red, as in Twelve of Coma Berenices. In other systems of double stars a white color is met with in both components, as in *Alpha* of Gemini and *Gamma* of Virgo. Red is associated with blue in Antares, *Eta* of Perseus, *Omikron* of Draco, etc., and garnet with blue in *Omega* of Auriga, and with green in *Alpha* of Hercules. Finally, Fifty-three of Ophiucus, *Mu* of Draco, *Delta* of Ophiucus, and Fifty-five of Coma Berenices, are formed of two bluish stars, while *Alpha* of Pisces and *Sigma* of Cassiope each consists of one blue and one green star.

Upon the whole, in the light of the stars—those distant suns which probably illume other worlds that are as yet unknown to us—the observer will possibly meet with all possible combinations of the principal colors along with their extended scale of tints. He will then ask himself whether these colorings are indeed real; whether all these tints, so harmonious in juxtaposition, are not the effect of contrast; and whether all these sparkling fires of ruby, topaz, and sapphire are not perhaps optical illusions merely. Having assured himself on this point, he will endeavor to learn whether these stars do not exhibit in their coloration a short period of variation or a secular one, as has been ascertained already with regard to the intensity of their light. The effect being known, he will strive to learn the cause, and perhaps will succeed in finding, in these differences in the intensity of luster and coloring, some indices that shall aid him in extending the knowledge which we possess in regard to the stellar world.—*Scientific American.*

### A GIGANTIC ARTIFICIAL MOON.

The colossal representation of the moon, which has been on exhibition at Steinway hall, in this city, during the past week. does not appear to have attracted anything like the attention it deserves. On a half globe, 16 feet in diameter, the mountains, plains and other characteristics of the lunar surface visible from the earth are shown in relief, with shadings and colorings faithfully representing the moon as seen through a powerful telescope. It is by far the largest, most elaborate and expensive portraits of the moon ever made; and, seeing that it was constructed for and under the immediate direction of one of the most eminent of living selenographers, Dr. Schmidt, now director of the observatory at Athens, Greece, we may safely accept it as a faithful portrait. It certainly gives at a glance a clearer and more comprehensive idea of the physiography of the moon than could be got by much study with any other means short of a telescope of great power. When gradually lighted from one side by a powerful lime light, the varying phases of the moon from new to full, are shown with impressive vividness.

The shadows of the mountain ranges, the black depths of the crater pits, the changing light upon the broad plains, and other lunar phenomena pass rapidly before the eye, enabling one to obtain in a few hours, indeed in a few moments, a more comprehensive knowledge of the lunar surface than can ever be had of the earth's surface until some enthusiastic geographer constructs in relief a terrestrial globe on a scale of corresponding magnitude.

The "moon" has been purchased and brought to this country for exhibition by Mr. E. Riverston. and it is to be hoped that it will ultimately find a permanent abiding place in some of our public institutions. Meanwhile students of astronomy and all persons taking an interest in science will find the exhibition well worthy of attention.—*Scientific American.*

### A PRIZE FOR SCIENTIFIC RESEARCH AND INVENTION.

The Royal Academy of Sciences of Turin, in accordance with the last will and testament of Dr. Cesare Bressa, and in conformity with the programme published in 1876, has announced that the term for competition for scientific works and discoveries made in the four previous years, 1877-80, to which only Italian authors and inventors were entitled, was closed on December 31st, 1880.

The academy has now sent notice to the California Academy of Sciences, and to other societies, that a new term for competition for the Bressa prize has begun, to which, according to the testator's will, scientific men and inventors of all nations will be admitted. The prize amounts to 12,000 Italian lire, or about $2,340, so it is well worth contending for.

The prize will therefore be given to the scientific author or inventor, whatever be his nationality, who during the years included from 1879 to 1882, shall have, according to the judgment of the Royal Academy of Sciences of Turin, made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology and pathology, as well as geology, history, geography and statistics.

The term will close December, 1882. The prize will in no case be given to any of the national inventors of the Academy of Turin, resident or non-resident. The President of the Royal Academy of Turin is E. Ricotti. The Secretary of the class of physical and mathematical sciences is Ascanio Sobrero. The Secretary of the class of moral, historical and philological sciences is Gaspare Gorresio.

Dr. Davenport, professor of analytical chemistry in the Massachusetts College of Pharmacy, says that a saturated solution of hyposulphite of sodium, applied with a cloth or brush, will quickly remove all tarnish from the surface of siver.

## Engineering, Civil & Mechanical.

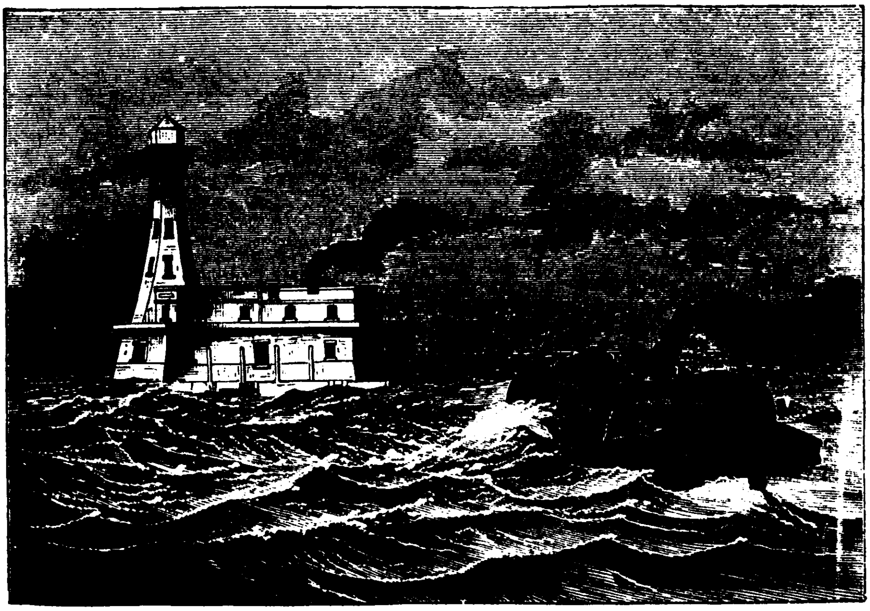
### THE BEAUMONT AIR-ENGINE AND HIGH-PRESSURES.

We mentioned the other week that one of the two most successful compressed-air locomotives was about to be introduced into England for the purpose of working tramcars, and a paper read the other night by Col. Beaumont before the Society of Arts shows conclusively that the time has arrived when the stage of preliminary experiment having been passed, the new inventions are to be tested in ordinary everyday work. Both the Mekarski and the Beaumont motor have been practically tried in this country for some time, and the only point on which full information is not available is the cost of the systems—in one sense the most important of all. There is no question that both the Beaumont and the Mekarski motors are practically successful applications of compressed air to locomotive purposes, and their freedom from noise, dust, and smoke will surely commend them to the attention of the public, while the perfect control of the motive power possessed by those in charge will satisfy the most exacting inspector of the Board of Trade. The early efforts to use compressed air failed mainly because the pressure used was too low—200lb., when air has to be stored in a reservoir, being far below what is possible and what is economically necessary. According to Col. Beaumont, the tramway engineers asserted that any system of mechanical traction must be capable of travelling 10 miles without being stopped for replenishing, if it is to be generally adopted, and taking the tractive resistance on a fair tramway at 25lb. to the ton, and a gross load of 12 tons to be hauled, he found the engine would need a magazine containing 500 horse-power. Suppose the reservoir to contain 100 cubic feet, and taking one-third of the total power stored as available, then the pressure must be about 1,000lb. on the square inch. The loss between the reservoir and the cylinders of the engine is enormous under the conditions which have been adopted in the earlier forms, and if the air is not discharged at a tolerably high temperature for such machines, a very serious loss of power is experienced, and ice quickly forms and blocks the ports. That is a matter now well understood, and every compressed-air engine will accordingly possess some means of heating the air, so that when the exhaust-port is reached, it shall still be appreciably warmer than the external air. In the Mekarski motor, which we recently described, the air is heated by passing it through superheated water contained in a reservoir filled at the rendezvous, which serves also to wet the air, and so act as a lubricant for the pistons—whether with any real advantage remains to be seen. In the Beaumont engine the air is supplied direct to the cylinders at the full reservoir pressure, and the temperature is kept up, by jacketing the cylinders with steam, which is provided by a small generator carried in a convenient corner of the engine. In both cases the steam whether mingled with the air or merely surrounding the cylinders, is condensed at every opening of the exhaust; but in the case of the Beaumont engine it runs back to the boiler, while the Mekarski locomotive scatters it as watery spray.

In the Beaumont engine, the power developed at any given reservoir pressure is in direct proportion to the quantity of air consumed; the use of the expansion-valve, together with the power of admitting a sufficient amount of pressure direct from the reservoir into the big cylinders, enabling the operator or driver to vary the quantity of air to be consumed in proportion to the work to be done. Engines built on Col. Beaumont's system have been tried on the Leeds tramways, at the Royal Arsenal, Woolwich, on the South-Eastern Railway, and lately on the Metropolitan line. The steepest gradient on the portion of that line traversed by the Beaumont motor was about 1 in 70, but a much stiffer incline was successfully negotiated on the Leeds tramways, the rails of which were, presumably, not so clean as those on the Metropolitan line thus providing a better grip for the wheels upon them.

In the experiments on the last named railway and in those, of a very practical character, made at the Royal Albert Dock, Isle of Dogs, the results show that three tons were moved one mile for each cubic foot of air at 1,000lb. initial pressure expended, which must be regarded as very satisfactory, as, from the figures supplied, the work is done by an expenditure of ¾lb. to 1lb. of coal. Tested under the dynamometer, the engine was found to give 33 per cent. of the horse-power expended in the work of compression, a result which is perhaps impossible in any system in which a reducing valve is employed. As the practical value of a compressed-air motor depends upon the amount of available energy it is capable of storing, it is of importance that none should be lost; for wire-drawing in such a case is a far more serious loss than in the steam-engine: hence Col. Beaumont has dispensed with a reducing-valve, and adapted the cylinders, or the engine proper, to take air of any pressure. It goes without saying that a pressure of 1,000lb. on the square inch demands great skill on the part of the mechanic in making joints; but such pressures have been used at Woolwich for some time, and give no trouble, now that the proper method of making the joints has been arrived at. Nay, so confident are inventors and mechanics, that they talk of using air at pressures up to 2,000lb. on the square inch, and, according to Col. Beaumont, it is quite simple to compress air up to 15,000lb., but not quite so easy to use it. Coming down to the purely commercial aspect of the question, a compressed-air engine company is prepared to work tramways at 6d. per mile for tractive power, and as horse-power now costs 7d. per mile, that is a considerable saving. On the underground railways, the air-engines would unquestionably be a great improvement, but a heavy outlay would be incured in providing the requisite plant; and it does not follow that the public would readily pay the "small increase in the fares" which Colonel Beaumont thinks would cover the loss he provides for, but does not believe in; for use in mines, for use on tramways, and perhaps, when it is completed, for working the traffic through the Channel Tunnel, it may pay to use compressed air; but wherever steam is at all possible, the air-motor has at present no chance. It is admitted on all sides, that something better than horse-traction is needed for working street tramways, and the compressed-air engine, free as it is from noise, dust, and smoke, and possessing within itself the power of quickly stopping, seems well adapted for the purpose; but as railways pay simply by the paying load carried, it is hopeless to ask the companies to expend capital and increase fares with the hope of getting a fair interest on it. The modern policy, a wise one, is to reduce fares as much as possible, and fill every seat in the carriage or dead load that under any circumstances must be hauled. When the Channel Tunnel is finished it will no doubt be advisable, perhaps necessary, to consider the use of air-engines for working it; but unless they are very greatly improved, there is little hope of their being employed on the underground lines of the metropolis, much as every traveller would like to see the innovation.

The Mekarski motor was tried in this country during last autumn on the Wantage tramways, and, as we mentioned the other week, has been working successfully in Nantes for over 20 months, but it does not fly quite so high as the Beaumont motor. Pressures have risen enormously of late years, it is true, and mechanics are not at all alarmed at the 1,000lb. used in the Beaumont motor; but while they are quite ready to believe that higher pressures still can be economically worked, they would like a little experience of the actual results in wear and tear before advancing any further. So far as 1,000lb. is concerned, Col. Beaumont is able to supply the experience, for the engine tried on the Metropolitan line has run many hundreds of miles without needing repair, and the reservoir of another was left at Christmas last with 300lb. pressure in it, and at the beginning of this month had still sufficient power to move the engine. The pressure of 15,000lb. has been obtained with the view of using air instead of powder for blasting in mines, and Col. Beaumont is at present engaged in devising methods of utilizing it for the purpose; but, as the question stands there is the offer to work tramways at one penny per mile less than they now cost for horse-power, and if the offer is accepted, as we believe it has been, for working the short line from Stratford to Leytonstone, the experience gained by a practical application of the new motor may soon lead to further developments. The use of air compressed to 1,000lb. is not altogether free from danger, for although it is possible to make a vessel capable of containing it, there is always risk that such a vessel may spring a leak in the course of work, and the consequences would be serious to anything in the shape of flesh and blood coming in contact with the air issuing from the leak; but owing to the absence of fire and furnace, the reservoirs once made would last a very long time, compared with steam boilers, and the chances of an accident in the shape of an explosion would be remote. For the data which Col. Beaumont has supplied, engineers will be grateful, as we now know that for an expenditure of one cubic foot of air at 1,000lb. pressure, we can propel three tons one mile, and as, with suitable machinery, ¾lb. of coal will compress a cubic foot to 66 atmospheres, it follows that ¼lb. of coal will be sufficient to haul one ton a mile, or about the average of the present rate of locomotives. Hence the air-motor must be more economical than horse-traction, and in the future it will, if the data are trustworthy, probably replace the steam-locomotive where the effluvia of that machine are objectionable.



THE CRIB.

SECTION OF TUNNEL.

## THE CHICAGO WATERWORKS.

The city of Chicago is justly noted for its business activity, its bold enterprises, its live way of doing things generally ; and the history of the city water supply system, from its comparatively small beginning to its latest development, is characteristic of the progressive spirit that pervades the great Northwest. Lying, as the city does, on the flat prairie, with no natural elevation upon which to place a reservoir to insure a proper distribution of the water, and with no desirable near source of supply, the engineers encountered exceptional difficulties in planning and executing the work.

Finding the first means of water supply inadequate, improvements were immediately made, and these in time proving insufficient, further improvements were instituted, involving a tunnel extending two miles into Lake Michigan. An accident having occured which cut off the supply of water for a time, rendering a large area liable to the dangers of an uncombated conflagration, steps were taken to provide a water supply of such character and extent as to render the possibility of even a temporary interruption very remote if not impossible. The first water works in Chicago were commenced in 1851, when the population of the city was about 35,000.

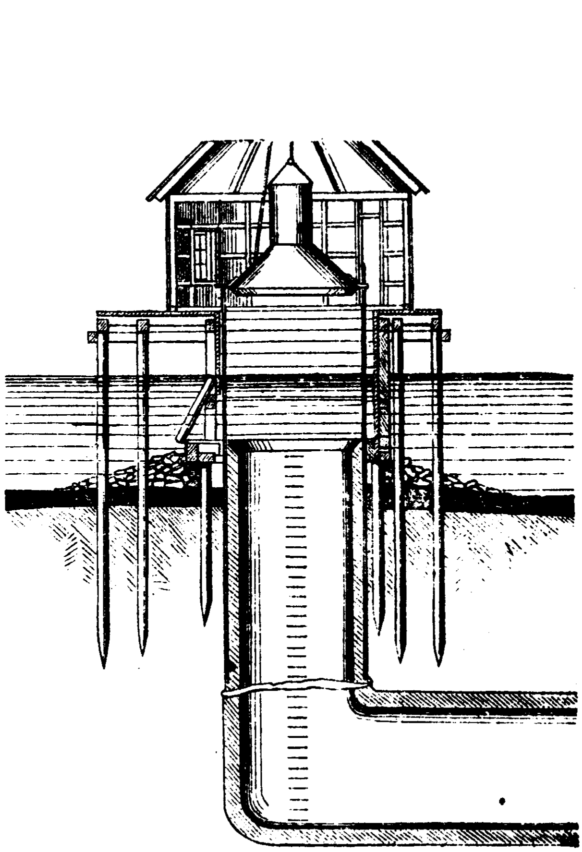
It was then thought that the small quantity of water discharged from the river would not affect the quality of the water in the lake at a point 1½ miles south. The works were put in operation in February, 1854, and consisted of one reservoir, containing about a half million of gallons, and eight and three-quarter miles of iron pipe, beside the pumping engine. The population at this time had increased to about seventy thousand, and the growth of the city, together with the introduction of sewerage and the establishment of packing houses, distilleries, etc., increased the quantity of filth flowing into the lake to such an extent that complaints of the impurity and offensiveness of the water were frequently made, and it was proposed to extend an iron pipe, five feet in diameter, one mile out into the lake, to obtain a supply beyond the effect of the sewerage. Various other experiments were discussed, but it was finally decided to extend a tunnel two miles into the lake. The work was commenced May 26, 1864, and the tunnel with all of its appurtenances was completed in March, 1867. In this tunnel provision was made for extension either lakeward or landward without interrupting the supply through it, except for a very short time ; but it was not supposed that an extension would be required for many years. The breakage of a siphon under Chicago Avenue Bridge, August 18, 1869, deprived the west division of the city of water for about sixty hours, greatly endangering a large portion of the city.

This circumstance led the City Council to direct the Board of Public Works to take immediate action with reference to the wants of the city in this respect.

It was decided to build a new tunnel, seven feet in diameter, parallel with the old one, extending six miles into the lake. This great work was commenced July 12, 1872, and finished July 7, 1874. Great difficulty was experienced in sinking both shore and crib shafts but the work was finally accomplished in the most satisfactory manner. In the construction of the new tunnel, as in the old, provision was made for extending it lakeward should sewerage contaminations hereafter make it necessary or desirable.

The crib is a substantial structure of solid masonry, the three lower courses of which are built of granite, on account of its superior frost resisting qualities. The upper courses are of limestone, the arches are of brick, the filling of rubber, and the deck is composed of ordinary concrete, on the top of which is placed a layer of asphalt concrete. The light-house tower is of brick, with an iron stairway. Upon the deck is built a brick house, in which the family of the person in care of the crib resides. No more desolate and isolated place of residence could be imagined than this is in winter. One might as well be on a desert island as far as human companionship is concerned, although there is a telephone line to the shore. But there are many days when the storms blow and the waves beat in their fury, and the broken floating ice dashes against its sides, that no one goes out from the shore. It is said that some of those who have lived at the crib have found the isolation so intolerable as to almost drive them insane. In the summer, however, boats constantly ply between the shore and the crib, carrying visitors, it being a favorite resort for boating and sailing parties.

Since the completion of the tunnel the immense growth of the city has so increased the sewerage flowing into the lake that it is believed that at times it extends as far as the crib and contaminates the water. Many plans have been suggested to remedy this, and on all hands it is confessed that the problem is a very grave one. It is probable that in ten years from now, with the present rate of increase, Chicago will have a million of inhabitants, and in that case no tunnel extending directly into the lake could insure pure water. The latest suggestion for procuring pure water for the city is that of Chicago's eminent architect, Mr. W. W. Boyington, who proposes that the city shall purchase 100 acres of land in Highlands, some 20 miles north of the city, where the ground is 130 feet higher than the city level. Here should be built an immense reservoir, into which water should be pumped from the lake, and thence conducted by a viaduct to the city.



THE FIRST CRIB—SHOWING THE CAST IRON RINGS AND GATE.

The shore end of the tunnel is connected with the new North Side pumping works shown in our engraving, and extends to the West Side works. The building is a model of architectural beauty. Its style is castellated, and the tall water tower gives it a very imposing appearance.

The building contains four large pumping engines, two of which are in continual use, while the other two are held in reserve. The steam cylinder is 70 in. in diameter, stroke 10 ft. The water pumps are 57 inches in diameter, stroke 10 feet. The working beams are each 28 feet long and weigh 20 tons. The fly wheel is 26 feet in diameter and weighs 40 tons.

The first engine was erected at these works in 1853. It had a capacity of 7,500,000 gallons in twenty-four hours. The second engine, erected in 1857, had a capacity of 13,000,000 gallons in twenty-four hours, and the third had a capacity of 18,000,000 gallons daily. The first and second engines were single, the third and fourth double. These engines are supplied with steam from five boilers 12 feet in diameter and 20 feet long.

In 1871 Chicago had 271 miles of pipe, now it has 500 miles, and it has over 3,000 fire hydrants. This extensive system of water supply has been perfected at an expense of about $8,000,000.—*Scientific American.*

### BOILER CAPACITY.

The so-called power of a steam boiler is dependent upon its capacity to evaporate a certain quantity of water in a given time—not upon its arbitrary feet and inches of heating surface. It may be urged, in turn, that its capacity to evaporate depends upon its heating surface; but, asserted without qualification, this is incorrect. Neither the terms or conditions are synonymous. The evaporative capacity depends not so much upon the amount as the disposition of the heating surfaces, and the construction of the boiler as regards maintaining proper combustion. The boiler of a locomotive is an example. Under the influence of the exhaust in the smoke-stack, and the air current induced by the speed of the machine, an enormous energy is developed. In other words, a great quantity of coal is burned in the furnace; but the same boiler, jacked up in a shop, would not supply the cylinders at the same number of revolutions per minute if dependent upon its heating surface wholly. Take also the boiler of any given engine which is rated for a given capacity. More power is needed, and the fires are forced, the boiler does more work; but nothing has been added to its feet and inches of heating surface. More coal has been burned in a given space of time.

Boiler efficiency depends upon so many more things besides heating surface that the mere statement that any given apparatus contains so many feet is not always a measure of its capacity. Grate surface is an item of importance, and the relation of it to the tube surface is another; so are the proportions of the stack and the nature of the setting. A two-foot rule is a poor rule to measure the evaporative capacity of a boiler by!

"But," says some person, "how are we to know anything about the size of a boiler for a stated engine if so many things change the character of the work done by it?"

We are to know in this way,—by the practice set up and instituted by the best engineering advice of the day. The power of an engine varies for the same size cylinder. Driven fast or slow, it does more or less work. It is the same with the boiler; driven fast or slow, it does more or less work, according to the amount of fuel burned in it. In the case of an engine, so many inches diameter of cylinder is called a horse power, and with the boiler so many feet of surface are allowed per "horse power." In 1866 Charles E. Emery made some extended experiments with engines and boilers, and the result of them showed that a good high-pressure steam engine would produce a H. P. for 25 or 30 pounds of water evaporated in the boiler, and this was the standard of measurement of H. P. of boilers set up at the Centennial Exhibition. But, since the efficiency of a square foot of heating surface in one type of boiler is greater than that of another, it follows that some require less feet for the same amount of duty.

Professor Trowbridge, now of Columbia College, published tables, some years ago, wherein the relative amount of heating surface of boilers is given as follows: Common flue boiler, 8 to 12 square feet per H. P.; plain cylinder, 6 to 10 feet; locomotive, 12 to 16 feet; vertical tubular, 15 to 20 feet. B. F. Isherwood, in his "Engineering Precedents," states in addition that tubular boilers require 14 to 18 feet, and water tubes but 10 to 12 feet.

We think that the wayfaring man who follows these precedents cannot greatly err therein.—*Steam Notes.*

### CHIMNEYS.

The object of a chimney is to convey away the smoke and produce a draft,—that is, a current of fresh air,—through the coals on the grates; this draught is produced by the difference in the specific gravity of the air inside and outside of the chemney. If the quality of the gases inside and outside were always the same, formulæ could be established for the size of chimneys, with considerable degree of accuracy. As a rule, the chimneys of this country are much too small for the number of boilers working into them. There are a large number of mills in New England, that started in a small way with one boiler, and by increase of machinery or low water, have increased the number of boilers to three and even four boilers, using the same chimney, There is one safe rule to follow, and that is, the area of the chimney should always equal the combined area of the tubes of the boilers discharging into it. The mills of Fall River, Lowell, Lawrence and Manchester, have generally, large, high chimneys of sufficient area for the duty required of them; there are exceptions to this rule, and in one of these cities named, we know of a large mill that has twelve 5-ft. boilers discharging into a chimney that is 36 inches square,—just large enough for three boilers. Chimneys should always have an inside core: this protects the outside wall from expansion and contraction; also helps retain the heat. This core should gradually expand, instead of decreasing as it rises. The old style was to build chimneys smaller at the top, but this system is going out of date. By increasing the area of the core as it rises, the chimney is relieved of its pressure and friction. Air always expands if it has a chance when the temperature is over 60° F.; when the diameter of the core is gradually expanded, the gases, having more room, become lighter and rise faster; thus increasing the velocity of the current.

A chimney 80 to 100 feet high should gradually expand from four to six inches at the top; chimneys 100 to 200 feet high should expand from eight to twelve inches.

The Merrimac Corporation, Lowell, Mass., will soon commence to erect the largest chimney in the United States. It will be 275 feet high, and will require 1,300,000 bricks. The core will be 16 feet at the base. Boilers of a capacity of 5,000 H. P., will discharge into it. The highest chimney in the world is at the Port Dundas Works, Glasgow, Scotland. The dimensions are as follows: total height, from foundation 458 feet, height above ground 455 feet. Iron chimneys or stacks are largely coming into use, more especially in the West. When made larger at the top than at the base they give a splendid draft. The Springfield Steam Supply Co., of Springfield, Mass., have one 70 feet high; it is 40 inches at base, and 45 at top. The Milwaukee Steam Supply Co., have three of this size in use; and the Lynn Steam Supply Co. will put up five of same dimensions. These chimneys cost two-thirds less than brick.

## Mechanics.

### MACHINERY AND CIVILIZATION.

Mr. Charles C. Coffin has been giving a series of lectures in the Lowell (Mass.) Institute, on our manufacturing industries and the relation of invention to civilization. From the Boston *Advertizer* we make the following extracts from one of these lectures:

The first need of men in this world is for something to eat; the second is for something to wear. The earliest historical allusion to the manufacture of textile fabrics, is the simile in the oldest poem extant—the Book of Job—the comparison of the swiftness of time to the weaver's shuttle. The weaver's shuttle of the East and the loom of the Orient through all the centuries have not changed. Throughout Asia, and even in some sections of Italy and Spain, the spindle of to-day is like that which Penelope deftly twirled when preparing garments for her absent lord. The use of machinery in the manufacture of clothing has been a powerful agency in modern civilization. Out of the multitudinous machines of the present century I select those of spinning and weaving to represent the progress of mechanic art. It is noteworthy that the first movement in free intellectual thought in antagonism to the dogmatism of the Middle Ages and the first mechanism to relieve woman from unceasing toil were coincident. During those years in which Martin Luther, Melancthon and their compeers were awaking the world to the new intellectual and religous life, a German carpenter constructed the spinning wheel, which made its appearance about 1530. The knitting machine was the second invention—the device of a young curate of Nottingham, the Rev. William Lee; and during those months when the Mayflower was crossing the Atlantic, the first stockings knit by the machine were placed on the market.

The lecturer commented upon the fact that the century following Lee's invention rolled away without any invention. Men were giving their attention to other things. The spirit of the age was against invention. The learned were lost in abstraction, were regardless of human needs, utterly ignorant of the resources of nature to alleviate human woe or to lift men to a higher plane of life. Another reason why inventions did not come earlier was, that all Christendom, through the Middle Ages and down to the beginning of the present century, was engaged in war. The conditions were all adverse to scientific research. In 1781, just one hundred years ago, came Watts' first pumping engine, with a condenser and the steam applied to propel the piston in both directions.

Aside from the very few wind and water mills, the human race at the beginning of the present century was living by its own muscular energy, digging and delving, spinning and weaving, with rude instruments and mechanisms.

The world is more enlightened now, but there are still many people who cannot see how the introduction of a machine which will do the work of many men can be promotive of the well-being of the community. Imagine yourself as standing on the bank of the Merrimac in 1821, with Nathan Appleton, William Appleton, Patrick T. Jackson, Kirk Boott, John W. Boott, Paul Moody and Nathaniel Bowditch. No sound breaks the stillness save the rushing of the water over the rock. It is the energy of nature running to waste, and these gentlemen determine to set it to work for their individual welfare. They purchased the surrounding farms and the old canal, which other men had constructed for the passage of rafts, set themselves to enlarging it, and in building a dam, not working with their own hands, but summoning the farmers, who came with their own oxen to haul rocks. Stonemasons are wanted, and the blacksmith to sharpen their tools. Young men come down from Vermont and New Hampshire to dig the canal. The gentlemen who are pushing the enterprise need bricks. Another class of labor is called for. Lumber is needed, and saw-mills are set to humming. Masons, hodcarriers, mixers of mortar, lime-burners, are set to work, with still more oxen, more teamsters and cartmen, besides coopers to make the casks for the lime. An architect plans the manufactory; the carpenters frame it and a corps of joiners finish it. A millwright calculates the power, sets another corps of men at work constructing the great wheel. The manufacturers of the spinning and carding and weaving machines have regiments hammering and filing brass, steel and iron. They in turn have set the founders, puddlers and smelters to work. Furnaces send up their lurid flames; vessels are sailing on the ocean to fetch and carry the materials. The miners far down in the earth, the sailor climbing the shrouds in mid-ocean, the mill-wright lost in thought as he calculates the power of nature's energy, the brickmaker moulding the plastic clay, the joiner plying his plane, the teamster urging his cattle; all have been called from their former vocations to aid in building the mills. Why have they come? Because these gentlemen offer them more remunerative wages than they have been receiving.

Let us follow on. The mills are erected, the machines are in place but human hands are still needed. The gentlemen summon the farmers' sons and daughters by the inducement of better wages. Have the gentlemen thrown any one out of employment? They have changed labor, they have made the spinning wheel and the loom of the household useless lumber, not throwing the old-time spinners and weavers out of employment, but transfering them to one in which they can do more for themselves and their fellow men. You ask, perhaps, what the masons, joiners and carpenters who built the mill are to do when the mill is completed. Are they not out of employment? The mill is only the beginning. Dwelling houses are needed, stores, shops for the grocer, butcher, baker, joiner, mason, blacksmith—the whole fraternity of trades and occupations. The first mill erected at Lowell was the beginning of a city to-day numbering between 50,000 and 60,000 inhabitants. It will be instructive in this connection to see what labor and capital together will accomplish through the use of the energy of nature, in giving value to raw materials.

The Southern farmer ploughs his lands, casts in the cotton seed. He sells his crop at 12 cents a pound, obtaining a livelihood by agricultural labor. The operative in Lowell, by manufacturing it into muslin, may make it worth 80 cents; by more delicate manipulation into lace, worth $1.00. But before the process could be undertaken by the machinist, the iron manufacturers were called upon to construct the machinery. The ore which the miner dug from the ground and which he sold for 75 cents, the iron smelter sold for $5. The machinist makes it worth $100. If, instead of putting it into spindles and wheels, it had been sold to the manufacturer of fine needles, he would have made it worth $6,800. The manufacturer of watch springs would have made it worth $200,000; or, if he were to use it for pallet arbors, it would be worth $2,578,505. Past earnings and present labor together gives this increased value to the 75 cents' worth of ore.

Invention renders old things obsolete and so is destructive; but there is a force more destructive than invention, a force that not only drives men from occupation, but upon the instant consigns their costly machines to destruction—a force wielded almost wholly by the female sex—the force of fashion, a power stronger than the combined strength of inventors, manufacturers and operatives. Not long ago, every woman in this audience quite likely regarded a hoop-skirt as necessary to make her wardrobe complete. Probably not less than 25,000,000 were manufactured per annum requiring an outlay of many millions of dollars for complicated machinery, furnaces, and rolling mills for the foundation of steel, manufactories for the weaving of tape, employing many thousand operative; but suddenly the idea gained possession of the female mind that dress would be more graceful and pleasing to the eye without them, and they were on the instant discarded, bringing about quick destruction to the manufacturers and loss of occupation to the operatives.

Invention is an educator. It begins with thought. The more thought put into his machine by the inventor, the higher the intelligence to operate it. Mechanics has become a distinct profession, requiring high mathematics, physics and the power of abstract thought. Trade and commerce recognize the new profession by offering it their highest pecuniary rewards. It is the master mechanic, receiving his salary of $15,000 per annum, who is the cheapest employee of some corporations in this country. Fifty, years ago, in 1830, the spindles of the world were as follows: United States, 1,000,000; Europe, 2,000,000; Great Britain, 8,000,000. To-day, the United States has 11,000,000; Europe, 20,000,000; Great Britain, 40,000,000. In cotton manufacture, it is estimated that one man to-day is able to do the work of 1,000 hand laborers, and that the cotton, silk and woolen industries of to-day would require the work of human being if prepared by hand labor.

One hundred years ago, when thread numbered 150 by the standard set up by spinners was considered the utmost degree of fineness possible by English spinners, a pound of cotton spun to such fineness would give a thread 74 miles in length, sufficient to reach from Boston to Concord, N. H. The machinery of to-day spins for useful purposes thread numbered 600—from one pound a thread 186 miles long. And machinery has been constructed so delicate that a pound of cotton has given a thread reaching 1,061 miles—farther than from Boston to Chicago! The weaver of my boyhood could throw the shuttle perhaps twenty-five times a minute, but not at that rate through the day. Human muscle would break down under such rapid action. In 1850, Compton's loom threw the shuttle fifty times a minute, whereas so great has been the advance in invention, that the loom of to-day is considered a slow moving machine if the shuttle does not fly 240 times a minute! "No man can afford to take as a gift to-day a cotton manufactory equipped with the machinery of 1860," was the remark of the Superintendent of the Amoskeag Mills. "We are breaking up the machinery of those days for old iron."

In some departments of the cotton manufacture a man with the present machines will do eight times the amount of work which he could accomplish in 1860. In the manufacture of coarse cloth an operative with ten machines does twice the work which he could accomplish with thirteen machines before the war. There never was a period so fruitful in discovery, so fertile in invention as the present, and the reason is manifest. The first discoverers and inventors groped in the dark. They were ignorant of nature's laws. They did not know what force was. They had a limited comprehension of what the simple mechanical powers were. There was little accumulated wealth of research.

In contrast, the mechanic of to-day has all the discoveries, the experiments, the ascertained facts, mathematics of machinery, the laws of force at his command. He inherits the scientific wealth of all the past and makes it his capital. Instead of gazing, as it were, upon old mines worked out, he beholds mountain ranges filled with golden ore, and engages in his work with the stimulus of the needs of the human race, and the ever-increasing wants of an advancing civilization.—*Journal of Science.*

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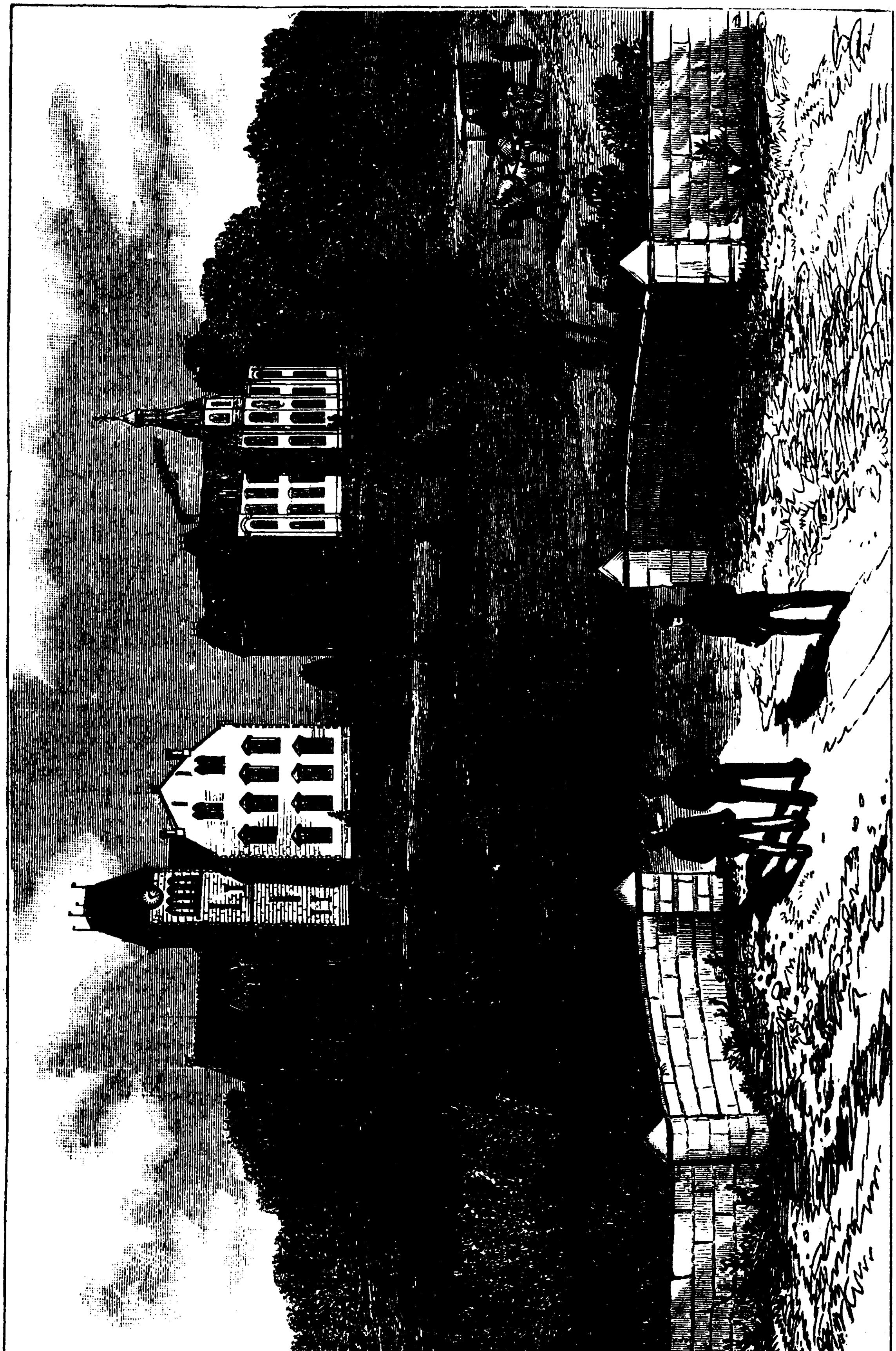
An apparatus for determining the velocity of a projectile in cannons and rifles, is described in the *Revue d'Artillerie.* It is the invention of MM. Siemens and Halske, and seems in the main a development of previous methods. The projectile passing along the bore brings the bare ends of several insulated wires into contact with the gun, and on each contact, a platinum wire opposite a rotating blackened drum, delivers a spark, marking the surface. This is effected through the agency of an induction apparatus, and a battery of 8 Leyden jars, the former being connected with the outer surface of the jars, and the interior of each of the latter with a gun wire. The highest knob of the battery is connected with the platinum wire which gives the sparks. As the projectile makes contact, the positive electricity of the wires flow to earth, and the spark passes.

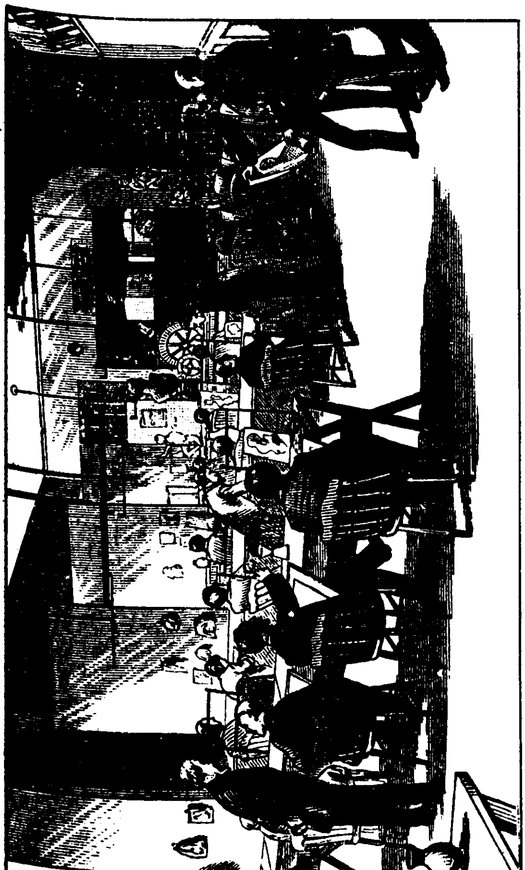
The Navy Department of the United States has decided to purchase the whaling steamer, *Mary and Helen*, now at San Francisco, in order to despatch her on a search for the Polar exploring vessel *Jeannette.* The Government will contribute $100,000 towards the expenses of the expedition.



THE BUILDINGS AND GROUNDS OF THE INSTITUTE.

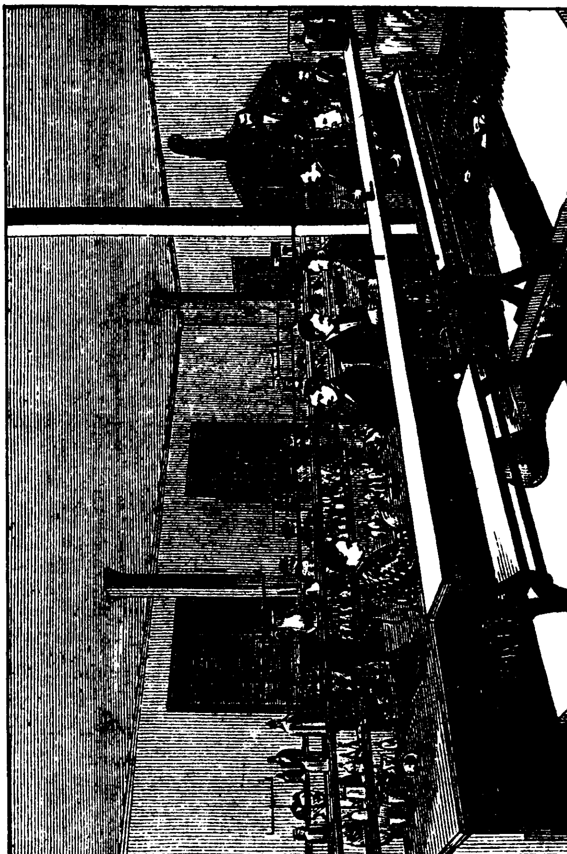
THE FREE INSTITUTE OF INDUSTRIAL SCIENCE AT WORCESTER, MASS.

MECHANICAL DRAWING-ROOM.



FREE DRAWING-ROOM.

THE WOOD ROOM.



THE CHEMICAL LABORATORY.

THE FREE INSTITUTE OF INDUSTRIAL SCIENCE AT WORCESTER, MASS.

# Educational.

## WORCESTER FREE INSTITUTE.

TECHNICAL EDUCATION IN MASSACHUSETTS.

Upon the brow of a commanding eminence, at a distance of two miles from the picturesque little city of Worcester, Mass., stands the handsome and imposing building known as the Worcester Free Institute. The school was founded by John Boynton in 1865, a gentleman who began life as a tinsmith, and who, after a brave and earnest struggle, came out victorious—his honor lily white, his name a synonym for directness of purpose and commercial integrity in the purest acceptation of the somewhat hackneyed term. Having borne the heat and burden of the day, it came to John Boynton to ponder over what he had gone through—this with a view towards smoothing the path for others who were preparing to gird on the armor ere entering the arena in which he himself had striven so gallantly against such heavy odds, who had not the same chances even as he had—and the outcome of honest John Boynton's cogitations may be given in his own words :

"Being desirous to devote a portion of the property, which, in the good providence of God, has fallen to my lot, for the promotion of the welfare and happiness of my fellow-men, I have determined to set apart, and do hereby set apart and give the sum of one hundred thousand dollars for the endowment and perpetual support of a Free School or Institute, to be established in the County of Worcester, for the benefit of the youth of that county.

"The aim of this school shall ever be the instruction of youth in those branches of education not usually taught in the public schools which are essential and best adapted to train the young for practical life ; and, especially, that such as are intending to be mechanics, or manufacturers, or farmers, may attain an understanding of the principles of science applicable to their pursuits which will qualify them in the best manner for an intelligent and successful prosecution of their business ; and that such as intend to devote themselves to any of the branches of mercantile business shall in like manner be instructed in those parts of learning most serviceable to them ; and that such as design to become teachers of common schools, or schools of the like character as our common schools, may be in the best manner fitted for their calling ; and the various schemes of study and courses of instruction shall always be in accordance with this fundamental design, so as thereby to meet a want which our public schools have hitherto but inadequately supplied."

Then out steps the Hon. Stephen Salisbury, another of Worcester's thinking sons—a graduate of Harvard, by-the-way—and with a gift of $200,000, specially to enable the Institute to receive students who are not residents of the County of Worcester, quoth he : "There is no intention and no desire to establish here a rival or substitute for the college. This school will not attempt to turn out, in this short period, an Arkwright, a Stephenson, or a Fulton, but it may give facilities and helps which these great mechanics did not possess."

It was on a glorious day in last week that I arrived in the City of Worcester. The railway depot, a charming specimen of twelfth-century Gothic, is, as regards appearance, convenience and comfort, an absolute model for boards of directors possessed of architectural proclivities. Worcester dates from 1685, but its gradual uprise began in 1713, the Indians, who called it "Quinsigamond," having assiduously depopulated it upon more than one occasion, notably in 1702. Worcester now boasts 60,000 souls.

The Free Institute is situated about two miles from the city, and to reach it one has to pass through avenues of the most quaint and picturesque residences, one vieing with the other in being "utter," "consummate" and "intense"—as the æsthetic jargon goes ; while churches, of pure Gothic, with cloisters and gables and flying buttresses, and chapels of the mediæval, line the way, causing the wayfarer to stop and let the mind leap into those early days when ecclesiastical architecture meant poesy in stone. To all the rich ones of the earth who would build themselves lordly places, I recommend a peep at Mr. Jonas Clarks' mansion on Elm Avenue.

The neighboring hill is topped by the Free Institute, an imposing building of granite, with a frontage of 146 feet, a depth of 61 feet, and boasting a tower 85 feet high. The Institute was built by contributions from the City of Worcester, over $15,000 having been subscribed by workmen in twenty shops and factories, a donation doubly welcome, as furnishing evidence of the appreciation of an enterprise intended to promote their special interests and to give dignity and character to their calling. To day the entire plant is valued at $630,000.

Ascending the hill, my ears were greeted by the well known throb of steam-power and the million-bee hum of the circular saw. I found Dr. Charles Thompson, A.M., Ph.D., Principal and Professor of Chemistry, in an office the dryness of whose surroundings was agreeably relieved by the blaze of Spring sunshine. Dr. Thompson bears all the unmistakable stamp of a worker. His brow denotes thought, his sharp grey-blue eye questions more sharply than his tongue can speak, and his manner is thoroughly impressive from the earnestness of the man.

"We are justly proud of our Institute, sir," he exclaimed, after I had presented my *Frank Leslie* credentials. "We are, I may say, unique in our way. We have never been in debt, for we believe that solvency is the boundary line of success. Our available income is $22,000, and from tuitions we receive $3,000. We show a surplus, and have all the pupils we can accommodate, and have all the work we can possibly do."

"Will you kindly explain to me the exact objects of the Institute, doctor ?"

Dr. Thompson leaped into his subject.

"This Technical School was chartered by the Legislature of Massachusetts, May 10th 1865, and opened for the reception of students November 12th, 1868. It is authorised to hold property to the amount of one million dollars. The City of Worcester, where it is located, contains about 60,000 inhabitants, who are largely engaged in manufactures, and characterized by unusual intelligence, sobriety and thrift. A great variety of work is always available through the liberality of the proprietors of Worcester shops, for the advantage of the students of the Institute."

"How many classes have you graduated ?"

Ten, aggregating two hundred and two students. The ease with which more than ninety per cent. of these young men have secured honorable and lucrative employment in stations for which their training especially prepared them confirms the confidence of the trustees in the soundness of the general principles upon which the school is organised.

"This Institution arose from a conviction on the part of its founders that there is need of a system of training boys for the duties of an active life, which is broader and brighter than the popular method of "learning" a trade, and more simple and direct than the so-called "liberal education." It is the undoubting opinion of the managers of the Institute, and all who have watched its operation, that the connection of academic culture and the practical application of science is advantageous to both, in a school where these objects are started together and carried on with harmony and equal prominence. The academy inspires its intelligence into the work of the shop, and the shop, with eyes open to the improvements of productive industries, prevents the monastic dreams and shortness of vision that sometimes paralyze the profound learning of a college. What is desired is, that all practice in engineering should spring from a clear comprehension of its principles. If the student's school training is conducted on this plan, his entrance upon the life of an engineer is an expansion of his course of study, rather than an abrupt transition to a new mode of life.

"In acquiring knowledge of any form of handicraft, or of the practical industries by which society is supported and carried on, it is essential that the student should practice under conditions as like as possible to those he will meet in life. The more his work is subjected to the inexorable tests of trade, and the more he feels just the same responsibility that rests upon an actual workman, the better he is. He must make the things that are to be used, rather than those contrived to suit the peculiarities of his temperament, the exigencies of his situation, or the mere purpose of instruction."

"What is the practice of this school, professor ?"

"Practice, in this school, is subjected to three conditions : First, it shall be a necessary part of each week's work ; secondly, it shall be judiciously distributed, and momentarily supervised ; and thirdly, the students shall not expect or receive any immediate pecuniary return for it.

"At the middle of the first year, every student (except the mechanical section) chooses some department, under the advice of the instructors, and, until his graduation devoice ten hours a week and the month which follows the second examination, to practice in that department—that is, for two and a half years. Students who select chemistry, work in the laboratory ; the civil engineers, at field work or problems in construction ; those who select drawing, in the drawing-room ; and physics, in the physical laboratory. The mechanical section practice in the work-shop from the beginning of the apprentice half-year. and their practice extends over the whole course of three and a half years.

"*Firstly*—The shop is managed as a manufacturing establishment in order that the students may always work in the wholesome atmosphere of real business. Excellence in construction is sought as a necessary force in construction. As great a variety of of work is secured by contracts as is compatible with thorough teaching, and the determination on the part of the Superintendent of the Washburne Machine Shop to maintain the highest standard of workmanship has so far been successfully carried out, and is, undoubtedly, the only way to fulfill the design of the shop. The Jurors at the Centennial Exposition decreed an award to the shop for its tools for working metals, which were exhibited in Machinery Hall, and first premiums have been awarded wherever these tools have been exhibited. *Secondly*—The work of each student is done under the personal supervision and direction of a skilled workman, and with the advantage of the best obtainable tools and machinery; for it is as true in handicraft as in the training of the intellect that no teaching and no tools are too good for the instruction of boys. *Thirdly*—Each student receives daily training in free-hand drawing during the apprentice term. Such discipline of the sense of form and proportion is secured in this way, and so much dexterity in developping various forms is acquired by the students, that when they undertake shopwork, they make more rapid and satisfactory progress than those who have not had the advantage of this training. *Fourthly*—The weekly practice is distributed so as to occupy five hours of each of two days. Every student is required to render a strict account of these hours. The time thus spent serves the double purpose of practice and of exercise; and fifthly, each student advances as fast as possible, unchecked by the difficulties of his neighbor, or the business necessities of his employer.

"The great idea," added Professor Thompson, "is that this institute offers a good education—based on the mathematics, living languages, physical sciences and drawing—and sufficient practical familiarity with some branch of applied science, to secure to its graduates a livelihood. It is specially designed to meet the wants of those who wish to be prepared as mechanics, civil engineers, chemists, or designers, for the duties of active life."

"What time does the training of students for mechanical engineers take?"

"Three and a half years, that of all others three years, of forty-two weeks each. There are, therefore, four classes, viz.: Apprentice, Junior, Middle and Senior."

"Have any of your graduates made way in the world yet?"

"Oh, dear, yes. I keep track of them all. Every young fellow who graduates here writes me yearly. See, here is my letter-book," placing a ponderous tome for my inspection. "They all do well. Several of them have salaries of $4,000 a year. One is a partner in a Boston patent lawyer firm; another is superintendent of the Pennsylvania Lead Works; another, superintendent of the Atlas Engine Company, Indianapolis; another, superintendent of the Atlanta Giant Powder Company. The Atcheson, Topeka and Santa Fé Roads have eight of our graduates in charge of different sections of the line. We have turned out four hundred graduates, and we have never lost four hundred cents by them. Their moral tone is superb. Here is a piece of cloth woven by one of our graduates on a loom invented by himself," and, with a pride that did him honor, the professor displayed the piece of cloth. "Now for a walk through the shops."

We passed into the Department of Physics, where half a dozen young fellows were attending to the instruction of a learned pundit, and from there into the Chemical Laboratory, where one young gentleman was cautiously experimenting in explosives. Then we crossed the yard to the machine-shop. The shop is a three-story brick building, one hundred feet long by forty feet wide, with a wing sixty-five by forty feet, for engine, boilers and blacksmith shop. These rooms are all equipped. Here was machinery performing its hard-handed mission, superintended by earnest students, smut-begrimed as to face and blue-black as to hands, who bent over their tasks with an attention that spoke a whole library of certificates in favor of their ultimate success.

"We commence with wood," observed Professor Thompson, "and not with iron. We get enough of work in this department, aided by a backing of $3,000, to run it. There is necessarily a good deal of waste and spoil on account of inexperience, hence our uphill work to make it pay."

We ascended to the wood-room, passing on the way a great glass-case containing models and decorations won for the Institute at various expositions, and arrived in a large, airy, well-ventilated apartment, bearing the refreshing aroma of sawdust.

"My faith in the Institute speaks for itself," laughed the Professor, as he introduced his son to me, a bright, handsome young lad, engaged in constructing a wooden seat, one of the first tasks to which the neophyte is put.

The lads board in different house in the town, and here is a chance for a philanthropic donation towards the erection on the grounds of a suitable house wherein the youthful workers can eat, drink and sleep. Such an institution would make them more clannish; it would tend to good-fellowship; the rush off for breakfast and dinner, with its attendant trudge into the city, would be avoided. A library might be added, and, in a word, a great boon conferred on these aspiring and earnest youths.

"The work executed in the shops is sold, and the sum received placed to the credit of the institution. The following is the outline of the course of study. Recitations and practice are assigned to the classes according to the following scheme, the figures indicating hours per week:

"First Half Year.—*Seniors*—Theoretical Mechanics, 5; French or German, 3; English, 2; Chemistry, 1; Physics, 4; Mechanical Drawing, 5; Practice, 10. *Middlers*—General Geometry, 5; Descriptive Geometry, 3; German, 2; English, 1; Chemistry, 4; Free Drawing, 2; Mechanical Drawing, 6; Practice, 10. *Juniors*—Algebra, 4; Geometry, 4; German, 3; English, 1; Chemistry, 2; Free Drawing, 6.

"Second Half Year—*Seniors*—Applied Mechanics, 5; French or German, 3; English, 2; Chemistry, 4; Mechanical Drawing, 6; Practice, 10. *Middlers*—Calculus, 5; German, 3; English, 1; Physics, 4; Free Drawing, 2; Mechanical Drawing, 6; Practice, 10. *Juniors*—Trigonometry, 4; Algebra, 4; German, 3; English, 1; Chemistry, 4; Free Drawing, 6; Practice, 10. *Apprentices*—English, 5; Free Drawing, 10; Shop Practice, 39.

Candidates for admission to the Junior Class should have attained the age of sixteen years, and must give evidence of proficiency in the common English branches, viz.: History of the United States, geography, grammar and arithmetic, and in algebra as far as quadratic equations. In general, students at the end of the second year in the High School are prepared for the studies of the Institute, though a full High School course is desirable.

If every student before admission could learn as much French as is contained in Keetle's "Elementary Grammar," the "language time" of the Institute course after Junior year could be devoted to German and English—a result greatly desired.

The entrance examination is intended to satisfy the faculty that each candidate gives reasonable promise of success in the studies of the Institute. All candidates are held to be on probation till the end of the first half-year, and the student's standing at that time determines his future course.

Students can enter an advance class at any time, but only after satisfactory examination in the studies already pursued by that class.

There is no charge for tuition to residents of Worcester County. Others are charged one hundred and fifty dollars per year, payable semi-annually in advance.

All students are charged the cost of chemicals used in the laboratories, and for breakage in every department. The regular charge in the chemical laboratory is eight dollars a year. Students who practice in the laboratory are charged fifteen dollars each."

I parted from Professor Thompson, and wended my way to the fine old residence of the munificent President of the Institute, Hon. Stephen Salisbury, LL.D. This venerable gentleman, whose eye flashes like that of an eagle, went into considerable detail as to the admirable effects of the working of the Institute, and of the part taken by the late Mr. Washburne, whose gift of the machine-shop has proved of such infinite value. Mr. Salisbury expressed a lively hope that this class of Institute would soon become an "epidemic" in the United States.—*Frank Leslie.*

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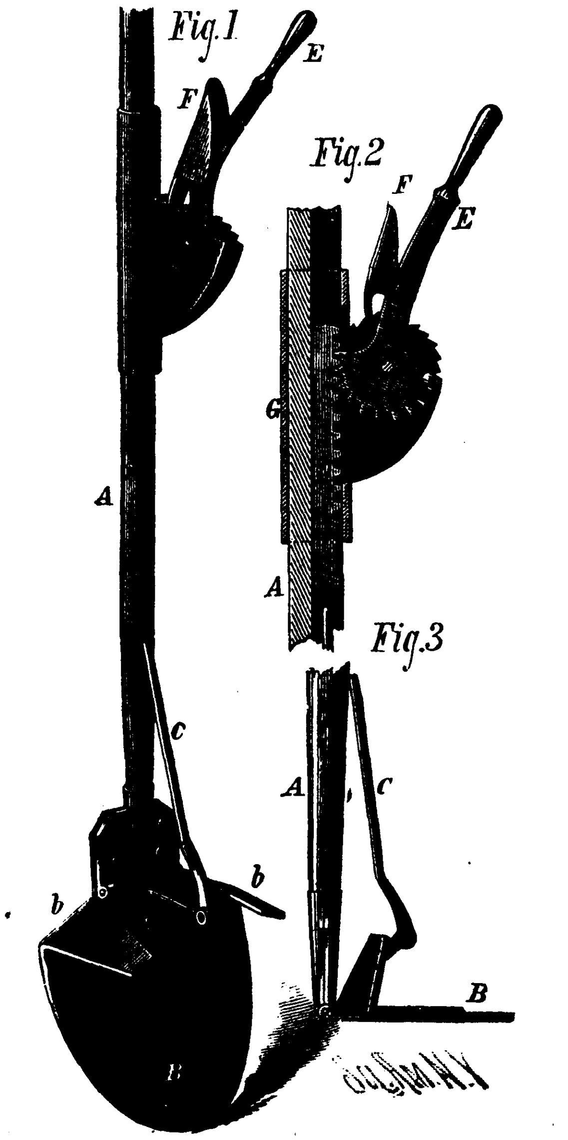
Workmen's pantaloons often become too filthy to wear, on account of being saturated with oil and grease, long before they are really worn out. The following method of washing such articles of clothing, so as not to discharge the color, is recommended. It is impossible to wholly prevent fading, but if not left in the water too long the washing out of the dye will not be very great: Water 1 gallon; soap ¼ lb.; boil to dissolve; add 2 ozs. borax; dilute with about 8 gallons water; work the goods through as quickly as possible and rinse without wringing. An aqueous solution of 1 part copperas and 7 parts logwood extract may be used for reviving the faded color of cheap black goods after cleansing as above.




## IMPROVED POST HOLE DIGGER.

The engraving shows an improved implement for digging fence post holes, which can be inserted in the ground like an ordinary spade, and when inserted to the proper depth can be transformed into a lifter, by which the earth may be readily removed. The handle, A, carries a blade, B, at its lower end, which is hinged so that it can be made to assume any position with respect to the handle, varying from a straight line with it to a right angle. The shovel, at its shoulders, is provided with extensions, *b*, reaching forward at or about right angles to the blade, which form stops to limit the extent of its insertion into the ground to permit of shifting the position of the blade without hinderance. To the blade of the shovel is secured a bent arm, to which is pivoted the end of a curved rod, C, extending backward to the handle, and provided with a sliding rack, D. To the handle is secured a sleeve, G, having a longitudinal slot and two parallel standards, between which is pivoted a lever, E, having a toothed segment, by means of which the rack may be moved back and forth to operate the shovel blade. The rear edges of the standards are provided with ratchet teeth, and the lever with a pawl, F, adapted to engage the teeth so as to hold the lever and other parts in any desired position.

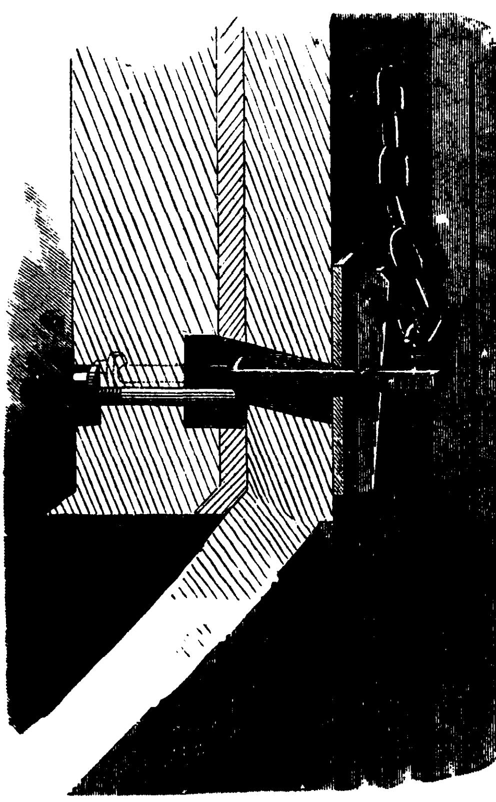
When the blade is in line with the handle it may be driven into the ground after the manner of an ordinary spade, and when inserted to the proper depth, by operating the lever it may be brought at right angles to the handle, so that the earth may be lifted vertically and removed.

This invention was lately patented by G. B. Van Vleet, of Lodi, N. Y.

## IMPROVED DOOR FASTENER.

We give an engraving of a very simple and effective door fastener, patented by Mr. F. M. Alexander, of Marshall, Texas, and intended more particularly for application to car doors.

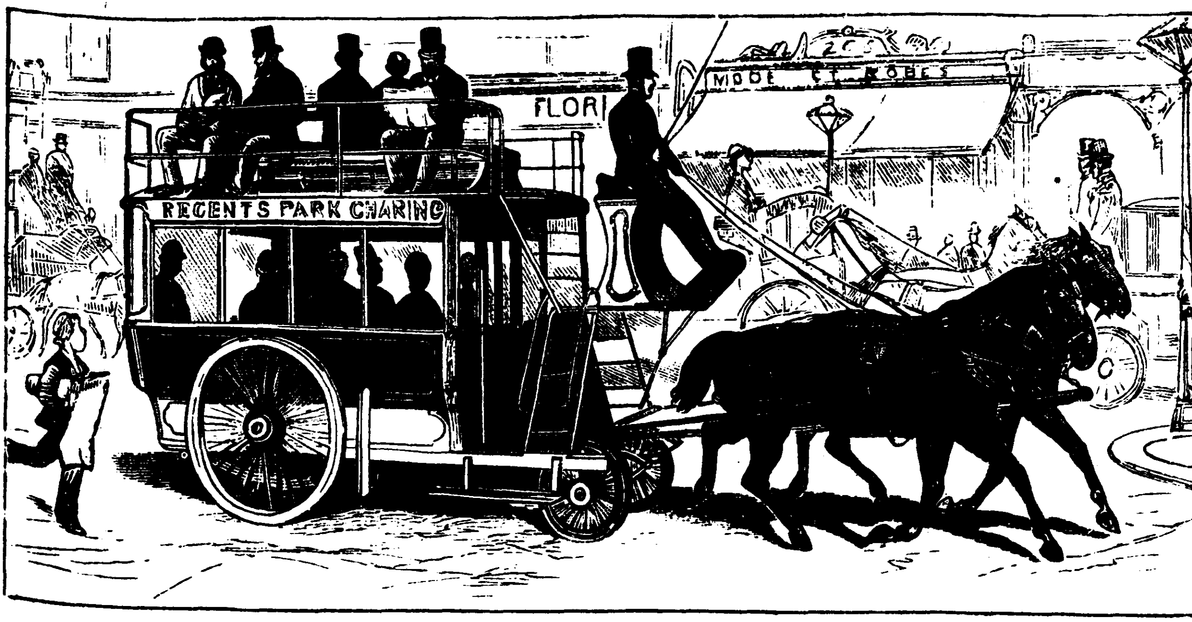
The staple is fastened in the side of the door frame with its outer end in a recess of the frame. The stile of the door is traversed by an oblique mortise covered on the outside by an iron plate having a slot, through which passes a short flat bar or hasp having a hook turned on its inner end and having in its outer end a rivet which prevents it from slipping inward through the plate attached to the door. The hasp has a mortise for receiving a key or pin attached to the car door by means of a chain. This key is mortised transversely for receiving a lock or seal. The staple is flush with the front of the door frame, and the locking of the door is effected by hooking the hasp over the staple and inserting the key as shown in the engraving. It will be seen that by means of this device the car door may be drawn tightly against the door frame, and the car will be securely locked.



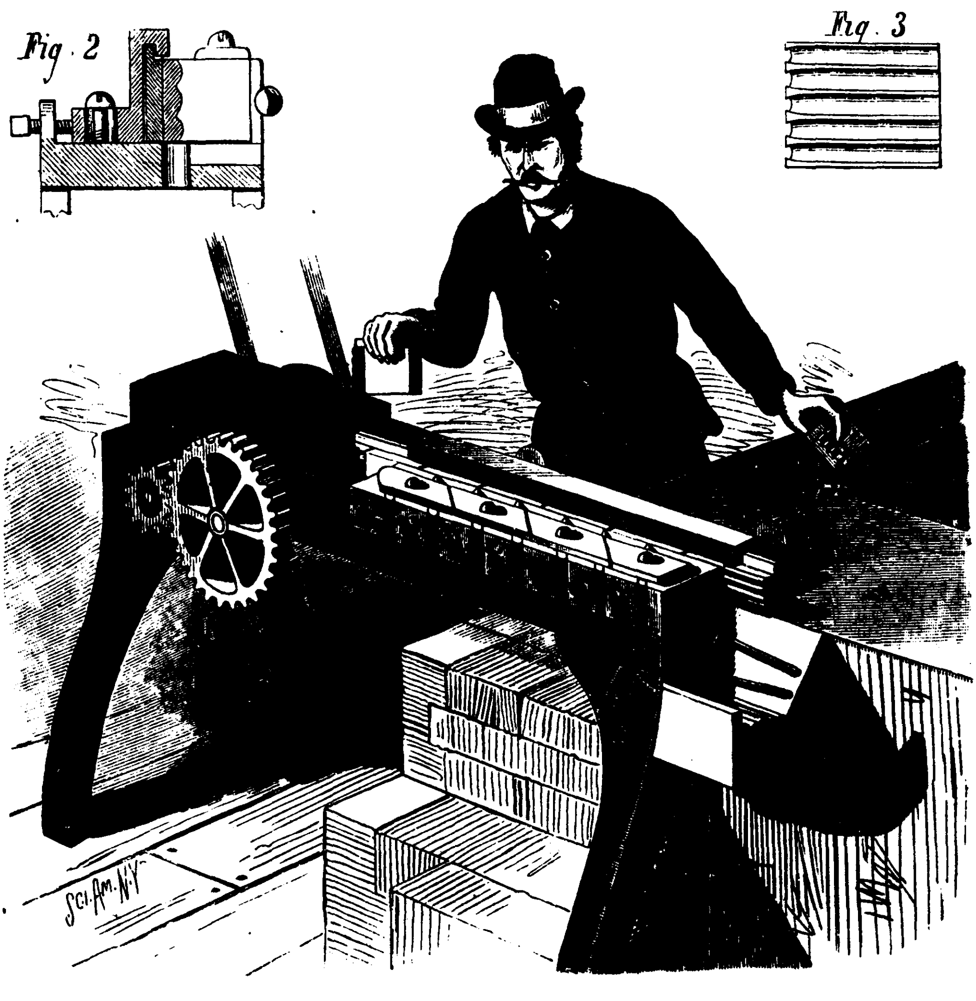
ALEXANDER'S DOOR FASTENER.

When the hasp is disconnected from the staple it hangs down upon the car door, its hooded end engaging the plate on the face of the door.

This fastener is very strong and effective, and at the same time inexpensive. The inventor informs us that railroad men who have seen it fully indorse it.




MOLESWORTH'S ROAD CAR.




SLATE PENCIL MACHINE.

# Miscellaneous.

## NEW ROAD CAR.

The road car shown in our engraving will shortly commence running on various routes in different parts of London, the London and District Omnibus Company (Limited) having entered into arrangements for the purpose with the inventor, Captain Molesworth, R.N. The chief difference between the old and the new vehicles is that the latter are principally supported on the two large wheels, which arrangement not only gives greater facility in running, but by means of the crank axle also brings the car much nearer the ground, passengers being thus able to step easily from the pavement on to the platform in front, which is no higher than an ordinary curbstone. An additional, and perhaps a more acceptable advantage gained in adopting this principle, is that, however rough the ground or however the load may be distributed, the car glides forward with an undulating, easy motion, most enjoyable compared with the rather "rough and tumble" jolting of the old omnibus. The two small wheels in front act rather as a foundation for the driver's seat than as an additional support to the car. This new arrangement affords great facilities for rapidly turning and changing the vehicle's course in crowded thoroughfares, and also enables the driver to have proper command of his horses, to be free from interference from passengers, and also to be in close communication with the conductor, who stands on the platform in front, where, in contrast to the old style, is the door. We have seen and travelled in one of the new vehicles, were much pleased with its comfort, roominess and brightness, and especially with the novel arrangement of the seats on the top; the "knife-board" being abolished for a double row of comfortable garden chairs, so placed as to allow of every one sitting with his or her face to the horses. These chairs are not shown in the illustration, but the majority of the cars are fitted with them.—*London Graphic.*

## SLATE PENCIL MACHINE.

It is easier for the schoolboy, with his innate inquisitiveness, to ask how slate pencils are made than it is for the boy of larger growth to answer; however, the machinery employed in making slate pencils is very simple, and the process will be readily understood by studying the annexed engraving.

The bed of the machine has a series of diagonal slots, in which multiple knives, shown in Fig. 3, are clamped by set screws. These knives differ in form and in the size of their curved cutting edges, and the smaller knives succeed the larger ones in acting on the slate blanks.

Opposite the cutting edges of the knives there is a groove adapted to slides capable of carrying blanks, from which the pencils are made. At the receiving end of the machine a frame arranged to slide lengthwise of the main frame is pushed forward by a cam and drawn backward by a weight.

The slate blanks from which the pencils are made are brought to a uniform thickness and length, and are placed on the slides, and put in the machine, one at a time, as the sliding frame falls back.

When the cam pushes the frame forward the slate blank is pushed through the first set of knives. When the next blank is pushed forward in the machine the first one is pressed beyond the second set of knives, and so on. When the blanks emerge from the machine after the first cutting the pencils are half formed.

The blanks are reversed and again put through the machine, when they are separated, and the finished pencils are delivered in a receiver at the end of the machine. This machine is the invention of Mr. J. C. Richards, of Brooklyn, N.Y.—*Illustrated Scientific News.*

TROUVE's utilisation of electricity in combination with surgical instruments is bearing fruit. A case is recorded from Vienna in which a doctor has succeeded in curing a cancer in the stomach mainly by the assistance rendered by the polyscope. The electric probe, which rings a bell when a ball or any metallic substance imbedded in the muscles is reached, is highly prized by Army surgeons, and an application of the same principle to surgical forceps has enabled a Berlin oculist to save the eye of a workman which was damaged by the intrusion of a spark of steel. This case had becomed so urgent that it was necessary to extract the piece of metal without delay or to excise the eye; but Dr. Hirschberg, by inserting a soft iron probe and subsequently converting it into an electro-magnet, withdrew the particle of metal, and saved the eye.

# Sanitary Matters.

## TRICHINOSIS.

Several cases of this disease have been recently reported in medical journals, and it seems probable that it is of more frequent occurrence than has been hitherto supposed, the milder cases being mistaken for typhoid fever, rheumatism, etc. This is not to be wondered at, since of some droves of hogs at least five per cent. are infected with this parasite, and it is evident that infected pork must be often eaten without producing ill effects. This is due to the fact that thorough cooking destroys the parasite.

In almost every case in which the disease has been observed in the human subject, it has been proved to be due to eating pork which has been merely smoked or dried. Can any measures be taken by health authorities to prevent danger from this source, and is it worth while to incur the expense of such prevention? As regards fresh pork sent to the markets for immediate consumption, such measures should certainly be taken as they would simply form a part of the systems of abattoirs and meat inspections which every city should have. But as regards salted and smoked or dried meats it is a different matter. It is certainly impossible for the city of New York to undertake an inspection of all such meats brought within her limits. Nor is it clear that it is possible to secure an inspection of this class of meats at the great centres where they are prepared, such as Chicago, Cincinnati, St. Louis, Boston, etc., in such manner that the inspection shall be uniform and reliable, and not bearing more hardly upon the business of one place than on that of another, without legislation by the general government, which, in its turn, would involve very considerable difficulties.

Upon the whole, it seems probable that the best results will be reached by the operation of ordinary business considerations, and that some of the largest packers and shippers of meats will find it to their interest to have meats examined and branded by authorized inspectors of the State or city, which certificate of inspection will confer an additional value upon the meat thus marked. If the examination be made upon the animal before it is cut up, the presence of trichinæ may be determined very easily. A single observer can readily dispose of several hundreds a day. If the hogs that are to found to be infected are destroyed, the farmers will soon find it worth while to take the precautions necessary to prevent infections of the animals. As soon as the presence of trichinæ in pork begins to entail pecuniary loss on the dealers in and packers of pork, the matter will be properly attended to, and probably not until then.—*Sanitary Engineer.*

## PASTEUR'S NEW DISEASE.

In the *Lancet* for February 5, we called attention to the remarkable effects which M. Pasteur had obtained by inoculating rabbits and guinea pigs with the saliva of a child which had died from hydrophobia. The animals, it will be remembered, died thirty-six hours after inoculation, and in their blood was found a bacterial organism, which was quite peculiar, which could be cultivated, and then produced, when inoculated into other animals, symptoms identical with those observed in the others. M. Pasteur did not assert that this was the special microbic organism of rabies, but he considered that his experiments and the microscopical characters of the organism warranted the assertion that the disease was not septicæmia, but a malady altogether new to experimental pathology. In order to ascertain whether a similar affection can be produced by the inoculation of the saliva of persons who have died from other common diseases, M. Pasteur has made some inoculations with such saliva, but without any results. But since the case of hydrophobia was in a child, M. Pasteur applied to M. Parrot for some saliva from children dying from diseases which are regarded as non-specific, and received some from the bodies of three children who had died the preceding day from broncho-pneumonia. In rabbits inoculated with this saliva there was found precisely the same organism as had been discovered in those which had been inoculated with the saliva from the case of hydrophobia. He thinks it certain, therefore, that this organism may often be found, and that it is one of those which have their habitat in the commencement of the alimentary tract. Hence, as he points out, it is not in any way connected with rabies, but it is a surprising fact there should exist in the saliva, at least of children, a special organism which is capable of causing so rapidly the death of rabbits and dogs, even when inoculated in very small doses. It is a fact of very great importance in the etiology of diseases which may be ascribed to microscopic organisms.—*Lancet.*

# Health and Home.

### THE CONDUCTOR'S STORY.

"Yes" said the conductor, biting off the tip end of a cigar and slowly scratching a match on his leg. "I've seen a good deal of railroad life that's interesting and exciting in the twenty years that I've been twisting brakes and slamming doors for a living.

"I've seen all kinds of sorrow and all kinds of joy—seen the happy bridal couple starting out on the wedding tour with the bright and hopeful future before them, and the black-robed mourner on her way to a new made grave wherein she must bury the idol of her lonely old heart."

"Wealth and pinching poverty ride on the same train, and the merry laugh of the joyous, healthy child is mingled with the despairing sigh of the aged. The great antipodes of life are familiar to the conductor, for every day the extremes of the world are meeting beneath his eye."

"I've multituded the ticket of many a black leg and handled the passes of our most eminent dead heads. I don't know what walk of life is more crowded with thrilling incidents than mine."

"Ever had any smash-ups?"

"Smash-ups? Oh, yes, several of them. None however that could'nt have been a good deal worse."

"There is one incident of my railroad life," continued the conductor, running his tongue over a broken place in the wrapper of his cigar, "that I never spoke of before to anyone. It has caused me more misery and wretchedness than any one thing that ever happened to me in my official career."

"Sometimes even now, after the lapse of years, I awake in the night with the cold drops of agony standing on my face and the horrible nightmare upon me with its terrible surroundings, as plain as on the memorable night it occurred."

"I was running extra on the Union Pacific for a conductor who was an old friend of mine, and who had gone South on a vacation for his health."

"At about 6 : 30, as near as I can remember, we were sailing along all comfortably one evening with a straight stretch of track ahead for ten or fifteen miles, running on time and every-body feeling tiptop, as overland travellers who get acquainted with each other and feel congenial. All at once the train suddenly slowed down, ran on an old siding and stopped."

"Of course I got off and ran ahead to the engine to see what the matter was. Old Antifat, the engineer, had got down and was on the main track looking ahead to where, twinkling along about seven miles down the road apparently, was the headlight of an approaching train. It was evidently "wild" for nothing was due that we knew off at that hour.

"However, we had been almost miraculously saved from a frightful wreck by the engineer's watchfulness and everybody went forward and shook old Antifat by the hand and cried and thanked him till it was the most affecting scene for awhile that I ever witnessed. It was as though we had stopped upon the very verge of a bottomless chasm, and everybody was laughing and crying at once, till it was a kind of a cross between a revival and a picnic."

"After we had waited about half an hour, I should say, for that blasted train to come up and pass us, and apparently she was no nearer, a cold clammy suspicion began to bore itself into the adamantine shell of my intellect. The more I thought of it, the more unhappy I felt. I almost wished that I was dead. Cold streaks ran up my back followed by hot ones. I wanted to go home. I wanted to be where the hungry, prying eyes of the great, throbbing work day world could not see me."

"I called Autifat to one side and said something to him. He swore softly to himself and kicked the ground, and looked at the head light still glimmering in the distance. Then he got on his engine and I yelled "all aboard." In a few moments we were moving again, and the general impression was that the train ahead was side-tracked and waiting for us, although there was'nt a side track within twenty miles, except the one we had just left."

"It was never exactly clear to the passengers where we passed that wild train, but I didn't explain it to them. I was too much engrossed with my surging thoughts."

"I never felt my own inferiority so much as I did that night. I never so fully realized what a mere speck man is upon the universe."

"When I surveyed the starry vault of Heaven and considered its illimitable space, where, beyond and stretching on and forever, countless suns are placed as centres, around which solar systems are revolving in their regular orbits, each little world peopled perhaps with its teeming millions of struggling humanity, and then other and mightier systems of worlds revolving about these systems till the mind is dazed and giddy with the mighty thought; and then when I compared all this magnificence, this brilliant aggregation of worlds and systems of worlds, with one poor, groveling worm of the dust, only a little insignificant atom, only a poor, weak erring, worthless fallible, blind groping railroad conductor, with my train peacefully side-tracked in the gathering gloom and patiently waiting for the planet Venus to pass on the main track, there was something about the whole sombre picture that has overshadowed my whole life and made me unhappy and wretched while others were gay."

"Sometimes Antifat and myself meet at some liquid restaurant and silently take something in memory of our great sorrow, but never mention it. We never tear open the old rankling wound or laugh over the night we politely gave the main track to Venus while we stood patiently on the siding."

### A BARBER ON BALDNESS.

Speaking of the credulity of many people touching the efficacy of hair tonics, an intelligent French hairdresser says:

Very often the hair falls out after sickness. In such cases it generally grows again without the aid of any hair tonic whatever; but when it falls out from natural causes it never grows again.

The celebrated Dr. Bazin, who was formerly physician in chief of the St. Louis Hospital at Paris, and who is known throughout the world as the most learned specialist for affections of the skin, told me one day that there was nothing that could make the hair grow after the baldness had come on gradually. This I believe firmly, for, if there was anything of the kind, we would not see so many New York doctors with heads as completely destitute of hair as the back of turtles. I am even persuaded that these gentlemen would follow the example of those Greek heroes who, under the leadership of Jason, made a voyage to Colchis to bring back the Golden Fleece. Modern Argonauts, the doctors, would consider themselves happy if they could bring back from such a voyage the secret of restoring the human fleece.

I don't think I am far from the truth when I say that during the past twenty-five years that I have practiced the profession of hairdresser, I have made the trial upon different bald heads of more than five hundred different hair tonics, and I am bound to admit that I never saw a single head the hair of which was restored after baldness. At the end of so many failures, I am completely undeceived as to the value of all the preparations, and I would not now recommend any one of them, because I would be afraid to commit the crime that is designated by the words, "obtaining money under false pretences." In my pathological studies upon the hair, I have found that people who perspire a great deal from the head are apt to get bald. The bad habit of wearing hats indoors is also very hurtful to the hair. In 1806, after the famous battle of Iena, in which the Prussians were completely defeated by Napoleon I., Baron Larrey, the celebrated military surgeon, perceived that many of the German prisoners were completely bald. Surprised, he made enquiries as to the cause of this, and he found that they owed their baldness to the shape—as homely as unhealthy—of their caps. The foul air of their head gear, having no issue, destroyed the vitality of the hair.

A CRACKED VOLCANO.—Within the space of ten months Mount Etna had five abundant eruptions of smoke and sand, without any subsequent flow of lava. In one instance, after profound subterranean rumblings and numerous earthquake shocks, there appeared on the eastern side of the mountain a great cloud of vapors and ashes, which escaped by a crevice nearly three miles long. The snows melted suddenly around the summit of the mountain, jets of hot vapor escaped at many places, and the small muddy craters of the western declivity became very active, as is usually the case on the approach of a great eruption. But to the surprise of all observers, within thirty-six hours afterward the volcano had returned to a state of perfect calm. Such a phenomenon has never before occurred within the memory of man. Vicenzo Tedeschi di Ercole attributes it to the existence of an immense opening, which appeared upon the mountain at the time of the eruption of May 26, 1879. He concludes that a very strong pressure is required for the formation of lava, and that a great tension of gas is indispensable in order to raise the lava to the surface of a mountain. It appears probable, therefore, that there will be no reason to fear any further eruption in the cone of Etna as long as the present crevice is open.—*Ann. de Chim. et de Phys.*

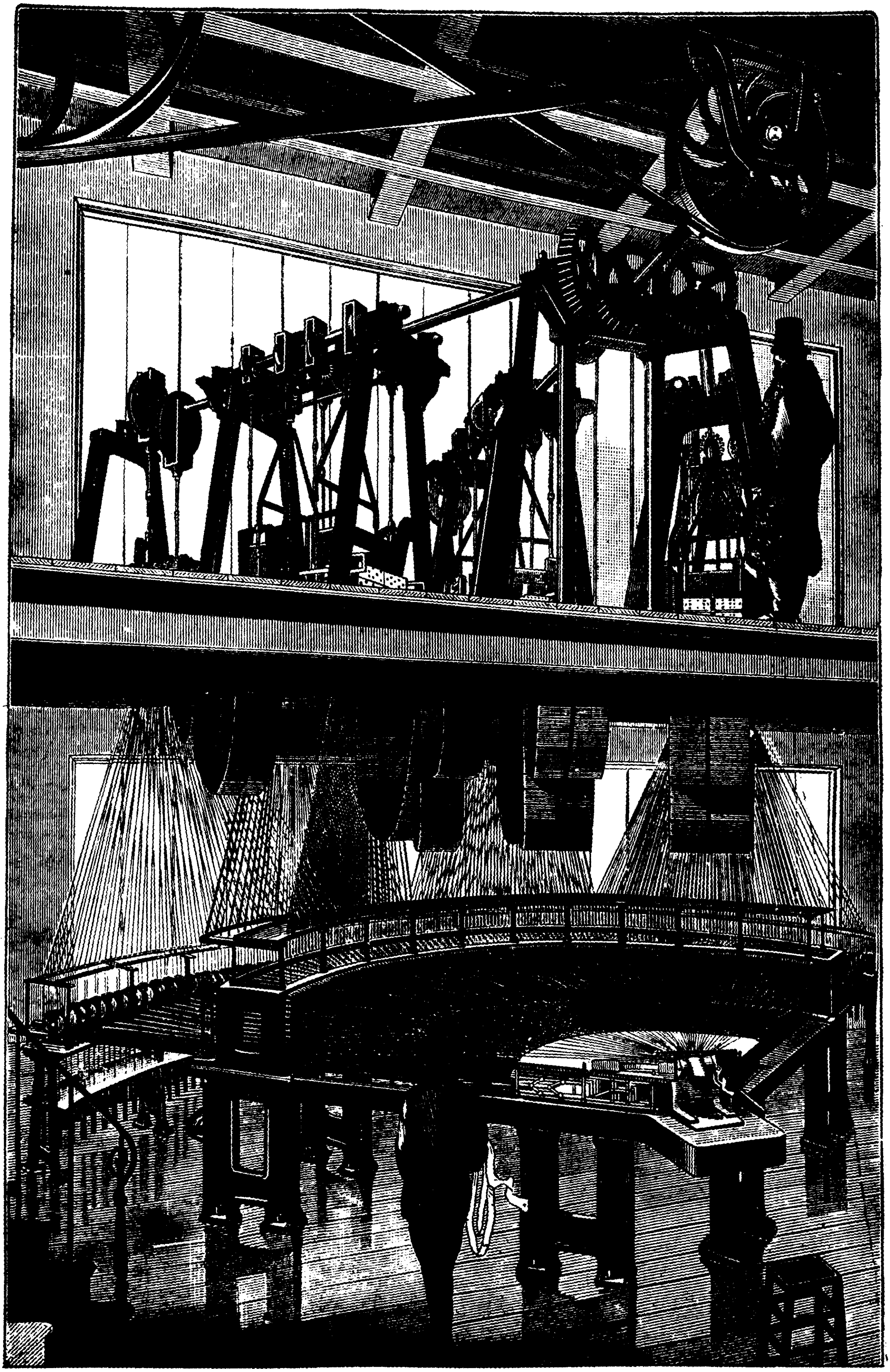


Fig. 5.—MALHERE'S LACE LOOM.

## MANUFACTURE OF REAL LACE BY MACHINERY.

Considerable attention has lately been paid in Europe to the manufacture of lace by machinery. A company has been organized in Paris with a capital of 2,500,000 francs to develop M. Malhère's lace loom.

This loom is a marvel of mechanism, having from 1,800 to 2,000 spindles, which are put in motion at the same time

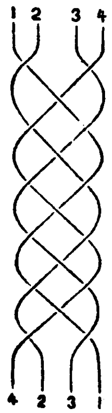



Fig. 1.

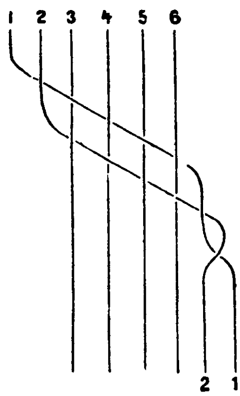



Fig. 2.

that 200 to 300 pins are placed or displaced. But the inevitable complication of the members of which it is composed, though a just object of admiration, is a legitimate cause of apprehension as to the regular working of the apparatus. In order to work economically the lace machine must move with great rapidity, and without very frequent interruptions; but whether these conditions can be realized is a matter that can be proved only by experiment.

This loom makes real lace, imitating hand work. We give a photographic reproduction of a sample of Valenciennes lace made with this machine, also a study of the rounded mesh of Valenciennes from Bruges. The pattern is not the work of a regular designer of lace, but was composed spontaneously by M. Malhère, who invented the loom: this explains its lack of elegance.

It is claimed that this loom can produce all kinds of lace, and that competent judges, and even lace-makers, confound the lace which it produces with that made by hand. The microscope demonstrates to the incredulous that the weaving is the same as hand-made lace, without the least resemblance to the imitation.

For the principal facts we are indebted to the report written on this subject by M. Jousselin, engineer. The report begins by explaining how the inventor was led to construct the machine.

M. Malhere, in studying with a magnifying glass the intertwining of the thread of the lace made by hand, ascertained that in all kinds of lace, in the network and in the flowers, the thread is subjected to the same operation. This was the first conception of the possibility of producing these operations mechanically. Indeed, if one considers a twist forming the mesh of the Valenciennes and the knot of the figure constituting the flower, it is ascertained that the thread No. 1 (Fig. 1) crosses successively over thread No. 2, over thread No. 4 (which was crossed over No. 3), and under No. 3, in order to return, passing over and under the threads until it resumes its original direction, forming thus, with the three other threads, a twist of four threads. In Fig. 2, the adjacent threads, 1 and 2, pass suddenly in a transverse direction, twisting with a half revolution, and passing in alternation over and under threads 3, 4, 5, 6.

This problem, then, is reduced to making a twist of two contiguous threads from right to left or from left to right, according to the requirements of the design, and making it in such a manner that this twisting will be effected at will from right to left or from left to right in order to reverse the thread below or above.

In consequence of this it is necessary to accomplish mechanically the transposition of the threads in order to put in proper relation those threads which are destined to be worked together, and M. Malhere conceived the fundamental idea of making a machine employing rotative disks, which contain two threads capable of being twisted together by a half revolution or a complete revolution. These disks are tangent and in pairs, capable of transferring the thread from disk to disk, and are arranged in the segment of a cylinder, in order that the threads between the disks and their converging point may be as nearly as possible of a uniform length. The lace is produced in the geometrical center of the segmental frame. Several bands of lace are

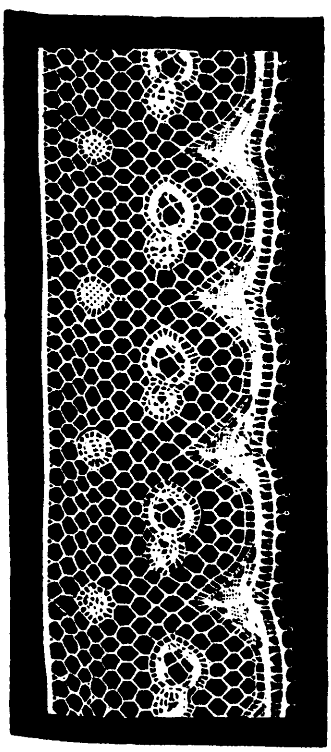


Fig. 3. Valenciennes made by the Lace Loom.—

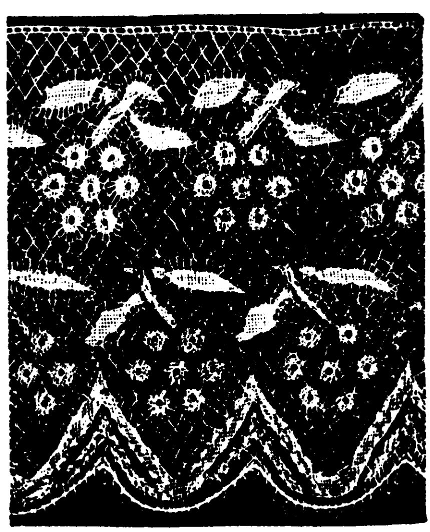


Fig. 4.—Bruges Valenciennes.

produced simultaneously by the superposition of the thread carriers. M. Malhere has also invented a comb with independent teeth which replace the pins of the hand lace worker. The movements of the several independent members of this machine are controlled by the Jacquard arrangement of perforated cards. Such is the succession of ideas which led to the invention of the lace loom.

The lace from the spindles of the hand lace-worker is not made like net or imitation lace, by two distinct groups of threads, warp and woof, but by veritable twisting, in the interlacing of which all the threads may concur, following the fancy of the designer.

The interlacing threads are collected and fixed in the central part of the machine (corresponding to the pillow of the hand lace-maker) by means of pins. This hand method of making lace suggested to M. Malhere the peculiar form which he has adopted for the frame of his automatic loom. It consists of two concentric cylinder segments supported at a convenient height upon a cast iron table. As all parts of the segmental frame are nearly equidistant from the converging point of the threads, the tension of the thread is uniform, and this arrangement allows each one of the bobbins to circulate in the interior of the cylindrical surface without any displacement of the threads. In the work by hand the lace-maker chooses among the suspended spindles around the drum those that she needs successively ; she rolls them between her fingers, either to the right or to the left, in order to twist the threads and interlace them ; then she sets the pins which fasten this portion of the mesh, until by another interlacing another mesh is formed, when she withdraws the pins from the portion of the work already finished. Then three kinds of movements are required : A conveying or removal of the selected spindles ; rotation of the spindles to the right or to the left ; the fixation and displacement of the pins.

From what has been said, it will be seen that each thread must work in a manner absolutely independent, and this independence of the different elements constitutes the great difficulty of the mechanical problem.

If one places himself in the center of the Malhere loom, having in front of him the lower segment, it will be seen that this segment is perforated over all its circumference, and that each one of the holes is filled by a metallic cylinder which manipulates the thread, and is operated and controlled by the Jacquard mechanism. According to the piercing of the pasteboard of the Jacquard band, the carriages carrying the bobbins are pushed from the groove of one pin to the groove of another, by little pushers, and may occupy successively all the disks.

In order that the threads leading from the bobbins to the rollers, which occupy the center of the loom, may be interlaced or twisted, the transposition of the bobbins must be by circular motion.

An arrangement of rack work and pinions worked by a double chain is controlled by another set of perforated cards, giving an intermittent traction to the chains. This latter Jacquard arrangement is capable of imparting to the cylinders a quarter or half revolution as is needed. We have said that the heads of the pins are tangent in a vertical direction and in a horizontal direction. This construction is not only designed to increase the height of the segments and the number of rows of pins, but to allow the transport of the bobbins from a determined horizontal row into the row situated below or above it. When a bobbin is to be transferred from one row to another, the pins in the Jacquard mechanism corresponding to the motion required cause the pin in the segmental frame to turn a quarter of a revolution only, the sliding groove assuming a vertical position, then the bobbins are moved forward in a vertical direction, and a second quarter revolution of the pin places the bobbin in a horizontal position in such a way as to renew the interlacing of t e threads.

The heads of the pins may be compared to the turntable of a railroad. The aim is to remove or add threads, as cars are added or removed in the composition of trains.

The insertion of the retaining pins may be from above or below. The inventor has preferred the latter method, as it furnishes a solid base for the pins and facilitates the removal of the finished fabric. These pins have a lateral and vertical motion.

At the moment that the interlacing of the threads is effected, the retaining pins placed behind and at a little distance from the roller must remain pressed down in order not to interfere with the play of the thread. When the interlacing is accomplished the pin rises in the angle formed by the threads, and the threads are separated by the horizontal movement of the carriages which carry them.

Arriving at a height a little above the upper net of threads, the pin is maintained laterally by a metallic platform, which is traversed over all its surface by radial slots equal in number to the pins, and the lower end of each pin is attached to a slider, moving in a vertical guide, which is capable of moving towards the roller, bringing the pin against the twist previously formed, where it is arrested by a stop, and the pin continues stationary as long as it is necessary to maintain the mesh. In order to release itself and before returning to the point of departure, it falls below the net of threads, in such a way as not to touch them in its retrograde movement. These quadrangular displacements of the pins are effected independently, being controlled by Jacquard mechanism.

Such, in general terms, is the lace loom of M. Malhere which has been recently exhibited in Paris. The apparatus is certainly a masterpiece of mechanism, and is an ingenious conception. The accompanying engraving indicates in some measure the intricacy of the machinery.—*La Nature.*

## Miscellaneous Items.

Adhesive for Belts.—A writer says a good adhesive for leather belts is printers' ink. "I have the case of a six-inch belt running dry and smooth and slipping, which latter was entirely prevented for a year by one application of printers' ink." —*Mining and Scientific Press.*

Making Holes in Glass or Porcelain.—The operation of making holes and sections in glass and porcelain is often a troublesome and unsatisfactory one. The firm of Richter & Co., in Chemnitz, have found a way of so impregnating thin German silver discs (.59 to .98 inch diameter) with diamond that when fitted to a quickly rotating tool, these cut through glass or porcelain in a few seconds, or effect any desired carving with great accuracy. With cylinders made on the same principle, round holes can be quickly and exactly made. The wear of the implement, even after much use, is hardly perceptible.

Danger of Lightning from Telephone Connections.—The Cantonal government of Zurich, having been applied to by a telephone company for permission to fix the supports of insulators on the tops of certain public buildings, applied to Prof. Kleiner for an opinion. The following is a summary of the chief points in his report :

1. The danger of lightning in houses over which telephone wires are stretched is not increased, but lessened, if the total conductivity of a wire is approximately equal to that of a lightning conductor. This condition is not always fulfilled under existing arrangements. It may be insured by very simple arrangements, such as the introduction of a special wire for the conduction of lightning wherever the number of wires of two millimeters in thickness running in the same direction is less than 60. This should be insisted upon in all cases. Single connections running along the houses should be stronger than at present—at least as strong as telegraph wires.

2. As the properties of a telephonic plexus for attracting and conducting lightning extend over far wider tracts than those of a lightning rod, a strict regulation of their make and condition is necessary.

The use of telephones should be suspended during thunderstorms.—*Neue Zurich Zeitung.*

## Scientific Items.

### HEATING BY ELECTRICITY.

We have been much pleased to notice the various comments upon an article in *Scribner's Monthly.* One thing treated of in this article was the fusing disk for cutting iron, and the other was the production of heat by friction for warming water to heat a railway car. The water in this case has to be heated by friction discs, driven at a high rate of speed by some sort of connection with the axles of the railway car. We believe there is a great deal shorter way to heat a railway car or to heat a room. Some months ago a gentleman forwarded to us a model of what he called a "shad pan." We have spent some pleasant hours with it, and recently very much astonished some gentlemen of Boston who are underwriters and mechanics, and are great on the electric light question. This little arrangement was connected to a dynamo-electric machine of small calliber, and in less than two minutes it was so hot that the gentlemen readily warmed their hands, as from a steam radiator.

Now why cannot something of this sort be attached to a railway car? It can be made of larger or smaller capacity, so as to have one under every seat or every other seat; they are all connected by a covered copper wire; they would not leak, the water would not freeze up and break the pipes and it requires a great deal less power to generate the electricity than it would to generate heat enough to heat water and then, by secondary radiation warm the car. There is no reason why houses, offices and factories cannot be warmed by electricity cheaper than by steam. The matter is an actual fact; has been patented, and other patents are now pending. It will not be a strange thing if, within another year, this little apparatus is put into operation. It has only been shown twice, and in each case has been a source of much surprise and gratification to men who are usually considered well up in mechanical and other matters.—*Boston Jour. Com.*

### THE ELECTRIC LIGHT IN AKRON OHIO.

A novel, and thus far successful experiment in electric lighting was inaugurated in Akron, Ohio, April, 9.

The town is lighted by two groups of lamps, one supported by an iron tower rising 208 feet above the street, the other by a wooden mast on the observatory of Buchtel College, about 40 feet higher than the tower lamps. Each group consists of four lamps of 4,000 candle power each, or an aggregate light of 32,000 candle power.

The chief novelty of the system is the tall tower, made of boiler plate in 55 sections, each 50 inches in length. At the bottom the diameter of the tower is 3 feet; at the top, 8 inches. The tower is steadied by six wrought iron guys reaching to the top. Over the lamps is a five-foot copper reflector which serves also as a hood. Thirty feet from the street is a wrought iron balcony, to which the lamps are lowered for trimming.

The entire electric circuit is 9,110 feet, the conducting wire being of copper. The total cost of setting up the system, including boilers, engines, etc., was $11.317, and the cost of running the lights a year is estimated at $1,580. The cost of the iron tower was $1,609.

The light promised from these two centres is to be equivalent to bright moonlight over a circuit of half a mile radius from each group of lights, or two circular areas each one mile in diameter. It is thought that four more centres of illumination would supply the entire city. From 300 to 400 or more street gas lamps will be displaced by the electric lamps now in operation.

### THE TELEPHOTOGRAPH.

An apparatus has been devised by Mr, Shellford Bidwell which he calls the "telephotograph," and which, though still crude, makes an important step forward towards a solution of the problem of transmitting images by electricity. The instrument is described in the *Iron Age* as follows: The positive pole of a battery is connected, through a set of adjustable resistance coils, to a platinum stylus which rests its marking point on a plate of zinc, covered with a sheet of paper moistened with a solution of iodine of potassium. The circuit of the battery is completed through a galvanometer by a wire from the zinc plate to the negative pole of the battery. This is the receiving part of the apparatus. The transmitter consists of a second battery, the negative pole of which is connected to the platinum stylus through a sensitive selenium cell, the circuit being completed also through the zinc plates and the galvanometer. Now, if the selenium cell be exposed to a strong light, or, in other words, if a beam of light be focused on it, and the variable resistance be so adjusted that the opposing currents in the two battery circuits exactly neutralize each other, no current will flow from the stylus to the plate across the iodised paper, and hence no stain of liberated iodine will mark the paper if the stylus be drawn across it. But if the light be shaded off the selenium, the resistance of the latter will increase, and the current from the first battery, will, therefore, predominate, so as to cause a flow of electricity down the stylus. When the stylus is drawn across the paper it leaves its trace as a brown mark of liberated iodine; and this trace is strong or faint, according as the current is strong or feeble—that is to say, in proportion as the light is less or more intense. The galvano-metre serves to indicate when the balance of currents is exact; and the connecting wires which correspond to the telegraph line between the two stations, where the transmitter and receiver are placed, may of course be of any length. With an apparatus having substantially these elements, Mr. Bidwell, before the physical society, succeeded in transmitting simple designs.

## Natural History.

### THE STAG BEETLE AND CHAMPION BEETLE.

The common stag beetle (*Lucanus servus*) must have been known to the ancients, for Pliny says in one of his books on natural history: "Beetles (he calls them scarabei) have hard covering over their feeble wings, but none of them have a sting. There, is, however, a large family, which have horns, on whose points are two-pronged forks, which can be closed at will and are capable of pinching. They are hung on the necks of children as a charm." Rigidius calls them Lucanus. Moufet, who, in his "Insectorum sive Minimorum Animalium Theatrum," has collected with great industry all that was known about insects up to his time, describes the stag beetle, but believes that the same description will apply to the female; while Aristotle asserts that in insects the males are always smaller than the females. Now every boy who is acquainted with beetles and lives in a region abounding in oaks, where the stag beetles make their appearance, knows that those having horns are males, while the females have simply short curved mandibles in no way conspicuous. The most recent observations on other kinds of stag beetles have taught us that according to the scanty or abundant nourishment of the larvæ, the beetles turn out small or large, and this is especially true of the males. The horn-like mandibles of the smaller beetles through small development confers upon the whole beetle a changed appearance, in comparison with a fully developed one. We may, therefore, see in a single family medium and smaller forms, without bestowing on them special names, as in earlier times.

The stag beetle is the largest of the European beetles. The male has enormous horn-like jaws or mandibles, the tips being armed with antler-like projections, slender antennæ, the upper lip is bent downward, and the tongue is deeply slit. The color is a dull black, the wing covers and horns are a glistening chestnut brown.

In June these beetles are found in the oak forests, where on beautiful evenings the males fly with a loud humming noise about the tops of the trees, while the females keep themselves concealed. In the day-time they run among the dry leaves on the ground and betray their presence by their rustling, or they sit on the bleeding trunks of the oaks and lap up the sap. Chop gives an interesting account in his "Garten-laube" of their behavior at these feasts.

In June, 1863, while lying under the cooling shade of an old oak tree on a very warm afternoon, a peculiar rustling sound attracted his attention. A soft snapping or grating was heard at short intervals, as if small dry twigs were being broken. Shortly a blackish object fell from the tree to the ground; it proved to be a stag beetle, which he found after a long search in the act of creeping up the rough bark again. The rustling did not cease, and when the observer looked upward he saw, seven or eight feet up the trunk, a peculiar brown mass. In the course of half an hour eleven stag beetles, of both sexes, had fallen down one after another, and because the crackling sound was still heard Chop procured a ladder in order to examine this remarkable appearance. A curious sight met his view. Upon a small surface the sap was flowing down from the old bark. To this dainty meal a very mixed company of insects had invited themselves as guests.

Large ants climbled busily up and down, dainty flies of all kinds sat together in crowded heaps, and hornets swarmed fiercely humming around the trunk. But the most conspicuous guests were undoubtedly the stag beetles. There were twenty-four individuals of them counted, those already captured not being reckoned. They played apparently the most important character at this banquet, and in spite of the sweet food did not seem to be in very good humor. Even the bold hornets avoided coming too near the powerful nippers of their clumsy companions, and held themselves at a respectful distance. The beetles fought a furious battle with one another, and certainly two-thirds of them contended together. The females, with their short, strong teeth, angrily bit each other in their struggle for the food. The contest between the males was especially interesting. Their horns were interlocked and projected over the neck shields of their antagonists, and they fought furiously together until one of the combatants dropped to the ground from sheer exhaustion. Sometimes a skillful fighter would succeed in seizing his opponent about the body, and with his head erected let him struggle in the air for a little while, and finally drop him. The observer, although near, was unnoticed, the fighters struggling

*Continued on page 190.*

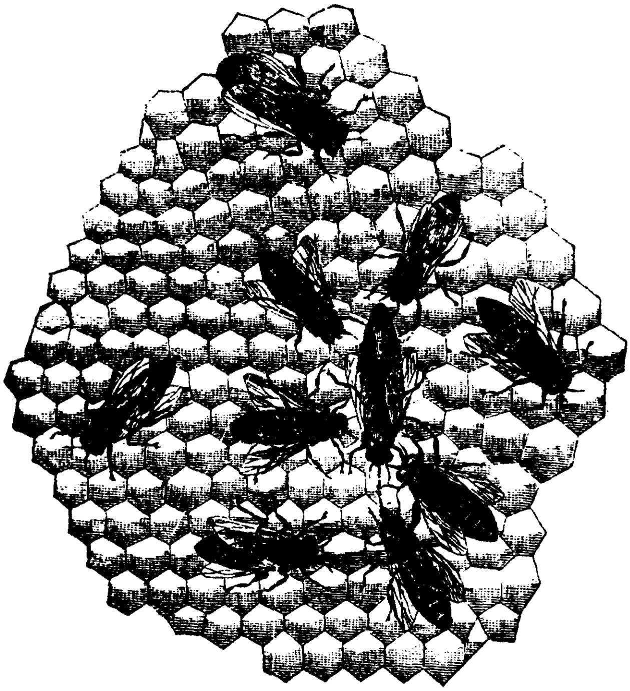


FIG. 1.—PIECE OF COMB WITH WORKERS AND DRONE CELLS.

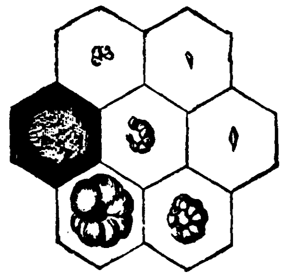


FIG. 2.—EGGS AND LARVÆ.

## BEE NOTES.

BY L. C. BOOT.

The season is now at hand when prompt action must be taken to secure a large force of bees to gather the honey as the season advances. If colonies are in proper condition at this season, brood rearing will progress very rapidly. The requirements are: a properly arranged movable comb hive, clean, straight worker combs, a fair quantity of bees, the necessary food with which brood-rearing may be carried on, and most important than all, a good prolific queen. As our notes are particularly for the benefit of the beginner, I will speak of some of the common hindrances to progress. The inexperienced often fail to observe the difference between worker and drone combs, and the consequences are that a large proportion of the comb, and that often in the very center of the hive, will be drone. After a little experience, the difference may be observed, and such combs removed, or at least placed at the outside of the brood nest, where they will not occupy space that properly belongs to the workers. The advantages to be gained by the use of Artificial Comb Foundation in securing straight worker combs, are worthy of investigation. The worker cells are about one-fifth smaller than drone cells. Figure 1 shows a piece of comb which consists of worker cells at the left, and drone cells at the right and upper side. A study of this engraving will aid in determining the kinds of comb. The different kinds of bees are also shown in the same engraving, very true to nature. As it is very essential to know that the queen is present in the hive at this season, her appearance and the attention shown her in the engraving, may aid in recognizing her. If the inexperienced are unable to make out the queen, her presence may often be ascertained by finding eggs or brood. If eggs are found, the queen must have been in the hive within at least four or five days. The eggs and larvæ in different stages are shown in figure 2, somewhat magnified. The absence of a queen may often be determined by finding queen cells that have been started. Bees will sometimes start these cells when the queen is unprolific, before they destroy her. Queen cells in different stages are shown at *a*, *b*, *c*, and *d* in figure 3.

After other necessary things are provided, the next important object is to secure sufficient stores. While there are advantages to be gained by supplying a proper amount of liquid food, I am of the opinion that the average beginner will do best to avoid feeding it, if each hive has a good supply of sealed stores, but the essential point is not to allow them to consume all of their stores and thus interrupt proper brood rearing. During the past winter bees have consumed more than the usual amount of honey, and the consequence will be that great care will be necessary in furnishing food before the supply is exhausted.

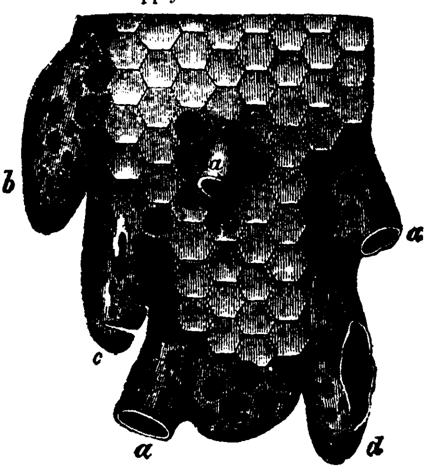



FIG. 3.—QUEEN CELLS IN DIFFERENT STAGES.

TRANSFERRING BEES.—If it has not already been done no time should be lost in transferring swarms from the common box-hives to those with movable combs. In the space given me here I can only briefly call attention to the different operations necessary to be performed. Those who are interested in the proper care of bees, and desire to proceed with a view to such results as are attained by the best methods, must secure a practical work where all the different methods are minutely described and illustrated. Such works are prepared with great care, with a view to those wants, and will be found invaluable. [We may here add that "Quinby's New Bee-keeping," contains the most complete directions for this and all else relating to apiary management.—ED.]—*Gardener's Chronicle.*

THE STAG BEETLE AND CHAMPION BEETLE.

and the victors licking the sap greedily. They seemed disturbed when the breath touched them, and the slightest noise, as the breaking of a twig, immediately affected the whole company. They would all raise themselves quickly and appear to listen. A similar thing would happen if one of the beetles that had fallen to the ground ascended the tree again and approached the others. In this case the males would move toward them with wide open mandibles eager to engage in combat with them. Toward evening the greater part of the beetles buzzed away, and the crackling sound was much diminished when the observer left the garden at eight o'clock. The struggles of a male over a female are of a more serious and determined nature, as the deep impressions and perforations in the wing covers show.

At the end of June or the first days of July the short swarming time is past. The pairing takes place in the night, the females lay their eggs in the decayed wood of an old oak tree, and the hard remains of the dead bodies of the males lie strewed around. It may even occur, and has frequently been observed, that after the pairing the feeble males, while still alive, are eaten by the rapacious ants, the hard front of the body being robbed of the soft back part, and they drag themselves painfully along on their long legs, a singular habitation for solitary ants. The bodies of the females are seldom found, because few of them come forth from their brooding places, and because the females are much more seldom met with than the males, who are about six times as numerous.

The larvæ grow very slowly, and are nourished by the decayed wood of the oak tree. It requires four or five years for them to attain their growth of about four and one quarter inches and the thickness of a finger.

Their appearance is similar to that of others of their family. They have four-jointed antennæ on the horn-like head; the last joint is very short. The anterior of the three rings around the body is imperfectly defined on account of the cross folds, and has six strong legs which are yellow like the body; the horny parts about the mouth are black.

These larvæ were without doubt known to the ancients, for Pliny says: "The large wood worms which are found in hollow oaks and called 'cossis' are regarded as a choice morsel, and are even fattened with meal." They must have long been in use as a means of nourishment, for Hieronymus says: "In Pontus and Phryia large, fat, white worms with black heads, which are generated in decayed wood, afford a considerable source of revenue and are valued as very dainty food." The full grown larva prepares a firm case, as large as the fist, from the decayed splinters of wood, and smooths it out well inside. Three months sometimes pass before the larva assumes a chrysalis state and afterward becomes a beetle. From the hatching of the egg to the development of the perfect beetle requires about five years, some say six, and they enjoy for scarcely four weeks their winged existence. They may be kept in confinement by nourishing them with sweetened water or sweet beer.

Bültner mentions a swarm of stag beetles which were drowned in the Baltic and washed ashore. Cornelius gives an account of the great number of beetles which appeared in a limited locality at Elberfeld, in 1867, and thinks that every five years they will return again, and that the supposed developing time must be five instead of six years. Haaber mentions this and thinks this supposition is confirmed, as he observed a large number of beetles in 1862, and again in 1867 in the region of Prague.

Here, at Elberfeld, they flourished in old oak stumps, which appear especially favorable to their propagation. It would be of interest for other regions to note the flying year of the stag beetles. These beetles extend over the whole of the middle and northern Europe, and are only wanting in regions where they are no oaks.

The champion beetle (*Cerambyx heros*) may be seen on an oak stem with the stag beetle in our engraving. It is a magnificent insect, of a glittering black. The head is long, the eleven jointed antennæ swell out in the third to fifth joint into a club-shape, and end in a long slender joint, which appears to be separated, and in the male is considerably longer than the body. The neck shield is grooved or wrinkled, and has in the middle a thorny point at the broadest place. The wing covers have a blunt three-cornered shield in front. The under part of the body is covered with silky hairs, and is silvery white.

The larva has a granulated horny shield on the back of most of the joints, and lives three or four years in the inside of decayed oak trees. The broad flat passageways in the decayed wood which they bore out, wind in various directions next to the bark. A trunk which is already perforated seems to possess a particular attraction for the female, and the work accomplished by these colossal larva is enormous. The beetle emerges from the chrysalis in July, and is not seen by day; it only projects the points of its antennæ out of its retreat and speedily draws them back again if it is not approached very cautiously. The antennæ must project a long distance to enable one to bring the sly fellows to light. In most cases they will allow the points to be torn off before they can be drawn out of their retreat. After the sun has set they come out voluntarily and fly swiftly around, but not very high, in search of others of their family. The pairing ensues during the night, and the swarming time is, as with the stag beetle, a limited one.—*Bremm's Animal Life.*

## CURIOUS HABIT OF A DRAGON-FLY.

One day this summer, when I was looking at some tadpoles in a dish of water, I was struck in the face by a jet of water. On searching for the cause, I found that the larva of a dragon-fly (Æschna) was my assaillant. When disturbed it sent out a fine stream of water from the bronchial apparatus in the caudal end of its body to the distance of two or three feet, and not content with one volley, it would wheel and discharge, like a small gun, at all points of the compass. I put it in a tumbler of water, and it lowered the front of the body, and shot the water far over the edge of the glass. I cannot say it ever took deliberate aim, but I know I got sprinkled many times when I inadvertently touched the glass.

Prof. Packard, in writing of the larval dragon-fly, says: "By a syringe-like apparatus lodged in the end of the body, it discharges a stream of water for a distance of two or three inches behind it, thus propelling the insect forward. The apparatus combines the functions of locomotion and respiration." ("Guide to the Study of Insects," p. 601.)

If all Æschnæ have the same habits as the one I caught, we must add that the apparatus is also a means of defence.—*Sarah P. Monks.*

## ANIMAL REASONING.

A correspondent of *Nature*, writing from Cambridge, Mass., says: A lady, a friend of mine, was at one time matron of a hospital for poor women and children which was maintained by subscription. One of the inmates was a blind girl who was there not as a patient, but temporarily till a home could be found for her. She had learned to feed herself, and at meal times a tray containing her dinner was placed on her knees as she sat in a comfortable chair for her special convenience in feeding herself. One day, while she was eating, the pet cat of the establishment placed herself before the girl looked long and earnestly at her, so earnestly that the matron fearing the animal meditated some mischief to the girl, took her out of the room. Again the next day, at the same hour, the cat entered the room, but this time walked quietly to the girl's side, reared herself on her hind legs, and noiselessly, stealthily reached out her paw to the plate, selected and seized a morsel that pleased her, and, silently as she came, departed to enjoy her stolen meal. The girl never noticed her loss, and when told of it by her companions laughed very heartily.

It is evident that the cat from observation had entirely satisfied herself that the girl could not see, and by a process of reasoning decided she could steal a good dinner by this practical use of her knowledge.

A gentlemen who had recently occasion to visit certain old and deserted Mexican and Ophir mines, says that in these mines, undisturbed for years, a remarkable fungus has occurred. This is favoured by the warmth of the old levels, and the moisture present. Some of the fungi are several feet in height, and, being snow white, resemble sheeted ghosts. In places are what at a little distance appear to be white owls, and there are representations of goats with long beards, all as white as though carved in purest marble. The rank growth has almost closed some of the drifts. Some kinds of fungus hang down from the timbers like large bunches of snow white hair, and others are great pulpy masses. The latter generally rise from the rocks forming the floor of the drifts, and seem to have been grown from something dropped or spilled on the ground when the work was in progress years ago. These growths have in several places raised from the ground rocks weighing from 10 to 50 and even 100 lb. Some of the rocks have thus been lifted more than 3ft. In the higher levels, where the air is comparatively dry, the fungi are less massive, and much firmer in texture. They present grotesque appearances like rams' horns, snakes, blossoming stems, &c. Nothing in the nature of toadstools or mushrooms was found.

### SALICYLIC ACID FOR BEE STINGS.

Although salicylic acid, from having been too highly extolled, has fallen somewhat into disfavor, there can be no doubt that it is useful in the case of bee stings. An Austrian paper recommends the following treatment: First, to remove the sting as quickly as possible with a forceps or by scratching with a finger, but never between the thumb and forefinger, because this squeezes more of the poison into the wound. Next squeeze the wound until a drop of blood comes out, and rub the place as large as a dollar with an aqueous or dilute alcoholic solution of salicylic acid. The effect is still better by injecting the salicylic acid into the wound with the hypodermic syringe. After this the spot is painted with collodion to keep out the air. A sting treated thus causes little or no pain, slight inflammation and swelling, and is not followed by nettle-fever or lameness in the most sensitive and nervous individuals.

## Sanitary and Plumbing.

### URINAL SETTING—WORK IN "TRINITY BUILDING," NEW YORK.

Those of our readers who have followed the several descriptions of the plumbing work in "Trinity Building," will remember that we spoke of the urinals as being rather peculiar in their setting. On each floor there are two urinals, situated at the end of a range of three or four closets. Our sketch was taken after the pipes were all in, but before the flooring was down. One of the urinals only is shown in place. They are wasted by 2-inch lead pipes. Under each is an Adee trap, with an ordinary S-trap lower down. That each fixture should have its own trap is essential, and, for the sake of convenience, they are put on the same line of pipe, and waste into the soil pipe through the same hub. This waste pipe, consequently, has two air spaces between the traps. Now, if a discharge of water is made into the first trap, the air in the pipe between that and the next trap will be forced out, and either escape backward past the inflowing water, or be driven forward out of the next trap and fixture or down into the sewer. The latter rarely happens, but forcing of air out at the other fixture is common, unless some measures are taken to prevent it. In this case the waste pipe is branched between each of the Y-traps and below the lower one with 1½-inch branches, which are taken into one line and taken into a hub on the vertical air pipe which stands in the corner. It will be noticed that this pipe, which is 3-inch, tapers at the bend at the bottom, and is taken off in a horizontal direction toward the left. This line is the ventilating pipe from the water-closets, and, being on the ground floor, the pipe ends without going lower.

This branching of the ventilating pipes gives the freest vent to the air, and at the same time, by connecting with the pipe below the fixture, prevents any danger from pressure in the pipes below the traps.

Generally little or no pressure can be discovered in sewers and soil pipes in New York. In Trinity Building, however, during the past winter we observed on several occasions a considerable pressure. The inflow of air from a 4-inch pipe was like a blast; indeed, it was so strong as to extinguish a large gas flame when held fairly over it, and cause it to roar loudly when held at the edge of the pipe. We searched for our syphon gauge in order to measure this pressure, but found that in a recent moving it had been broken, and so were unable to give the exact figures in regard to it.

There is more necessity to provide for the perfect ventilation of the smaller fixtures and the pipes near basins, urinals and water-closets than is generally understood. Those portions of the pipe next the fixtures are the most foul The waste pipe of a urinal is usually so lined with filth for the first 18 inches that few men not accustomed to such things can stand by when it is opened. It becomes necessary, then, to allow as much ventilation as possible at these points.

At the front of the engraving there is a 2-inch iron waste pipe shown, which enters the main soil pipe on the right by means of a Y-branch. Several branches are taken from this pipe, one of which, in iron, bends around into the right-hand corner. This is the air or ventilating pipe, which leads to the 3-inch air pipe shown in the corner. This branch of the soil pipe is intended to waste the safes under the water-closets and the marble slab under the urinals. Its trap, it will be seen, is of cast iron and has a hand plate. The daily washing of the marble will always insure a supply of water in it. The lead branch toward the left is for the safes under the urinal.

The use of lead against the wall is permissible, because the pipes are so placed that they will be out of the reach of vermin. Beneath the floor, however, as little as possible was used.

All of the floors in this building are now completed, and the job is considered very satisfactory. Mr. W. S. Clarke, the plumber, labored under great disadvantages in having to complete one floor at a time, in order to reduce the inconvenience to the occupants as much as possible. He was obliged to begin at the upper floor and go downward. This method of working caused delay, and made it often necessary to dispose pipes in unusual positions.

### IMPROVED WATER METER.

*(See next page.)*

There is no question of more vital importance to a city than that of its water supply. What at first seemed like a plentiful supply in many of our large cities has proved inadequate when the increasing waste has remained unchecked, but when this waste is checked by registering the amount of water used by means of efficient meters, the original estimates were found ample. This proved to be the case in this city, for according to the report of the Commissioner of Public Works in 1880, the supply which ten years ago was required for a population of 842,000, by the introduction of water meters is made to suffice for a population of 1,280,000.

The city of Brooklyn, which, during the last season, almost suffered a water panic, would have been enabled to distribute a plentiful supply of water and to arrest waste if a good water meter had been adopted. In fact, the universal adoption of an efficient meter, to be used as a part of the water supply system, is the only means of insuring economy in the use of water.

We give herewith an engraving of a meter, which, according to the reports of the New York and Chicago Water Commissioners, has proved very satisfactory. The following tabulated statement of the test at Chicago indicates very accurate registration:

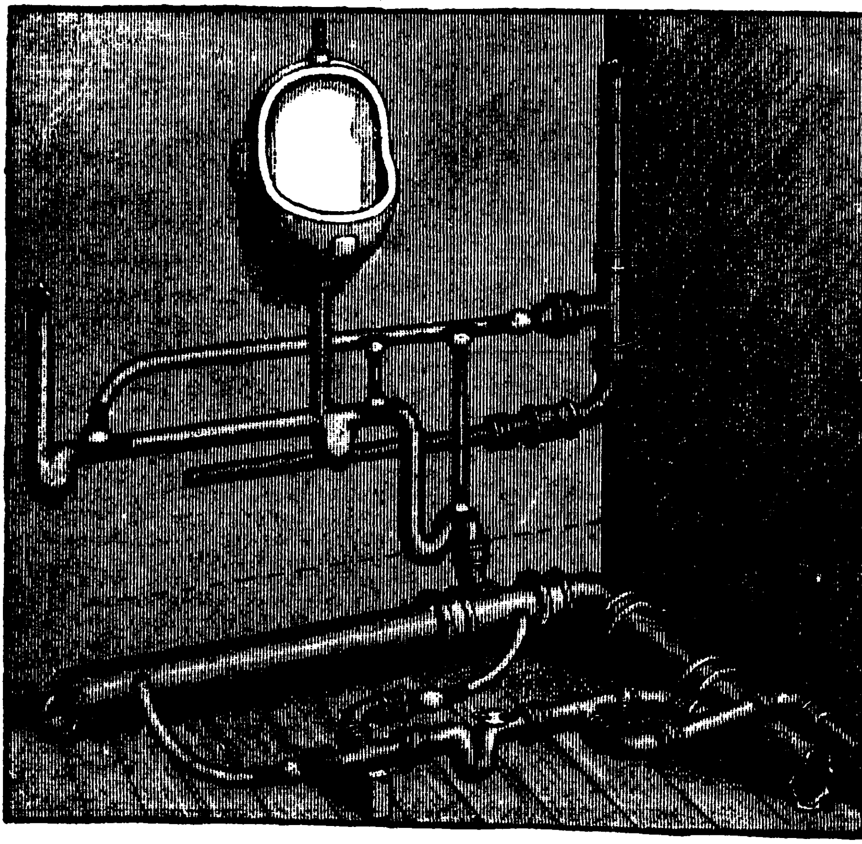
| Duration in Minutes. | No of C. feet by Meter Register. | Actual quantity delivered. | Pressure upon Main. | Remarks. |
|---|---|---|---|---|
| 2 29-60 | 10 | 10·3 | 29·5 | Discharging through 1 inch nozzle. |
| 2 37-60 | 10 | 10·4 | 30·5 | " " ¾ " " |
| 2 52-60 | 10 | 10·5 | 29·5 | " " ⅝ " " |
| 3 18-60 | 10 | 10·3 | 30·5 | " " ½ " " |
| 9 18-60 | 10 | 10·3 | 29·5 | " " ¼ " " |

The meter is shown in Fig. 1 with one of its heads and the cover of the recording mechanism removed, showing the inside of the cylinder and valve chamber with the piston and valves in position. Fig. 2 is a detail view of the piston, and Figs. 3 and 4 are, respectively, auxiliary and main valves.

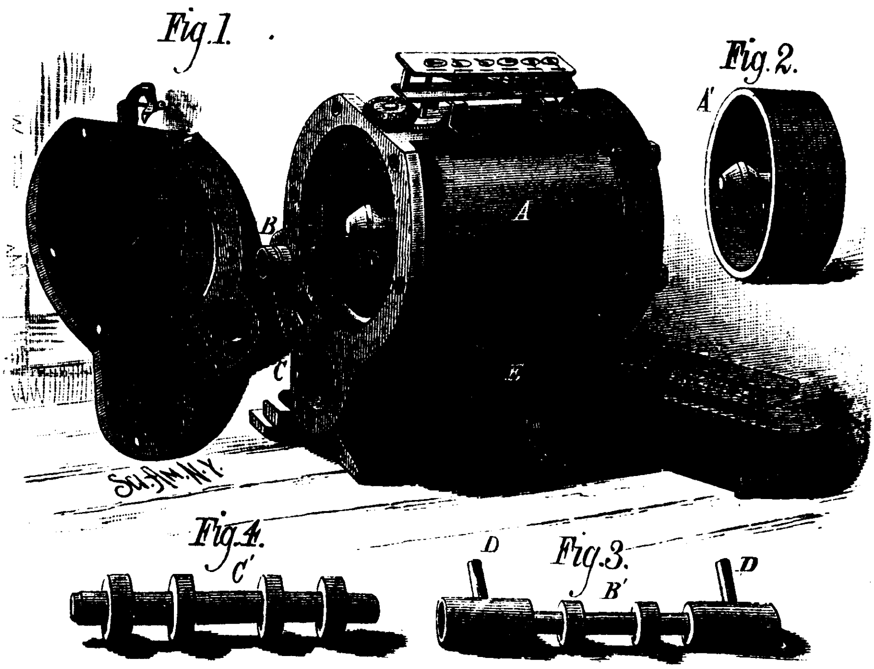
Water is admitted to the meter through the inlet, E, to the main valve chamber, C, passing between the two middle heads of the main valve, C′, through ports into the cylinder, A, forcing the piston to one end of the cylinder. When near the end of its stroke it strikes one of the pins, D, projecting from the valve, B, and moves the valve in the same direction, thereby directing the flow of water into the valve chamber, C, between one of the outside heads of the main valve, C′, and the head of the meter. The main valve is then forced to the opposite end of the valve chamber, when the flow of water into the cylinder, A, is reversed, and the piston is moved back into its original position, forcing the water on the eduction side of the piston, downward and out through the exit opening, which is exactly opposite the inlet opening.

The recording mechanism is operated by a double cam, F, projecting from the center of the piston, A′, as seen in Fig. 2. This cam engages a forked lever having two projecting lugs, G G, projecting into the cylinder. This forked lever is attached to the lower end of a vertical shaft which extends through a stuffing box, and carries a double lever at the top, having two pawls which engage a ratchet wheel actuating the recording mechanism on the top of the meter, the wheel being moved forward one tooth for each stroke of the piston.

This meter is inexpensive in its construction and registers accurately.



URINALS IN "TRINITY BUILDING."—ARRANGEMENT OF THE PIPES.




SEQUEIRA'S WATER METER.