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GUSTAVE TROUVÉ.

The accompanying portrait of M. Gustave Trouvé is taken from a small volume devoted to an account of his labors recently published by M. Georges Dary. M. Trouvé, who may be said to have had no ancestors from an electric point of view, was born in 1839 in the little village of Haye-Descartes. He was sent by his parents to the College of Chinon, whence he entered the École des Arts et Metiers, and afterward went to Paris to work in the shop of a clock-maker. This was an excellent apprenticeship for our future electrician, since it is in small works that electricity excels; and, if its domain is to be increased, it is only on condition that the electric mechanician shall never lose sight of the fact that he should be a clock-maker, and that his fingers, to use M. Dumas's apt words, should possess at once the strength of those of the Titans and the delicacy of those of fairies. It was not long ere Trouvé set up a shop of his own, whither inventors flocked in crowds; and the work he did for these soon gave up to him the secrets of the art of creating. The first applications that he attempted related to the use of electricity in surgery, a wonderfully fecund branch, but one whose importance was scarcely suspected, notwithstanding the results already obtained through the application of the insufflation pile to galvano-cautery. What the surgeon needed was to see plainly into the cavities of the human body. Trouvé found a means of lighting these up with lamps whose illuminating power was fitted for that sort of exploration. This new mode of illumination having been adopted, it was but natural that it should afterward find an application in dangerous mines, powder mills, and for a host of different purposes. But the perfection of this sort of instruments was the wound explorer, by the aid of which a great surgeon sounded the wounds that Italian balls had made in Garibaldi's foot.

GUSTAVE TROUVE.

The misfortunes of France afterward directed Trouvé's attention to military electricity, and led him to devise a perfect system of portable telegraphy, in which his hermetic pile lends itself perfectly to all maneuvers and withstands all sorts of moving about.

The small volume of which we have spoken is devoted more particularly to electric navigation, for which M. Trouvé specially designed the motor of his invention, and by the aid of which he performed numerous experiments on the ocean, on the Seine at Paris, and before Rouen and at Troyes. In this latter case M. Trouvé gained a medal of honor on the occasion of a regatta. Our engraving represents him competing with the rowers of whom he kept ahead with so distinguished success. We could not undertake to enumerate all the inventions which we owe to M. Trouvé; but we cannot, however, omit mention of the pendulum escapement that beats the second or half second without any variation in the length of the balance; of the electric gyroscope constructed at the request of M. Louis Foucault; of the electro-medical pocket-case; of the apparatus for determining the most advantageous inclination to give a helix; of the electric bit for stopping unruly horses; and of the universal caustic-holder. He has given the electric polyscope features such that every cavity in the human body may be explored by its aid. As for his electric motor, he has given that a form that makes the rotation regular and suppresses dead-centers--a result that he has obtained by utilizing the eccentrization of the Siemens bobbin.

Although devoting himself mainly to improving his motor (which, by the way, he has applied to the tricycle), M. Trouvé does not disdain telephony, but has introduced into the manufacture of magnets for the purpose many valuable improvements.--*Electricité*.

TROUVE'S ELECTRIC BOAT COMPETING IN THE REGATTA AT TROYES, AUG. 6, 1882.

FRIEDRICH WÖHLER.

At the age of eighty-two years, and full of honor, after a life actively devoted to scientific work of the highest and most accurate kind, which has contributed more than that of any other contemporary to establish the principles on which an exact science like chemistry is founded, the illustrious Wöhler has gone to his rest.

After he had worked for some time with Berzelius in Sweden, he taught chemistry from 1825 to 1831 at the Polytechnic School in Berlin; then till 1836 he was stationed at the Higher Polytechnic School at Cassel, and then he became Ordinary Professor of Chemistry in the University of Göttingen, where he remained till his death. He was born, July 31, 1800, at Eschersheim, near Frankfort-on-the-Main.

Until the year 1828 it was believed that organic substances could only be formed under the influence of the vital force in the bodies of animals and plants. It was Wöhler who proved by the artificial preparation of urea from inorganic materials that this view could not be maintained. This discovery has always been considered as one of the most important contributions to our scientific knowledge. By showing that ammonium cyanate can become urea by an internal arrangement of its atoms, without gaining or losing in weight, Wöhler furnished one of the first and best examples of isomerism, which helped to demolish the old view that equality of composition could not coexist in two bodies, A and B, with differences in their respective physical and chemical properties. Two years later, in 1830, Wöhler published, jointly with Liebig, the results of a research on cyanic and cyanuric acid and on urea. Berzelius, in his report to the Swedish Academy of Sciences, called it the most important of all researches in physics, chemistry, and mineralogy published in that year. The results obtained were quite unexpected, and furnished additional and most important evidence in favor of the doctrine of isomerism. In the year 1834, Wöhler and Liebig published an investigation of the oil of bitter almonds. They prove by their experiments that a group of carbon, hydrogen, and oxygen atoms can behave like an element, take the place of an element, and can be exchanged for elements in chemical compounds. Thus the foundation was laid of the doctrine of compound radicals, a doctrine which has had and has still the most profound influence on the development of chemistry--so much so that its importance can hardly be exaggerated. Since the discovery of potassium by Davy, it was assumed that alumina also, the basis of clay, contained a metal in combination with oxygen. Davy, Oerstedt, and Berzelius attempted the extraction of this metal, but could not succeed. Wöhler then worked on the same subject, and discovered the metal aluminum. To him also is due the isolation of the elements yttrium, beryllium, and titanium, the observation that silicium can be obtained in crystals, and that some meteoric stones contain organic matter. He analyzed a number of meteorites, and for many years wrote the digest on the literature of meteorites in the *Jahresbericht der Chemie*; he possessed, perhaps, the best private collection of meteoric stones and irons existing. Wöhler and Sainte Claire Deville discovered the crystalline form of boron, and Wöhler and Buff the hydrogen compounds of silicium and a lower oxide of the same element. This is by no means a full statement of Wöhler's scientific work; it even does not mention all the discoveries which have had great influence on the theory of chemistry. The mere titles of the papers would fill several closely-printed pages. The journals of every year from 1820 to 1881 contain contributions from his pen, and even his minor publications are always interesting. As was truly remarked ten years ago, when it was proposed by a Fellow of the Royal Society that a Copley medal should be conferred upon him, "for two or three of his researches he deserves the highest honor a scientific man can obtain, but the sum of his work is absolutely overwhelming. Had he never lived, the aspect of chemistry would be very different from that it is now."

While sojourning at Cassel, Wöhler made, among other chemical discoveries, one for obtaining the metal nickel in a state of purity, and with two attached friends he founded a factory there for the preparation of the metal.

Among the works which he published were "Grundriss der Anorganischen Chemie," Berlin, 1830, and the "Grundriss der Organischen Chemie," Berlin, 1840. Nor must we omit to mention "Praktischen Uebringen der Chemischen Analyse," Berlin, 1854, and the "Lehrbuch der Chemie," Dresden, 1825, 4 vols.

At a sitting of the Academy, held on October 2, 1882, M. Jean Baptiste Dumas, the permanent secretary, with profound regret, made known the intelligence of the death of the illustrious foreign associate, Friedrich Wöhler, professor in the University of Göttingen. He said: "M. Friedrich Wöhler, the favorite pupil of Berzelius, had followed in the lines and methods of work of his master. From 1821 till his last year he has continuously published memoirs or simple notes, always remarkable for their exactness, and often of such a nature that they took among contemporaneous production the first rank by their importance, their novelty, or their fullness. Employed chiefly, during his sojourn in Sweden, in work on mineral chemistry, he has remained all his life the undisputed chief in this branch of science in German universities. This preparation and preoccupation, which one might have thought sufficient to occupy his time, did not, however, prevent him from taking the chief part in the development of organic chemistry, and of filling one of the most elevated positions in it.

"His contemporaries have not forgotten the unusual sensation produced by the unexpected discovery by which he was enabled to make artificially, and by a purely chemical method, urea, the most nitrogenous of animal substances. Other transformations or combinations giving birth to substances which, until then, had only been met with in animals or plants, have since been obtained, but the artificial formation of urea still remains the neatest and most elegant example of this order of creation. All chemists know and admire the classical memoir in which Wöhler and Liebig some time after made known the nature of the benzoic series, and connected them with the radicals of which we may consider them as being the derivatives comparable with products of a mineral nature. Their memoirs on the derivatives of uric acid, a prolific source of new and remarkable substances, has been an inexhaustible mine in the hands of their successors.

"This is not a moment when we should pretend to review the work which M. Wöhler has done in mineral chemistry. Among the 240 papers which he has published in scientific journals, there are few which the treatises of chemistry have not immediately turned to account. We need only confine ourselves to the discovery of aluminum, to which the energy and inventive genius of our *confrère*, Henry Deville, soon gave a place near the noble metals. United by a rivalry which would have divided less noble minds, these two great chemists carried on together their researches in chemistry, and joined their forces to clear up points still obscure in the history of boron, silicium, and the metals of the platinum group, and remained closely united, which each year only strengthened.

"The reader will pardon me a souvenir entirely personal. We were born, M. Wöhler and I, in 1800. I am his senior by a few days. Our scientific life began at the same date, and during sixty years everything has combined to bind more closely the links of brotherhood which has existed for so long a time."

OUR HEBREW POPULATION.

The United Jewish Association has made a canvass of the denomination in this country, finding 278 congregations, and a total Jewish population of 230,984. New York has the largest number--80,565. Then follows Pennsylvania, with 20,000; California, with 18,580; Ohio with 14,581; Illinois, with 12,625, and Maryland, with 10,357.

The Jewish population in the largest cities is as follows:

New York	60,000
San Francisco	16,000
Brooklyn	14,000
Philadelphia	13,000
Chicago	12,000
Baltimore	10,000
Cincinnati	8,000
Boston	7,000
St. Louis	6,500
New Orleans	5,000
Cleveland	3,500
Newark	3,500
Milwaukee	3,500
Louisville	2,500
Pittsburg	2,000
Detroit	2,000
Washington	1,500
New Haven	1,000
Rochester	1,000

This total Jewish population of 230,984 has six hospitals, eleven orphan asylums and homes, fourteen free colleges and schools, and 602 benevolent lodges. Of the free schools maintained by the Hebrews, five are in New York, four in Philadelphia, and one each in Cincinnati, St. Louis, Chicago, and San Francisco. Their hospitals are in New York, Philadelphia, Baltimore, Cincinnati, New Orleans, and Chicago, while their orphan asylums, homes, and other benevolent institutions are scattered all over the country.

THE MYSTERIES OF THE BAIKAL.

The Angara is cold as ice all the summer through, so cold, indeed, that to bathe in it is to court inevitable illness, and in winter a sled drive over its frozen surface is made in a temperature some degrees lower than that prevailing on the banks. This comes from the fact that its waters are fresh from the yet unfathomed depths of the Baikal, which during the five short months of summer has scarcely time to properly unfreeze. In winter the lake resembles in all respects a miniature Arctic Ocean, having its great ice hummocks and immense leads, over which the caravan sleds have to be ferried on large pieces of ice, just as in the frozen North. In winter, too, the air is so cold in the region above the lake that birds flying across its icy bosom sometimes drop down dead on the surface. Some authors say that seals have been caught in the lake of the same character as those found in the Arctic seas; for this assertion I have no proof. An immense caravan traffic is carried across the frozen lake every season between Russia and China. To accommodate this the Russian postal authorities once established a post house on the middle of the lake, where horses were kept for travelers. But this was discontinued after one winter, when an early thaw suddenly set in, and horses, yemschliks and post house all disappeared beneath the ice, and were never seen more. In summer the lake is navigated by an antiquated steamer called the General Korsakoff, which ventures out in calm weather, but cannot face the violent storms and squalls that sometimes rise with sudden impetuosity. Irkutskians say, indeed, that it is only upon Lake Baikal and upon this old hull that a man really learns to pray from his heart. The lake is held in superstitious reverence by the natives. It is called by them Svyatoe More, or the Holy Lake, and they believe that no Christian was ever lost in its waters, for even when a person is drowned in it the waves always take the trouble to cast the body on shore.

Its length is 400 miles, its width an average of 35 miles, covers an area of 14,000 square miles and has a circumference of nearly 1,200 miles, being the largest fresh water lake in the Old World, and, next to the Caspian and the Aral, the largest inland sheet of water in Asia. Its shores are bold and rugged and very picturesque, in some places 1,000 feet high. In the surrounding forests are found game of the largest description, bears, deer, foxes, wolves, elk and these afford capital sport for the sportsmen of Irkutsk.

Around the coasts are many mineral springs, hot and cold, which have a great reputation among the Irkutskians. The hot springs of Yurka, on the Selenga, 200 versts from Verchore Udevisk and not many miles from the eastern shore of the Baikal, which have a temperature of 48 degrees Réaumur and whose waters are strongly impregnated with sulphur, are a favorite watering place for natives as well as Russians and Buriats.--*Herald Correspondent with the Jeannette Search Expedition*.

TRAVELING SAND HILLS ON LAKE ONTARIO.

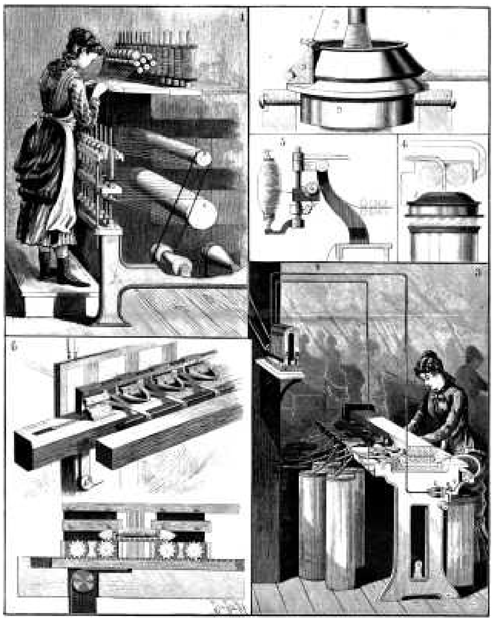
An interesting example of sand-drift occurs near Wellington Bay, on Lake Ontario, ten miles from Pictou. The lake shore near the sand banks is indented with a succession of rock-paved bays, whose gradually shoaling margins afford rare bathing grounds. East and West Lakes, each five miles long, and the latter dotted with islands, are separated from Lake Ontario by narrow strips of beach. Over the two mile-wide isthmus separating the little lakes, the sand banks, whose glistening heights are visible miles away, are approached. On near approach they are hidden by the cedar woods, till the roadway in front is barred by the advancing bank, to avoid which a roadway through the woods has been constructed up to the eastern end of the sand range. The sand banks stretch like a crescent along the shore, the concave side turned to the lake, along which it leaves a pebbly beach. The length of the crescent is over two miles, the width 600 to 3,000 or 4,000 feet.

Clambering up the steep end of the range among trees and grapevines, the wooded summit is gained, at an elevation of nearly 150 feet. Passing along the top, the woods soon disappear, and the visitor emerges on a wild waste of delicately tinted saffron, rising from the slate-colored beach in gentle undulation, and sleepily falling on the other side down to green pastures and into the cedar woods. The whole surface of this gradually undulating mountain desert is ribbed by little wavelets a few inches apart, but the general aspect is one of perfect smoothness. The sand is almost as fine as flour, and contains no admixture of dust The foot sinks only an inch or two in walking over it; children roll about on it and down its slopes, and, rising, shake themselves till their clothing loses every trace of sand. Occasionally gusts stream over the wild waste, raising a dense drift to a height of a foot or two only, and streaming like a fringe over the steep northern edge. Though the sun is blazing down on the glistening wilderness there is little sensation of heat, for the cool lake breeze is ever blowing. On the landward side, the insidious approach of the devouring sand is well marked. One hundred and fifty feet below, the foot of this moving mountain is sharply defined against the vivid green of the pastures, on which the grass grows luxuriantly to within an inch of the sand wall. The ferns of the cedar woods almost droop against the sandy slope. The roots of the trees are bare along the white edge; a foot or two nearer the sand buries the feet of the cedars: a few yards nearer still the bare trunks disappear; still nearer only the withered topmast twigs of the submerged forest are seen, and then far over the tree tops stands the sand range. Perpetual ice is found under the foot of this steep slope, the sand covering and consolidating the snows drifted over the hill during the winter months. There is something awe-inspiring, says the correspondent of the Toronto Globe, in the slow, quiet, but resistless advance of the mountain front. Field and forest alike become completely submerged. Ten years ago a farm-house was swallowed up, not to emerge in light until the huge sand wave has passed over.

RECENT IMPROVEMENTS IN TEXTILE MACHINERY.

At the recent exhibition at Boston of the New England Institute, several interesting novelties were shown which have a promise of considerable economic and industrial value.

Fig. 1 represents the general plan and pulley connections of the Harris Revolving-Ring Spinning Frame. The purpose of the improvements which it embodies is to avoid the uneven draught of the yarn in spinning and winding incident to the use of a fixed ring. With the non-revolving ring the strain upon the yarn varies greatly, owing to the difference in diameter of the full and empty bobbin. At the base of the cone, especially in spinning weft, or filling, the diameter of the cop is five or six times that of the quill at the tip. As the yarn is wound upon the cone, the line of draught upon the traveler varies continually, the pull being almost direct where the bobbin is full, and nearly at right angles where it is empty. With the increasing angle the drag upon the traveler increases, not only causing frequent breakages of the yarn, but also an unequal stretching of the yarn, so that the yarn perceptibly varies in fineness. The unequal strain further causes the yarn to be more tightly wound upon the outside than upon the inside of the bobbin, giving rise to snarls and wastage.



RECENT IMPROVEMENTS IN TEXTILE MACHINERY.--1, 2.--SPINNING WITHOUT A MULE--THE HARRIS REVOLVING RING SPINNING FRAME. 3, 4, 5.--NEW ELECTRIC STOP MOTION FOR DRAWING FRAMES. 6.--NEW POSITIVE MOTION LOOM.

These difficulties have hitherto prevented the application of ring spinning to the finer grades of yarn. They are overcome in the new spinning frame by an ingenious device by which a revolving motion is given to the ring in the same direction as the motion of the traveler, thereby reducing its friction upon the ring, the speed of the ring being variable, and so controlled as to secure a uniform tension upon the yarn at all stages of the winding.

The construction of the revolving ring is shown in Fig. 2. C is the revolving ring; D, the hollow axis support; H, a section of the ring frame; E, the traveler.

To give the required variable speed to the revolving ring there is placed directly over the drum, Fig. 1, A, for driving the spindle a smaller drum, B, from which bands drive each ring separately. The shaft, which is attached by cross girts to the ring rail, and moves up and down with it, is driven by a pair of conical drums from the main cylinder shaft; and is so arranged with a loose pulley on the large end of the receiving cone as to remain stationary while the wind is on or near the base of the bobbin. When the cone of the bobbin diminishes so as to materially increase the pull on the traveler, the conical drums are started by a belt shipper attached to the lilt motion. By the movement of the belt on these drums a continually accelerated motion is given to the rings, their maximum speed being about one-twentieth the number of revolutions per minute as the spindle has at the same moment. This action is reversed when the lift falls. The tension of the wind upon the bobbin is thus kept uniform, the desired hardness of the wind being secured by the use of a heavier or lighter traveler according to the compactness of cop required.

The model frame shown at the fair did its work admirably well, spinning yarns as high as No. 400, a fineness hitherto unattainable on ring frames. It is claimed that this invention can do whatever can be done with the mule, and without the skilled labor which mule spinning demands.

This invention is exhibited by E. & A. W. Harris, Providence, R.I.

NEW ELECTRIC STOP MOTION.

Figs. 3, 4, and 5 illustrate some of the applications of the electric stop motion in connection with cotton machinery. The merit of this invention lies in simplifying the means by which machinery may be stopped automatically the instant, its work, from accident or otherwise, begins to be improperly done. The use of electricity for this purpose is made possible by the fact that comparatively dry cotton is a nonconductor of electricity. In the process of carding, drawing or spinning, the cotton is made to pass between rollers or other pieces forming parts of an electric circuit. So long as the machine is properly fed and in proper working condition, the stopping apparatus rests; the moment the continuity of the cotton is broken or any irregularity occurs, electric contact results, completing the circuit and causing an electro magnet to act upon a lever or other device, and the machine is stopped. The current is supplied by a small magneto-electric machine driven by a band from the main driving shaft, and is always available while the engine is running.

Fig. 3 shows the general arrangement of the apparatus as applied to a drawing frame. In the process of drawing down the roll of cotton--the sliver--four things may happen making it necessary to stop the machine. A sliver may break on the way from the can to the drawing rollers, or the supply of cotton may become exhausted; the cotton may lap or accumulate on the drawing rollers; the sliver may break between the drawing rollers and the calender rollers; or the front can may overflow. In each and all of these cases the electric circuit is instantly completed; the parts between which the cotton flows either come together, as when breakage occurs, or, if there is lapping, they are separated so as to make contact above. In any case, the current causes the electro-magnet, S, against the side of the machine to move its armature and set the stop motion in play.

Figs. 4 and 5 represent in detail the manner in which electric connection is made in two cases requiring the intervention of the stop motion. In Fig. 4 the upper part of a receiving can is shown. When the can is full the cotton lifts the tube wheel, J, until it makes an electrical connection, and the stop motion is brought into instant action. In Fig. 5, the traction upon the yarn holds the hook borne by the spring, F, away from G, and the electric circuit is interrupted. A breakage of the yarn allows this spring to act; contact is made, and the stop motion operates as before.

This simple and efficient device is exhibited by Howard & Bullough & Riley, of Boston.

NEW POSITIVE MOTION LOOM.

Fig. 6 shows the essential features of a positive motion loom, intended for weaving narrow fabrics, exhibited by Knowles, of Worcester, Mass. The engraving shows so clearly how, by a right and left movement of the rack, the shuttle is thrown by the action of the intermediate cogwheels, that further description is unnecessary.

SPINNING WITHOUT A MULE.

At the recent semi-annual meeting of the New England Cotton Manufacturers' Association, held at the Institute of Technology, Boston, the following paper on the Harris system of revolving ring spinning was read by Col. Webber for the author:

It is well known that one of the most serious difficulties in ring spinning is the variable pull upon the traveler, caused by the difference in diameter of the full and empty bobbins, and this is especially noticeable in spinning weft, or filling, when the diameter of the quill at the tip is not over 3-16 of an inch, while that of the base of the cone, or full bobbin, is from an inch to an inch and one-eighth. This variation in diameter causes the line of draught upon the traveler, which, with the full bobbin, forms nearly a tangent to the interior circle of the ring, to be nearly radial to it with an empty one, and this increased drag upon the traveler not only causes frequent breakage in spinning, but also stretches the yarn, so that it is perceptibly finer when it is spun on the nose of the bobbin than when it is spun on the bottom of the cone.

Endeavors have been made to compensate for this difficulty by making a less draught at that period of the operation; but we believe the principle of curing one error by adding another to be wrong, and aim by our improvement to avoid the cause of the trouble, which we do by giving a revolving motion to the ring itself in the same direction as that of the traveler, at a variable speed, so as to aid its slip, and reduce its friction on the ring. This we accomplish by means of a shaft with whorls on it, located directly over the drum for driving the spindle, from which bands drive each ring separately; and attached by cross-girts to the ring-rail, and moving up and down with it.

This shaft is driven by a pair of conical drums from the main cylinder shaft, and is so arranged with a loose pulley on the large end of the receiving cone as to remain stationary while the wind is on or near the base of the bobbin, or nearly parallel to the path of the traveler.

When the cone of the bobbin begins to diminish to such a point as to materially increase the radial pull on the traveler, these conical drums are put in operation by a belt shipper attached to the lift motion, which moves the belt on to the cones, and gives a continually accelerated motion to the rings, so that when the wind reaches the top of the bobbin the rings will have their maximum speed of about 300 revolutions per minute, or about one-twentieth the number of revolutions of the spindle at this point, if the latter make 6000 revolutions per minute, and this we find in actual practice to produce results which are highly satisfactory.

As the lift falls again, the belt is moved back on the cones, giving a retarding motion to the rings, until it reaches the point at which it began to operate, and is then either moved on to the loose pulley, and the rings remain stationary, or for very fine yarn are kept in motion at a slow speed. We are often asked if this does not affect the twist, but answer that it does not in the least, as the relative speeds of the rolls and spindles remain the same, and the only thing that can be affected is the hardness of the wind upon the bobbin, and this is adjustable by the use of a heavier or lighter traveler, according to the compactness of cop required.

We claim by means of this improvement the ability to use a much smaller quill or bobbin, and consequently holding as much yarn in a less outside diameter, enabling us to use a smaller ring, thus saving power both in the weight of bobbin to be carried and in the distance to be moved by the traveler; and we believe the power to be saved in this manner and by the diminution of the dead pull on the traveler, when the wind is at the tip of the bobbin, to be more than sufficient to give the necessary motion to the revolving rings. We are as yet unable to answer this question of power fully, as we have not yet tested a full size frame, but we propose to do this in season to answer all questions at the next meeting of your association.

The same invention is also applicable to warp spinning, by giving the ring a continuous accelerating and retarding motion, in which the maximum speed is given to the ring at the first start of the frame when the bobbin is empty, sufficient to diminish the strain on the yarn, and gradually reducing the motion at each traverse of the rail, as the bobbin is filled; but we claim the great advantage of our invention to be the capability of spinning any grade of yarn on the ring frame that can be spun on the hand or self-operating mule, and in proof of this we call your attention to the model frame now in operation at the fair of the New England Manufacturers' and Mechanics' Institute, where we are spinning on a quill only 5-32 inches diameter at top, and where we can show you samples of yarn from No. 80 to No. 400 spun on this frame from combed roving from the Conant Thread Company and Willimantic Linen Company, which we believe has never before been accomplished on any ring frame.

We invite you to examine this invention at the fair, and also call your attention to the adjustable roller beam, by means of which the rolls can be adjusted at any desirable angle or pitch, so as to throw the twist more or less directly spinning, and an improvement in the quality of the yarn from the same cause, which will increase the production from the loom, and finally eradicate other objectionable features of the labor question, which so often disturb the peaceful harmony between labor and capital.

Mr, Goulding asked if it had been demonstrated whether more or less power was required for the same numbers than effect of running the machine a little out of true, and the reply was that the advantage of the new method over the old would be more apparent in such a case than with a perfect frame. In regard to speed, the inventor proposed as a maximum rate, when the wind was at the tip of the bobbin, 300 revolutions per minute, but from this point the speed would diminish.

Conant Thread Company and Willimantic Linen Company, which we believe has never before been accomplished on any ring frame.

We invite you to examine this invention at the fair, and also call your attention to the adjustable roller beam, by means of which the rolls can be adjusted at any desirable angle or pitch, so as to throw the twist more or less directly into the bite of the rolls, according to the character of the yarn desired, or the quality of the stock used.

Finally, we claim, by the use of this invention, to be able to spin any fibrous material which can be drawn by draught-rolls, of any required degree of softness of twist, such as can be spun by any mule whatever, and to do this with the attention only of children of from twelve to fourteen years of age.

We also claim an increased production, owing to less breakage of ends, from the yarn not being overstrained in spinning, and an improvement in the quality of the yarn from the same cause, which will increase the production from the loom, and finally eradicate other objectionable features of the labor question, which so often disturb the peaceful harmony between labor and capital.

Mr. Goulding asked if it had been demonstrated whether more or less power was required for the same numbers than by other methods, and Col. Webber replied that no more power was required to move the rings than was saved by friction on the ring and the saving of weight of the bobbins. He thought it required no more power than the old way.

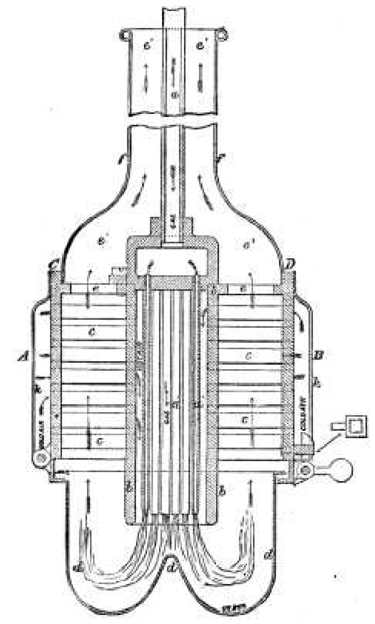
The method of lubricating the ring.--The inventor, who was present, stated, in response to a query, that he claimed an advantage for his ring in spinning all numbers from the very coarsest up, both in quality and quantity, and especially the former.

Mr. Garsed inquired of Col Webber what would be the effect of running the machine a little out of true, and the reply was that the advantage of the new method over the old would be more apparent in such a case than with a perfect frame. In regard to speed, the inventor proposed as a maximum rate, when the wind was at the tip of the bobbin, 300 revolutions per minute, but from this point the speed would diminish.

It was suggested by a member that the only advantage of a revolving ring was to relieve the strain on the traveler just to the extent of the ring's revolutions. If the ring were making 300 revolutions per minute, and the traveler 6,000, the strain on the latter would be equal to 5,700 revolutions on a stationary ring. Col. Webber, however, thought that the motion of the ring gave the traveler a lift that prevented its stopping at any particular point, and cited the fact that all numbers up to 400 could be spun with this ring as proof of its superiority over the old method.

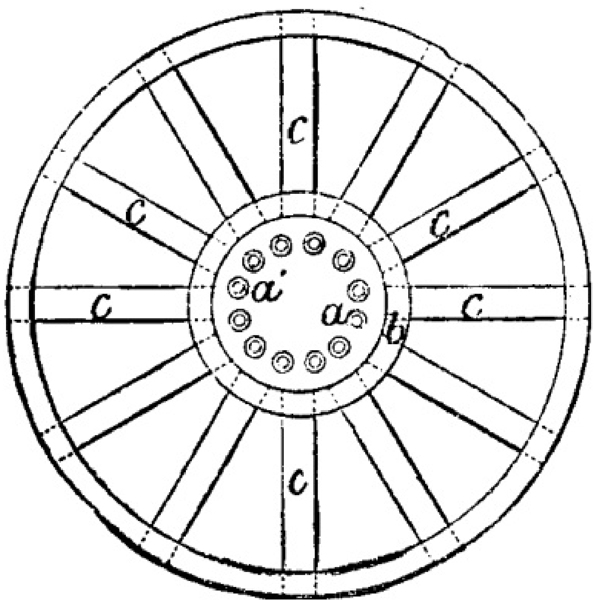
NEW GAS BURNER.

Speaking at the last meeting of the Gaslight and Coke Company, Mr. George Livesey said many things with a view to inspire confidence of the future in the minds of timid gas proprietors. Among others he mentioned the advances now being made by invention in regard to improved appliances for developing the illuminating power of coal gas, with especial reference to a new burner just patented by Mr. Grimston. Mr. Livesey passed a very high encomium upon the burner, and this expression of opinion by such an authority is sufficient to arouse deep interest in the apparatus in question. It is therefore with much pleasure that we present our readers with the following early account of Mr. Grimston's burner, for which we are indebted to the inventor and Mr. George Bower, of St. Neots, in whose manufactory the burners are now being made in all sizes. It should be premised, to save disappointment, that the invention is yet so fresh that its ultimate capabilities are unknown. The accompanying illustration, therefore, represents the bare skeleton of one of the first models; and the actual performance of only the very earliest burner, made in great part by Mr. Grimston himself, has been fully tested. Before proceeding to describe the invention, a brief history may be interesting of how it happened that Mr. Grimston, an electric lighting engineer, became a gas burner maker. The story will undoubtedly help to explain the reasons for many of the characteristics of the new burner.



IMPROVED GAS BURNER. FIG. 1.--Sectional Elevation.

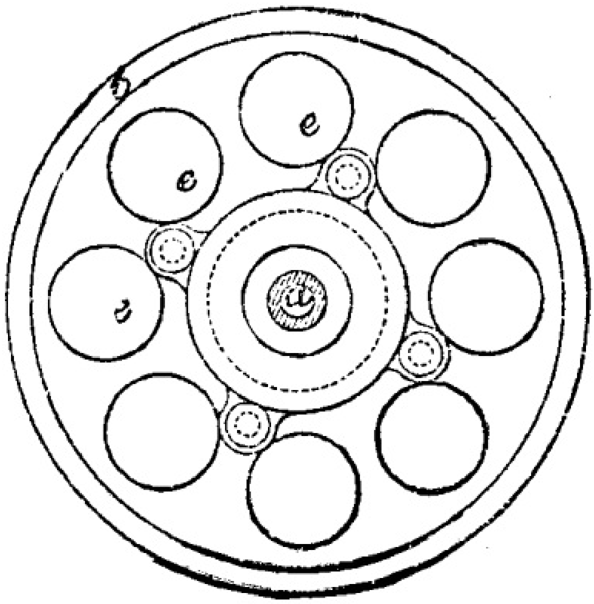
It appears, then, that Mr. Grimston, who was connected with the electrical engineering establishment of Siemens Bros. & Co., Limited, was some months ago shown the construction and working of the Siemens regenerative gas burner, which is now sufficiently well known to render a description unnecessary here. In common with most spectators of this very ingeniously and philosophically designed appliance, Mr. Grimston was struck with its bulk and the superficial clumsiness of the arrangement whereby the air and gas supply are heated in it by the products of combustion. These lamps have, of course, materially improved of late; but when Mr. Grimston first saw them, perhaps 18 months ago, they certainly could not be called neat and compact in design. He at once grasped the idea embodied in these lamps, and set about constructing an arrangement which should be based on a similar principle, but at the same time avoid the inconveniences complained of. It is not too much to say that he has succeeded in both these aims, and the burner which now bears his name strikes the observer at once by the brilliant light which it produces by the simplest and most obvious means. We may now describe, by reference to the accompanying illustrations, how Mr. Grimston produces the regenerative effect which is likewise the central idea of the Siemens burner.



IMPROVED GAS BURNER. FIG. 2.--Section through A B.

The light is simply that produced by an arrangement of a kind of Argand burner turned upside down. The central gas-pipe, *a* (Figs. 1 and 3), is connected to a distributing chamber, whence the annular cluster of brass tubes, *a', a*, (Figs. 1 and 2), are prolonged downward, forming the burner. The burner is inclosed in an iron or brass annular casing, b, b, which forms the main framework of the apparatus. The annular space which it affords is the outlet chimney or flue for the products of combustion of the burner beneath, and is crossed by a number of thin brass tubes, c, c, which lead from the outer air into the inner space containing the burner tubes, a', a', already described. The upper openings of the annular body, b, are shown at e, e

(Fig. 3), which communicate direct with the chimney proper, e', e'. The burner is lighted by opening the hinged glass cover, d, which fits practically air-tight on the bottom of the body, so that the air needed to support combustion must all pass through the tubes, c, c, the outer ends of which are protected by the casing, k, k.



IMPROVED GAS BURNER. FIG. 3.--Section through C D.

When the gas is lighted at the burner, and the glass closed, the burner begins to act at once, although some minutes are necessarily required to elapse before its full brilliancy is gained. The cold air passes in through the tubes provided for it, and when these are heated to the fullest extent on their outside, by the hot fumes from the burner, they so readily part with their heat to the air that a temperature of 1,000° to 1,200° Fahr. is easily obtained in the air when it arrives inside, and commences in turn to heat the burner-tubes. The air-tubes are placed so as to intercept the hot gases as completely as possible; and also, of course, obtain heat by conduction from the sides of the annular body. It is evident that the number and dimensions of these tubes might be increased so as to abstract almost all the heat from the escaping fumes, but for the limitations imposed, first, by a consideration of the actual quantity of air required to support combustion, and, secondly, by the obligation to let sufficient ascensional power remain in the gases which are left to pass out through the upper chimney. If the gases are cooled too much, they will either fall back into the lamp and extinguish the flame, or will be removable only by the draught of a long chimney. It will probably be the aim of the inventor to balance these requirements, and so to produce burners with very short or longer chimneys, according as appearance is to be consulted or the highest possible effect produced. The burner is a ring of brass tubes of considerable diameter, in proportion to the quantity of gas consumed, and thus provides for the delivery of gas expanded by heat. In connection with this device an explanation may be found of the failure of the British Association Committee on Gas Burners to find any advantage from previously heating the air and gas consumed. The Committee did not make the necessary provision for the increased bulk of the combustible and its air supply, caused by their heightened temperature; and the same quantity of gas measured cold (at the meter) could only be driven through the ordinary small burner holes at a velocity destructive of good results. Herr Frederick Siemens perceived this in his early experiments, and not only increased the orifices of his burners, but provided for the closer contact of the more rarefied gas and air by the use of notched deflectors, which are now an essential part of his apparatus. Mr. Grimston also uses separate tubes of large area for his hot gas, but dispenses with deflectors, save in so far as the same duty may be performed by the plain lower edge of the inner cylinder of the lamp body, and the indentation of the glass beneath, which, as will be noticed, is made to follow the shape of the flame. It only remains now to speak of the flame and its qualities. It is, in the first place, a flame of hot gas, burning at an extremly small velocity of flow, and wholly exposed to view from the exact point which it is required to light. In this latter respect it differs materially, and with advantage, from the Siemens burner, which, while presenting an extremely brilliant and beautiful ball of flame outside its central tube of porcelain, may yet be tailing smokily downward inside this opaque screen, and thereby causing unperceived waste. The flame of the Grimston burner, on the other hand, is quite exposed, and all its light, from the ends of the burner-tubes to the point where visible combustion ceases, is made available for use. As a perfect Argand flame in the usual position has been likened in form to a tulip flower, so the flame of this burner presents the appearance of an inverted convolvulus. So far as he has already gone, Mr. Grimston prefers to keep the tubes of the burner at such a distance from each other that the several jets part at the point where they turn upward, so that the convolvulus figure is not maintained to the edge of the flame. From its peculiar position the light is, of course, completely shadowless as regards the lamp which affords it; and this, of itself, is no small recommendation for a pendant. It shows well for the simplicity and effectiveness of the perfected burners that Mr. Grimston's experimental example, although necessarily imperfect In many ways, burns with a remarkably steady light, of great brilliancy, which is assured by the fact that the products of combustion are robbed of all their heat to magnify the useful effect, so that the hand may be borne with ease over the outlet of the chimney. With respect to the endurance of the apparatus, it will be sufficient to remark that there is nothing in the gas or air heating arrangements to get out of order, and they are all easily accessible while the burner is in action. The glass is not liable to breakage, although it is in close proximity to the flame, as may be gathered from the testimony of the inventor, who has never broken one, notwithstanding the severity of some of his experimental studies upon his first lamp. The consumption of gas in the first working-model burner made by Mr. Grimston was 10 cubic feet per hour, and its illuminating power averaged 60 candles. The diameter of this burner was 1¼ inches across the tubes. It is scarcely necessary to state that if this high duty, which was obtained with the ordinary 16-candle gas of the Gaslight and Coke Company, can be maintained, to say nothing of being exceeded, in the commercial article, the Grimston burner, with its other advantages over all existing methods of obtaining equal results, has a great future before it. For example, it does not require a separate air supply under high pressure, or any extra material to render incandescent, and it may be turned on full immediately upon lighting. It throws a shadowless light, and lends itself to ventilating arrangements; and it is not by any means cumbersome, delicate in construction, or costly in manufacture. One of the greatest advantages to which it lays claim is, however, the power of yielding almost as good results in a small burner as in a large one. This is a consideration of great moment, when it is remembered that the tendency of most of the high power burners hitherto introduced is to benefit the lighting of streets, large interiors, and, generally speaking, points of great consumption. Meanwhile, the private user of burners, consuming from 3 to 5 cubic feet of gas per hour, has been left to attain as best he might, by the use of burners excellent of their kind, to the maximum effect of the standard Argand. Now, however, Mr. Grimston seeks to make the small consumer partake of the advantages erstwhile reserved for the wholesale user of large and costly Siemens and other lamps, and he even looks to this class of patrons with particular care. The example which we now illustrate, in Fig. 1, is a sectional presentment precisely half the actual size of a 5-foot burner, which it is intended to prepare for the market before all others. Another simple form of the burner, with vertical tubes, will, we understand, be introduced as soon as possible. It will be readily understood that the principle is capable of being embodied in many shapes; and it is satisfactory to learn that the inventor is quite alive to the necessity of producing a cheap as well as a good burner.

Gas companies, as Mr. Livesey has expressed it, will be well content with a slower relative growth of consumption, if their consumers are at the same time making their gas go as far again as formerly, by the use of burners which turn nominal 16-candle gas into gas of 30-candle actual illuminating power. How far Mr. Grimston's invention may succeed in this work it is not for us to say. It is sufficient for the present that he has done excellently well in showing how Herr Frederick Siemens' scientific principles of regenerative gas burner construction may be carried out yet in another way. There is nothing more common in industrial annals than for one man to begin a work which another is destined to bring to greater perfection. Whether this natural process is to be repeated in the present instance must be left for the future to decide. In any case, Mr. Grimston's success, if success is to be his reward, though it will be well merited by his ingenuity and perseverance in solving a difficult problem, will never cause us to forget the prior claims of Herr Frederick Siemens, of Dresden, to the palm of the discoverer. Mr. Grimston may or may not be the happy inventor of the best gas-burner of the day; but there is the consolation of knowing that in the same field in which he will find his recompense there is room for any number and variety of useful improvements of a like character and object.--*Journal of Gas Lighting*.

DEFTY'S IMPROVEMENTS IN GAS BURNERS AND HEATERS.

Among other inventors who have turned their attention to gas consumption is to be found Mr. H. Defty, who has made several forms both of heating and lighting burners. Mr. Defty has sought in the latter to apply the principle of heating the air and gas in a simple manner, with the object of obtaining improved photometrical results. The double-chimney Argand, as tried many years since by Dr. Frankland and others, makes a reappearance in one of Mr. Defty's models, illustrated in the accompanying diagram (Fig. 1).

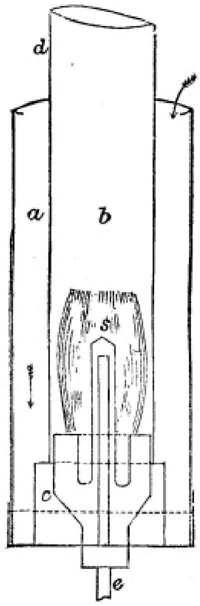


Fig. 1.

Here we have the double-chimney, a and b, for heating the air supplied to an ordinary Argand, by causing it to pass downward between the two chimneys, and inward to the point of combustion through a wire-gauze screen, c, under the inner chimney; but, in addition thereto, Mr. Defty hopes to gain an improved result by causing the gas to pass through the internal tube, s, which rises up in the middle of the flame. The gas, which enters at e, is made to pass up through the inner tube and down through the annular space to the burner.

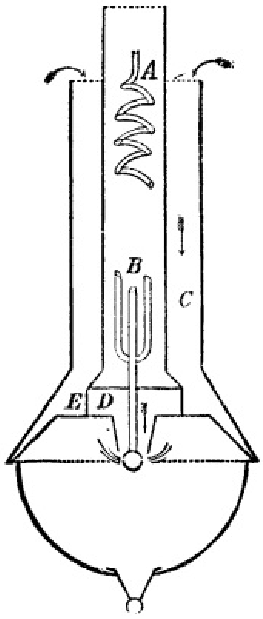


Fig. 2.

A more important form of lantern is the subject of the next diagram (Fig. 2), which shows a suspended globe lantern in which there is an attempt made to heat the air by the waste heat of the products of combustion. It will be perceived by the diagram that a globe lantern is furnished with a double chimney; the annular space, C, between the inner and outer chimneys allowing for the access of air in a downward direction. At the lower of this annular channel are the tubes D, protected by the graduated mesh, E, and which admit the air to the burner below. The products of combustion of the flame rise through the inner chimney, passing around the tubes, and thereby giving up some of their heat to the incoming air. Farther up, the chimney is partly filled with the convoluted gas-pipe, A, which also takes up some of the waste heat, and delivers the gas to the burner at a correspondingly high temperature. A very simple method of lighting this burner, which in itself does not present anything remarkable, is arranged at the lower part of the globe, where a hole is cut and a loose conical glass plug (which can, of course, be made to partake of the general ornamentation of the globe) may be pushed up to allow of the passage of the lighting agent, and is then dropped in its place again. Formal tests of the performances of these burners are not available; and the same may be said of the heating burners which are shown in the following diagrams.

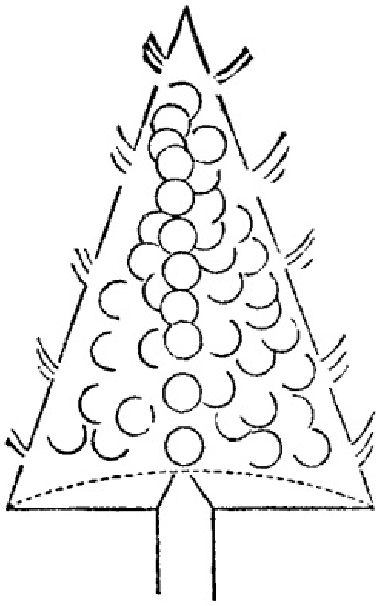


FIG. 3.

The first of these (Fig. 3) is called by Mr. Defty a "pyramid heater," and is designed to heat the mixture of air and gas before ignition, by conduction from its own flame. The inventor claims to effect a perfect combustion in this manner with considerable economy of fuel. It is evident, however, that a good deal of the gas consumed goes to heat the burner itself.

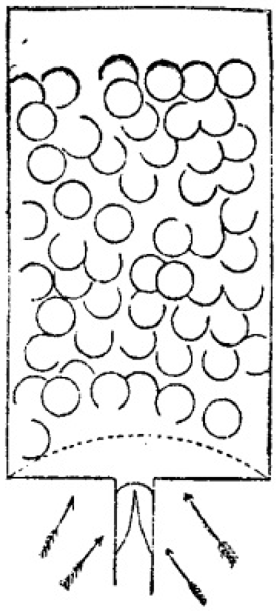


FIG. 4.

The next and last of Mr. Defty's productions to be at present described is the so-called "crater burner," shown herewith (Fig. 4). This is an atmospheric burner which is purposely made to "fire back," as well as to burn on the top of the apparatus. The body of the burner, like the pyramid heater just described, is full of fire-clay balls, which become very hot from the lower flame, and thus, after the burner has been for some time in action, a pale, lambent blaze crowns the top, apparently greater in volume than when it is first lighted. Here, again, there is a lamentable absence of reliable data as to economic results, which will, perhaps, be afforded when the apparatus in question is ready to be offered to the public.

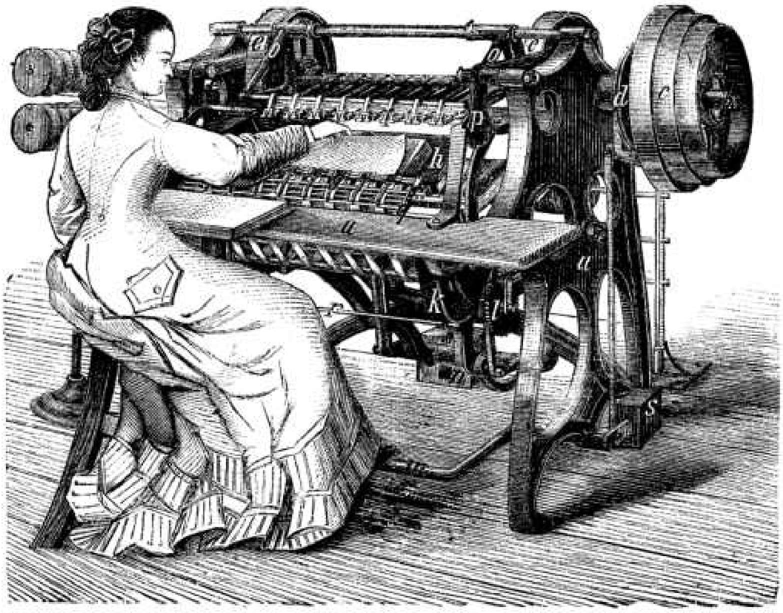
Whether one inventor or another succeeds in distancing his rivals, it is matter, says *The Journal of Gas Lighting*, for sincere congratulation among the friends of gas lighting that so much attention is being concentrated upon the improvement of gas burners for all purposes. This is an open field which affords scope for more workers than have yet entered upon it, and there is the certainty of substantial reward to whoever can realize a worthy advance upon the established practice.

NEW BINDING MACHINES.

The accompanying cuts represent two new machines for binding together books and pamphlets. They are the invention of Messrs. Brehmer & Co., and are now much used in England and Germany. The material used for binding is galvanized iron wire.

Machine Operated by Hand (Fig. 1).--This machine serves for fastening together the pages of pamphlets through the middle of the fold, or for binding together several sheets to form books up to a thickness of about half an inch.

It consists of a small cast-iron frame, with which is articulated a lever, *i*, maneuvered by a handle, *h*. This lever is provided at its extremity with a curved slat, in which engages a stud, fixed to the lower part of a movable arm, *c*, whose extremity, *d*, rises and descends when the lever handle, *h*, is acted upon. This maneuver can be likewise performed by the foot, if the handle, *h*, be connected with a pedal, X, placed at the foot of the table that supports the machine, as shown in Fig. 2. The lever, *i*, is always drawn back to its first position, when left to itself, by means of the spring, *z*.



IMPROVED BINDING MACHINE.

The staples for binding have nearly the form of the letter U, and are placed, to the number of 250 or 300, on small blocks of wood, *m*. To prepare the machine for work, the catch, *a*, is shoved back, and the whole upper part of the piece, *b*, is removed. The rod, *e*, with its spring, is then drawn back until a small hole in *e* is perceived, and into this there is introduced the hook, *f*, which then holds the spring. The block of wood, *m*, filled with staples, is then rested against a rectangular horizontal rod, and into this latter the staples are slipped by hand. The upper part of the piece, *b*, is next put in place and fastened with the catch, *a*. Finally, the spring is freed from the hook, *f*. When it is desired to bind the pages of a pamphlet, the latter is placed open on the support, *g*, which, as will be noticed, is angular above, so that the staple may enter exactly on the line of the fold. Then the handle, *h*, is shoved down so as to act on the arm, *c*, and cause the descent of the extremity, *d*, as well as the vertical piece, *b*, with which it engages. This latter, in its downward travel, takes up one of the staples, which are continually thrust forward by the rod and spring, and causes it to penetrate the paper. At this moment, the handle, *h*, makes the lever, *n*, oscillate, and this raises, through its other extremity, a vertical slide whose head bends the two points of the staple toward each other. The handle, *h*, is afterward lifted, the position of the pamphlet is changed, and the same operation is repeated. When it is desired to form a book from a number of sheets, the table, *l*, is mounted on the support, *g*, its two movable registers are regulated, and the sheets are spread out flat on it. The machine, in operating, drives the staples in along the edge of the sheets, and the points are bent over, as above indicated.

The axis on which the lever, *i*, is articulated is eccentric, and is provided on the side opposite the lever with a needle, *k*, revolving on a dial. The object of this arrangement is to regulate the machine according to the thickness of the book.

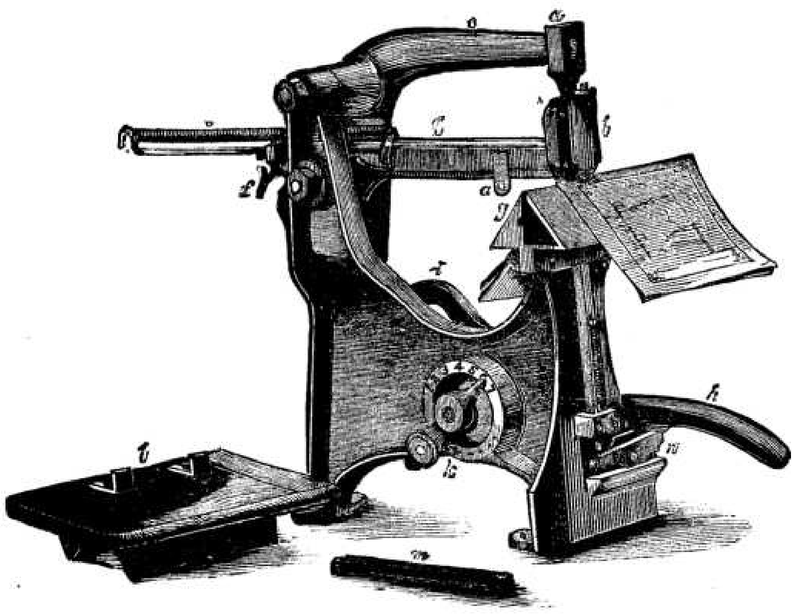


FIG. 1.

Machine to be Operated by a Motor (Fig. 3).--This machine, although working on the same principle, is of an entirely different construction. It is designed for binding books of all dimensions. It consists of a frame, *a*, in two pieces, connected by cross-pieces, and carries a table, *u*, designed to receive the sheets before being bound together. Motion is transmitted by means of a cone, *c*, mounted loose on the shaft, *b*. To start the machine, the foot is pressed on the pedal, *m*, which, through the intermedium of links and arms, brings together the friction plates, *d*, one of which is connected with the shaft, *b*, and the other with the cone, *c*. When it is desired to stop the machine, the pedal is left free to itself, while the counterpoise, *s*, ungears the friction plates. The machine fastens the paper with galvanized iron wire wound round bobbins placed at the side of the apparatus. This wire it cuts, and forms into staples.

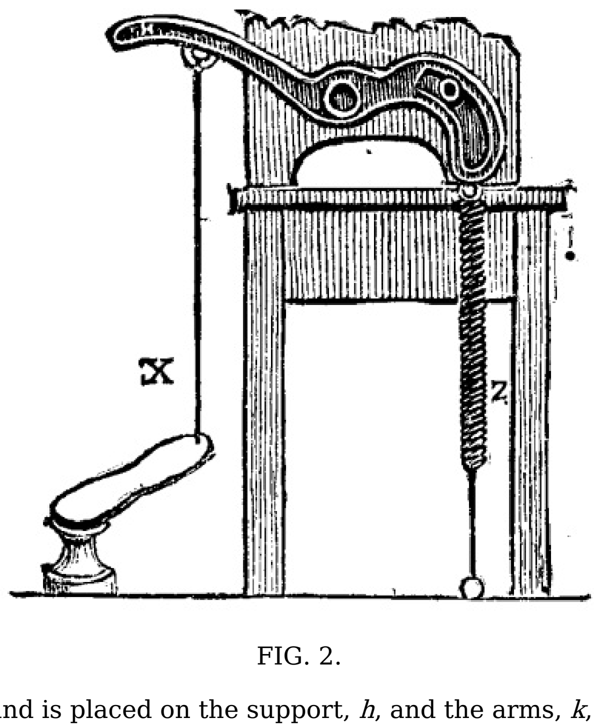


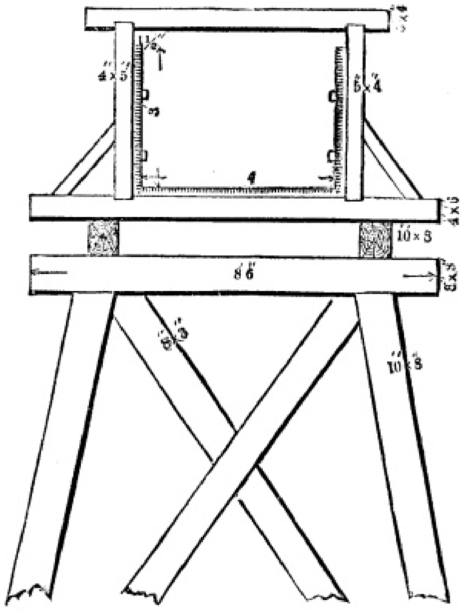
FIG. 2.

The book to be bound is placed on the support, *h*, and the arms, *k*, that carry the fasteners cause it to move backward and forward. It also undergoes a second motion--that is, it moves downward according to the number and thickness of its pages. This motion, which takes place every time the operator adds a new sheet, is regulated by a cog-wheel register, *l*, which is divided, and provided with a needle.

The iron wires pass from the bobbins on a support to the left of the machine by means of feed rollers, which thrust them through the eight clips. In the interior of these latter there is a double knife, which, actuated by one of the cams of the wheel, *e*, cuts the wire and bends it thus . The extremities of the staples are thrust through the back of the half opened leaves, and then bent toward each other thus , by the front fastener. This motion is effected by means of two levers, *p* (moved by the cams, *e*), whose extremities at every revolution of the machine seize by the two ends a link that maneuvers the fasteners. The binding of one sheet finished, the lower arms of the machine again take their position, the wires move forward the length necessary to form new staples, a new sheet is laid, and the same operation is proceeded with. The number of staples and their distance are changed, according to the size of the book, by introducing into the machine as much wire as will be necessary for the staples. To prevent their number from increasing the thickness of the back of the book (as would happen were they superposed), the support, *h*, moves laterally at every blow, so as to cause the third staple to be driven over the first, the second over the fourth, etc.

FLUMES AND THEIR CONSTRUCTION.

In crossing ravines in this State, flumes or wrought iron pipes are used. Many miners object to flumes on account of their continual cost and danger of destruction by fire. Where used and practicable, they are set on heavier grades than ditches, 30 to 35 ft. per mile, and, consequently, are proportionately of smaller area than the ditches. In their construction a straight line is the most desirable. Curves, where required, should be carefully set, so that the flume may discharge its maximum quantity. Many ditches in California have miles of fluming. The annexed sketch, drawn by A. J. Bowie, Jr., will show the ordinary style of construction.



SKETCH OF FLUME.

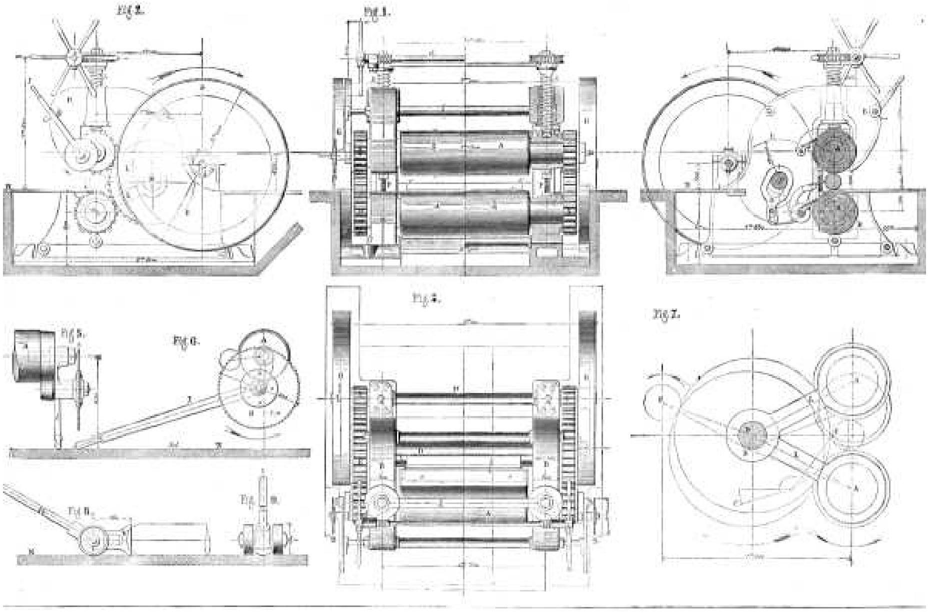
The planking ordinarily used is of heart sugar pine, one and a half to two inches thick, and 12 to 18 inches wide. Where the boards join, pine battens three inches wide by one and a half thick cover the seam. Sills, posts, and caps support and strengthen the flume every four feet. The posts are mortised into the caps and sills. The sills extend about 20 inches beyond the posts, and to them side braces are nailed to strengthen the structure. This extension of the sill timbers affords a place for the accumulation of snow and ice, and in the mountains such accumulations frequently break them off, and occasionally destroy a flume.

To avoid damage from slides, snow, and wind storms, the flumes are set in as close as possible to the bank, and rest, wholly or partially, on a solid bed, as the general topography and costs will admit. Stringers running the entire length of the flume are placed beneath the sills just outside of the posts. They are not absolutely necessary, but in point of economy are most valuable, as they preserve the timbers. As occasion may demand, the flume is trestled, the main supports being placed every eight feet. The scantling and struts used are in accordance with the requirements of the work.--*Min. and Sci. Press*.

CHUWAB'S ROLLING MILL FOR DRESSING AND ROUNDING BAR IRON.

This new forge apparatus has been devised for the purpose of finishing up round irons of all diameters while hot, as they come out of the ordinary rolling mill, by rendering them perfectly circular, cylindrical, straight, smooth, and level at the extremities, as if they had passed through a slide lathe. Such a high degree of external finish is a very valuable feature in those round irons that are employed in so great quantity for shafting, cylindrical axles, etc., as well as in the manufacture of bolts and locks. Figs. 1, 2, 3, and 4 of the opposite engraving will allow it to be seen that this apparatus which is usually installed at the side of the finishing cylinder is, in part, beneath the general level of the forge floor. It may be placed parallel with or perpendicular to the apparatus that it does duty for, this depending upon the site at disposal or the mode of transmission.

The apparatus consists essentially of two tempered iron cylinders, A, 0.5 of a meter in diameter by 1.5 meters in length, revolving in the *same direction* (contrary to what takes place in ordinary rolling mills) between two frames, B, that are open on one side to allow of the entrance of the finishing bar. This latter is held between the cylinders, A, which roll it so much the faster in proportion as its diameter is smaller, and by a scraper guide, C, of the same length as the cylinder table, and which may be regulated at will by bolts, c, fixed to the frame, B. The bottom cylinder remains always in the same position, while the axle, D, which carries the intermediate wheels, E, moves about to gear in all the relative positions of the cylinders. The displacement of the upper cylinder is effected through the clamping screws, b, which are actuated by toothed disks that gear with two endless screws keyed at the extremities of one shaft in common, d, which is set in motion by hand through the winches, m m. The scraper guards, e e, take up and throw aside all scales that might become attached to the cylinders, which are constantly moistened by small streams of water coming from an ordinary conduit.



CHUWAB'S DRESSING AND ROUNDING ROLLING MILL.

Fig. 1--Elevation and Longitudinal Section.

Fig. 2--Side View.

Fig. 3--Transvers Section.

Fig. 4--Plan View.

Figs. 5 & 6--Saws for Dressing the Extremities of the Bars.

Fig. 7--Diagram Showing the Motion of the Wheels and Guide.

Figs. 8 & 9--Apparatus for Shifting tha Bars.

As the driving belts are mounted on pulleys, G, of a diameter proportioned to the velocity of the shafting, the iron pinions, h, in order to produce 60 revolutions per minute in the first shaft, H, gear on each side with the intermediate wheels, E, and these actuate the two bronze pinions, a a, that are mounted on the extremities of the cylinders, A A. The axle, D, of the intermediate wheels does not revolve with them, but is capable of rising and descending in the elongated aperture that traverses the frames, B. The displacement of this axle is secured through the arms, L L, whose extremities articulate on the one hand with the cylinders, A A, and on the other with D. The result of this is that every displacement upward of the top cylinder corresponds to a different position of the intermediate shaft, and one that is always equidistant from the centers of the cylinders, A A, thus securing a constant gearing of the wheels in all the positions of the cylinders, A A.

The diagram in Fig. 7 shows the relative displacements of all these parts, as well as those of the scraper guide, C. The diameter to be obtained is determined beforehand by the two contact screws, P.

The whole thus regulated, the bar of iron, still very hot, coming from the ordinary rollers, is straightened up, if need be, by a few blows of a hammer, so that it may roll forward over the pavement, N, between the rounding cylinders, A A; these being held apart sufficiently to allow of its easy introduction. Next, a few revolutions of the winches that control the screws suffice to lower the upper cylinder to the exact position limited by the contact screws, P, and the bar is rolled between the two cylinder tables with a constant velocity in the generatrices. As a consequence, the number of revolutions made is so much the greater in proportion as the diameter of the shaft is smaller with respect to that of the cylinders.

It should be remarked that the bar, during its rotation under pressure, is held by the guide, C, so that its diagrammatic axis (Fig. 7) exceeds the line, A A, joining the centers of the cylinders just enough to prevent its escape to the opposite, and so that the pressure upon the said guide (which performs the role of scraper) is merely sufficient to detach the scales which form during the operation.

Under such conditions, and at a velocity of 30 revolutions per minute in the two cylinders, it will take but a fraction of a minute to finish a bar the length of the table, that is to say, 1.5 meters. Then, by loosening the upper cylinder, the bar may be easily shoved along in one direction or the other, so as to continue the finishing operation on successive lengths. This moving of the bar forward is further facilitated by the aid of a clamp with rollers and a movable socket, V (Figs. 8 and 9). For large diameters (150 millimeters and beyond) traction is employed by the aid of two small windlasses placed opposite each other, and at a distance apart twice the greatest length of the bars to be finished. The chains of these windlasses are attached to the extremities by clamps that lock by the pulling exerted.

The details of the arrangement of the saws (Figs. 5 and 6) show that to make a section of the ends or of any other part of the bar, it is only necessary to lower the lever of one them. By reason of the contrary rotation of the bar, the effective stress on the lever will be very moderate, while the cut produced will be a clean and quickly performed one. It should be remarked that, as a consequence of the cone on the projecting extremity of the cylinder journals (Fig. 5), and on the rollers that control the saws, it is only necessary to move the lever to the right or left in order to stop the motion of each of the saws. These latter, to prevent all possibility of accident, are inclosed within semicircular guards. Finally, the controlling rollers are made of a material which is quite elastic (compressed cardboard, for example), so that they may roll smoothly and adhere well.

From what precedes, it will be seen that round iron bars of any diameter will come from this apparatus completely finished. It will be seen also that with cylinders of suitable profile, there might likewise be finished axles, or pieces that are more or less conical as well as those provided with shoulders.

The apparatus may, if preferred, be driven by small special motors affixed to the frame. Such an arrangement, which is more costly than the preceding, is, nevertheless, indicated in cases where shafting would be in the way.

The weight of the materials entering into the construction of this machine, proposed by Mr. Chuwab, includes about 15 tons of metal, of which 5,000 kilogrammes are for the two tempered cylinders; 250 kilogrammes of iron screws, and 350 of bolts; and 500 kilogrammes of bronze, 90 of which are for nuts.--*Revue Industrielle*.

THE BURNING OF TOWN REFUSE AT LEEDS.

[Footnote: From selected papers of the Institution of Civil Engineers, London, by Charles Slagg, Assoc. Memb. Inst. C.E.]

In large towns it is necessary to adopt some regular system of removal and disposal of the cinders and ashes of house fires, and of the animal and vegetable refuse of the houses, and, in short, of everything thrown away which cannot be admitted into the sewers. In towns where the excreta are separated by means of water closets, the disposal of the other refuse presents less difficulty, but still a considerable one, because the animal and vegetable refuse is not kept separate from the cinders and ashes, all being thrown together into the ash pit or dust bin. The contents, therefore, cannot be deposited upon ground which may afterward be built upon, although that custom obtained generally in former times. Hence the refuse has been removed to a depot where that wretched industry is created of picking out the other parts from the cinders and ashes.

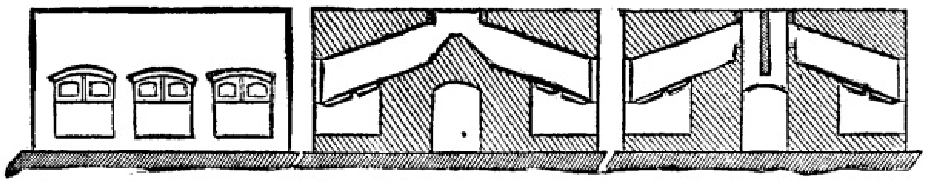


FIG. 1.--DESTRUCTOR.

Elevation.

Section through feeding-holes of cells.

Section through air-passages of cells.

But in towns unprovided with water closets, or so far as they are not adopted in any town, where the privies are connected with the ash pits, and where, consequently, the excreta of the population are added to the other contents of ash pits, the difficulties of removal and disposal of the refuse are much increased.

Where the privy-ashpit system is in use--as it still is to a large extent--as much of the contents of the ash pits as can be sold at any price, however small, are collected separately from the drier portions, and sent out of town as manure; but what remains is still too offensive to be deposited on ground near the town; and when it is attempted to collect the excreta separately by the pail system, the process is no less unsatisfactory. These difficulties led to the adoption, under the advice of the late Mr. A.W. Morant, M. Inst. C.E., the Borough Engineer at Leeds, of Fryer's method of destruction by burning--that is, of the dry ashes and cinders and the animal and vegetable refuse. The author was Mr. Morant's assistant. The first kiln was constructed at Burmantofts, 1½ miles from the center of the town in a northeasterly direction, and has been in use since the beginning of the year 1878. In 1879 another kiln was constructed at Armley Road, a mile from the center of the town in a west-southwesterly direction, which has been in use since the beginning of 1880.

Each destructor kiln has six cells, three in each face of a block of brick work 22 feet long, 24 feet through from face to face, and 12 feet high. Each cell is 8 feet long and 5 feet wide, arched over, the height being 3 feet 4 inches, and both the bottom and arch of the cell slope down to the furnace doors with an inclination of 1 in 3. The lower end of each cell has about 26 square feet of wrought-iron firebars, the hearth being 4½ feet above the ground.

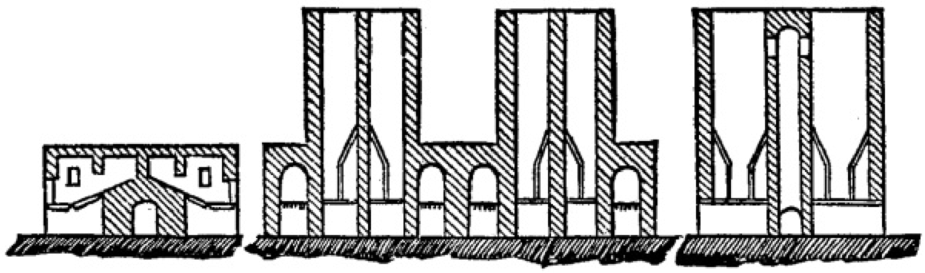


FIG. 2.--CARBONIZER.

Section through furnaces.

Longitudinal section.

Cross section.

There are two floors, one on the ground level, a few feet only above the outlet for drainage, the other floor, or raised platform, being 15 feet above it. The refuse is taken in carts up an incline of 1 in 14 on cast-iron tram plates to the upper floor, and deposited upon and alongside of the destructor, and is shoveled into a row of hoppers at the head of the cells. These hoppers are in the middle of the width of the destructor, and each communicates with a cell on each side of it. The refuse is always damp, and often wet, and after being put into the cells is gradually dried by the heat reflected upon it from the firebrick arch of the cell, before it descends to the furnace. This distinguishes the system from the common furnace, and enables the wet material to be burned without other fuel. No fresh fuel is used after the fires are once lighted. The vapor passes off with the gases of combustion into a horizontal flue between the two rows of cells, through an opening at the head of each cell, alongside that through which the refuse is fed into it, the two openings being separated by a firebrick wall. The refuse is prevented from falling into the flue by a bridge wall across the outlet opening, over which the gases pass into the flue.

Between the destructor and the chimney a multitubular boiler is placed, which makes steam enough for grinding into sand the clinkers which are the solid residue of the burnt refuse. At Burmantofts an old chimney was made use of, which is but 84 feet high; but at Armley Road a new chimney was built, 6 feet square inside and 120 feet high. It is necessary to make the horizontal flue large; that at Armley Road is 9 feet high and 4 feet wide. A large quantity of dust escapes from the cells--about 7 cwt. a month--and unless the velocity of the air in the flue between the destructor and the chimney were checked, the dust would be carried up the chimney and might cause complaints; as, indeed, it has done with the 120-foot chimney, but whether with any substantial grounds is uncertain. The dust is removed from the horizontal flue or dust chamber once a month. Experience seems to indicate that there should be some sort of guard or grating to prevent the entry into the chimney of charred paper and similar light substances which do not fall to dust, and which are sometimes carried up with the draught.

A six-celled destructor kiln burns about 42 tons of refuse in twenty-four hours, leaving about one-fourth of its bulk of clinkers and ashes. The clinkers are withdrawn from the furnaces five times each day and night, or about every two-and-a-half hours, into iron barrows, and wheeled outside the shed which covers the destructor, and when cold are wheeled back to the mortar mills, of which there are two at each depot, each having a revolving pan 8 feet in diameter, with 27-cwt. rollers, the pan making twenty two revolutions a minute. Forty shovelfuls of clinkers and twelve of slaked lime make 7 cwt. of mortar in thirty-five minutes in each pan, which is sold at 5s. 6d. per ton. The engine driving the two mortar mills has a 14 inch cylinder, 30 inches length of stroke, and makes sixty revolutions per minute with 45 pounds steam pressure per square inch in the boiler, when both mortar mills are running. The boiler is 11 feet long, 8 feet in diameter, and has 132 tubes 4 inches in external diameter, which, together with the external flues, are cleaned out once a month.

At first sight it would probably appear that no good mortar could be made from such refuse as has been described, but having passed through the furnace, the clinkers are, of course, perfectly clean, and with good lime make a really strong and excellent mortar. They are also largely used for the foundation of roadways.

The number of men employed is as follows: Two furnace men in the daytime and two at night. They work from midnight on Sundays to 2 P.M. on Saturdays, the fires being fully charged and left to burn through the Sundays. One foreman, who attends also to the running of the engine, and one mortar man. A watchman attends while the workmen are off.

In addition to a destructor, there is at the Burmautofts depot a "carbonizer" kiln, in which the sweepings of the vegetable markets are burned into charcoal. The carbonizer consists of eight vertical cells, in two sets or stacks of four, separated by a space containing two double furnaces, back to back, there being a double furnace also at each end of the eight cells. Each of the stacks of four cells is 15 feet 6 inches high; the ends and middle parts, forming the tops of the furnaces, being 6 feet high. The block of brick work containing the eight cells and furnaces is 26 feet 6 inches long and 12 feet 4 inches wide at the floor level. Each cell is 3 feet 6 inches by 2 feet, and about 10 feet deep, with a chamber below about 3 feet deep, into which the charred material falls and is completely burned. The top of the cells is level with the upper platform, and they are fed through a loose cover, which is immediately replaced. Inside the cells cast-iron sloping shelves are hung upon the walls so that their upper edges touch the walls, but the lower edges are some inches off, so that the hot air of the furnaces passes upward behind the shelves round the four sides of the cell in a spiral manner, and out near the top into a vertical flue, which conducts it down to the horizontal flue at the bottom, which leads to the chimney. The charcoal is withdrawn from the bottom of the heating chamber through a sliding plate 2 feet above the floor, and is wheeled red hot to the charcoal cooler, which is a revolving cylinder, nearly horizontal, kept cool by water falling upon it, and delivers the charcoal in two degrees of fineness at the end. It is worked by a small attached engine, supplied with steam from the boiler before mentioned. Each cell of the carbonizer can reduce to charcoal 50 cwt. of vegetable refuse in twenty four hours, but at Leeds not quite so much is put through. The quantity of market refuse passed through six cells of the carbonizer varies from 3 to 10 tons a day, and averages about 4½ tons, from which 15 cwt. of charcoal is obtained. The fuel for burning the charcoal is derived from the ash pit refuse, some selected loads being for that purpose passed over a sloping screen fixed between the upper platform and the furnace floor, the fine ashes which pass through the screen being taken away to the manure heaps, and the combustible parts to the furnaces of the carbonizer. In this way a good deal of the ash pit refuse is got rid of; it is often one-twelfth part of the whole quantity.

The carbonizer and the destructor are set 33 feet apart, to allow room for drawing the furnaces and for the mortar mills, but the space is hardly sufficient. One man is employed in attending to the carbonizer.

Besides the openings at the top of the destructor through which the ash pit refuse is fed into the cells, there is a larger opening in each cell, kept covered usually, through which bed mattresses ordered by the medical sanitary office to be destroyed can be put into the cells. These openings are midway between the central openings and the furnace doors, and whatever is put into the cells through these comes into immediate contact with the fire. Advantage is taken of these openings for the destruction of dead animals and diseased meat, and as much as 20 tons in a year have been passed through the destructor.

The whole works are roofed over. The lower floor is open on two sides, but the upper one is closed in, with weather boarding at Burmantofts and with corrugated iron at Armley Road. At the former place the works were in some measure experimental, and the platform was constructed of timber, but at Armley Road it is of plate-iron girders, with brick arching, weight being considered advantageous in reducing the vibration of carting heavy loads over it.

The cost of each depot has been £4,500, exclusive of land, of which about an acre is required for the destructor, carbonizer, inclined road, weigh office, and space. A supply of water is necessary, a good deal being required for cooling the clinkers. The population of the two districts belonging to these works is about 160,000.

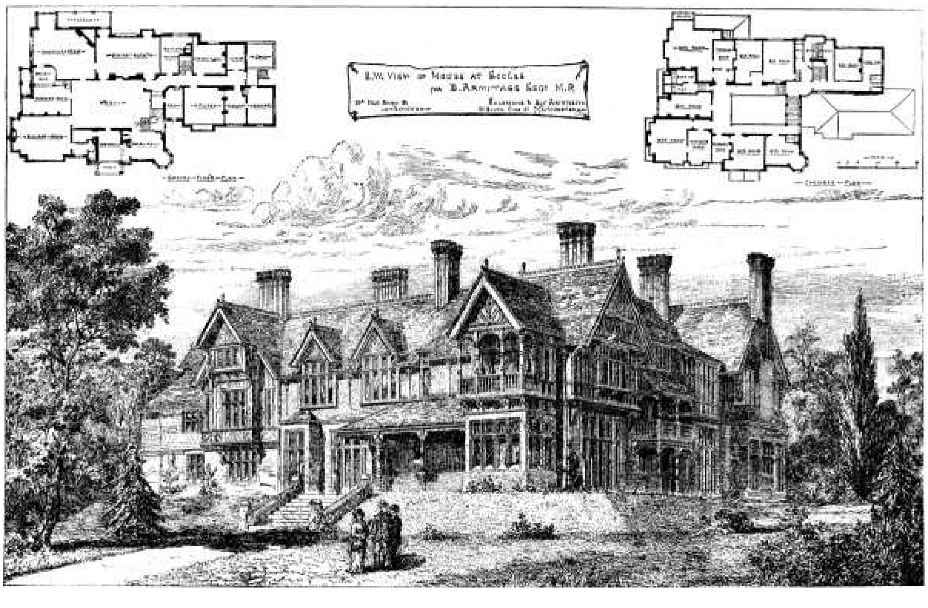
The author has no longer any connection with the works described, and for the recent experience of their working he is indebted to Mr. John Newhouse, the superintendent of the sanitary department of the corporation.

GREEN WOOD.

The specific volume of the different constituents of green woods has been estimated by M. Hartig to be as follows, per 1,000 parts: Hard green wood, fiber stuff, 441; water, 247; air, 312. Soft green wood, fiber stuff, 279; water, 317, air, 404. Evergreen wood, fiber stuff, 270; water, 335; air, 395. A certain amount of water--7 or 8 per cent in all--is included with the fiber stuff, showing that about one-third only of the mass of the wood is solid stuff; the remainder is either water or air space.

THE ARMITAGE HOUSE.

This house is now in course of erection under the superintendence of Messrs. Salomons and Ely, in the Claremont road, Pendleton, near Manchester. The walls are faced in the lower part with red bricks, and red stone, from the neighborhood of Liverpool, is used for the window-dressings, etc. The upper part of walls will be faced with red tiles and half-timber work, and the roof will be covered with Staffordshire tiles. Lead lights will be largely used in the windows. Internally, the finish will be almost entirely in real woods, including walnut for the dining-room and vestibule, pitch-pine for the large hall, staircase, and billiard-room, ash for the morning-room, and oak for Mr. Armitage's own room. In all these the ceilings and dados are to be in wood. The contract for the whole of the above work, amounting to £6,507, is let to Mr. James Herd, of Manchester.--*Building News*.



SUGGESTIONS IN ARCHITECTURE.--AN ENGLISH COUNTRY RESIDENCE.

THE COLLOTYPE PROCESS IN PRACTICE.

That theory and practice are two very different things holds good in photography especially, and perhaps in no other branch of our art have so many theoretical formulæ been promulgated as in the collotype or Lichtdruck process. As our readers are aware, we have had an opportunity of seeing collotype printing in operation in several European establishments of note, and have, from time to time, published in these columns our experiences. But requests still come to us so frequently for information on the process that we have deemed it well to make a practical summary for the benefit of those who are working--or desire to work--the method.

The formulæ and manipulations here set down are those of Löwy, Albert, Allgeyer, and Obernetter, four of the best authorities on the subject, and we can assure our readers there is nothing described but what is actually practiced.

Glass Plate for the Printing Block.--Herr Albert, of Munich, uses patent plate of nearly half an inch in thickness, as most of his work is printed upon the Schnell press (machine press). Herr Obernetter, of Vienna, since he only employs the slower and more careful hand press, prefers plate glass of ordinary thickness as being handier in manipulation and better adapted to the common printing-frame.

Herr Löwy, of Vienna, again, uses plate glass a quarter of an inch thick, as his productions range from the finest to the roughest.

Preliminary Coating of the Glass Plate.--Herr Albert's original plan was to apply a preliminary coating of bichromated gelatine to the thick glass plate, the film being exposed to light through the back of the glass, and thus rendered insoluble and tightly cemented to the surface; this film serving as a basis for the second sensitive coating, that was afterward impressed by the negative. This double treatment is now definitely abandoned in most Lichtdruck establishments, and, instead, a preliminary coating of soluble silicate and albumen dissolved in water is used.

Herr Löwy's method and formula are as follows: The glass plate is cleaned, and coated with--

```
Soluble glass.             3 parts.
White of egg.              7 "
Water.               9 to 10 "
```

The soluble glass must be free from caustic potash. The mixture, which must be used fresh, is carefully filtered, and spread evenly over the previously cleaned glass plate. The superfluous liquid is flowed off, and the film dried either spontaneously or by slightly warming. The film is generally dry in a few minutes, when it is rinsed with water, and again dried; at this stage the plate bears an open, porous film, slightly opalescent--so slight, however, as only to be observed by an experienced eye.

Application of the Sensitive Film.--We now come to the second stage of the process, the application of a film of bichromated gelatine to the plate.

Herr Löwy's formula is as follows:

```
Bichromate of potash.            16  grammes.
Gelatine.                         2½ ounces.
Water.                     20 to 22    "
```

According to the weather, the amount of water must be varied; but in any case the solution is a very fluid one. An ounce is about 35 grammes, as most of our readers know. A practical collotypist sees at a glance the quality of the prepared plate, without any preliminary testing. A good preliminary film is a glass that is transparent, yet slightly dull; the film is so thin, you can scarcely believe it is there. The plate is slightly warmed upon a slate slab, underneath which is a water bath; it is then flooded with the above mixture of bichromated gelatine, leaving only sufficient to make a very thin film. When coated, the plate is placed in the drying chamber.

Drying the Sensitive Film.--Much depends upon the drying. A water bath with gas burner underneath is used for heating, and a slate slab, perfectly level, receives the glass plate. The drying chamber is kept at an even temperature of 50° C.

The object to be attained is a fine grain throughout the surface of the gelatine, and unless this grain is satisfactory the finished printing block never will be. If the gelatine film be too thick, then the grain will be coarse; or, again, if the temperature in drying be too high, there will be no grain at all. The drying is complete in two or three hours, and should not take longer.

The Negative to be Printed from.--The sensitive film being upon the surface of a thick glass plate, it is necessary that the cliché or negative employed should be upon patent plate, or not upon glass at all, so as to insure perfect contact. Best of all, is to employ a stripped negative, in which case absolute contact is insured in printing. It is only in these circumstances that the most perfect impression can be secured. If the negative is otherwise satisfactory, and only requires stripping, it must be upon a leveling stand, and fluid gelatine of a tolerable consistence is poured over it. When dry, a pen-knife is run around the margin, and the film leaves the glass without any trouble.

Herr Obernetter says that many of the negatives he receives have to be reproduced before they can be transformed into Lichtdruck plates, and he employs either the wet collodion process or the graphite method, according to circumstances. If the copy is desired to be softer than the original, collodion is employed; if vigor be desired, graphite is used, and here is his formula:

```
Dextrine.                         62    grains.
Ordinary white sugar.             77       "
Bichromate of ammonia.            30.8     "
Water.                             3.21 ounces.
Glycerine.                    2 to 8    drops.
```

The film is dried at a temperature of 130° to 140° F. in about ten minutes, and while still warm is printed under a negative in diffused light for a period of five to fifteen minutes. In a well-timed print the image is slightly visible; the plate is again warmed a little above atmospheric temperature in a darkened room, and then fine levigated graphite is applied with a fine dusting brush, a sheet of white paper being held underneath to judge of the effect. Breathing upon the film renders it more capable of attracting the powder. When the desired vigor has been attained, the superfluous powder is dusted off, and the plate coated with normal collodion. Afterward the film is cut through at the margins of the plate by means of a sharp knife, and put into water. In a little while--from two to five minutes--the collodion, with the image, will be detached from the glass; the film is at once turned over in the water, and brought out upon the glass plate. Under a soft jet of water any air-bubbles that may exist between the collodion and the glass are removed, and then a solution of gum arabic (two grammes of gum dissolved in one hundred grammes of water) is poured over, and the film is allowed to dry spontaneously.

Exposure of the Printing Block under the Negative.--The exposure is very rapid. Any one conversant with photolithographic work will understand this. At any rate, every photographer knows that bichromated gelatine is much more rapid than the chloride of silver he generally has to do with.

There is no other way of measuring the exposure than by the photometer or personal experience, and the latter is by far the best.

After leaving the printing frame, the plate is immersed in cold water. Here it remains at discretion for half an hour, or an hour; the purpose, of course, being to wash out the soluble bichromate. It is when the print comes out of this bath that judgment is passed upon it. An experienced eye tells at once what it is fit for. If it is yellow, the yellowness must be of the slightest; indeed, Herr Furkl (the manager of Herr Löwy's Lichtdruck department) will not admit that a good plate is yellow at all. A yellow tint means that it will take up too much ink when the roller is passed over it. The plates of Herr Obernetter, however, are rather more yellow than Herr Löwy's--certainly only a tinge, but still yellow; and Herr Obernetter's work proves, at any rate, that the yellowish tinge is by no means inseparable from good results.

The washed and dried plate should appear like a design of ground and polished glass. The ground glass appearance is given by the grain. If there are pure high-lights (almost transparent) and opalescent shadows, the plate is a good one.

Printing from the Block.--We have now a printing-block ready for the press. If it is to be printed by machinery--that is to say, upon a Schnell press--the surface is etched; if it has to be more carefully handled in a hand press, etching is rarely resorted to; it is moistened only with glycerine and water. To etch a plate for a Schnell press, it is placed upon a leveling stand, and the following solution is poured upon it:

```
Glycerine............................ 150 parts.
Ammonia.............................. 50   "
Nitrate of potash (saltpeter)..........  5   "
Water................................ 25   "
```

Another equally good formula, recommended by Allgeyer, who managed Herr Albert's Lichtdruck printing for some years, is:

```
Glycerine............................ 500 parts.
Water................................ 500   "
Chloride of sodium (common salt)......  15   "
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In lieu of common salt, 15 parts of hyposulphite of soda, or other hygroscopic salt, such as chloride of calcium, may be employed.

The etching fluid is permitted to remain upon the image for half an hour. During this time, by gently moving the finger to and fro over the surface, the swelling or relief of the image can be distinctly felt. The plate is not washed, but the etching fluid simply poured off, so that the film remains impregnated with the glycerine and water; at the most, a piece of bibulous paper is used to absorb any superfluous quantity of the etching fluid. After etching, the plate is taken straight to the printing press. The inking up and printing are done very much as in lithography. If it requires a practiced hand to produce a good lithographic print, it stands to reason that in dealing with a gelatine printing block, instead of a stone, skill and practice are more necessary still. Therefore at this point the photographer should hand over the work to the lithographer, or rather the Lichtdruck printer. It is only by coaxing judiciously, with roller and sponge, that a good printing block can be obtained, and no amount of teaching theoretically can beget a good printer. To appreciate how skillful a printer must be, it is only necessary to see the imperfect proofs that first result, and to watch how these are gradually improved by dint of rolling, rubbing, etching, cleaning, etc. In all Lichldruck establishments, two kinds of rollers are used, viz., of leather and glue. In some establishments, too, they employ two kinds of ink; but Herr Löwy manages to secure delicacy and vigor at the same time by using one ink, but rolling up with two kinds of roller.

Collotype printing is not merely done by hand presses, but is also done by machinery. At Herr Albert's a gas engine of six-horse power is employed to drive the machines, and each machine requires the attention of a skilled mechanic and a girl. The press is very like the lithographic quick press. Upon a big steel bed lies the little collotype block. The glass printing block, with its brownish film of gelatine, moves horizontally to and fro, and, as it does so, passes under half a dozen rollers, which not only supply ink, but disperse it. Some of the rollers are of leather and others of glue, and, whenever the printing block retires from underneath them, an ink slab takes the place of the block, and imparts more ink to the rollers; sometimes as many as eight rollers are used, for the difficulty of machine printing is to apply the ink as delicately and equally as possible. It is necessary at intervals to damp the block, and when the printer in charge finds this to be the case, he stops the press, and applies a little glycerine and water with a cloth or sponge; then a leather roller is passed over to remove superfluous moisture, and the press is again started.

Herr Obernetter relies upon the Star or Stern press--a small lithographic press--one man sufficing to manage it, who turns a wheel with large spokes, reminding one of the steering wheel of a ship. The Lichtdruck plate, gelatine film upward, is laid upon a sheet of plate glass by way of a bed, the plate having first been treated with a solution of glycerine and water; it is then inked up as previously described, except that Herr Obernetter uses two kinds of ink--a thick one and a thin--applied by two rollers of glue. In the first place, a moist sponge is rubbed over the surface; then a soft roller covered with wash-leather, and of the appearance of crêpe, is passed over two or three times to remove surplus moisture; then a roller charged with thick ink is put on, and then another with thin is applied. It takes fully five minutes to sponge and roll up a plate, the rolling being done gently and firmly. A sheet of paper is now laid upon the plate, the tympan is lowered, and the scraper adjusted with due pressure; a revolution of the wheel completes the printing, the well-known scraping action of the lithographic press being used in the operation.

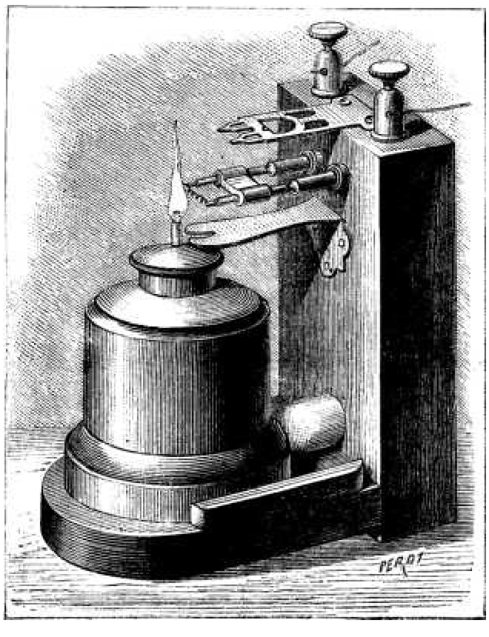


FIG. 1.--ORDINARY NAPHTHA LIGHTER OF MR. LOISEAU.

Some Lichtdruck prints are printed upon thick plate-paper, and are ready for binding without further ado, these being for book illustrations. Other pictures, that are to pass muster among silver photographs, are, on the other hand, printed upon fine thin paper, and then sized by dipping in a thin solution of gelatine; after drying, they are further dipped in a solution of shellac and spirit.--*Photo. News*.

DOMESTIC ELECTRICITY.

Among the most valuable, and, up to the present time, the least generally appreciated services that electricity can render for domestic purposes is that of its application in lighters. At the present epoch of indifferent matches, to have, instantaneously, a light by pulling a cord, pressing on a button, or turning a cock, is a thing worthy of being taken into serious consideration; and our own personal experience permits us to assert that, regarded from this point of view, electricity is capable of daily rendering inappreciable services.

According to the nature of the application that is to be made of them, the places in which they are to be put, and the combustible that they are to inflame, etc., electric lighters vary greatly in form and arrangement.

We shall limit ourselves here to pointing out the simplest and most practical of the numerous models of such apparatus that have been constructed up to the present time. All those that we shall describe are based on the incandescence of a platinum wire. A few have been constructed based on the induction spark, but they are more complicated and expensive, and have not entered into practical use. Before commencing to describe these apparatus, we shall make a remark in regard to the piles for working them, and that is that we prefer for this purpose Leclanché elements with agglomerated plates and a large surface of zinc. In order to bring about combustion in any given substance, it is necessary to bring near it an incandescent body raised to a certain temperature, which varies with the nature of the said substance, and which is quite low for illuminating gas, higher for petroleum, and a white heat for a wax taper or a candle. We have said that we make use exclusively of a platinum wire raised momentarily to incandescence by the passage of an electric current. The temperature of such wire will depend especially upon the intensity of the current traversing it; and, if this is too great, the platinum (chosen because of its inoxidizability and its elevated melting point) will rapidly melt; while, if the intensity is too little, the temperature reached by the wire will itself be too low, and no inflammation will be brought about. Practice soon indicates a means of obviating these two inconveniences, and teaches how each apparatus may be placed under such conditions that the wire will hardly ever melt, and that the lighting will always be effected. For the same intensity of current that traverses the wire, the temperature of the latter might be made to vary by diminishing or increasing its diameter. A very fine wire will attain a red heat through a very weak current, but it would be very brittle, and subject to break at the least accident. For this reason it becomes necessary to employ wires a little stronger, and varying generally from one to two-tenths of a millimeter in diameter. The current then requires to be a little intenser. The requisite intensity is easily obtained with elements of large surface, which have a much feebler internal resistance than porous-cup elements; and since, for a given number of elements, the intensity of the current decreases in measure as the internal resistance of the elements increases, it becomes of interest to diminish such internal resistance as much as possible. The platinum wires are usually rolled spirally, with the object in view of concentrating the heat into a small space, in order to raise the temperature of the wire as much as possible. There is thus need of a less intense current to produce the inflammation than with a wire simply stretched out. In fact, the same wire traversed by a current of constant intensity scarcely reaches a *red* heat when it is straight, while it attains a *white* heat when it is wound spirally, because, in the latter case, the cooling surface is less.

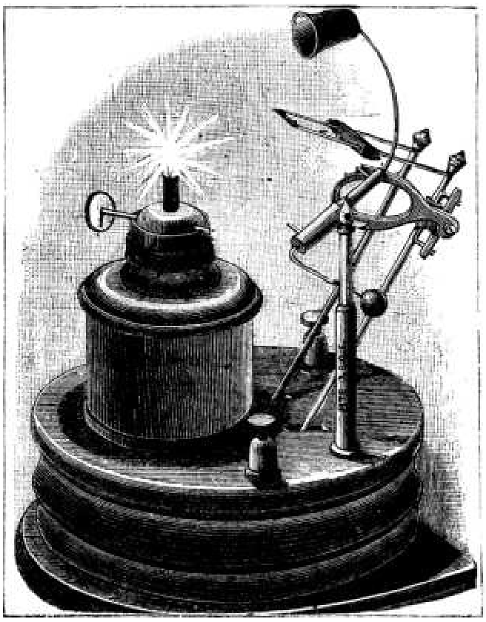


FIG. 2--RANQUE'S NEW FORM OF LIGHTER WITH EXTINGUISHER.

We shall now proceed to the examination of a few practical forms of electric lighters.

In Fig. 1 will be seen quite a convenient spirit or naphtha lighter, which has been devised more especially for the use of smokers. By pushing the lamp toward the wall, the wick is brought into proximity with the spiral, and the lamp, acting on a button behind it, closes the current. Pressure on the lamp being removed, the latter moves back slightly, through the pressure of a small spring which thrusts on the button. Owing to this latter simple arrangement, the spiral never comes in contact with the flame, and may thus last for a long time. Mr. Loiseau, the proprietor of this apparatus, employs a very fine platinum wire, flattened into the form of a ribbon, and it takes only the current from a *single element* to effect the inflammation of the wick. The system is so arranged that any one can easily replace in a moment the spiral that has accidentally got out of order; and, in order that this may be done, the maker has placed the spiral on a small, distinct piece that he styles the "conflagrator." The latter consists of two small, thin tubes of brass, held parallel and firmly by means of a brass cross-piece. A small bit of paper wound round each tube in front of the cross-brace insures insulation. The outer extremity of the two tubes supports the platinum spiral, which is fixed to them very simply by the aid of two small brass needles of conical form, which pinch the wire in the tube and hold it in place. There is nothing easier to do than replace the wire. All that is necessary is to remove the two little rods with a pair of pincers; to make a spiral of suitable length by rolling the wire round a pin; and to fix it into the tubes, as we have just explained. With two or three extra "conflagrators" on hand, there need never any trouble occur.

In Fig. 2 we show a new and simple form of Mr. Ranque's lighter, in which an electro-magnet concealed in the base brings the spiral and the wick into juxtaposition. The extinguisher, which is balanced by a counterpoise, oscillates about a horizontal axis, and its support carries two small pins, against which act successively two notches in a piece of oval form, fixed on the side of the movable rods.

In the position shown in the cut, on the first emission of a current the upper notch acts so as to depress the extinguisher, but the travel of the rods that carry the spiral is so limited that the latter does not strike against the extinguisher. On the next emission, the lower notch acts so as to raise the extinguisher, while the spiral approaches the wick and lights it. It is well to actuate these extinguishing-lighters, which may be located at a distance, not by a contact button, but by some pulling arrangement, which is always much more easy to find in the dark without much groping about. There might be used for such a purpose the very motion of the front door, when opened, for lighting the hall; but that would offer the inconvenience of operating likewise in the daytime, and of thus needlessly using up the pile and the naphtha. In all these spirit or naphtha lighters it is important that the spiral *shall not touch* the wick, but that it shall be placed a little above and on the side, in the mixture of air and combustible vapor.

Several apparatus have likewise been devised for lighting gas by electricity, and a few of these we shall describe.

The simplest form of these is Mr. Barbier's lighter for the use of smokers, for lighting candles, sealing letters, etc. It consists of a small gas-burner affixed to a round box, seven to eight centimeters in diameter, and connected to the gas-pipe by a rubber tube. By maneuvering the handle, the cock is opened and an electric contact set up of sufficient duration to raise to a red heat the spiral, and to light the gas. It is well in this case, for the sake of economizing in wire, to utilize the lead gas-pipe as a return wire, especially if the pile is located at some little distance from the lighter. In the arrangement generally in use the key is provided with a special spring, which tends to cause it to turn in such a way as to assume a vertical position, and with a tooth, which, on engaging with a piece moving on a joint, holds it in a horizontal position as soon as it has been brought thereto. In order to extinguish the burner, it is only necessary to depress the lever, and thus allow the key to assume again the vertical position, that is to say, the position that closes the aperture through which the gas flows out. In a new arrangement, the notch, spring, and the lever are done away with, the cock alone taking the two positions open or closed.

Another very ingenious system is that of Mr. Loiseau, consisting of an ordinary gas-burner (fish-tail, bat's-wing, etc.), carrying at its side a "conflagrator," analogous to that of the spirit-lighter (Fig. 1), but arranged vertically. One of the rods of the "conflagrator" is connected with the positive of the pile, and the other with the little horizontal brass rod which is placed at the bottom of the burner. On turning the cock so as to open it, a small flow of gas occurs opposite the platinum spiral, while at the same time a rigid projecting piece affixed to the cock bears against a small, vertical metallic piece, and brings it in contact with the brass rod. The circuit is thus closed for an instant, the spiral is raised to a red heat, and lights the gas, and the flame rises and finally lights the burner. It goes without saying that on continuing the motion the contact is broken, so as not uselessly to waste the pile and so as to stop the escape of gas.

For gas furnaces, Mr. Loiseau is constructing a *handle-lighter* which is connected with the side of the furnace by flexible cords. The contact button is on the sleeve itself, and the spiral is protected against shocks by a metallic covering which is cleft at the extremity and the points bent over at a right angle. All the lighters here described work well, and are rendering valuable services. They may be considered as the natural and indispensable auxiliaries of electric call bells, and their use has most certainly been rendered practical through the Leclanche pile.

THEILER'S TELEPHONE RECEIVER.

This telephone receiver differs from its predecessors in dispensing with an armature, the lateral vibration of the electro-magnet itself being utilized. In previous systems in which an electro-magnet is used, the sonorous vibrations are due either to the motion of an iron diaphragm or armature placed close to the poles of the electro-magnet, or to the expansion and contraction of the magnet itself. In Theiler's telephone the electro-magnet may be of the usual U-shape, and may consist either of soft iron or of hardened steel permanently magnetized, wound with a suitable number of turns of insulated wire. This electro magnet is fixed in such a manner that the vibration of either one or of both its limbs is communicated to a diaphragm or diaphragms The patentees also employ two or more electro-magnets in the same circuit, and utilize the vibration of both magnets in the manner described. By attaching a light disk or disks to the vibrating limbs, the diaphragm may be dispensed with. Fig. 1 represents one of the telephone receivers provided with two diaphragms or sounding boards, connected to the two limbs or cores of the U-shaped electro-magnet by short tongues. These tongues are firmly inserted in the diaphragms and fixed to the magnet, as shown. The poles of the electro-magnet are brought very close together by being shaped as shown, and the middle part of the magnet is firmly screwed to the case of the instrument. The ends of the helix surrounding the magnet cores may be attached as usual to two terminals, or soldered to a flexible conductor communicating with the other parts of the telephone apparatus. When a vibratory current is sent through the helix of the electro-magnet, the extremities are rapidly attracted and repelled, and this vibratory motion of the magnet cores being communicated to the diaphragms or sounding boards, the latter are set in vibration of varying amplitude produced by a current of varying strength, as in all other telephones. Instead of making the electro-magnet of one continuous piece of iron, as represented in Fig. 1, the patentees find it more practicable to make it of the form shown in Fig. 2, where the electro-magnet represented consists of two limbs or cores, a sole piece, and pole extensions, the whole being screwed together, and practically constituting one continuous piece of iron carrying the two coils. In Fig. 2 only one of the limbs or cores of the electro-magnet is attached to the diaphragm, the other limb being held fixed by a screw. Sometimes the patentees hinge one of the magnet cores, or both, in the sole piece, in which case the diaphragms or sounding boards can be made much thicker than when the cores are rigidly fixed to the sole piece, because the magnetic attraction of the poles has then only to overcome the resistance of the diaphragm. Instead of using a diaphragm, they sometimes fix a stem to one of the cores of the electro-magnet, and mount thereon a light disk of vulcanite, wood, ivory, gutta-percha, or any other substance which it is capable of vibrating. When using this telephone receiver, the disk is pressed to the ear in such a manner that its surface covers the aperture of the ear. When these telephone receivers are used on a line of some considerable length, the patentees prefer to magnetize the electro-magnet by a constant current from a local battery, and to effect the variation of this constant magnetization inductively and not directly. The electro-magnet is, then, not inserted in the line at all, but in the primary circuit of an induction coil, and connected with a local battery. The line is connected to the secondry circuit of the induction coil. This device possesses the advantage that the electro-magnet can be powerfully magnetized with very little battery power, no matter how long the line may be, and that steel magnets are entirely dispensed with. It is not necessary to have a separate battery for this purpose, as the microphone battery may also be used for the telephone receiver. The shape of the vibrating electro-magnets is immaterial, as they may be made of a variety of forms.--*Eng. Mechanic*.

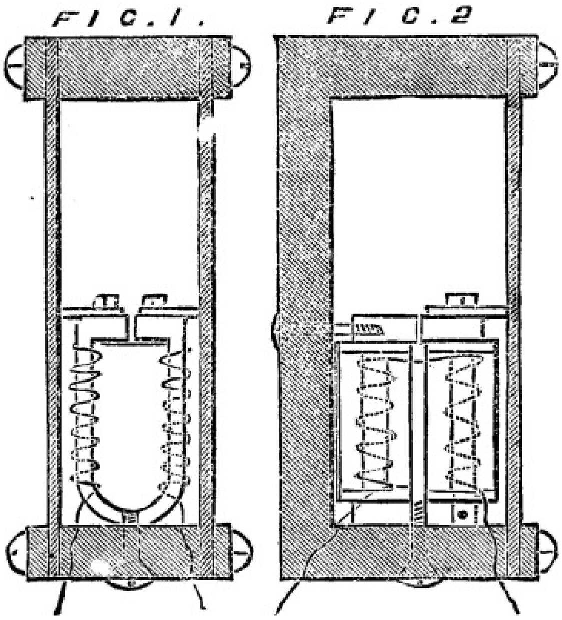


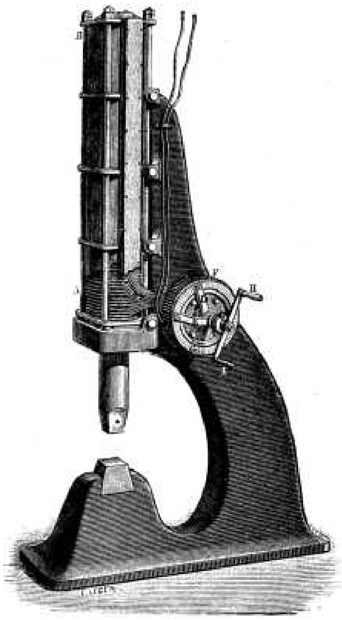
FIG. 1. FIG. 2

ON AN ELECTRIC POWER HAMMER.

By MARCEL DEPREZ.

[Footnote: *La Lumiére Electrique*.]

In a lecture delivered by me on the 15th of last June in the amphitheater of the Conservatoire des Arts et Metiers, on the application of electricity to the production, transmission, and division of power, I operated for the first time an electric power hammer that I shall here describe. Its essential part is a sectional solenoid that I have likewise made an application of in an electric motor which I presented in July, 1830, to the Societé de Physique. Let us suppose we superpose, one on the other, a hundred flat bobbins of a centimeter in thickness in such a way as to form a single solenoid one meter in height, and that the incoming and outgoing wires of each of them be connected with the contiguous bobbins exactly in the same way as they are in the consecutive sections or a dynamo-electric machine ring. Finally, let us complete the resemblance by causing each junction of the wire of one of the bobbins with the wire of its neighbor to end in a metallic plate set into an insulating piece containing as many plates as there are bobbins, plus one. Over this species of collector, which maybe rectilinear or wound around a cylinder, let us pass two brushes fixed to an insulating piece that may be moved by hand. Now, if we place these two brushes at a distance such that the number of the plates of the collector included between them be, for example, equal to ten, and we give them any degree of displacement whatever, after rendering them interdependent, the current entering through one of these brushes and making its exit through the other will always traverse 10 bobbins. Everything will occur, then, as if we caused the ten-bobbin solenoid to move instead of the brushes. This granted, and the brushes being in any position whatever, let us send a current into the apparatus, and place therein a soft iron cylinder. By virtue of a well known law, such cylinder will remain suspended in the interior of the solenoid, and its longitudinal center will place itself at so much the greater distance from that of the solenoid the more the current increases in intensity. It would even fall entirely if the current had not an intensity above a minimum value dependent upon many elements concerning which we have not now to occupy ourselves. We will suppose the current intense enough to keep the distance of the two centers much below that which would bring about a fall of the cylinder. When such a condition is fulfilled, it is found that if we try to remove the iron cylinder from the equilibrium that it is in, we must apply a pressure that increases with the amount of separation, just exactly as if it were suspended from a spring. It results from this fact that if we displace the brushes a distance equal to the thickness of one plate of the collector, the active solenoid will undergo the same displacement, and its longitudinal center will move away from that of the iron cylinder, and that the attraction exerted upon the latter will increase. It will not be able to assume its first value, and equilibrium cannot be re-established unless the cylinder undergoes a displacement identical with that of the solenoid. Now, as this latter depends upon the motion communicated to the system of brushes, we see that, definitively, the cylinder will faithfully reproduce the motion communicated to the brushes by the hand of the operator. This apparatus, then, constitutes a genuine electric servo-motor in which the current is never interrupted nor modified in quantity or direction, no more indeed than the magnetization developed in the soft iron cylinder. Everything takes place as if the iron cylinder were suspended in a solenoid ten centimeters in length that was caused to rise and fall; with the difference that the weight of the cylinder exerts no action on the hand of the operator.



ELECTRIC POWER HAMMER.

These explanations being understood, there remain but few things to be said to cause the operation of the hammer to be thoroughly comprehended. The elementary sections constituting the electric cylinder, A B, of the hammer are 80 in number, and form a total length of one meter. Their ingoing and outcoming wires end in a collector of circular form shown at F G. The brushes are replaced by two strips, C E and C D, fixed to the double winch, H C I, which is movable around the fixed center, C. They can make any angle whatever with each other, so that by trial there maybe given the active solenoid the most suitable length. When such angle has been determined, the angle, E C D, is rendered invariable by means of a set screw, and the apparatus is maneuvered by imparting to the double winch, H C I, an alternating circular motion.

The iron cylinder weighs 23 kilogrammes; but, when the current has an intensity of 43 amperes and traverses 15 sections, the stress developed may reach 70 kilogrammes; that is to say, three times the weight of the hammer. So this latter obeys with absolute docility the motions of the operator's hands, as those who were present at the lecture were enabled to see.

I will incidentally add that this power hammer was placed on a circuit derived from one that served likewise to supply three Hefner-Alteneck machines (Siemens D_5 model) and a Gramme machine (Breguet model P.L.). Each of these machines was making 1,500 revolutions per minute and developing 25 kilogrammeters per second, measured by means of a Carpentier brake. All these apparatus were operating with absolute independence, and had for generator the double excitation machine that figured at the Exhibition of Electricity.

In an experiment made since then, I have succeeded in developing in each of these four machines 50 kilogrammeters per second, whatever was the number of those that were running; and I found it possible to add the hammer on a derived circuit without notably affecting the operation of the receivers.

It results from this that with my system of double excitation machine I have been enabled to easily run with absolute independence six machines, each giving a two-third horse-power. The economic performance, e/E, moreover, slightly exceeded 0.50.

SOLIGNAC'S NEW ELECTRIC LAMP.

When it becomes a question of practical lighting, it is very certain that the best electric lamp will be the one that is most simple and requires the fewest mechanical parts. It is to such simplicity that is due all the success of the Jablochkoff candle and the Reynier-Werdermann lamp. Yet, in the former of these lamps, it is to be regretted that the somewhat great and variable resistance opposed to the current in its passage through two carbons that keep diminishing in length, in measure as they burn, proves a cause of loss of light and of variation in it. And it is also to be regretted that the duration of combustion of the carbons is not longer; and, finally, it is allowable to believe that the power employed in volatilizing the insulator placed between the carbons is prejudicial to the economical use of this system. In order to obviate this latter inconvenience, an endeavor has been made in the Wilde candle to do away with the insulator, but the results obtained have scarcely been encouraging. An endeavor has also been made to render the duration of the carbons greater by employing quite long ones, and causing these to move forward successively through the intermedium of a species of rollers, or of counterpoises, as in the lamps of Mersanne and Werdermann; but then the system becomes more complicated. Finally, in order to keep the resistance of the carbons at a minimum and constant, their contact with the rheophores of the circuit has been established at a short distance from the arc, and this is one of the principal advantages possessed by the Reynier-Werdermann system. At a certain epoch it was thought that the problem might be simply solved by arranging in front of each other two carbons actuated by a spiral spring, as in car lamps, and kept at a proper distance apart for forming the electric arc by two funnel-shaped pieces of calcined magnesia, into which they entered like a wedge in measure as their conical point were away through combustion. This was the system of Mr. De Baillehache, and the trials that were made therewith were very satisfactory. But, unfortunately, the magnesia was not able to resist very long the temperature to which it was submitted. The problem found a better solution in the sun-lamp but has been solved in another manner, and just as simply, by Mr. Solignac, and the results obtained by him have been very satisfactory as regarded from the standpoint of steadiness of the luminous point.

In this system, a general view of which is given in Fig. 1, and the arrangement in Figs. 2 and 3, the carbons, F F, which are horizontal and about fifty centimeters in length, are thrust toward each other by two barrels, K, K, which wind up two chains, E, E, passing around the pulleys, D, D, fitted to the extremities of the carbons. These latter are provided beneath with small glass rods, G, G, whose extremities toward the arc abut at a short distance from the latter against a nickel stop, L (Fig. 3), which supports them, moreover, at M, by means of a tappet whose position is regulated by a screw. The current is transmitted to the carbons by two friction rollers, I, I, which serve at the same time as a guide for them, and which give the electric flux a passage of only one or two centimeters over the front of the carbon to form the arc. Finally, the whole is held by a support, A, and two pieces, CB, CB, which at the same time lead the current to the friction rollers through projections, J. The two systems are made to approach or recede from each other, in order to form the arc, by means of a regulating screw, H.

At present, the lighting of these lamps is effected by means of this screw, H, but Mr. Solignac is now constructing a model in which the lighting will be performed automatically by means of a solenoid that will react upon a carbon lighter, as in several already well known systems.

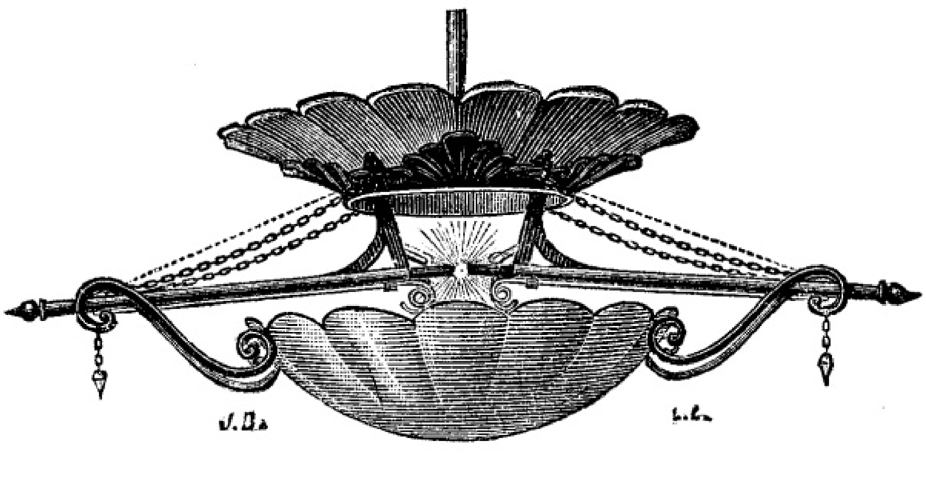


Fig. 1

If the preceding description has been well-understood, it will be seen that the carbons are arrested in their movement toward each other only by the glass rods, G, abutting against L; but, as the stops, L, are not far from the arc, and as the heat to which they are exposed is so much the greater in proportion as the incandescent part of the carbons is nearer them, it results that for a certain elongation of the arc the temperature becomes sufficient to soften the glass of the rods, G, G, so that they bend as shown at O (Fig. 3), and allow the carbons to move onward until the heat has sufficiently diminished to prevent any further softening of the glass. In measure as the wearing away progresses, the preceding effects are reproduced; and, as these are produced in an imperceptible and continuous manner, there is perceived no jumping nor inconstancy in the light of the arc. Under such conditions, then, the regulation of the arc is effected under the very influence of the effect produced; and not under that of an action of a different nature (electro-magnetism), as happens in other regulators. It is certain that this idea is new and original, and the results that we have witnessed from it have been very satisfactory. There is but one regulation to perform, and that at the beginning, but this once done the apparatus operates with certainty, and for a long time. With a Meritens machine of the first model it has been found possible to light five lamps of this kind placed in the same circuit.

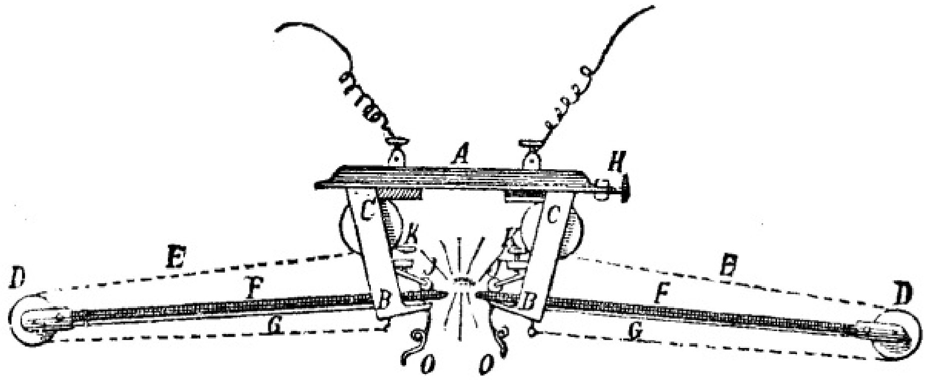


Fig. 2

According to the inventor, this lamp will give a light of 100 carcels per one horse-power, and with a three horse-power six lamps may be lighted; but we have made no experiments to ascertain the correctness of these figures.

As for the cost of the glass rods, that amounts to one franc per two hundred meters length. They can, then, be considered only as an insignificant expense in the cost of the carbons. We consequently believe that it will be possible to employ this system advantageously in practice.--*Th. du Moncel*.

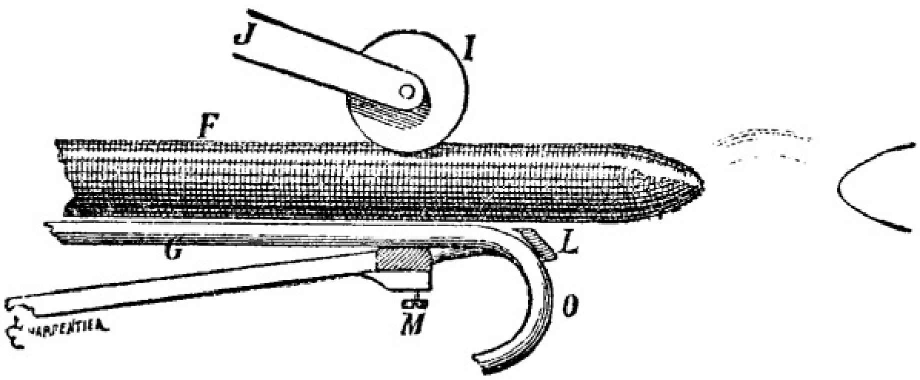


Fig. 3

MONDOS'S ELECTRIC LAMP.

Since the month of May last, the concert at the Champs Elysées has been lighted by sixteen voltaic arc lamps on a new and very simple system, which gives excellent results in the installation under consideration. The sixteen lamps are on the divisible system, and their regulation is based upon the principle of derivation. They are supplied by a Siemens alternating current machine and arranged in four circuits, on each of which are mounted four lamps in series. The accompanying figures will allow the reader to readily understand the system, which is as simple as it is ingenious, and which has been combined by Mr. Mondos so as to obtain a continuous and independent regulation of each lamp.

In this system the lower carbon is stationary, the luminous point descending in measure as the carbons wear away through combustion. The upper carbon descends by its own weight, and imperceptibly, so as to keep the arc at its normal length.

The mechanism that controls the motions of the upper rod that supports the carbon-holder consists of two bobbins of fine wire, E (Fig. 2), mounted on a derived circuit on the terminals of the lamp; of a lever, L, articulated at O, and supporting a tube, TT', and the whole movable part balanced by a counterpoise, P. This lever, P, carries two soft iron cores, F, which enter the bobbins, E, and become magnetized under the influence of the current that passes through them. The upper part of the tube, T, carries a square upon which is articulated at O' a second lever, L', balanced by a second counterpoise, P', and carrying a flat armature, *p*, opposite the cores, F', that are fixed to the first horizontal lever, L. The carbon-holder rod, CC', slides freely in the tube, TT', and is wedged therein by a small piece, *a m l*, fixed to the lever, L'. For this reason the tube, TT', is provided with a notch opposite the piece *a m l*, and the two arms, *a* and *m*, of the latter are shaped like a V, as may be seen in part in the plan in Fig. 2. It is now easy to understand how the system operates; when the current is not traversing the circuit, the carbons are separated; but, at the moment the circuit is closed for lighting a series of lamps, it traverses the electro-magnet, which then becomes very powerful, and draws down the cores, F, along with the lever, L, the tube, TT', and the carbon-holder, CC', and brings the carbons in contact. The arc then forms, and the current divides between the arc and the bobbins, E. Its action upon the cores, F, becomes weak, and it can no longer balance the counterpoise, P, which falls back, and raises the system again. The arc thus becomes *primed*. The cores, F, however, preserve a certain amount of magnetization; the armature, *p*, is attracted, and the lever, L', assumes a position of equilibrium such that the piece, *a m l*, wedges the rod, CC', in the tube, TT', and holds it suspended. When, through wear of the carbons, the arc elongates, a greater portion of the current passes into the bobbins, E, the armature, *p*, is attracted with more force, and the lever, L', swings around the point, O'. The rotation of L' separates the piece, *a m l*, from the rod, CC', which, being thus set free, slides by its own weight and shortens the arc. The current then becomes weak in E, the armature, *p*, is not so strongly attracted, the lever, L', pivots slightly around O' under the action of the weight, P', and the brake or wedge enters the notch anew, and stops the descent of the carbon. In practice, the motions that we have just described are exceedingly slight; the carbon moves imperceptibly, and the length of the arc remains invariable.

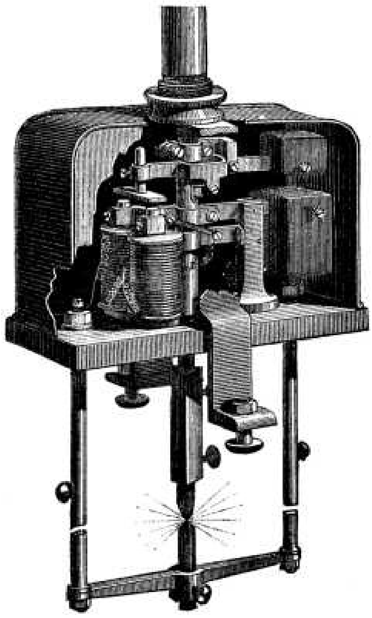


Fig. 1--MONDOS'S ELECTRIC LAMP.

It will be seen, then, that the lever, L, and the tube, TT', serve exclusively for *lighting*, and the lever, L', exclusively for regulating the distance of the carbons.

This lamp exhibits great elasticity, and can operate, without a change of any part of its mechanism, with currents of very different intensities. It suffices for obtaining a proper working of the apparatus in each case, to regulate the distance from the weight, P', to the point of suspension, O', and the distance from the armature, *p*, to the cores, F. At the Champs Elysées concerts the lamps are operating with alternating currents; but they are capable of operating with continuous ones also, although the slight tremor of the electro-magnetic system, due to the use of alternating currents and as a consequence of rapid changes of magnetization, seems in principle very favorable to systems in which the descent of the carbon is based upon friction instead of a clutch. At the Champs Elysées concerts the lamps burn crayons of 9 to 10 millimeters with a current of 9 to 10 amperes and an effective electro-motive power of 60 volts per lamp. The light is very steady, and the effect produced is most satisfactory. The dispensing with all clock-work movement and regulating springs makes this electric lamp of Mr. Mondos a simple and plain apparatus, capable of numerous applications in the industries, in wide, open spaces, in all cases where foci of medium intensity have to be employed, and where it is desired to arrange several lamps in the same circuit.--*La Nature*.

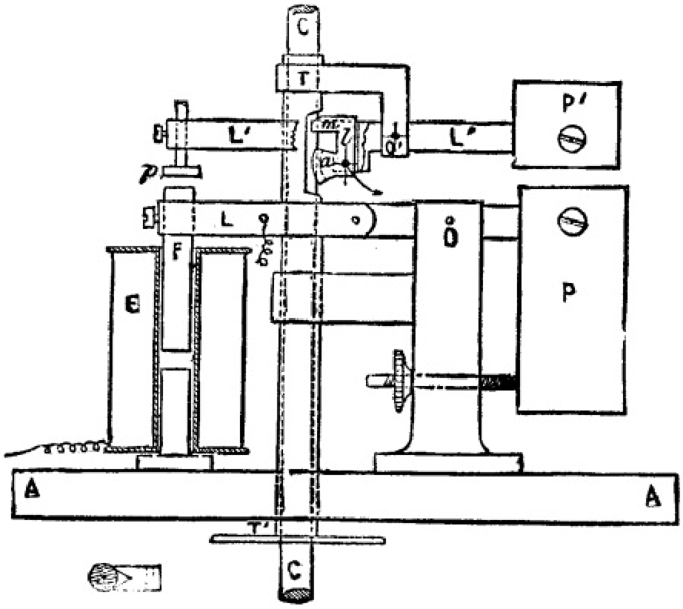


Fig. 2--REGULATING MECHANISM.

[AMERICAN POTTERY AND GLASSWARE REPORTER.]

ALUMINUM--ITS PROPERTIES, COST, AND USES.

Aluminum is a shining, white, sonorous metal, having a shade between silver and platinum. It is a very light metal, being lighter than glass and only about one-fourth as heavy as silver of the same bulk. It is very malleable and ductile, and is remarkable for its resistance to oxidation, being unaffected by moist or dry air, or by hot or cold water. Sulphureted hydrogen gas, which so readily tarnishes silver, forming a black film on the surface, has no action on this metal.

Next to silica, the oxide of aluminum (alumina) forms, in combination, the most abundant constituent of the crust of the earth (hydrated silicate of alumina, clay).

Common alum is sulphate of alumina combined with another sulphate, as potash, soda, etc. It is much used as a mordant in dyeing and calico printing, also in tanning.

Aluminum is of great value in mechanical dentistry, as, in addition to its lightness and strength, it is not affected by the presence of sulphur in the food--as by eggs, for instance.

Dr. Fowler, of Yarmouthport, Mass., obtained patents for its combination with vulcanite as applied to dentistry and other uses. It resists sulphur in the process of vulcanization in a manner which renders it an efficient and economical substitute for platinum or gold.

Aluminum is derived from the oxide alumina, which is the principal constituent of common clay. Lavoissier, a celebrated French chemist, first suggested the existence of the metallic bases of the earths and alkalies, which fact was demonstrated twenty years thereafter by Sir Humphry Davy, by eliminating potassium and sodium from their combinations; and afterward by the discovery of the metallic bases of baryta, strontium, and lime. The earth alumina resisting the action of the voltaic pile and the other agents then used to induce decomposition, twenty years more passed before the chloride was obtained by Oerstadt, by subjecting alumina to the action of potassium in a crucible heated over a spirit lamp. The discovery of aluminum was at last made by Wohler in 1827, who succeeded in 1846 in obtaining minute globules or beads of this metal by heating a mixture of chloride of alumina and sodium. Deville afterward conducted some experiments in obtaining this metal at the expense of Napoleon III., who subscribed £1,500, and was rewarded by the presentation of two bars of aluminum. The process of manufacture was afterward so simplified that in 1857 its price at Paris was about two dollars an ounce. It was at first manufactured from common clay, which contains about one-fourth its weight of aluminum, but in 1855 Rose announced to the scientific world that it could be obtained from a material called "cryolite," found in Greenland in large quantities, imported into Germany under the name of "mineral soda," and used as a washing soda and in the manufacture of soap. It consists of a double fluoride of aluminum, and only requires to be mixed with an excess of sodium and heated, when the mineral aluminum at once separates. Its cost of manufacture is given in this estimate for one pound of metal: 16 lb. of cryolite at 8 cents per pound, $1.28: 2½ lb. metallic sodium at about 26 cents per pound, 70 cents; flux and cost of reduction, $2.02; total, $4.

Aluminum is used largely in the manufacture of cheap jewelry by making a hard, gold-colored alloy with copper, called aluminum bronze, consisting of 90 per cent. of copper and 10 per cent. of aluminum. Like iron, it does not amalgamate directly with mercury, nor is it readily alloyed with lead, but many alloys with other metals, as copper, iron, gold, etc., have been made with it and found to be valuable combinations. One part of it to 100 parts of gold gives a hard, malleable alloy of a greenish gold color, and an alloy of ¾ iron and ¼ aluminum does not oxidize when exposed to a moist atmosphere. It has also been used to form a metallic coating upon other metals, as copper, brass, and German silver, by the electro-galvanic process. Copper has also been deposited, by the same process, upon aluminum plates to facilitate their being rolled very thin; for unless the metal be pure, it requires to be annealed at each passage through the rolls, and it is found that its flexibility is greatly increased by rolling. To avoid the bluish white appearance, like zinc, Dr. Stevenson McAdam recommends immersing the article made from aluminum in a heated solution of potash, which will give a beautiful white frosted appearance, like that of frosted silver.

F.W. Gerhard obtained a patent in 1856, in England, for an improved means of obtaining aluminum metal, and the adaptation thereof to the manufacture of certain useful articles. Powdered fluoride of aluminum is placed alone or in combination with other fluorides in a closed furnace, heated to a red heat, and exposed to the action of hydrogen gas, which is used as a reagent in the place of sodium. A reverberating furnace is used by preference. The fluoride of aluminum is placed in shallow trays or dishes, each dish being surrounded by clean iron filings placed in suitable receptacles; dry hydrogen gas is forced in, and suitable entry and exit pipes and stop-cocks are provided. The hydrogen gas, combining with the fluoride, "forms hydrofluoric acid, which is taken up by the iron and is thereby converted into fluoride of iron." The resulting aluminum "remains in a metallic state in the bottom of the trays containing the fluoride," and may be used for a variety of manufacturing and ornamental purposes.

The most important alloy of aluminum is composed of aluminum 10, copper 90. It possesses a pale gold color, a hardness surpassing that of bronze, and is susceptible of taking a fine polish. This alloy has found a ready market, and, if less costly, would replace red and yellow brass. Its hardness and tenacity render it peculiarly adapted for journals and bearings. Its tensile strength is 100,000 lb., and when drawn into wire, 128,000 lb., and its elasticity is one-half that of wrought iron.

General Morin believes this alloy to be a perfect chemical combination, as it exhibits, unlike the gun metal, a most complete homogeneousness, its preparation being also attended by a great development of heat, not seen in the manufacture of most other alloys. The specific gravity of this alloy is 7.7. It is malleable and ductile, may be forged cold as well as hot, but is not susceptible of rolling; it may, however, be drawn into tubes. It is extremely tough and fibrous.

Aluminum bronze, when exposed to the air, tarnishes less quickly than either silver, brass, or common bronze, and less, of course, than iron or steel. The contact of fatty matters or the juice of fruits does not result in the production of any soluble metallic salt, an immunity which highly recommends it for various articles for table use.

The uses to which aluminum bronze is applicable are various. Spoons, forks, knives, candle-sticks, locks, knobs, door-handles, window fastenings, harness trimmings, and pistols are made from it; also objects of art, such as busts, statuettes, vases, and groups. In France, aluminum bronze is used for the eagles or military standards, for armor, for the works of watches, as also watch chains and ornaments. For certain parts, such as journals of engines, lathe-head boxes, pinions, and running gear, it has proved itself superior to all other metals.

Hulot, director of the Imperial postage stamp manufactory in Paris, uses it in the construction of a punching machine. It is well known that the best edges of tempered steel become very generally blunted by paper. This is even more the case when the paper is coated with a solution of gum arabic and then dried, as in the instance of postage stamp sheets. The sheets are punched by a machine the upper part of which moves vertically and is armed with 300 needles of tempered steel, sharpened in a right angle. At every blow of the machine they pass through the holes in the lower fixed piece, which correspond with the needles, and perforate five sheets at every blow. Hulot now substitutes this piece by aluminum bronze. Each machine makes daily 120,000 blows, or 180,000,000 perforations, and it has been found that a cushion of the aluminum alloy was unaffected after some months' use, while one of brass is useless after one day.

Various formulæ are given for the production of alloys of aluminum, but they are too numerous and intricate to enter into here.

DETERMINATION OF POTASSA IN MANURES.

By M.E. DREYFUS.

The method generally adopted for the determination of potassa in manures, i. e., the direct incineration of the sample, may in certain cases occasion considerable errors in consequence of the volatilization of a portion of the potassium products.

To avoid this inconvenience, the author proposes a preliminary treatment of the manure with sulphuric acid at 1.845 sp. gr., to convert potassium nitrate and chloride into the fixed sulphate. The sulphuric acid attacks the manure energetically, and much facilitates the incineration, which may be effected at a dark red heat. The ignited portion (10 grms.) is exhausted with boiling distilled water acidulated with hydrochloric acid, and the filtrate, when cold, is made up to 500 c. c. Of this solution 50 c c., representing 1 grm. of the sample, are taken, and, after being heated until close upon ebullition, baryta-water is added until a strong alkaline reaction is obtained. The sulphuric and phosphoric acids, alumina, magnesia, etc, are thus precipitated. The filtrate is heated to a boil, and mixed with ammonia and ammonium carbonate, to precipitate the excess of baryta in solution. The last traces of lime are eliminated by means of a few drops of ammonium oxalate. The filtrate is evaporated down on the water-bath, and the ammoniacal salts are expelled by carefully raising the temperature to dull redness. After having taken up the residue in distilled water it is treated with platinum chloride, and the potassium chloro-platinate obtained is reduced with oxalic acid. The quantity of potassa present in the manure can be calculated from the weight of platinum obtained.--*Bull. de la Soc. Chim. de Paris*.

THE ORIGIN AND RELATIONS OF THE CARBON MINERALS.

[Footnote: Read before the New York Academy of Sciences, February 6, 1882.]

By J.S. NEWBERRY.

What are called the carbon minerals--peat, lignite, coal, graphite, asphalt, petroleum, etc.--are, properly speaking, not minerals at all, as they are organic substances, and have no definite chemical composition or crystalline forms. They are, in fact, chiefly the products or phases of a progressive and inevitable change in plant-tissue, which, like all organic matter, is an unstable compound and destined to decomposition.

In virtue of a mysterious and inscrutable force which resides in the microscopic embryo of the seed, a tree begins its growth. For a brief interval, this growth is maintained by the prepared food stored in the cotyledons, and this suffices to produce and to bring into functional activity--some root-fibrils below and leaves above, with which the independent and self-sustained life of the individual begins. Henceforward, perhaps for a thousand years, this life goes on, active in summer and dormant in winter, absorbing the sunlight as a motive power which it controls and guides. Its instruments are the discriminating cells at the extremities of the root-fibrils, which search for, select, and absorb the crude aliment adapted to the needs of the plant to which they belong, and the chlorophyl cells--the lungs and stomach of the tree--in the leaves. During all the years of the growth of the plant, these organs are mainly occupied in breaking the strongly riveted bonds that unite oxygen and carbon in carbonic acid; appropriating the carbon and driving off most of the oxygen. In the end, if the tree is, e. g., a *Sequoia*, some hundreds of tons of solid, organized tissue have been raised into a column hundreds of feet in height, in opposition to the force of gravitation and to the affinities of inorganic chemistry.

The time comes, however, sooner or later, when the power which has created and the life that has pervaded this wonderful structure abandon it. The affinities of inorganic chemistry immediately reassert themselves, in ordinary circumstances rapidly tearing down the ephemeral fabric.

The disintegration of organic tissue, when deserted by the force which has animated and preserved it, gives rise to the phenomena which form the theme of this paper.

Most animal-tissue decomposes with great rapidity, and plant tissue, when not protected, soon decays. This decay is essentially oxidation, since its final result is the restoration to the atmosphere of carbonic acid, which is broken up in plant-growth by the appropriation of its carbon. Hence it is a kind of combustion, although this term is more generally applied to very rapid oxidation, with the evolution of sensible light and heat. But, whether the process goes on rapidly or slowly, the same force is evolved that is absorbed in the growth of plant-tissue; and by accelerating and guiding its evolution, we are able to utilize this force in the production at will of heat, light, and their correlatives, chemical affinity, motive power, electricity, and magnetism. The decomposition of plants may, however, be more or less retarded, and it then takes the form of a destructive distillation, the constituents reacting upon each other, and forming temporary combinations, part of which are evolved, and part remain behind. Water is the great extinguisher of this as of the more rapid oxidation that we call combustion; and the decomposition of plant-tissue under water is extremely slow, from the partial exclusion of oxygen. Buried under thick and nearly impervious masses of clay, where the exclusion of oxygen is still more nearly complete, the decomposition is so far retarded that plant-tissue, which is destroyed by combustion almost instantaneously, and if exposed to "the elements"--moisture with a free access of oxygen--decays in a year or two, may be but partially consumed when millions of years have passed. The final result is, however, inevitable, and always the same, viz., the oxidation and escape of the organic mutter, and the concentration of the inorganic matter woven into its composition--in it, but not of it--forming what we call the ash of the plant.

Since the decomposition of organic matter commences the instant it is abandoned by the creative and conservative vital force, and proceeds uninterruptedly, whether slowly or rapidly, to the final result, it is evident that each moment in the progress of this decomposition presents us with a phase of structure and composition different from that which preceded and from that which follows it. Hence the succession of these phases forms a complete sliding scale, which is graphically shown in the following diagram, where the organic constituents of plant tissue--carbon, hydrogen, oxygen, and nitrogen--appear gradually diminishing to extinction, while the ash remains nearly constant, but relatively increasing, till it is the sole representative of the fabric.

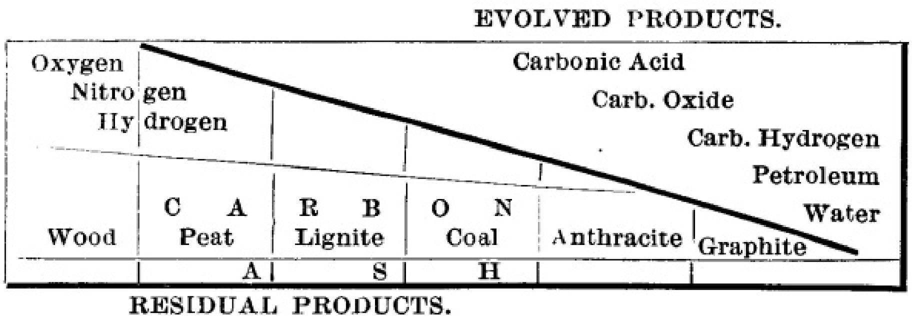


DIAGRAM SHOWING THE GENETIC RELATIONS OF THE CARBON MINERALS.

We may cut this triangle of residual products where we please, and by careful analysis determine accurately the chemical composition of a section at this point, and we may please ourselves with the illusion, as many chemists have done, that the definite proportions found represent the formula of a specific compound; but an adjacent section above or below would show a different composition, and so in the entire triangle we should find an infinite series of formulae, or rather no constant formulae at all. We should also find that the slice, taken at any point while lying in the laboratory or undergoing chemical treatment, would change in composition, and become a different substance.

In the same way we can snatch a brand from the fire at any stage of its decomposition, or analyze a decaying tree trunk during any month of its existence, and thus manufacture as many chemical formulae as we like, and give them specific names; but it is evident that this is child's play, not science. The truth is, the slowly decomposing tissue of the plants of past ages has given us a series of phases which we have grouped under distinct names, and we have called one group peat, one lignite, another coal, another anthracite, and another graphite. We have spaced off the scale, and called all within certain lines by a common name; but this does not give us a common composition for all the material within these lines. Hence we see that any effort to define or describe coal, lignite, or anthracite accurately must be a failure, because neither has a fixed composition, neither is a distinct substance, but simply a conventional group of substances which form part of an infinite and indivisible series.

But this sliding scale of solid compounds, which we designate by the names given above, is not the only product of the natural and spontaneous distillation of plant tissue. Part of the original organic mass remains, though constantly wasting, to represent it; another part escapes, either completely oxidized as carbonic acid and water, or in a volatile or liquid form, still retaining its organic character, and destined to future oxidation, known as carbureted hydrogen, olefiant gas, petroleum, etc.

Hence, in the decomposition of vegetable tissue, two classes of resultant compounds are formed, one residual and the other evolved; and the genesis and relation of the carbon minerals may be accurately shown by the following diagram:

```
                       PLANT TISSUE
                           _________________
                        |
  _Residual Products_   |   _Evolved Products_
                        |
       Peat.          }
         |            }
      Lignite.        }
         |            }   { Carbonic Acid.
   Bitumious Coal.    }   { Carbonic Oxide.
         |            }   { Carbureted Hydrogen, etc.
 Semi-bitumious "     }   { Water.
         |            }   {         {Maltha.
     Anthracite.      }   {         {  |
         |            }   {         {Asphalt etc.
Graphitie Anthracite. }   { Petro-  {  |
         |            }   { leum    {Asphaltic Coal.
      Graphite.       }             {  |
         |            }             {Asphaltic Anthracite.
       Ash.           }             {  |
                                    {     "    Graphite.
```

[NOTE.--In this diagram, the vertical line connecting the names of the residual products (and of the derivatives of petroleum) indicates that each succeeding one is produced by further alteration from that which precedes it, and not independently. Also, the arrangement of the braces is designed to show that any or all of the evolved products are given off at each stage of alteration.]

The theory here proposed has not been evolved from my inner consciousness, but has grown from careful study, through many years, of facts in the field. A brief sketch of the evidence in favor of it is all that we have space for here.

RESIDUAL PRODUCTS.

Peat.--Dry plant-tissue consists of about 50 per cent, of carbon, 44 per cent, of oxygen, with a little nitrogen, and 6 per cent. of hydrogen. In a peat-bog, we find the upper part of the scale represented above very well shown: plants are growing on the surface with the normal composition of cellulose. The first stratum of peat consists of browned and partially decomposed plant-tissue, which is found to have lost perhaps 20 per cent. of the components of wood, and to have acquired an increasing percentage of carbon. As we descend in the peat, it becomes more homogeneous and darker until at the bottom of the marsh ten or twenty feet from the surface, we have a black, carbonaceous paste, which, when dried, resembles some varieties of coal, and approaches them in composition. It has lost half the substance of the original plant, and shows a marked increase in the relative proportion of carbon.

Lignite.--Each inch in vertical thickness of the peat-bog represents a phase in the progressive change from wood-tissue to lignite, using this term with its common signification to indicate, not necessarily carbonized ligneous tissue, but plant-tissue that belongs to a past though modern geological age--i.e., Tertiary, Cretaceous, Jurassic, or Triassic. These lignites or modern coals are only peat beds which have been buried for a longer or shorter time under clay, sand, or solidified rock, and have progressed farther or less far on the road to coal. As with peats, so with lignites, we find that at different geological levels they exhibit different stages of this distillation--the Tertiary lignites being usually distinguished without difficulty by the presence of a larger quantity of combined water and oxygen, and a less quantity of carbon, than the Cretaceous coals, and these in turn differ in the same respects from the Triassic.

All the coals of the Tertiary and Mesozoic ages are grouped under one name; but it is evident that they are as different from each other as the new and spongy from the old and well-rotted peat in the peat-bog.

Coal.--By mere convention, we call the peat which accumulated in the Carboniferous age by the name of bituminous coal; and an examination of the Carboniferous strata in different countries has shown that the peat-beds formed in the Carboniferous age, though varying somewhat, like others, with the kind of vegetation from which they were derived, have a common character by which they may be distinguished from the more modern coals; containing less water, less oxygen, and more carbon, and usually exhibiting the property of coking, which is rare in coals of later date. Though there is great diversity in the Carboniferous coals, and it would be absurd to express their composition by a single formula, it may be said that, over the whole world, these coals have characteristics, as a group, by which they can be recognized, the result of the slow decomposition of the tissue of plants which lived in the Carboniferous age, and which have, by a broad and general change, approximated to a certain phase in the spontaneous distillation of plant-tissue. An experienced geologist will not fail to refer to their proper horizon a group of coals of Carboniferous age any more than those of the Cretaceous or Tertiary.

Anthracite--In the ages anterior to the Carboniferous, the quantity of land vegetation was apparently not sufficient to form thick and extensive beds of peat; but the remains of plant-tissue are contained in all the older formations, though there only as anthracite or graphite--the last two groups of residual products. Of these we have examples in the beds of graphite in the Laurentian rocks of Canada, and of anthracite of the lower Silurian strata of Upper Church and Kilnaleck, Ireland.

From these facts it is apparent that the carbon series is graded geologically, that is, by the lapse of time during which plant-tissue has been subjected to this natural and spontaneous distillation. But we have better evidence than this of the derivation of one from another of the groups of residual products which have been enumerated. In many localities, the coals and lignites of different ages have been exposed to local influences--such as the outbursts of trap-rock, or the metamorphism of mountain chains--which have hastened the distillation, and out of known earlier groups have produced the last. For example, trap outbursts have converted Tertiary lignites in Alaska into good bituminous coals; on Queen Charlotte's Island, on Anthracite Creek, in southwestern Colorado, and at the Placer Mountains, near Santa Fe, New Mexico, Cretaceous lignites into anthracite; those from Queen Charlotte's Island and southwestern Colorado are as bright, hard, and valuable as any from Pennsylvania. At a little distance from the focus of volcanic action, the Cretaceous coals of southwestern Colorado have been made bituminous and coking, while at the Placer Mountains the same stratum may be seen in its anthracitic and lignitic stages.

A still better series, illustrating the derivation of one form of carbon solids from another, is furnished by the coals of Ohio, Pennsylvania, and Rhode Island. These are of the same age; in Ohio, presenting the normal composition and physical characters of bituminous coals, that is, of plant tissue generally and uniformly descending the scale in the lapse of time from the Carboniferous age to the present. In the mountains of Pennsylvania the same coal beds, somewhat affected by the metamorphism which all the rocks of the Alleghanies have shared, have reached the stage of *semi-bituminous* coals, where half the volatile constituents have been driven off; again, in the anthracite basins of eastern Pennsylvania, the distillation further effected has formed from these coals *anthracite*, containing only from three to ten per cent. of volatile matter; while in the focus of metamorphic action, at Newport, Rhode Island, the Carboniferous coals have been changed to *graphitic anthracite*, that is, are half anthracite and half graphite. Here, traveling from west to east, a progressive change is noted, similar to that which may be observed in making a vertical section of a peat bog, or in comparing the coals of Tertiary, Mesozoic, and Carboniferous age, only the latter is the continuation and natural sequence of the former series of changes.

In the Laurentian rocks of Canada are large accumulations of carbonaceous matter, all of which is graphite, and that which is universally conceded to be derived from plant-tissue. The oxidation of graphite is artificially difficult, and in nature's laboratory slow; but it is inevitable, as we see in the decomposition of its outcrops and the blanching of exposed surfaces of clouded marbles, where the coloring is graphite. Thus the end is reached, and by observations in the field, the origin and relationship of the different carbon solids derived from organic tissue are demonstrated.

It only remains to be said, in regard to them, that all the changes enumerated may be imitated artificially, and that the stages of decomposition which we have designated by the names graphite, anthracite, coal, lignite, are not necessary results of the decomposition of plant-tissue. A fallen tree may slowly consume away, and all its carbonaceous matter may be oxidized and dissipated without exhibiting the phases of lignite, coal, etc.; and lignite and coal, when exposed to air and moisture, are burned away to ashes in the same manner, simply because in these cases complete oxidation of the carbon takes place, particle by particle, and the mass is not affected as a whole in such a way as to assume the intermediate stages referred to. Chemical analysis, however, proves that the process is essentially the same, although the physical results are different.

EVOLVED PRODUCTS.

The gradual wasting of plant-tissue in the formation of peat, lignite, coal, etc., may be estimated as averaging for peat, 20 to 30 per cent.; lignite, 30 to 50 per cent.;

coal, 50 to 70 per cent.; anthracite, 70 to 80; and graphite, 90 per cent. of the original mass. The evolved products ultimately represent the entire organic portion of the wood--the mineral matter, or ash, being the only residuum. These evolved products include both liquids and gases, and by subsequent changes, solids are produced from some of them. Carbonic acid, carbonic oxide, nitrogenous and hydrocarbon gases, water, and petroleum, are mentioned above as the substances which escape from wood-tissue during its decomposition. That all these are eliminated in the decay of vegetable and animal structures is now generally conceded by chemists and geologists, although there is a wide difference of opinion as to the nature of the process.

It has been claimed that the evolved products enumerated above are the results of the primary decomposition of organic matter, and never of further changes in the residual products; i.e., that in the breaking-up of organic tissue, variable quantities of coal, anthracite, petroleum, marsh gas, etc., are formed, but that these are never derived, the one from the other. This opinion is, however, certainly erroneous, and the formation of any or all the evolved products may take place throughout the entire progress of the decomposition. Marsh gas and carbonic acid are seen escaping from the surface of pools where recent vegetable matter is submerged, and they are also eliminated in the further decomposition of peat, lignite, coal, and carbonaceous shale. Fire damp and choke-damp, common names for the gases mentioned above, are produced in large quantities in the mines where Tertiary or Cretaceous lignites, or Carboniferous coals or anthracites are mined. It has been said that these gases are simply locked up in the interstices of the carbonaceous matter and are liberated in its excavation; but all who have worked coal mines know that such accumulations are not sufficient to supply the enormous and continuous flow which comes from all parts of the mass penetrated. We have ample proof, moreover, that coal, when exposed to the air, undergoes a kind of distillation, in which the evolution of carbonic acid and hydrocarbon gases is a necessary and prominent feature.

The gas makers know that if their coal is permitted to lie for months or years after being mined, it suffers serious deterioration, yielding a less and less quantity of illuminating gas with the lapse of time. So coking coals are rendered dry, non-caking, and valueless for this purpose by long exposure.

Carbureted hydrogen, olefiant gas, etc., are constant associates of the petroleum of springs or wells, and this escape of gas and oil has been going on in some localities, without apparent diminution, for two or three thousand years. We can only account for the persistence of this flow by supposing that it is maintained by the gradual distillation of the carbonaceous masses with which such evolutions of gas or of liquid hydro-carbons are always connected. If it were true that carbureted hydrogen and petroleum are produced only from the primary decomposition of organic tissue, it would be inevitable that at least the elastic gases would have escaped long since.

Oil wells which have been nominally exhausted--that is, from which the accumulations of centuries in rock reservoirs have been pumped--and therefore have been abandoned, have in all cases been found to be slowly replenished by a current and constant secretion, apparently the product of an unceasing distillation.

In the valley of the Cumberland, about Burkesville, one of the oil regions of the country, the gases escaping from the equivalent of the Utica shale accumulate under the plates of impervious limestone above until masses of rock and earth, hundreds of tons in weight, are sometimes thrown out with great violence. Unless these gases had been produced by comparatively recent distillation, such explosions could not occur.

In opening a coal mine on a hillside, the first traces of the coal seam are found in a dark stain in the superficial clay; then a substance like rotten wood is reached, from which all the volatile constituents have escaped. These appear, however, later, and continue to increase as the mine is deepened, until under water or a heavy covering of rock the coal attains its normal physical and chemical characters. Here it is evident that the coal has undergone a long-continued distillation, which must have resulted in the constant production of carbonic acid and carbureted hydrogen.

A line of perennial oil and gas springs marks the outcrop of every great stratum of carbonaceous matter in the country. Of these, the most considerable and remarkable are the bituminous shales of the Silurian (Utica shale), of the Devonian (Hamilton and Huron shales), the Carboniferous, etc. Here the carbonaceous constituent (10 to 20 per cent.) is disseminated through a great proportion of inorganic material, clay and sand, and seems, both from the nature of the materials which furnished it--cellular plants and minute animal organisms--and its dissemination, to be specially prone to spontaneous distillation. The Utica shale is the lowest of these great sheets of carbonaceous matter, and that supplies the hydro-carbon gases and liquids which issue from the earth at Collingwood, Canada, and in the valley of the Cumberland. The next carbonaceous sheet is formed by the great bituminous shale beds of the upper Devonian, which underlie and supply the oil wells in western Pennsylvania. In some places the shale is several hundred feet in thickness, and contains more carbonaceous matter than all the overlying coal strata. The outcrop of this formation, from central New York to Tennessee, is conspicuously marked by gas springs, the flow from which is apparently unfailing.

Petroleum is scarcely less constant in its connection with these carbonaceous rocks than carbureted hydrogen, and it only escapes notice from the little space it occupies. The two substances are so closely allied that they must have a common origin, and they are, in fact, generated simultaneously in thousands of localities.

During the oil excitement of some years since, when the whole country was hunted over for "oil sign," in many lagoons, from which bubbles of marsh-gas were constantly escaping, films of genuine petroleum were found on the surface; and as the underlying strata were barren of oil, this could only have been derived from the decaying vegetable tissue below. In the Bay of Marquette, two or three miles north of the town, where the shore is a peat bog underlain by Archæan rocks, I have seen bubbles of carbureted hydrogen rising in great numbers attended by drops of petroleum which spread as iridescent films on the surface.

The remarks which have been made in regard to the heterogeneous nature of the solid hydrocarbons apply with scarcely less force to the gaseous and liquid products of vegetable decomposition. The gases which escape from marshes contain carbonic acid, a number of hydrocarbon gases (or the materials out of which they may be composed in the process of analysis), and finally a larger or smaller volume of nitrogenous gas. It is possible that the elimination of these gases takes the form of fractional distillation, and definite compounds may be formed directly from the wood-tissue or its derivatives, and mingle as they escape. This is, however, not certain, for the gases, as we find them, are always mixtures and never pure. In the liquid evolved products, the petroleums, this is emphatically true, for we combine under this name fluids which vary greatly in both their physical and chemical characters; some are light and ethereal, others are thick and tarry; some are transparent, some opaque; some red, some brown, others green; some have an offensive and others an agreeable odor; some contain asphalt in large quantity, others paraffine, etc. Thus they form a heterogeneous assemblage of liquid hydrocarbons, of which naphtha and maltha may be said to form the extremes, and which have little in common, except their undefinable name. The causes of these differences are but imperfectly understood, but we know that they are in part dependent on the nature of the organic material that has furnished the petroleums, and in part upon influences affecting them after their formation. For example, the oil which saturates the Niagara limestone at Chicago, and--which is undoubtedly indigenous in this rock, and probably of animal origin, is black and thick; that from Enniskillen, Canada, is also black, has a vile odor, probably in virtue of sulphur compounds, and, we have reason to believe, is derived from animal matter. The oils of northwestern Pennsylvania are mostly brown, sometimes green by reflected light, and have a pungent and characteristic odor. These are undoubtedly derived from the Hamilton shales, which contain ten or twenty per cent, of carbonaceous matter, apparently produced from the decomposition of sea-weeds, since these are in places exceedingly abundant, and nearly all other fossils are absent.

The oils of Italy, though varying much in appearance, have usually an ethereal odor that is rather agreeable; they are of Tertiary age. The oils of Japan, differing much among themselves, have as, a common character an odor quite different from the Pennsylvania oils. So the petroleums of the Caspian, of India, California, etc., occurring at different geological horizons, exhibit a diversity of physical and chemical characters which may be fairly supposed to depend upon the material from which they have been distilled. The oils in the same region, however, are found to exhibit a series of differences which are plainly the result of causes operating upon them after their production. Near the surface, they are thicker and darker; below, and near the carbonaceous mass from which they have been generated, they are of lighter gravity and color. We find, in limited quantity, oils which are nearly white and may be used in lamps without refining--which have been refined, in fact, in Nature's laboratory. Others, that are reddish yellow by transmitted light, sometimes green by reflected light, are called amber oils; these also occur in small quantity, and, as I am led to believe, have acquired their characteristics by filtration through masses of sandstone. Whatever the variety of petroleum may be, if exposed for a long time to the air it undergoes a spontaneous distillation, in which gases and vapors, existing or formed, escape, and solid residues are left. The nature of these solids varies with the petroleums from which they come, some producing asphaltum, others paraffine, others ozokerite, and so on through a long list of substances, which have received distinct names as mineral species, though rarely, if ever, possessing a definite and invariable composition. The change of petroleum to asphalt may be witnessed at a great number of localities. In Canada, the black asphaltic oil forms by its evaporation great sheets of hard or tarry asphalt, called gum beds, around the oil-springs. In the far West are numerous springs of petroleum, which are known to the hunters as "*tar springs*," because of the accumulations about them of the products of the evaporation and oxidation of petroleum to tar or asphalt. Certain less common oils yield ozokerite as a solid, and considerable accumulations of this are known in Galicia and Utah.

Natural paraffine is less abundant, and yet in places it occurs in considerable quantity. Asphalt is the common name for the solid residue from the evaporation and oxidation of petroleum; and large accumulations of this substance are known in many parts of the world, perhaps the most noted of all being that of the "Pitch Lake". of the Island of Trinidad; there, as everywhere else, the derivation of asphalt from petroleum is obvious, and traceable in all stages. The asphalts, then, have a common history in this, that they are produced by the evaporation and oxidation of petroleum. But it should also be said that they share the diversity of character of petroleums, and the term asphalt represents a group of substances of which the physical characters and chemical composition differ greatly in virtue of their derivation, and also differ from changes which they are constantly undergoing. Thus at the Pitch Lake in Trinidad, the central portion is a tarry petroleum, near the sides a plastic asphalt, and finally that which is of almost rock-like solidity. Hence we see that the solid residues from petroleum are unstable compounds like the coals and lignites, and in virtue of their organic nature are constantly undergoing a series of changes of which the final term is combustion or oxidation. From these facts we might fairly infer that asphalts formed in geological ages anterior to the present would exhibit characters resulting from still further distillation; that they would be harder and drier, i.e., containing less volatile ingredients and more fixed carbon. Such is, in fact, the case; and these older asphalts are represented by *Grahamite, Albertite*, etc., which I have designated as asphaltic coals. These are found in fissures and cavities in rocks of various ages, which have been more or less disturbed, and usually in regions where springs of petroleum now exist. The Albertite fills fissures in Carboniferous rocks in New Brunswick, on a line of disturbance and near oil-springs. Precisely the same may be said of the Grahamite of West Virginia. It fills a vertical fissure, which was cut through the sandstones and shales of the coal-measures; in the sandstones it remained open, in the shales it has been closed by the yielding of the rock. The Grahamite fills the open fissure in the sandstone, and was plainly introduced when in a liquid state. In the vicinity are oil springs, and it is on an axis of disturbance. From near Tampico, Mexico, I have received a hydrocarbon solid--essentially Grahamite, asphalt, and petroleum. These are described as occurring near together, and evidently represent phases of different dates in the same substance. I have collected asphaltic coals, very similar to Grahamite and Albertite in appearance and chemical composition, in Colorado and Utah, where they occur with the game associates as at Tampico. I have found at Canajoharie, New York, in cavities in the lead-veins which rut the Utica shale, a hydrocarbon solid which must have infiltrated into these cavities as petroleum, but which, since the remote period when the fissures were formed, has been distilled until it is now *anthracite*. Similar anthracitic asphalt or asphaltic anthracite is common in the Calciferous sand-rock in Herkimer County, New York, where it is associated with, and often contained in, the beautiful crystals of quartz for which the locality is famous. Here the same phase of distillation is reached as in the coke residuum of the petroleum stills.

Again, in some crystalline limestones, detached scales or crystals of *graphite* occur, which are undoubtedly the product of the complete distillation of liquid hydrocarbons with which the rock was once impregnated. The remarkable purity of such graphite is the natural result of its mode of formation, and such cases resemble the occurrence of graphite in cast iron and basalt. The black clouds and bands which stain many otherwise white marbles are generally due to specks of graphite, the residue of hydrocarbons which once saturated the rock. Some limestones are quite black from the carbonaceous matter they contain (Lycoming Valley, Pa., Glenn's Falls, N. Y., and Collingwood, Canada), and these are sold as black marbles, but if exposed to heat, such limestones are blanched by the expulsion of the contained carbon; usually a residue of anthracite or graphite is left, forming dark spots or streaks, as we find in the clouded and banded marbles.

Finally, the great work going on in Nature's laboratory may be closely imitated by art; the differences in the results being simply the consequence of differing conditions in the experiments. Vegetable tissue has been converted artificially into the equivalents of lignite, coal, anthracite, and graphite, with the emission of vapors, gases, and oils closely resembling those evolved in natural processes. So petroleum may be distilled to form asphalt, and this in turn converted into Albertite and coke (i.e., anthracite). Grahamite has been artificially produced from petroleum by Mr. W. P. Jenney.

In the preceding remarks, no effort has been made even to enumerate all the so-called carbon minerals which have been described. This was unnecessary in a discussion of the relations of the more important groups, and would have extended this article much beyond its prescribed length. Those who care to gain a fuller knowledge of the different members of the various groups are referred to the admirable chapter on the "Hydrocarbon Compounds" in Dana's Mineralogy.

It will, however, add to the value of this paper, if brief mention be made of a few carbon minerals of which the genesis and relations are not generally known, and in regard to which special interest is felt, such as the diamond, jet, the hydrocarbon jellies, "Dopplerite," etc.

The diamond is found in the *débris* of metamorphic rocks in many countries, and is probably one of the evolved products of the distillation of organic matter they once contained. Under peculiar circumstances it has apparently been formed by precipitation from sulphide of carbon or some other volatile carbon compound by elective affinity. Laboratory experiments have proved the possibility of producing it by such a process, but the artificial crystals are microscopic, perhaps only because a long time is required to build up those of larger size.

Jet is a carbonaceous solid which in most cases is a true lignite, and generally retains more or less of the structure of wood. Masses are sometimes found that show no structure, and these are probably formed from bitumen which has separated from the wood of which it once formed part, and which it generally saturates or invests. In some cases, however, these masses of jet-like substance are plainly the residuum of excrementitious matter voided by fishes or reptiles. These latter are often found in the Triassic fish-beds of Connecticut and New Jersey, and in the Cretaceous marls of the latter State.

The discovery of a quantity of hydrocarbon jelly, recently, in a peat-bed at Scranton, Pa., has caused some wonder, but similar substances (Dopplerite, etc.) have been met with in the peat-beds of other countries; and while the history of the formation of this singular group of hydrocarbons is not yet well understood, and offers an interesting subject for future research, we have reason to believe that these jellies have been of common occurrence among the evolved products of the decomposition of vegetable tissue in all ages.

The fossil resins--often erroneously called gums--amber, kauri, copal, etc., though interestingly related to the hydro-carbons enumerated on the preceding pages, form no essential part of the series, and demand only the briefest notice here.

Amber is the resin which exuded from certain coniferous trees that, in Tertiary times, grew abundantly in northern Europe. The leaves and trunks of these trees have generally perished; but masses of their resin, more enduring, buried in the earth on the shores of the Baltic, have in the lapse of time changed physically and chemically, and have become fitted for the ornamental purposes for which they have been used by all civilized nations.

Kauri is the resin of *Dammara australis*, a living coniferous tree of New Zealand, and the "gum" is dug from the earth on the sites of forests which have now disappeared.

Copal is a commercial name given to the resins of several different trees, but the most esteemed, and indeed the only true copal, is the product of *Trachylobium Mozambicense*, a tree which grows along the Zanzibar coast, and has left its resin buried in the sands of old raised beaches which it has abandoned.

The diversity of character which the fossil resins exhibit shows the complexity of the vital processes in operation in the vegetable kingdom, and gives probability to the theory that some of the differences we find in the carbon minerals are due to differences in the plants from which they have been derived.

The variations in the physical and chemical characters of different coals from the same basin, and from different parts of the same stratum, have been sometimes credited to the same cause; but they are probably in greater degree due to the differences in the conditions under which these varieties have been formed.

Cannel coal, as I have shown elsewhere (*Amer. Jour. Science*, March, 1857), is completely macerated vegetable tissue which was deposited as carbonaceous mud at the bottom of lagoons in the coal-marshes.

Caking coals were probably peat, which accumulated under somewhat uniform conditions, was constantly saturated with moisture, and became a comparatively homogeneous and partially gelatinous carbonaceous mass; while the open-burning coals which show a distinctly laminated structure and consist of layers of pitch-coal, alternating with bands of mineral charcoal or cannel, seem to have been formed in alternating conditions, of more or less moisture, and the bituminous portions are inclosed in cells or are separated by partitions, so that the mass does not melt down, but more or less perfectly holds its form when exposed to heat.

The generalities of the origin and relations of the carbon minerals have now been briefly considered; but a review of the subject would be incomplete without some reference to the theories which have been advanced by others, that are in conflict with the views now presented. There have always been some who denied the organic nature of the mineral hydrocarbons, but it has been regarded as a sufficient answer to their theories, that chemists and geologists are generally agreed in saying that no instances are known of the occurrence in nature of hydrocarbons, solid, liquid, or gaseous, in which the evidence was not satisfactory that they had been derived from animal or vegetable tissue. A few exceptional cases, however, in which chemists and geologists of deserved distinction have claimed the possibility and even probability of the production of marsh gas, petroleum, etc., through inorganic agencies, require notice.

In a paper published in the *Annales de Chimie et de Physique*, Vol. IX., p.481, M. Berthelot attempts to show that the formation of petroleum and carbureted hydrogen from inorganic substances is possible, if it be true, as suggested by Daubre, that there are vast masses of the alkaline metals--potassium, sodium, etc.--deeply buried in the earth, and at a high temperature, to which carbonic acid should gain access; and he demonstrates that, these premises being granted, the formation of hydrocarbons would necessarily follow.

But it should be said that no satisfactory evidence has ever been offered of the existence of zones or masses of the unoxidized alkaline metals in the earth, and it is not claimed by Berthelot that there are any facts in the occurrence of petroleum and carbureted hydrogen in nature which seem to exemplify the chemical action which he simply claims is theoretically possible. Berthelot also says that, in most cases, there can be no doubt of the organic origin of the hydrocarbons.

Mendeleeff, in the *Revue Scientifique*, 1877, p. 409, discusses at considerable length the genesis of petroleum, and attempts to sustain the view that it is of inorganic origin. His arguments and illustrations are chiefly drawn from the oil wells of Pennsylvania and Canada, and for the petroleum of these two districts he claims an inorganic origin, because, as he says, there are no accumulations of organic matter below the horizons at which the oils and gases occur. He then goes into a lengthy discussion of the possible and probable source of petroleum, where, as in the instances cited, an organic origin "is not possible." It is a sufficient answer to M. Mendeleeff to say, that beneath the oil bearing strata of western Pennsylvania are sheets of bituminous shale, from one hundred to five hundred feet in thickness, which afford an adequate, and it may be proved the true source, of the petroleum, and that no petroleum has been found below these shales; also that the oil-fields of Canada are all underlain by the Collingwood shales, the equivalent of the Utica carbonaceous shales of New York, and that from the out-crops of these shales petroleum and hydrocarbon gases are constantly escaping. With a better knowledge of the geology of the districts he refers to, he would have seen that the facts in the cases he cites afford the strongest evidence of the organic origin of petroleum.

Among those who are agreed as to the organic origin of the hydrocarbons, there is yet some diversity of opinion in regard to the nature of the process by which they have been produced.

Prof. J. P. Lesley has at various times advocated the theory that petroleum is indigenous in the sand-rocks which hold it, and has been derived from plants buried in them. ("Proc. Amer. Philos. Soc.," Vol. X., pp. 33, 187, etc.)

My own observations do not sanction this view, as the limited number of plants buried in the sandstones which are now reservoirs of petroleum must always have borne a small proportion in volume to the mass of inorganic matter; and some of those which are saturated with petroleum are almost completely destitute of the impressions of plants.

In all cases where sandstones contain petroleum in quantity, I think it will be found that there are sheets of carbonaceous matter below, from which carbureted hydrogen and petroleum are constantly issuing. A more probable explanation of the occurrence of petrolem in the sandstones is that they have, from their porosity, become convenient receptacles for that which flowed from some organic stratum below.

Dr. T. Sterry Hunt has regarded limestones, and especially the Niagara and corniferous, as the principal sources of our petroleum; but, as I have elsewhere suggested, no considerable flow of petroleum has ever been obtained from the Niagara limestone, though at Chicago and Niagara Falls it contains a large quantity of bituminous matter; also, that the corniferous limestone which Dr. Hunt has regarded as the source of the oil of Canada and Pennsylvania is too thin, and too barren of petroleum, or the material out of which it is made, to justify the inference.

The corniferous limestone is never more than fifty or sixty feet thick, and does not contain even one per cent. of hydrocarbons; and in southern Kentucky, where oil is produced in large quantity, this limestone does not exist.

That many limestones are more or less charged with petroleum is well known; and in addition to those mentioned above, the Silurian limestone at Collingwood, Canada, may be cited as an example. As I have elsewhere shown, we have reason to believe that the petroleum here is indigenous, and has been derived, in part, at least, from animal organisms; but the limestones are generally compact, and if cellular, their cavities are closed, and the amount of petroleum which, under any circumstances, flows from or can be extracted from limestone rock is small. On the other hand, the bituminous shales which underlie the different oil regions afford an abundant source of supply, holding the proper relations with the reservoirs that contain the oil, and are spontaneously and constantly evolving gas and oil, as may be observed in a great number of localities. For this reason, while confessing the occurrence of petroleum and asphaltum in many limestones, I am thoroughly convinced that little or none of the petroleum of commerce is derived from them.

Prof. S.F. Peckham, who has studied the petroleum field of southern California, attributes the abundant hydrocarbon emanations in that locality to microscopic animals. It is quite possible that this is true in this and other localities, but the bituminous shales which are evidently the sources of the petroleum of Pennsylvania, Ohio, Kentucky, etc., generally contain abundant impressions of sea weeds, and indeed these are almost the only organisms which have left any traces in them. I am inclined, therefore, now, as in my report on the rock oils of Ohio, published in 1860, to ascribe the carbonaceous matter of the bituminous shales of Pennsylvania and Ohio, and hence the petroleum derived from them, to the easily decomposed cellular tissue of algæ which have in their decomposition contributed a large percentage of diffused carbonaceous matter to the sediments accumulating at the bottom of the water where they grew. In a recent communication to the National Academy of Sciences, Dr. T. Sterry Hunt has proposed the theory that anthracite is the result of the decomposition of vegetable tissue when buried in porous strata like sandstone; but an examination of even a few of the important deposits of anthracite in the world will show that no such relationship as he suggests obtains.

Anthracite may and does occur in sedimentary rocks of varied character, but, so far as my observation has extended, never in quantity in sandstone. In the Lower Silurian rocks anthracite occurs, both in the Old World and in the New, where no metamorphism has affected it, and where it is simply the normal result of the long continued distillation of plant tissue; but the anthracite beds which are known and mined in so many countries are the results of the metamorphism of coal-beds of one or another age, by local outbursts of trap, or the steaming and baking of the disturbed strata in mountain chains, numerous instances of which are given on a preceding page.

M. Mendeleeff, in his article already referred to, misled by a want of knowledge of the geology of our oil-fields, and ascribing the petroleum to an inorganic cause, connects the production of oil in Pennsylvania and Caucasia with the neighboring mountain chains of the Alleghanies and the Caucasus; but in these localities a sufficient amount of organic matter can be found to supply a source for the petroleum, while the upheaval and loosening of the strata along lines parallel with the axes of elevation has favored the decomposition (spontaneous distillation) of the carbonaceous strata. It should be distinctly stated, also, that no igneous rocks are found in the vicinity of productive oil-wells, here or elsewhere, and there are no facts to sustain the view that petroleum is a volcanic product.

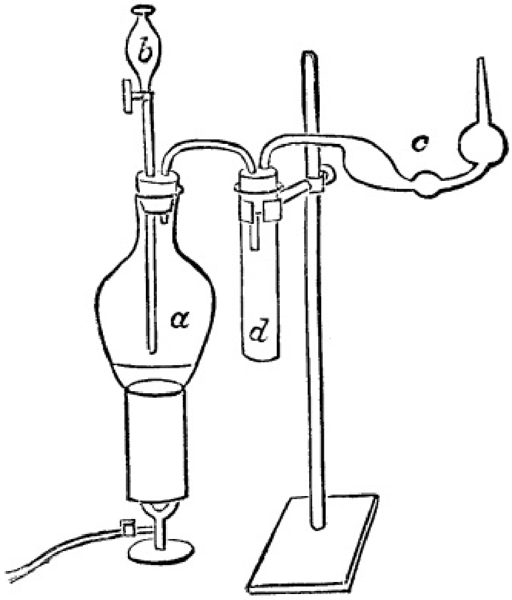
In the valley of the Mississippi, in Ohio, Illinois, and Kentucky, are great deposits of petroleum, far removed from any mountain chain or volcanic vent, and the cases which have been cited of the limited production of hydrocarbons in the vicinity of, and probably in connection with, volcanic centers may be explained by supposing that in these cases the petroleum is distilled from sedimentary strata containing organic matter by the proximity of melted rock, or steam.

Everything indicates that the distillation which has produced the greatest quantities of petroleum known was effected at a low temperature, and the constant escape of petroleum and carbureted hydrogen from the outcrops of bituminous shales, as well as the result of weathering on the shales, depriving them of all their carbon, shows that the distillation and complete elimination of the organic matter they contain may take place at the ordinary temperature.

ESTIMATION OF SULPHUR IN IRON AND STEEL.

By GEORGE CRAIG.

For wellnigh two years I have been estimating sulphur in iron and steel by a modification of the evolution process, which consists in passing the evolved gases through an ammoniacal solution of peroxide of hydrogen, which oxidizes the sulphureted hydrogen to sulphuric acid, which latter is estimated as usual. The *modus operandi* is as follows:



100 grains of the iron or steel are placed in the 10 oz. flask, a, along with ½ oz. water; 1½ oz. hydrochloric acid are added from the stoppered funnel, b, in such quantities at a time as to produce a moderate evolution of gas through the nitrogen bulb, c, which contains 1/8 oz. (20 vols.) peroxide of hydrogen and ½ oz. ammonia. The tube, d, is to condense the bulk of the hydrochloric acid which distills over during the operation. When all the acid has been added and the evolution of gas becomes sluggish, heat is applied and the liquid boiled till all action ceases. Air is blown through the aparatus for a few minutes and the contents of c and d washed into a small beaker and acidified with hydrochloric acid, boiled, barium chloride added, and the barium sulphate filtered off after standing a short time. A blank experiment must be done with each new lot of peroxide of hydrogen obtained, which always gives under 0.1 barium sulphate with me.

The whole operation is finished within two hours, the usual oxidation process occupying nearly two days; and the results obtained are invariably slightly higher than by the oxidation processes.

Until lately I have always added excess of chlorate of potash to the residue left in a, evaporated it nearly to dryness, diluted, filtered, and added chloride of barium to the diluted filtrate, but only once have I obtained a trace of precipitate after standing 48 hours, and the pig-iron in that case contained 8 per cent. of silicon, so that all the sulphur is evolved during the process. It has been objected to the evolution process that when the iron contains copper all the sulphur is not evolved, but theoretically it ought to be evolved whether copper is present or not; and to test the point I fused 3 lb. of ordinary Scotch pig-iron with some copper for half an hour in a Fletcher's gas furnace. No copper could be detected in the iron by mere observation with a microscope, but it gave on analysis 0.225 per cent. of copper, and on estimating the sulphur in it by the above process and by oxidation with chlorate of potash and hydrochloric acid, using 100 grains in each case, and performing blank experiments, I found:

By peroxide of hydrogen process	0.0357 per cent.
By oxidation ($KClO_3$ and HCl) process,	0.0302 per cent.

so that even in highly cupriferous pig-iron all the sulphur is evolved on treatment with strong hydrochloric acid.--

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THE AIR IN RELATION TO HEALTH.

[Footnote: Abstract of a lecture before the Master Plumbers' Association, New York, Nov. 2. 1882.]

By Prof. C. F. CHANDLER.

It is only about one hundred years since the first important facts were discovered which threw light upon the chemistry of atmosphere. It was in 1774 that Dr.

Priestley, in London, and Scheele, in Sweden, discovered the vital constituents of the atmosphere--the oxygen gas which supports life. The inert gas, nitrogen, had been discovered a year or two before. When we examine our atmosphere, we find it is composed of oxygen and nitrogen. The nitrogen constitutes no less than 80 per cent, of the atmosphere; the remaining 20 percent, consists of oxygen, so that the atmosphere consists almost entirely of these two gases, odorless and colorless and invisible. The atmosphere is, however, never free from moisture; a certain amount of aqueous vapor is always present. The quantity can hardly be stated, as it varies from day to day and month to month; it depends upon the temperature and other conditions. Then we have the gas commonly called carbonic acid in extremely minute quantities, about one part in 2,500, or four one-hundredths of one per cent. A small quantity of ammonia and a small quantity of ozone are also present.

Besides these gases which have been enumerated, and which play an important part in supporting life in both the kingdoms of nature, we find a great many solids. Every housewife knows how dust settles upon everything about the house. This dust has recently been the subject of most active study, and it proves to be quite as important as the vital oxygen that actually supports life. When we examine this dust--and it falls everywhere, not only in the city streets, but upon the tops of mountains, upon the deck of the ocean steamer, and the Arctic snow--we find some of it does not belong to the earth, and, as it is not terrestrial, we call it cosmical. And when it falls in large pieces we call it a meteorite or shooting star. When the Challenger crossed the Atlantic, and soundings were made in the deep sea, in the mud that was brought up and examined there were found various little particles that were not terrestrial. They were dust particles that were dropped into the atmosphere of the earth from outer space. Then we have terrestrial dust, and we divide that into mineral and organic. The mineral consists chiefly of clay, sand, and, near the ocean, salt. Then we have organic matter. Some of this is dead leaves which have been ground to powder. Animal matter has also become dry and reduced to powder, and we actually find the remains of animals and plants floating upon the atmosphere, especially in the city. Examinations of the dust which had collected upon the basement and higher windows of a Fifth avenue residence showed that the dust upon the basement floor was chiefly composed of sand. And the higher up I went, the smaller proportion of sand and a larger proportion of animal matter, so that the dust that blows into our faces is largely decomposing animal substance.

But we have a living matter in the atmosphere. We often notice in the summer, after a rain, that the ground is yellow. On gathering up the yellow powder and examining it under the microscope, we find that it consists of pollen. The pollen of rag weed and other plants is supposed to be the cause of hay fever. But we also have something far more important in the germs of certain classes of vegetation. The effects are familiar. If food is put away, it becomes mouldy. This mould is a peculiar kind of vegetation which is called a fungus, and the plants fungi. In order for this mould to develop a certain temperature and a certain degree of moisture are necessary. Our food, we say, decays. Now, what we call decay is really the growth of these fungi. Animal and vegetable substances which these fungi seize upon are destroyed. All ordinary fermentations and putrefactions are due to mould fungi, yeast plants, or bacteria, and liquids undergoing these processes carry these fungi and their germs wherever they go. The refuse of the city pollutes the air. You have only to pass along any street to find more or less rubbish. That furnishes the nidus for the growth and development of these germs, and until we adopt better methods of getting rid of that refuse, we never shall have the air of this city in the condition that it should be.

One of the most constant sources of the pollution of the air in inhabited localities is the decomposition that takes place in the ground. Refuse of every kind gets into it. Our sewers are leaky, and putrefaction is constantly going on. The soil down to the limit of the ground water contains a large amount of air. This air, when the atmospheric pressure in the house is diminished, is drawn in with such organic impurities as it contains. A cement floor in the cellar is not a protection against this entrance of the ground air, for the cement is porous to the passage of air, but a remedy may be found by laying on the cement a covering of coal tar pitch, in which bricks are set on edge, the spaces between the bricks are filled with the melted pitch, and the bricks then covered with coal tar pitch. When the house is building, the foundation walls should also be similarly coated, outside as well as inside. Such a cellar floor was considered to be absolutely impervious to ground air and moisture. The lecturer had recently laid this floor in his own house with the greatest success. The atmosphere of the entire house is improved, and the expense is very moderate. Another source of the contamination of the air of houses is the heating apparatus. Stoves and furnaces, however well constructed at first, will, from the contraction and expansion of the metal, soon allow the escape of coal gas, and this danger is greatly increased by the use of dampers in the stove-pipe. When, to regulate the fire, the damper in the pipe is closed, the gases, having their passage to the chimney cut off, will escape through any cracks or openings in the stove into the room. Prof. Chandler, having kept a record of accidents from this cause, had accumulated a formidable list of suffocations due to the use of the damper. The danger was now somewhat lessened by providing dampers with perforations in the center, which allowed the gases to escape when the damper was closed. As regards the maintenance of pure air in houses, the preference was given to the open fire-place. The hot-air furnace deriving a supply of pure air from out of doors was, when properly constructed, a very satisfactory method of heating, but in city houses the mistake was often made of carrying the cold air duct of the furnace to the front of the house, where it was exposed to the dust of the streets. It should be taken from the rear end of the house, and carried some distance above the surface of the yard. It was an excellent expedient to insert in the cold air duct a wire screen to hold a layer of cotton to retain the floating impurities which might enter the air-box. This could be removed from time to time, and the cotton replaced. Steam heating has been objected to by many for reasons in no wise due to the apparatus, but to neglect in the use of it. The complaint of closeness where steam is used is due to the fact that a room containing a steam radiator can be heated with every door and window closed, and no fresh air admitted, while with stoves and open fire-places a certain quantity of fresh air must be admitted to maintain the fire. Where radiators are used, the ventilation of the rooms should, therefore, be looked after. Again, the complaint that steam apparatus has an unpleasant odor is due to the fact that the radiators are allowed to become covered with dust, which is cooked, and gives rise to the smells complained of. The radiator should be from time to time cleaned. When these precautions are taken, no means of heating is more satisfactory than steam.

Sewer gas is another source of contamination; this is a very indefinite term, to which formerly many false and exaggerated properties of causing specific diseases were attributed. It is now, however, recognized to mean simply the air of sewers, generally not differing very greatly from common air, containing a certain proportion of marsh gas, carbonic acid, and sulphureted hydrogen, etc. No one of these gases, however, is capable of producing the diseases attributed to sewer gas. Careful research has shown that it is the sewage itself, containing germs of specific disease, which is added to the air in the sewer by the breaking of bubbles of gas on its surface, which is the cause of the diseases associated with sewers.

An intimate connection is believed to exist between the germs of sewer air and diphtheria, and probably also between sewer air and scarlet fever. This sewer gas is to be excluded from our houses by proper systems of plumbing, and to such an extent have these now been perfected, that there is no objection to having plumbing fixtures in all parts of the house. This opinion has lately been objected to in the *Popular Science Monthly*, as it was at a meeting of the Academy of Medicine last spring, but on wholly insufficient grounds.

The objectors all insist that a trap will allow sewer gas to pass through it, and the experiments made at the Academy of Medicine showed that sulphureted hydrogen gas, etc., would so pass. The advocates of the trap have never denied that the water seal would absorb gases on one side and give them off on the other, but they do deny that, in the conditions existing in good plumbing, such gases will be given off in quantities to do any damage, and they confidently assert that the germ which is the dangerous element will not pass the seal at all. Pumpelly investigated the matter for the National Board of Health, and in no instance was he able to make the germ pass the seal of the trap. It is now proposed to set up against the weight of this scientific testimony the results of an investigator in Chicago, whose work was at once appropriated as an advertisement by stock jobbing disinfectant companies in a manner which raises a suspicion that the investigation was made in their interest. He described tersely the essentials of good plumbing, the necessity of a trap on the house drain, the ventilation of the soil-pipe, and the ventilation of the trap against siphonage. Of the first, he said that it offered protection to each householder against the entrance into his house of the germs of a contagious disease which passed into the common sewer from the house of a neighbor. Were the trap dispensed with, the contagion in the sewer would have free entrance into the houses connecting with it.

Prof. Chandler, in conclusion, alluded to the cordial relations now existing between the Board of Health and the majority of the master plumbers of the city. He said that for himself his opinion of the craft had greatly risen during his intimate connection with plumbers the last two years. He thought the majority of the jobs now done in the city are well executed. He believed that the Board of Health had not been obliged to proceed against more than eight master plumbers since the new law went into force. He called upon the Association to adopt a "code of ethics," which should define what an honest plumber can do and cannot do, and he illustrated his meaning by citing an extraordinary case of fraudulent workmanship which had been recently reported to him. His remarks on this point were greeted with frequent outbursts of applause.

THE PLANTAIN AS A STYPTIC.

The following abstract of a paper read by Dr. Quinlan at the recent British Pharmaceutical Congress, may prove of interest to medical readers in this country, where the plant mentioned is a common weed:

"About a year ago Dr. Quinlan had seen the chewed leaves of the *Plantago lanceolata* successfully used to stop a dangerous hemorrhage from leech bites in a situation where pressure could not be employed. He had searched out the literature of the subject, and found that, although this herb is highly spoken of by Culpepper and other old writers as a styptic, and alluded to as such in the plays of Shakespeare, its employment seems to have died out. Professor Quinlan described the suitable varieties of plantain, and exhibited preparations which had been made for him by Dr. J. Evans, of Dublin, State apothecary. They dried leaves and powdered leaves, conserved with glycerine, for external use; the juice preserved by alcohol, as also by glycerine, for internal use; and a green extract. He gave an account of the chemistry of the juice, from which it appeared that it was not a member of the tannin series; and also described its physiological effect in causing a tendency to stasia in the capillaries of the tail of a goldfish, examined with a microscopic power of 400 X. He regarded its styptic power as partly mechanical and partly physiological. The juice, in large doses, he had found useful in internal hemorrhages. The knowledge of the properties of this plant he thought would be useful in cases of emergency, because it could be obtained in any field and by the most uninstructed persons."

BACTERIA.

Bacteria, whether significant of disease or decline of health, are found more or less numerous in everything we eat and drink. The germs or spores of many kinds, known as *termo*, *lineola*, tenue, spirillum, vibriones, etc, exist in almost infinite numbers; some of the smallest are too small to be seen by the highest powers, which, being lodged in all vegetable and animal substances, spring into life and develop very rapidly under favorable circumstances. They develop most rapidly when decomposition commences, and seem to indicate the degree or activity of that decomposition, also hastening the same. They are found most numerous in the feces, and usually fully developed in the fresh evacuations of persons of all ages. They may be seen plainly under a thin glass with high powers with strong or clear light, when the material is much diluted with water.

These bacteria appear almost as numerously, yet more slowly, in urine, either upon exposure to air or when freshly evacuated, when the general health of the individual is declining, or any tendency to decomposition. A diagnosis can be aided very greatly by a study of these bacteria, as they indicate or determine the vitality, vigor, and purity of the system, whether more or less subject to disease, even before any signs of disease appear. They seem to preindicate the hold of the life force on the material, and always appear when that force is broken. Their relative quantity found in feces is as a barometric indication of the general health or some particular disturbance, and it is surprising how very fast they multiply while simply passing the intestines under circumstances favorable for their growth. These forms, so small, are important, because so very numerous, and their study has been, perhaps, avoided by many; yet they certainly mean something and effect something, even the non-malignant varieties as mentioned above, and it is certainly worth while to continue to study their meaning, even beyond what has already been written by others on the subject.--*J.M. Adams, in The Microscope*.

THE SOY BEAN

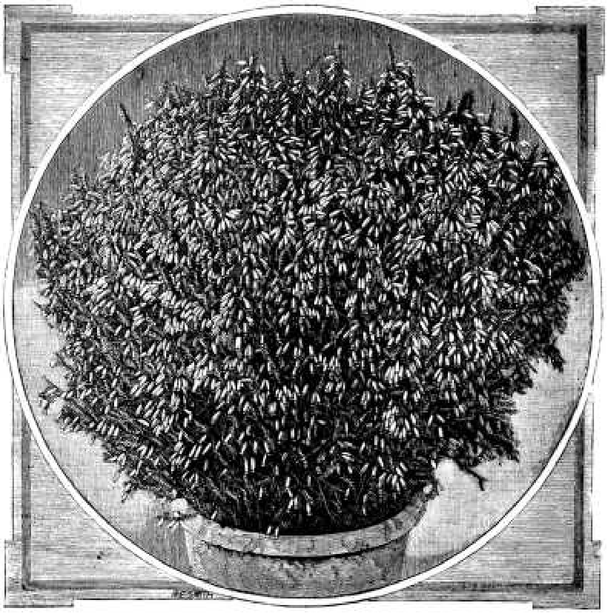
(*Soja hispida*.)

A good deal of attention has lately been directed to this plant in consequence of the enormous extent to which it is cultivated in China for the sake of the small seeds which it produces, and which are known as soy beans. These vary considerably in size, shape, and color, according to the variety of the plant which produces them. They are for the most part about the size and shape of an ordinary field pea, and, like the pea, are of a yellow color; some, however, are of a greenish tint. These seeds contain a large quantity of oil, which is expressed from them in China and used for a variety of purposes. The residue is moulded with a considerable amount of pressure into large circular cakes, two feet or more across, and six inches or eight inches thick. This cake is used either for feeding cattle or for manuring the land; indeed, a very large trade is done in China with bean cake (as it is always called) for these purposes. The well-known sauce called soy is also prepared from seeds of this bean. The plant generally known as Soja hispida is by modern botanists referred to Glycine soja. It is an erect, hairy, herbaceous plant. The leaves are three-parted and the papilionaceous flowers are born in axillary racemes. It is too tender for outdoor cultivation in this country, but, has been recommended for extended growth in our colonies as a commercial plant. The plants are readily used from seed.--*J.R.F., in The Garden*.

THE SOY BEAN. *(Soja Lispida)*

ERICA CAVENDISHIANA.

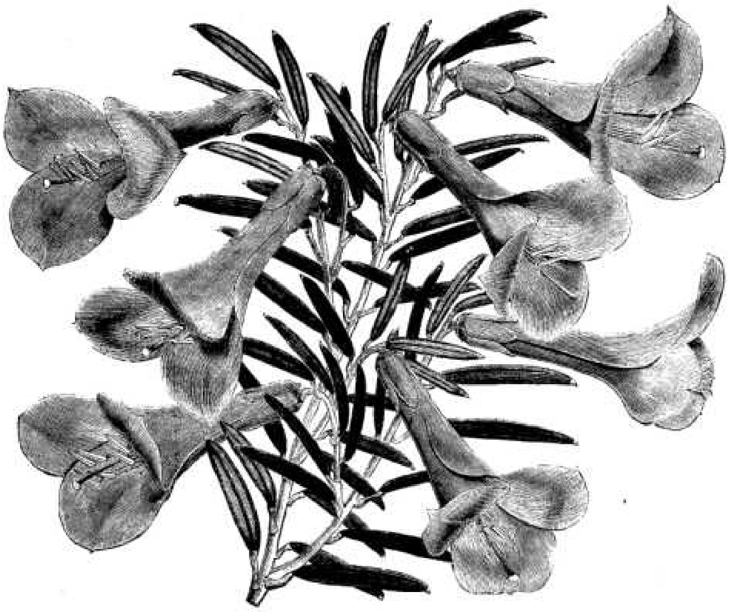
The plant of which the illustration is given is one of those fine specimens which has made the collection of J. Lawless, Esq., The Cottage, Exeter, famous all over the south and west of England. It is only one specimen among a considerable collection of hard-wooded plants which are cultivated and trained in first rate style by Mr. George Cole, the gardener, one of the most successful plant growers of the day. The plant was in the winning collection of Mr. Cole exhibited at the late spring show held at Plymouth.--*The Gardeners' Chronicle*.



ERICA CAVENDISHIANA.

PHILESIA BUXIFOLIA.

We figure this plant, not as a novelty, but for the purpose of showing what a fine thing it is when grown under propitious circumstances. Generally, we see it more or less starved in the greenhouse, and even when planted out in the winter garden its flowers lack the size and richness of color they attain out-of-doors. It comes from the extreme south of South America, which accounts for its hardihood, and is a near ally of the Lapageria: the latter is remarkable for withstanding even the noxious fumes of the copper smelting works in Chili, and as the Philesia has similar tough leaves, it is probable that it would support the vitiated atmosphere of a town better than most evergreens. In any case, there is no reasonable doubt but that, if cultivators would take the necessary pains, they might select perfectly hardy varieties both of the Lapageria and of the Philesia. As it is, we can only call the Philesea half-hardy north of the Thames, while the Lapageria is not even that. The curious Philageria, raised in Messrs. Veitch's nursery and described and figured in our columns in 1872, p. 358, is a hybrid raised between the two genera. For the specimen of Philesia figured we are indebted to Mr. Dartnall.--*The Gardeners' Chronicle*.



PHILESIA BUXIFOLIA--HARDY SHRUB--FLOWERS, ROSE PINK.

MAHOGANY.

The mahogany tree, says the *Lumber World*, is a native of the West Indies, the Bahamas, and that portion of Central America that lies adjacent to the Bay of Honduras, and has also been found in Florida. It is stated to be of moderately rapid growth, reaching its full maturity in about two hundred years. Full grown, it is one of the monarchs of tropical America. Its trunk, which often exceeds forty feet in length and six in diameter, and massive arms, rising to a lofty height, and spreading with graceful sweep over immense spaces, covered with beautiful foliage, bright, glossy, light, and airy, clinging so long to the spray as to make it almost an evergreen, present a rare combination of loveliness and grandeur. The leaves are small, delicate, and polished like those of the laurel. The flowers are small and white, or greenish yellow. The fruit is a hard, woody capsule, oval, not unlike the head of a turkey in size and shape, and contains five cells, in each of which are inclosed about fifteen seeds.

The mahogany tree was not discovered till the end of the sixteenth century, and was not brought into European use till nearly a century later. The first mention of it is that it was used in the repair of some of Sir Walter Raleigh's ships, at Trinidad, in 1597. Its finely variegated tints were admired, but in that age the dream of El Dorado caused matters of more value to be neglected. The first that was brought to England was about 1724, a few planks having been sent to Dr. Gibbons, of London, by a brother who was a West Indian captain. The doctor was erecting a house, and gave the planks to the workmen, who rejected them as being too hard. The doctor then had a candle-box made of the wood, his cabinet-maker also complaining of the hardness of the timber. But, when finished, the box became an object of general curiosity and admiration. He had one bureau, and her Grace of Buckingham had another, made of this beautiful wood, and the despised mahogany now became a prominent article of luxury, and at the same time raised the fortunes of the cabinet-maker by whom it had been so little regarded. Since that lime it has taken a leading rank among the ornamental woods, having come to be considered indispensable where luxury is intended to be indicated.

A few facts will furnish a tolerably distinct idea of the size of this splendid tree. The mahogany lumbermen, having selected a tree, surround it with a platform about twelve feet above the ground, and cut it above the platform. Some twelve or fifteen feet of the largest part of the trunk are thus lost. Yet a single log not unfrequently weighs from six or seven to fifteen tons, and sometimes measures as much as seventeen feet in length and four and a half to five and a half feet in diameter, one tree furnishing two, three, or four such logs. Some trees have yielded 12,000 superficial feet, and at average price pieces have sold for $15,000. Messrs. Broadwood London, pianoforte manufacturers, paid £3,000 for three logs, all cut from one tree, and each about fifteen feet long and more than three feet square. The tree is cut at two seasons of the year--in the autumn and about Christmas time. The trunk, of course, furnishes timber of the largest dimensions, but that from the branches is preferred for ornamental purposes, owing to its closer grain and more variegated color.

In low and damp soil its growth is rapid; but the most valuable trees grow slowly among rocks on sterile soil, and seem to gather compactness and beauty from the very struggle which they make for an existence. In the Bahamas, in the most desolate regions, once flourished that curiously veined and much esteemed variety once known in Europe as "Madeira wood," but which has long since been exterminated. Jamaica, also, which used to be a fruitful source of mahogany, and whence in 1753 not less than 521,000 feet were shipped, is now almost depleted. That which is now furnished from there is very inferior, pale, and porous, and is less esteemed than that of Cuba, San Domingo, or Honduras.

In a dry state mahogany Is very durable, and not liable to the attack of worms, but, when exposed to the weather it does not last long. It would therefore make excellent material for floors, roofs, etc., but its costliness limits its utility in this direction, and it is chiefly employed for furniture, doors, and a few other articles of joinery, for which it is among the best materials known. It has been used for sashes and window frames, but is not desirable for this purpose on account of the ease with which it is affected by the weather. It has also been used in England to some extent for the framing of machinery in cotton-mills. Its color is a reddish brown of different shades and luster, sometimes becoming a yellowish brown, and often much veined and mottled with darker shades of the same color. Its texture is uniform, and the rings indicating its annual growth are not very distinct. The larger medullary rays are absent, but the smaller ones are often very distinct, with pores between them. In the Jamaica woods these pores are often filled with a white substance, but in that brought from Central America they are generally empty. It has neither taste nor odor, shrinks very slightly, and warps, it is said, less than any other wood.

The variety called Spanish mahogany comes from the West Indies, and is in smaller logs than the Honduras mahogany, being generally about two feet square and ten feet long. It is close grained and hard, generally darker than the Honduras, free from black specks, and sometimes strongly marked; the pores appear as though chalk had been rubbed into them.

The Honduras mahogany comes in logs from two to four feet square and twelve to fourteen long; planks have been obtained seven feet wide. Its grain is very open and often irregular, with black or gray specks. The veins and figures are often very distinct and handsome, and that of a fine golden color and free from gray specks is considered the best. It holds the glue better than any other wood. The weight of a cubic foot of mahogany varies from thirty-five to fifty-three pounds. Its strength is between sixty-seven and ninety-six, stiffness seventy-three to ninety-three, and toughness sixty-one to ninety-nine--oak being considered as one hundred in each case.

There are three other species of the genus *Swietania* besides the mahogany tree, two of them natives of the East Indies. One is a very large tree, growing in the mountainous parts of central Hindostan, and rises to a great height, throwing out many branches toward the top. The head is spreading and the leaves bear some resemblance to those of the American species. The wood is a dull red, not so beautiful as that known to commerce, but harder, heavier, and more durable. The natives of India consider it the most durable timber which their forests afford, and consequently use it, when it can be procured, wherever strength and durability are particularly desired. The other East Indian species is found in the mountains of Sircars, which run parallel to the Bay of Bengal. The tree is not so large as any of the other species described, and the wood is of much different appearance, being of a deep yellow, considerably resembling box. The grain is close, and the wood both heavy and durable. The third species, known as African mahogany, is brought from Sierra Leone. It is hard and durable, and used for purposes requiring these properties in an eminent degree. If, however, the heart of the tree be exposed or crossed in cutting or trimming the timber, it is very liable to premature and rapid decay.

ANIMALS AND THE ARTS.

In many of the museums efforts are made to perfect economic collections of animals, so as to show how they can be applied to advantage in the arts and sciences. The collection and preparation of the corals, for example, form an important industry. The fossil corals are richly polished and set in studs and sleeve-buttons, forming rich and ornamental objects. The fossil coral that resembles a delicate chain has been often copied by designers, while the red and black corals have long been used. The best fisheries are along the coasts of Tunis, Algeria, and Morocco, from 2 to 10 miles from shore, in from 30 to 150 fathoms. Good coral is also common at Naples, near

Leghorn and Genoa, and on various parts of the sea, as Sardinia, Corsica, Catalonia, Provence, etc. It ranges in color from pure white through all the shades of pink, red, and crimson. The rose pink is most valued. For a long time Marseilles was the market, but now Italy is the great center of the trade, the greater number of boats hailing from Torre del Greco, while outside persons are forced to pay a heavy tax. The vessels are schooners, lateen-rigged, from three to fourteen tons. Large nets are used, which, during the months between March and October, are dragged, dredge-like, over the rocks. A large crew will haul in a season from 600 to 900 pounds. To prevent the destruction of the industry, the reef is divided into ten parts, only one being worked a year, and by the time the tenth is reached the first is overgrown again with a new growth. In 1873 the Algerian fisheries alone, employing 3,150 men, realized half a million of dollars. The choice grades are always valuable, the finest tints bringing over $5 per ounce, while the small pieces, used for necklaces, and called collette, are worth only $1.50 per ounce. The large oval pieces are sent to China, where they are used as buttons of office by the mandarins.

THE CONCH-SHELL.

Somewhat similar in appearance to coral is the conch jewelry, sets of which have been sold for $300. The tint is exquisite, but liable to fade when exposed to the sun. It is made from the great conch, common in Southern Florida and the West Indies. The shells are imported into Europe by thousands, and cut up into studs, sleeve-buttons, and various articles of ornament. These conches are supposed to be the producers of pink pearls, but I have opened hundreds of them and failed to find a single pearl. The conch shell is used by the cameo cutter. Rome and Paris are the principal seats of the trade, and immense numbers of shell cameos are imported by England and America, and mounted in rings, brooches, etc. The one showing a pale salmon-color upon an orange ground is much used. In 1847, 300 persons worked upon these shells in Paris alone, the number of shells used being immense. In Paris 300,000 helmet-shells were used in one year, valued at $40,000 of the bull's mouth, 80,000, averaging a little over a shilling apiece, equal to $34,000. Eight thousand black helmets were used, valued at $9,000. The value of the large cameos produced in Paris in the year 1847 was about $160,000, and the small ones $40,000. In the Wolfe collection of shells at the Museum of Natural History, Central Park, is a fine specimen of the queen conch from the Florida reef, with a fine head cut into the outer surface, showing how it is done. The tools of the worker in cameos are of the most delicate description. Fine files, knitting-needle like implements, triangular-shaped steel cutters, are arranged in a seemingly endless confusion before the worker. The shell or piece of shell to be cut is either lashed or glued to a heavy block or held in the hand, and the face, animal, or other object outlined first with a delicate lead; having thus laid the foundation, the lines are gone over with a delicate needle first, then various kinds, the work gradually growing before the eye, reminding one of the work of the engraver on wood.

LIVING BEETLES, ETC.

Insects have always been used more or less in decoration, especially in Brazil, where the richly-colored beetles of the country are affected as articles of personal adornment. Recently in a Union Square jewelry store a monster beetle was on exhibition, having been sent there for repairs. It was alive, and about its body was a delicate gold band, locked with a minute padlock; a gold chain attached it to the shawl of the owner. Sometimes they are worn upon the headgear, their slow, cumbersome movements preventing them from attracting great attention. They are valued at from $50 to $100 apiece. Snakes, the rich green variety so common in New England, are worn by some ladies as bracelets, while the gorgeous reptiles are often imitated in gold and silver, with eyes of diamonds, rubies, or black pearls. Gold bears are the proper thing now for pins. In the East the chameleon is often worn as a head ornament, the animal rarely moving, and forming at least a picturesque decoration, with its odd shape and sculptured outlines. Various other reptiles, as small turtles, alligators, etc., are pressed into service. The curious soldier-crab has been used as a pin. Placed in a box with a rich pearly shell prepared for the purpose, it will change houses, and then, secured by a gold or silver chain, roams about the wearer, waving its red and blue claws in a warlike manner. Birds are, perhaps, more commonly used as natural ornaments than any other, and a cloak of the skins of humming birds is one of the most magnificent objects to be imagined. One, of a rare species, was once sold in Europe for $5,000. Single birds are often worth $700 or $800. A cloak of the skin of the great auk would bring $8,000 or $10,000. Some of the most beautiful pheasants are extremely valuable--worth their weight in gold. Tiger claws are used in the decoration of hats, and are extremely valuable and hard to obtain.

Within ten years the alligator has become an important factor to the artistic manufacturer. The hide, by a new process, is tanned to an agreeable softness and used in innumerable ways. The most costly bags and trunks are made from it; pocket-books, card-cases, dining-room chairs are covered with it, and it has been used as a dado on the library wall of a well-known naturalist. It makes an excellent binding for certain books. Among fishes the shark provides a skin used in a variety of ways. The shagreen of the shark's ray is of great value. Canes are made of the shark's backbone, the interstices being filled with silver or shell plates. Shark's teeth are used to decorate the weapons of various nations. The magnificent scales, nearly four inches across and tipped with seemingly solid silver, of the giant herring, are used, while scales of many of the tribe have long been used in the manufacture of artificial pearls.

PEARLS.

The latter are perhaps the most valuable of all the offerings of animate nature, and are the results of the efforts of the bivalve to protect itself from injury. A parasite bores into the shell of the pearl bearer, and when felt by the animal it immediately fortifies itself by covering up the spot with its pearly secretion; the parasite pushes on, the oyster piling up until an imperfect pearl attached to the shell is the result. The clear oval pearls are formed in a similar way, only in this case a bit of sand has become lodged in the folds of the creature, and in its efforts to protect itself from the sharp edges, the bit becomes covered, layer by layer, and assumes naturally an oval shape. This growth of the pearl, as it is incorrectly termed, can be seen by breaking open a $500 gem, when the nacre will be seen in layers, resembling the section of an onion. The Romans were particularly fond of pearls, and, according to Pliny, the wife of Caius Caligula possessed a collection valued at over $8,000,000 of our money. Julius Caesar presented a jewel to the mother of Brutus valued at $250,000, while the pearl drank by Cleopatra was estimated at $400,000. Tavernier, the famous traveler, sold a pearl to the Shah of Persia for $550,000. A twenty-thousand-dollar pearl was taken from American waters in the time of Philip II. It was pear-shaped, and as large as a pigeon's egg. Another, taken from the same locality, is now owned by a lady in Madrid who values it at $30,000.

Fresh water pearls are often of great value. The streams of St. Clair County. Ill., and Rutherford County, Tenn., produce large quantities, but the largest one was found near Salem, N. J. It was about an inch across, and brought $2,000 in Paris. The pearls from the Tay, Doon, and Isla rivers, in Scotland, are preferred by many to the Oriental, and in one summer $50,000 worth of pearls have been taken from these localities by men and children. Mother-of-pearl used in the arts is sold by the ton, from $50 to $700 being average prices. The last year's pearl fisheries in Ceylon alone realized $80,000, to obtain which more than 7,000,000 pearl oysters were brought up.

SEPIA AND SILK.

The sepia of the artist comes from a mollusk, and is the fossil or extant ink-bag of a cephalopod or squid, while the cuttle-fish bone is used for a variety of purposes. In the islands of the Pacific the young of the pearly nautilus are strung upon strings and sold for $25 and $20 as necklaces. The tritons are in fair demand, and many tons of cowries are sent to Europe yearly, while the shipment of a thick-lipped strombus in one year to Liverpool amounted to 300,000. The rich coloring of the haliotis is used for inlaying art furniture. From the pinna, silk of a peculiar quality is obtained. It is the byssus or cable of the animal. The threads are extremely fine, and equal in diameter throughout their entire length. It is first cleaned with soap and water, and dried by rubbing through the hands, and finally passed through combs of bone, iron, or wood, of different sizes, so that a pound of the material in the rough gives only about three ounces of pure thread. It is mixed with a third of real silk and spun into gloves, stockings, etc., having a beautiful yellow hue. The articles made from it are, however, not in general use. A pair of gloves from pinna silk would cost $1.50, and stockings about $3. Fine specimens of such work can be seen in the British Museum.

Though not of animal origin, amber is one of the choicest vegetable productions used in the arts. It is the fossil gum of pines. Great beds of it occur at various points in Europe. On the Prussian seaboard it is mined, and often washes ashore. In 1576 a piece of amber was found that weighed thirteen pounds, and for which $5,000 was refused. In the cabinet of the Berlin Museum there is a piece weighing eighteen pounds. Ambergris, from which perfumery is made, is a secretion taken from the intestines of the whale, and a piece purchased from the King of Tydore by the East India Company is reported to have cost $18,000. Whales' teeth, the tusks of elephants, and those of the walrus and narwhal, are all used. Elephants' feet are cut off at a convenient length, richly upholstered, and used as seats; the great toe-nails, when finely polished, giving the novel article of furniture an attractive and unique appearance.

It is probably not generally known that the web of certain spiders has been used. Over 150 years ago, Le Bon, of France, succeeded in weaving the web material into delicate gloves. Prof. B.G. Wilder investigated the question thoroughly, and was a firm believer that the web of the spider had a commercial value, but as yet this has not been realized. It would be difficult to find an animal that does not in some way contribute to the useful or decorative arts.--*C.F.H., in N.Y. Post*.

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