

HOME-MADE APPARATUS FROM HOME MATERIALS.

We commence in this issue the publication of a series of articles by George M. Hopkins, the well known author of *Experimental Science*, which is certain to interest a wide circle among our readers, many of whom doubtless are looking for such information and suggestions as the articles contain. Everyone, boy or man, with a touch of mechanical instinct is possessed at times with the desire to amuse himself by putting some of the simpler mechanical movements into the concrete shape of a steam engine, lathe, electric motor, tool, or what-not. In the case of most of us, the task is rendered difficult by the lack of proper materials or the necessary implements, which may often be beyond reach, either because the would-be mechanic lives in a village or country district, where such things are unobtainable, or because the cash to buy the necessary outfit is not available: the latter a frequent obstacle, we fear, to engineering schemes, where the engineer is yet on the roll-call of the district school and his pence are subject to a steady drain for candy, kites and fireworks.

In the series of articles referred to, the author shows by drawings and descriptions how, by the use of ready-to-hand material about the house, the amateur mechanic may construct useful working apparatus without "going off the block" or outside the village boundaries; and the reader will discover that it is wonderful how much a little ingenuity can accomplish with those odds and ends of metal work—the leavings of the plumber and the furnace man, discarded kitchen utensils or the wreck of a worn-out sewing machine—which would ordinarily find their way to the "ash-man" and the junkshop.

Particular value attaches to these articles from the fact that the illustrations are made from actual apparatus, constructed at different times either by the author or his assistant; and the reader who sets out to make one of these machines may rest satisfied that he is building a "working" model that will work.

ACTINO-ELECTRIC PHENOMENA PRODUCED BY VIOLET RAYS.*

BY BICHAT AND SWINGEDAUF.

The production of electric currents under the action of light has been known for some time, especially by the work of Ed. Becquerel. An experiment made by Hertz in 1887 was the starting point for a great number of researches which will be briefly described. During his experiments with electric oscillations he showed that the sparking distance between the two spheres of an exciter was increased simply by the fact that they were lighted by another spark or a source rich in violet rays. A short time after, M. Hallowachs showed the influence of the more refrangible rays upon the loss of charge of negative electricity. The latter phenomenon will be first considered. If a metal plate is united to an electroscope and illuminated by an arc lamp, the loss of charge is made evident. If the plate is negatively electrified, the gold leaves approach each other rapidly; if positively, no effect is produced. Messrs. Righi and Stoletow operate as follows: A metallic plate and a sheet of wire gauze are placed parallel at about one-eighth of an inch; M. Righi unites the two conductors to the two pairs of quadrants of an electrometer; M. Stoletow connects the metal plate to the negative pole of one hundred cells of battery and the gauze to the positive pole, with a sensitive galvanometer in the circuit. When the plate is lighted through the wire gauze, the galvanometer is deflected. When the connections are changed the effect is null. It is the violet or ultra-violet rays that have the greatest action, but with potassium the light of a candle and even the less refrangible rays give the effect. All the substances transparent for violet or ultra-violet rays let the active rays pass, but glass and mica cut off the greater part. If the negatively charged body is transparent for the active rays, such as water, the effect is less, while non-transparent liquids, as solutions of fuchsine, act like the metals.

M. Righi was the first to show the action of light upon non-electrified bodies, in 1888. If the plate and wire gauze which are united to the two pairs of quadrants of an electrometer with charged needle are of different metals, a deviation is obtained when the plate is illuminated through the gauze screen; the deflection is independent of the charge of the plate or the distance apart, but depends on the nature of the metals used. If the same metals are used, a deflection is obtained; this system constitutes a photo-electric couple. Such couples may be placed in series and are analogous to piles on open circuit. If the gauze is suppressed and an isolated body is lighted, it is electrified, but much more slowly. The maximum potential depends upon the nature of the metal; the electrification is positive in general, but is negative in some exceptional cases. Messrs. Elster and Geitel have shown that polarization of the light has a marked effect. In the case of a sodium-potassium amalgam upon whose surface the light of a lamp polarized by a Nicol's prism falls at an angle of 45°, the deviation of a gal-

vanometer in circuit with it and a battery of 250 volts is a maximum when the plane of polarization and the plane of incidence are perpendicular, and vice versa, the relation between maxima and minima being as 1 to 10. As to the mechanism of the transport of electricity under the action of the rays, the question is not fully decided. M. Arrhenius, in 1887, supposed that the gas acquires a kind of electrolytic conductivity under the action of the rays; several other physicists had the same opinion. This idea has been disputed by others since that time, especially by M. Righi, who seems to have demonstrated that the discharge takes place by convection, with a speed of 150 to 750 feet per second. Other experiments seem to confirm this opinion, notably that of M. Ernst Simon, who shows that the change in the specific inductive capacity of the gases, which should be considerable if they became conductors, is in reality feeble. The nature of the particles is to be considered. Messrs. Lenard and Wolf have shown that under the action of the refrangible rays the surface layer of metals is disintegrated, and the particles taken from the surface may thus carry the charge. M. Righi, however, supposes that the gaseous molecules carry the charge. If the gases condensed at the surface are driven off by heating, the effect is much less. Other experiments seem to confirm this idea. M. Lenard has recently found that a metal plate in a vacuum, lighted by ultra-violet rays, emits rays charged negatively and deviated by the magnetic field like cathodic rays. These phenomena give an explanation of atmospheric electricity. It has been found by M. Buisson that ice, when dry, acts like a metal under these circumstances, but when wet the effect is null. On the other hand, the action of the ultra-violet rays increases when the pressure diminishes, and the atmosphere absorbs these radiations coming from the sun. According to M. Brillouin, the electrification of the atmosphere is due to the action of the solar light upon the ice-needles of the cirrus. These needles, lighted by the sun in air relatively rarefied, lose negative electricity and the surrounding air becomes negatively electrified without becoming conductor. This air yields its charge when in contact with the earth. Different observations seem to uphold this idea. It remains to be seen whether the phenomena of ultra-violet rays are connected with those of like nature due to flames, incandescent bodies, phosphorus, cathodic rays, etc. To connect these, it suffices to admit that in all cases there is emission of cathodic rays; a further study of the subject would be useful.

The second series of phenomena is the increase of the sparking distance. The action of the ultra-violet rays upon the spark was first discovered by Hertz. He showed the action of the rays from one spark upon another by arranging two sets of dischargers, one beside the other, both being connected with the same induction coil. One discharger was regulated at a small distance, and gave a spark at each interruption of the circuit; the second had the maximum distance at which such a spark passed. If now a metal or glass plate was placed between the two dischargers, the latter spark ceased, but reappeared upon removing the plate. It was found that the interposition of the plate diminished a two-inch sparking distance to one inch. The action of the spark is propagated in straight lines, and the active rays are absorbed by most solids; quartz is transparent, also water, alcohol and ether. Melted paraffine, benzine, bisulphide of carbon, are almost opaque. The rays are reflected and refracted like light rays; a prism of quartz interposed will suppress the action by deflecting the rays; if the discharger is moved to the base of the prism, the action reappears. Different experiments show that it is the ultra-violet rays which produce the action. Ordinary sources, rich in these rays, give analogous results, the electric arc, for instance. It may be concluded, with Hertz, that ultra-violet light has the property of increasing the distance of disruptive discharge of an induction coil, or like discharges. The increase depends upon several factors: The form of the poles; it is greater with balls than with points. The nature and pressure of the gases; when the pressure is diminished, it passes toward a minimum. The nature of the poles; platinum is especially sensitive, copper and zinc are less so, and aluminium insensitive. A meniscus of pure water is insensitive, while that of an absorbent liquid is sensitive. Messrs. Wiedemann and Ebert, who made the experiments, consider that the increase augments with the absorbent power of bodies for the active rays. The surface of the poles must be acted upon, and not the intervening space; both poles are sensitive, according to Hertz, but Wiedemann and Ebert, with 0.12-inch poles, find the cathode alone sensible. The authors have shown that the sensitiveness of the positive pole depends upon its radius, being null for a diameter less than 0.2 inch, but then increases. The action is manifest in a time smaller than one-billionth of a second, as shown by M. Swingedauf. The action depends upon the condition of the charge; it is an increasing function of the rapidity of the variation of potential at the instant the spark occurs, as the latter experimenter shows. It seems, then, that the increase of sparking

distance between two poles under the action of ultra-violet light depends upon the nature, form, and distance of the poles, the nature of the dielectric and the speed of variation of potential. In conclusion, it may be asked whether the phenomena of descriptive discharge and those of loss of charge provoked by ultra-violet rays are not correlative; certain experiments seem to favor this idea, but a systematic and exact study of the two actions is necessary.

SCIENCE NOTES.

John D. Rockefeller has given \$100,000 to the psychological laboratory at Columbia University.

Mt. St. Elias has been badly shaken by an earthquake. It is said that the mountain was considerably torn up. The shock was so severe that a mass of ice, acres in extent, broke loose from the top of the mountain, and went crashing down the sides carrying everything with it.

The New York Central and Hudson River Railroad is building a new passenger station at the Bedford Park entrance to the New York Botanical Garden. The passenger shelters and waiting rooms on the east side will open directly into the plaza, and the name of the station will be changed to Bronx Park.

A mountain-climbing party in the Sandwich Islands was attacked by a colony of wild bees. They had climbed Konahunui, the highest peak near Honolulu. In descending precipitous cliffs they were attacked by the bees, which stung them when they were helpless to ward off the insects. For nearly a mile the bees followed them until they reached a point where they could defend themselves.

A model of the cathedral of St. John the Divine has been under construction for the past two years. It will be a miniature building, 50 by 25 feet, with a height of 35 feet. It is on a scale of an inch to the foot. The structure will be built of plaster, and a wooden frame will accommodate over a hundred persons. It is to be exhibited on the site of the cathedral, and possibly inside of a temporary structure. The work upon the cathedral proceeds slowly.

Surgeon-General Van Reypen does not consider that Guam is a good naval station. He says that typhoid fever is practically endemic in the island, owing to the pollution of the drinking water. There have been twenty-five cases and four deaths from this cause in a force of 143 men. The climate is also debilitating, but is not otherwise bad. The mean annual temperature is above 77° Fah. The Surgeon-General considers it would be better to establish a station at Cabras Island, which, as it is not inhabited at present, has its soil free from infection.

A new life-saving net has been adopted by the New York Fire Department. It consists of a circular gas pipe frame, which shuts up like an old-fashioned purse, and which when opened has a diameter of 18 feet. A canvas net is attached to the frame, and the canvas is lined with a layer of wadding two inches thick. The shock to a person striking the net is reduced to a minimum, and the difficulty in holding it is lessened by means of strong springs by which the canvas is attached to the frame. They take up the force of the impact. A trial was recently held, and a fireman jumped from a height of four stories into the net, and the shock of the impact was trifling. The men who were holding the net felt practically no strain.

An American circus has been visiting Germany, and our consul at Aix-la-Chapelle gives an interesting account of the way the Germans received the show. The bill-posting was a revelation to them, both in magnitude and character. The way in which the tents were erected and the ground prepared astonished the people. When the circus itself arrived, not a workman went to the factories, and the spindles were idle all day. At every performance the tents were filled, and the vague antipathy against the United States has been turned into respect and awe. The people now consider that anything is possible to Americans. Our consul considers that if an agent of American goods would follow in the wake of the circus, he would make ready sales.

According to the national law of Italy, dated February 7, 1892, anybody who suppresses, destroys, sells, or in any way turns to his own profit paintings, statues, or other works of art kept in galleries, libraries or private collections mentioned in the law of June 28, 1871, is liable to imprisonment and fine. Prince Chigi has just been tried for selling one of his own pictures, a Madonna and Child, by Botticelli. It was stated that a vast sum was paid the Prince for this picture. The Roman court fined him \$63,000 and sentenced him to three months' imprisonment. In order to get the picture out of Italy, it is reported that another subject was painted over the picture. This completely mystified the customs officers, and the sale of the picture was not discovered until it was well out of the country. It is rumored that other pictures are in danger of being smuggled out of Italy, but the government is taking measures to promptly punish anyone making a sale of this kind.

* Abstract of lecture reported by the Paris correspondent of the SCIENTIFIC AMERICAN.