ECCENTRICITIES OF THE STATIC DISCHARGE.

BY WALTON HARRISON.

In Fig. 1 is represented one of the fundamental experiments of Hertz. Two Ruhmkorff coils, *A* and *D*, of different sizes, are so connected that their primary windings are in series with a single interrupter *C* and a battery *E*. The secondary winding of the larger coil *A* is provided with ordinary spark terminals *B*, while the secondary winding of the coil *D* is connected with a spark micrometer *F*.

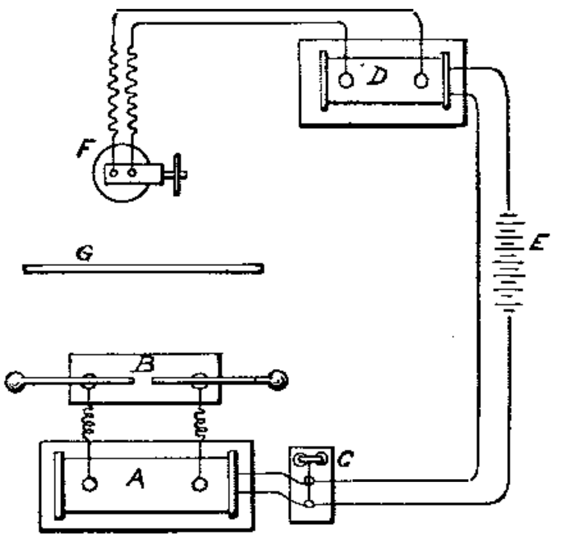

Fig. 1.

The instruments are so arranged that the spark terminals *B* are visible from the position of the spark micrometer. A plate *G*, which may be of glass, mica, metal, or almost any substance available, is now placed in such position that it screens the spark terminals *B* from the light of the spark micrometer, and the spark terminals *B* are so adjusted that the sparks just miss fire, while the sparks of the micrometer are allowed to play freely. If, now, the plate *G* be removed, a vigorous and continuous torrent of sparks is set up between the terminals *B*. The spark discharge may be repeatedly stopped and started by inserting and withdrawing the plate *G*. Hertz attributed this phenomenon to the action of ultra-violet light radiating from the spark micrometer and falling upon the terminals *B*, the effect of the illumination being to increase the ease with which the sparks can leap. During the period when the spark terminals are thus freely illuminated by ultra violet light, no Hertzian waves are generated.

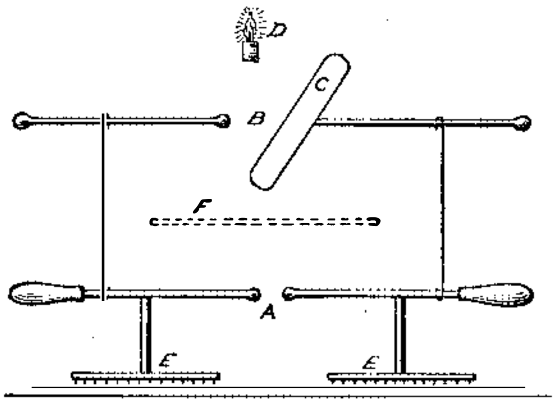

Fig. 2.

Other investigators have discovered that the cathode terminal is the one chiefly affected by the light.

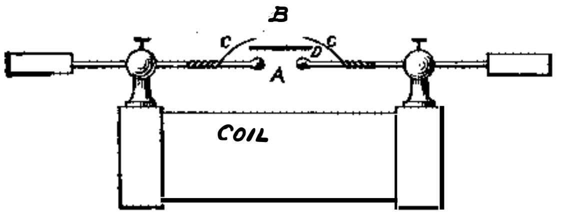

Fig. 3.

In Fig. 2 is shown a modification, by Elster and Geitel, of Hertz's experiment. The spark terminals *A* and *B* are connected together, a cathode plate *C* of polished zinc being substituted for one of the knobs. At *D* is a steady source of ultra-violet light, removable at will, and preferably consisting of a burning ribbon of magnesium. *E* and *E* represent the respective anode and cathode conductors of a Holtz static machine. A plate *F* of mica, glass, or other material opaque to ultra-violet rays, is located between *A* and *B*. When light from the source *D* illuminates the zinc cathode *C*, all sparking at *B* ceases, contrary to what might be expected in view of the experiment above described, and a continuous spark discharge is set up at *A*. This experiment is what Lodge calls " a curious inversion of Hertz's fundamental experiment." According to this authority, the ultra-violet rays increase or decrease the leaping distance of the static discharge accordingly as the normal difference of potential may be impulsive, as in a coil, or steady, as in a static machine.

In Fig. 3 is illustrated a modification, by the writer, of Hertz's experiment. A coil is provided with the usual knobs *A*, and with an interrupter. Two pieces *C C* of thin bare wire are mounted upon the knob stems, and bent into the conformity indicated. The adjustment is such that sparks are normally just able to leap the gap between the terminals *A*, but that no sparks can pass between the points *C C*. The plate *D* now being inserted between *A* and *B*, not only does the spark discharge at *A* cease, as might be expected from Hertz's experiment, but a continuous discharge is now abruptly set up between the points *C C*. Withdrawing the plate *D* causes this discharge to disappear, and the discharge between the knobs *AA* to reappear, so that, in effect, the spark discharge may be shifted back and forth from one spark gap to another by merely inserting and withdrawing the plate. It will be noted that in this experiment there are two spark gaps parallel to each other, and that each gap is exposed to the other when the plate is removed and each is screened from the other when the plate is inserted. The direction and character of the potential of each gap are apparently the same as that of the other. Why, then, does the plate thus apparently affect the two spark gaps unequally?

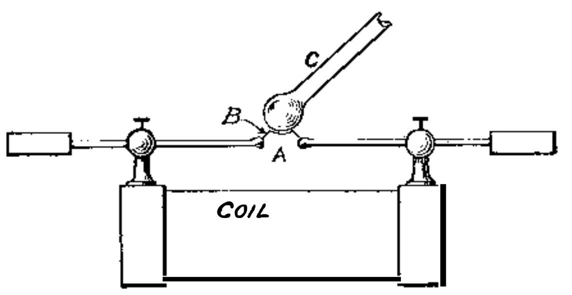

Fig. 4.

In Fig. 4 is represented a very simple experiment which, so far as known to the writer, has hitherto escaped observation, and in which the behavior of the spark is quite erratic. The coil shown is thrown into action so that the spark *B* plies steadily between the knobs *A*, and a small spherical body *C* of glass, rubber, or other insulating material is placed in immediate proximity to both knobs, but without touching either. The spark bends outward at its middle and hugs closely against the surface of the insulating body, partaking of its curvature, as indicated in the figure. The spark may thus double or even triple its original length. Moreover, by doing this the spark deserts a beaten path in which the air is heated, rarefied, ionized and permeated with metallic vapor, all tending to increase its conductivity, and cleaves for itself a new path apparently offering a much higher resistance.

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Sir William Crookes and Prof. James Dewar on Radium Emanations at Low Temperatures.

Sir William Crookes and Prof. James Dewar have examined the action of extreme cold on radium emanations, and published the results of their work in the Royal Society Proceedings.

The first endeavor was to ascertain whether scintillations produced by radium on a sensitive blende screen were affected by cold. A small screen of blende, with a morsel of radium salt close in front, was sealed in a glass tube. A lens was adjusted in place so that the scintillations could be seen. On dipping the whole into liquid air they grew fainter and soon stopped altogether. Some doubt was felt whether this might not have been caused, (1) by the presence of a liquid; (2) by the screen's losing its sensitiveness; and (3) by the radium's ceasing to emit heavy positive ions. To test this, two tubes were made, in one of which the radium could be cooled without the screen; while in the other the screen could be cooled while the radium salt was at the ordinary temperature. When the radium salt was cooled by liquid air, and the screen was at ordinary temperature, the scintillations were quite as vigorous as at the ordinary temperature, the screen and radium being *in vacuo*. With radium at the ordinary temperature and the screen cooled, in liquid air, it was observed that as the screen cooled the scintillations became fainter and at last could not be seen. On allowing the temperature to rise, the scintillations re-commenced.

The screen with a speck of radium salt in front of it was then sealed in a tube.

Water was put in the other end of the tube, and the tube sealed on the pump. A good exhaustion was kept up and the water boiled away, the vapor being condensed in phosphoric anhydride. The tube was sealed off when a few fine drops of water were still remaining in the tube. The scintillations were well seen in this saturated aqueous vapor. The lower end of the tube was dipped in liquid air, which instantly condensed the aqueous vapor and left a very good vacuum. On now examining the scintillations, they were, if anything, brighter and more vigorous than at first. When liquid hydrogen cooling was used instead of liquid air the action was equally marked, showing that the highest vacuum that can be obtained by the action of cold does not diminish the scintillations.

In the upper part of the tube, away from the radium and screen, two platinum wires were sealed to show the state of the vacuum. The spark passed easily at the ordinary temperature, showing a reddish line of aqueous vapor. When the other end of the tube was in liquid air the spark refused to pass.

It was thought that perhaps the passage of the induction spark might have liberated some occluded hydrogen, so another tube similar to the foregoing was made without the platinum wires. Here also immersion in liquid air, if it had any effect, brightened the scintillations, and on replacing the liquid and cooling by liquid hydrogen no change was observable.

In order to test the activity of radium in rendering air electrically conductive, some radium bromide was sealed up in a glass tube and heated to the highest temperature the glass would stand, during the production of as high a vacuum as the mercurial pump would give. The whole tube was then immersed in liquid hydrogen contained in a vacuum vessel. On bringing the radium in such a vessel into a room in which a charged electroscope was placed, it began to leak when the tube of radium surrounded with liquid hydrogen was some 3 feet away, and was very rapid in its action when a foot away from the electrometer. On immersing the tube containing the liquid hydrogen with submerged radium in another large vessel of liquid air and bringing the combination near the electroscope, the action was the same.

The luminosity of the radium salt in liquid hydrogen was much more marked with the pure compound than had been formerly observed with the diluted mixtures containing large quantities of barium salts.

Prof. Rutherford and Mr. Soddy made the important discovery that a considerable emanation is diffused into gases from solutions of radium salts, which emanation is capable of condensation from the gas mixture at the temperature of liquid air. As it was important to ascertain what was taking place in this respect with the anhydrous radium bromide when isolated in the highest vacuum, an interesting experiment was made.

A glass apparatus was used, consisting of a fine capillary tube, drawn out some 5 or 6 inches in length from an inverted U-tube, the two legs of which were each about 6 inches long, one leg terminating in a bulb. This latter leg was filled with hard-pressed purified asbestos. The radium salt was located in the bottom of the bulb. The whole, after being most carefully heated and exhausted to the limit of the mercurial pump, was sealed off. In the dark, no traces of phosphorescence could be seen in any part of the apparatus, unless from the pieces of radium bromide.

The fine capillary tube was now immersed in liquid air in a large glass, so that distillation might proceed undisturbed for days. After twenty-four hours of this operation, the capillary tube while still covered with liquid air, was examined. A marked phosphorescence was recognizable owing to some condensed emanation. The luminosity became naturally more marked the longer the action was allowed to proceed.

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Extermination of Worms and Snails by Electricity.

BY HUGO HALBERGER.

It was largely through an incidental observation that I was led to carry out a series of experiments for the purpose of ridding soils of worms, snails, and like creatures. I conceived the idea of drying by means of electricity a mold which had been constructed directly on the soil. Shortly after turning on the current, I noticed that worms were hurriedly struggling out of a neighboring bed. In crawling from one clod to another they writhed as if in pain. It seemed to me that the effect observed could have been produced only by the electric current. Indeed, the worms seemed to be immensely relieved and to return to their normal condition when the current was interrupted.

After this first observation I carried out a number of experiments. One terminal of an electrical circuit of 110 volts was thrust into the earth, the terminal being comprised of brass rods. The effect produced was even greater than that which I first studied. Within a radius of two meters the worms and snails emerged from the earth and crawled out of the influence of the electrical current. In this manner, by employing several brass rods, I succeeded in driving all the worms out of a bit of land.

The current used is of comparatively feeble strength. The voltage, however, must be correspondingly high. I believe that the remarkable effect of electricity on plants, which has been studied of late years rather narrowly, is to be attributed not so much to any beneficial influence on the plant itself, as to the extermination of the parasites that nest about the roots.

Munich, Germany.