Gates, Elmer. "Electrographs." (*Electricity*, New York: Dec. 13,1899) [Reprinted from the Photographic *Times*.]

ELECTROGRAPHS.

Pictures of Itself Made by the Electric Current Without a Camera

by Elmer Gates

Many amateurs and specialists have made photographs of the electric spark with the aid of the camera. Such photographs invariably look like flashes of lightning The pictures here shown were made without a camera by the electro-chemical action of the current while traversing a sensitive film of an ordinary photographic sensitive plate.

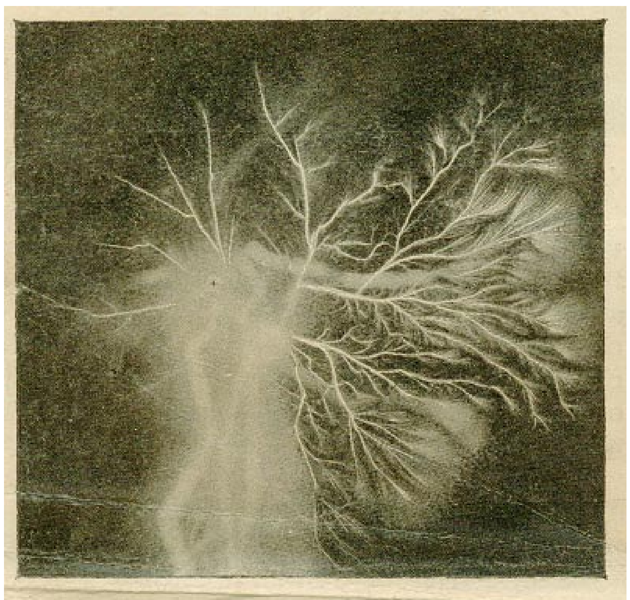

Fig. 1.

Fig. 1 is a print from the first electrographic negative I ever made. I placed an ordinary gilt-edge seed plate inside a light-proof envelop, taking care to keep the paper perfectly dry. I then started the static machine, which has ten plates of 30 inches in diameter, and caused a series of good strong sparks to pass between the knobs. I ran the machine at such a speed as to give a spark of only half the possible sparking distance. Then I pulled the knobs so far apart that no sparks could pass and there remained a brush-discharge instead of the spark. Then I held the envelope containing the sensitive plate, vertically between the two knobs with its face towards the positive pole. The plate was held transversely to the path taken by the spark in passing from knob to knob in such a way that the spark would strike the center of the plate. Then I pushed the knobs nearer together to allow one spark to pass. I was not quick enough, however, and two sparks passed, both of which punctured the paper, and jumped over the edge of the plate and then took the shortest direction to the other knob. In Fig. 1 the letter X shows where the first spark punctured the paper and then refused to travel over the film but jumped through the air between the paper and the film and the light from this spark produced a broad, white, crooked streak, of which X is the beginning. The second spark split. and part if it jumped over the side of the plate, and the other part was conducted through the film following a series of mutually divergent paths, electro-chemically precipitated the silver, leaving a permanent trace of it course through the conductor. The film is a better conductor glass. It is very thin and when the current strikes it at any spot, the direction of least resistance is radially outwards from that spot, because that is the only direction which gives a constantly increasing area of the cross-section of the conductive substance.

These electrographs surprise one by their multitudinous branchings in every direction. The current seems to try to get farther away from every part of itself, but this is not the cause of the branching. This separation of the current into a number of branches is produced, as I have said before, in conformity with the well known law that electricity travels in the direction of least resistance and that in any given conductor, the resistance diminishes as the area of its cross-section increases. The reason why the current has not spread radially in all directions with geometrical symmetry is that the plate cannot be held at exact right angles to the path of the spark, and the spark cannot me made to strike the plate exactly in its center. Minute local differences in resistance in the substance of the film produces abrupt changes in the direction of the branches. When a sensitive plate is placed between two shellac-covered glass plates, with a hole in one of the plates to admit the spark at the center of the film, the result is a marbled effect, as shown in Fig. 2.

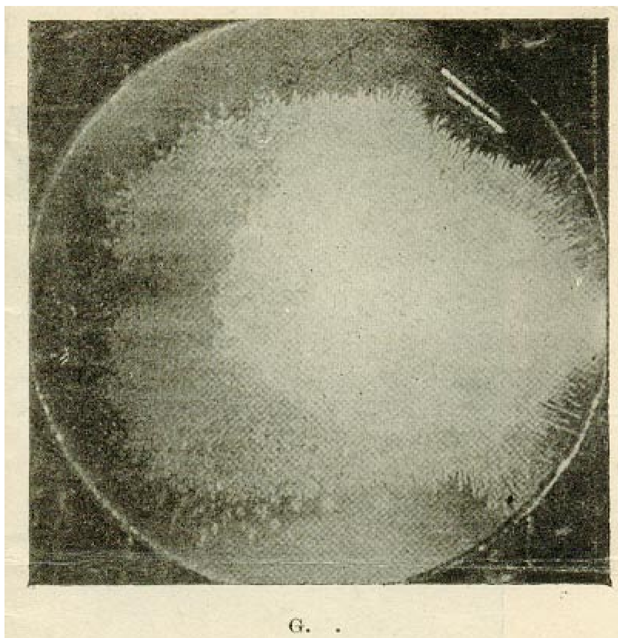

Fig. 2

I have made about 150 electrographs and the general conclusion at which I have arrived from the study of these results is, that the electric current in traversing a conductor does not invade uniformly all parts of the material of that conductor, but contrary to what has been the usual belief, it selects a number of separate and mutually [divergent paths. I am studying this subject in other kinds of conductors than films and expect to arrive at other results of interest.

In order to determine the difference between low and high potential I used the one-inch spark of a small two-plate static machine, and secured the beautiful little electrographs shown in Fig. 3.

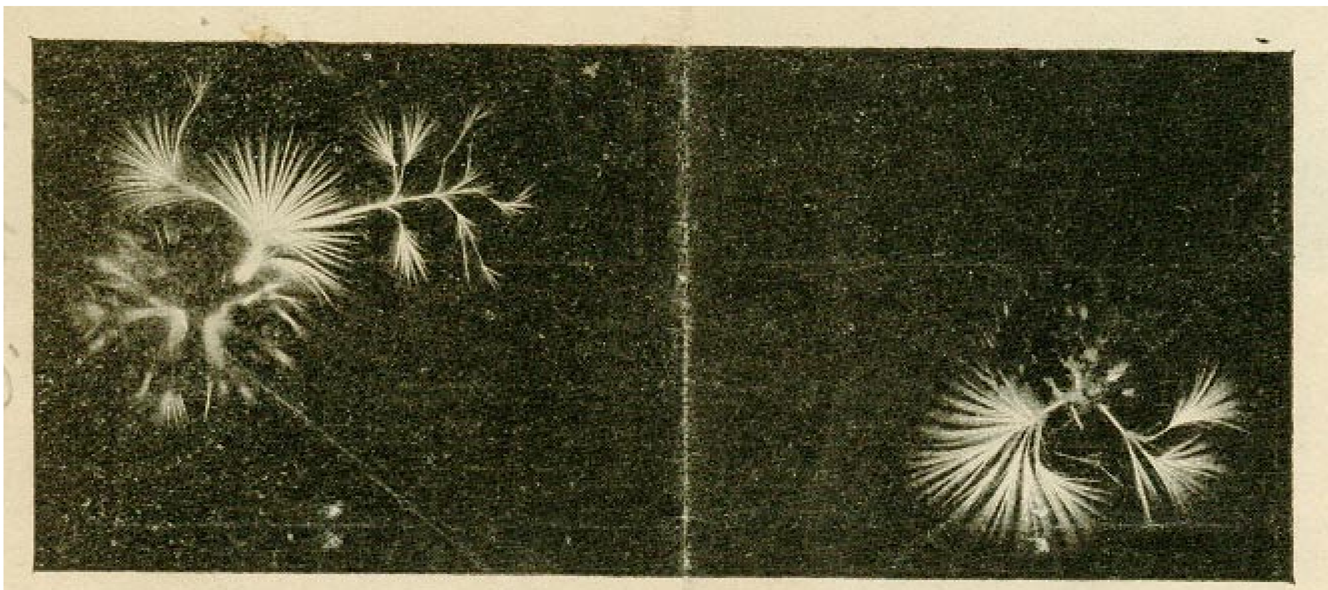

FIG. 3.

Fig. 3

When I used the larger machine, running at such speed as to give a 7-inch spark, I got the larger and more striking electrograph show in Fig. 4.

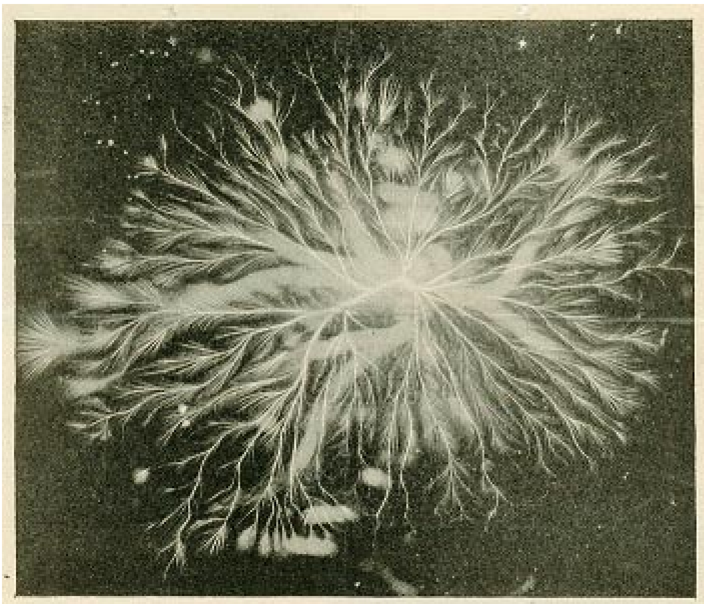

Fig. 4.

From these two experiments, in conjunction with a number of others, I have deduced the law that the area of an electrograph increases as the potential increases. A one-inch spark will produce a figure about one inch square whilst a twenty inch spark will produce a picture covering an area of over 100 square inches. I have also deduced the law that the amount of in an electrograph increases with the quantity of the current, that is. two electrographs made with the same potential, but one of them made with a greater quantity of current, will exhibit difference in the amount of detail, the greater detail being produced by the greater quantity of current. This is all shown by comparing Fig. 4, made with the seven inch spark of the static machine, and Fig. 5, which was made with the seven inch spark of an induction coil, giving much greater quantity than the static machine. This induction coil electrograph is interesting from another standpoint. It shows that there is no essential difference between the static current and the induction coil current except that of quantity.

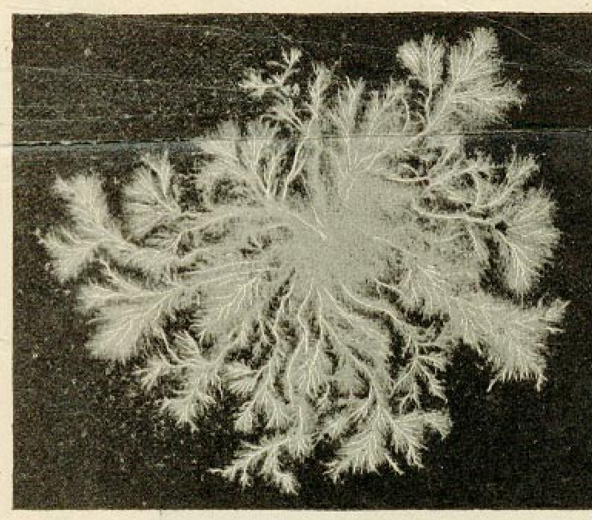

FIG. 5.

Fig. 6 was made with a sixteen inch static machine, but I added a an extra Leyden jar to the condenser of each pole of the static machine thus giving greater quantity of current and an unusual amount of detail. Any amateur who can obtain access to an induction coil or static machine can very readily repeat these experiments by placing a sensitive plate in the plate-holder and holding it between the terminals while the spark is passing and developing plate in the usual way. By regulating the sparking the sparking discharge so that only on spark can pass at a time the effect of a single discharge can be readily secured. It was somewhat of a surprise to me to learn that a current in traversing a conductive substance travels by means of a number of special mutually divergent paths; and these experiments have led me to deduce a number of other experiments which, when completed. will enable me to determine the course of the current in conductors of various kinds and shapes whilst subjected to various conditions.

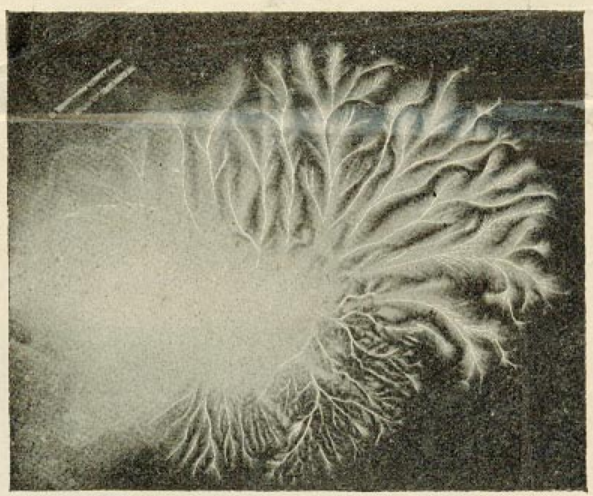

Fig. 6.