XXVII. On electricity

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XXVII. *On Electricity.* By Ez. WALKER, Esq.

To Mr. Tilloch.

SIR, AFTER all the hypotheses that have been invented to explain the phænomena of electricity, philosophers still entertain various opinions respecting the electric fluid. Some maintain that the spark is produced by two fluids passing through each other in contrary directions, forming a double current; but others are of opinion, that it consists of only one divided into two parts, which they call positive and negative electricity; whilst others even hesitate to admit the existence of the electric fluid, as completely established.

As many of the phænomena of nature are produced by electrical energy, and as no conclusion drawn from doubtful principles can be admitted in philosophy, it seems indispensably necessary, that this disputed point should be determined by clear and satisfactory experiments.

When a card is perforated by an electric spark, it is well known that a bur is raised on each side. This experiment has often been advanced as a proof that two positive powers pass through the card in contrary directions; but this conclusion is too hypothetical to be admitted as a physical truth, and every other experiment that has yet been made to investigate this point, is equally uncertain.

As many of the effects of electricity are strictly mechanical; the following experiments demonstrate, on that principle, that the electric spark consists of two forces passing through each other in contrary directions.

Experiment 1. Let a piece of tin-foil, about two inches long and an inch broad, be laid between two cards, with their ends fixed together with gum-water or varnish; and let ABCD (fig. 2. Plate II.) represent those cards when laid on a table, *ep* a piece of wire laid upon the cards, and *nh* another piece of wire laid under them; the distance *he* between the ends of the wires being about an inch.

A charge from a large Leyden jar being passed through the wires, a perforation was made in the top card at *e*, with an indent *downwards*, in the tin-foil and bottom card, under that point. The under card was also perforated at the end of the wire *h*, and at that point the tin-foil and upper card were indented *upwards*.

This experiment was repeated many times, without any variation in the phænomena, except that one end of the tin-foil was *sometimes* perforated.

Now it is evident from this experiment, that the power
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Acid River, & White River, in Java.

S. Porter, sculp.

from the inside of the jar passed from *p* to *n*, because an indent was made *downwards* at the point *e*; and it is also evident, that the power from the outside of the jar passed in the direction from *n* to *p*, as an indent was made *upwards* at the point *h*. Hence we may fairly conclude, that the electric spark consists not of one power only, but of two distinct positive powers acting in contrary directions and towards each other.

Experiment 2. I placed a single card upon a table, with a piece of wire upon it and another piece under it, so that their ends were one above the other; then two other cards were taken, and a piece of tin-foil placed upon the centre of each. One of these cards was placed under the bottom wire, with the tin-foil upwards, and the other was placed upon the top wire, the tin-foil being downwards.

An electric charge being passed through the two wires produced the same phænomena as those before mentioned; the middle card was perforated, the tin-foil upon the under card was indented *downwards*, but that upon the upper was indented *upwards*.

I communicated these experiments to Mr. Murray, philosophical lecturer, requesting him to repeat them, and the following is extracted from his answer, dated Swaffham, 17th July, 1813 :

"I took a single card," says Mr. Murray, "and placed one wire above it and another below, with the ends one above the other," &c. and proceeded as you direct: the result proved your conclusion to be correct, for the tin-foil both above and below the perforation was indented and in *contrary* directions.

"The theory of two powers moving contrariwise receives validity from the following experiment. The cards and tin-foil slips being used as before, I placed *two points below instead of one*, with *one above*; two corresponding indents were made on the tin-foil *upwards* and only one *downwards*. I reversed the experiment, and the two points being above the card, there appeared two indents *downwards* and only one *upwards*.

"I repeated these with uniform phænomena and unvarying results.

"You will think, I doubt not, with me, that the last mode of conducting the experiment places the subject in a point of view, beyond a doubt of the conclusion we have mutually drawn.

"I am, dear sir, with great respect, &c.

"J. MURRAY."

By

By comparing the indents made in the tin-foil, it appears that the two forces acting in contrary directions are nearly equal; but as no satisfactory conclusion could be drawn from these phænomena, I contrived an electrometer, by which these forces are compared to as great a degree of precision as the nature of the subject seems to require.

In fig. 3. Plate II. ABCD is a card placed in a vertical position upon a stand; EF, two thin pieces of mahogany which slide upon the card, by means of slits cut in them with a fine saw.

px and nx two pieces of wire sliding through E and F; px is placed on one side of the card and nx on the other, their ends being opposite to one another at the point x .

G, a piece of wood fixed upon the top of the card, from which two pendulums of equal dimensions and weight are suspended at b , on opposite sides of the card, having the centres of their bobs covering the points of the wires at x . One of these pendulums ax is suspended on this side of the card, upon the pin b ; but the other, being on the other side of the card, is not seen in the figure. The pendulum rods are made of very thin slips of mahogany, and the bobs of card paper.

When the instrument is adjusted, the ends of the wires are placed exactly between the two centres of the bobs at x , where a small circular opening is made, between the ends of the two pieces of wood, to give free passage to the electric fluid.

When a charge from a coated surface is passed through the wires, the card is perforated, and the pendulums are thrown off in contrary directions; and, as far as I am able to judge by inspection, to equal distances from the perpendicular*.

Hence it appears an established law of nature, that all electrical phænomena are produced, by two distinct powers acting in contrary directions, and with equal energy.

And these invisible agents seem to exist in every particle of matter, either in a state of rest or a state of action, according to their different modifications. But till that law which governs these modifications shall be perfectly understood, we must be content with observing *effects*, without knowing their *causes*.

To be continued in my next communication.

I am, dear sir, your obedient servant,
Lynn, August 4, 1813.

EZ. WALKER.

* As the wires nxp and the point of suspension of the pendulums are adjustable, the same card may serve for many experiments.