

XXIX. *Account of some Experiments in Electricity. In a Letter from Mr. William Swift to the Rev. Dr. King, F. R. S.*

Read April 29, 1779.

S I R,

Greenwich,  
April 28, 1779.

**B**EING encouraged by the attention the Royal Society did me last year to give to the account of some electrical experiments I had made, which you were so good as to present to them, I take the liberty to beg their indulgence again, and hope you will be pleased to lay before them some new improvements I have made in my electrical apparatus. I shall esteem myself very happy if what I have done is worthy the farther attention of that most learned and respectable body.

One particular addition I have made to the apparatus consists in what I call an anti-conductor: it is exactly like the prime conductor, but it is fixed to the cushion of the machine, and consequently, when the cylinder is put in motion, the anti-conductor is charged negatively, that is, the electric matter is diminished therein in the same proportion

portion as it is increased in the prime conductor in the same time.

Another thing peculiar to this machine is, that the whole is insulated, so that being able to collect the electric matter without any connection with the earth, and having at the same time bodies or conductors positively and negatively electrified, I apprehend I am enabled by this apparatus to exhibit many experiments more analogous to the natural effects of lightning from the clouds, than it is possible to do with only one conductor positively electrified; because in nature clouds are constantly flying in the air which are differently electrified, and, discharging themselves in each other, produce the lightning often seen in the atmosphere.

I have annexed a slight sketch of the apparatus: *a* is the glass cylinder; *b* the prime conductor, on two glass stems; *c* the anti-conductor, on two glass stems, connected with the cushion of the machine; *dd* is a pole or round staff, well covered with metal, with a ball at each end, which hangs over the two conductors *b* and *c*; this staff is fastened to the cross pole *f*, which is suspended by a silk line in such a manner that the staff *dd* is equally balanced.

It may be proper to mention a few common experiments and observations, to shew, that the two conductors

are charged and differently charged, that is, the one positively or *plus*, the other negatively or *minus*, as soon as the cylinder is put in motion by turning the wheel; though, perhaps, this will not be doubted by any persons conversant in electrical experiments, unless they have been fully persuaded, that the electric matter cannot be excited without connecting the machine with the earth, which is not the case in this apparatus, for the glass cylinder and both conductors are insulated.

1. When the cylinder moves, and a body approaches the prime conductor, such body will draw a spark from that conductor at the same distance, and consequently of the same length as will be drawn from the approaching body by the anti-conductor. And a pith ball is equally attracted by both, which sufficiently shews, that both conductors are charged or electrified.

2. The following common experiments will shew, that they are differently electrified.

I take a wire with a small piece of cocoa wood, about one inch and a half long, pointed, fastened to one end of the wire, and connecting the other end to the anti-conductor as soon as a conducting body approaches it there is a bright spark resembling a star, which appears to settle upon the end or point of the wood; but when the wire is connected with the prime conductor, there issues

from the end of the wood a pencil of rays diverging to the point towards the approaching body, which, I apprehend, demonstrates the conductors to be differently electrified.

3. It may also be seen by another experiment. I take two jars, coated as in the Leyden experiment, and charge one by the prime conductor, the other by the anti-conductor; the first will be positively, and the second negatively electrified; which is proved by applying a discharging rod to the balls connected with the inside of the jars, when both immediately discharge themselves, which they would not do, if both jars were charged from the same conductor.

These experiments I only mention, to shew, that the two conductors are both electrified, and with this difference, that the one has more, the other less, electrical matter than in its natural state.

4. When the pole *dd* is let down by slackening the silk line on which it hangs within the sphere of action of the two electrified conductors, and being equally balanced remains *in equilibrio* over both, as soon as the cylinder begins to turn, the pole vibrates regularly towards each conductor, and as it approaches the one or the other gives a flash or spark.

In this state if a ball be presented to either conductor, it makes no alteration; the pole continues to vibrate as before, even though a flash comes on the ball: but when a point is presented to either of the conductors *b* or *c*, the vibrations of the pole begin to abate, and no flash comes to the point. And as soon as any connection is made with the earth, the point being presented to one conductor, the pole attaches itself to the other with continual flashes.

5. I take two glass globes coated *ee*, and suspend them towards the ends of the pole *dd*. On turning the cylinder the pole will vibrate, and the globes will, in a short time, become charged; each globe will have its outward coat charged in the same way as the conductor over which it hangs, as will appear by discharging them into each other with a common discharging rod. This experiment shews the possibility of compressing the electric matter, though the globes are perfectly insulated.

6. While the machine remains in this state, let the prime conductor *b* be connected with other clouds, fig. 2. which are made to move over houses having conductors terminated with points; the globe *e* over the prime conductor will be thrown upwards or repelled, and the other globe only will receive a charge from the anti-conductor *c*: or if, on the contrary, the anti-conductor *c* be

connected with the flying clouds, the opposite globe only will receive its charge from the prime conductor. But if balls instead of points be made to terminate the conductors of the houses, the globes *ee* will vibrate till both be equally charged.

7. Or if we take off the globes and place a large jar or battery to each conductor, and charge them by turning the cylinder till the electrometer rises to ninety degrees, the strokes of the vibrations of the pole *dd* become very strong; then, by means of an insulated rod, I place a point on the upper part of either conductor where the knob of the pole strikes, and no explosion will come on that point. But if instead of a point, a ball be so interposed, there will be an explosion; and the larger the ball is, the greater the explosion will be. In the latter part of this experiment, when the ball is interposed, if any person applies his finger to any wire on the board *www*, or to the solid pieces of marble standing on the board, he will be sensibly affected with a shock every time the explosion happens; but when the knob is in contact with the point in the former part of the experiment, as there is no explosion, neither will his finger be affected on the marble or any part of the wire.

8. Another experiment, which seems to agree in effect with all the foregoing, is as follows.

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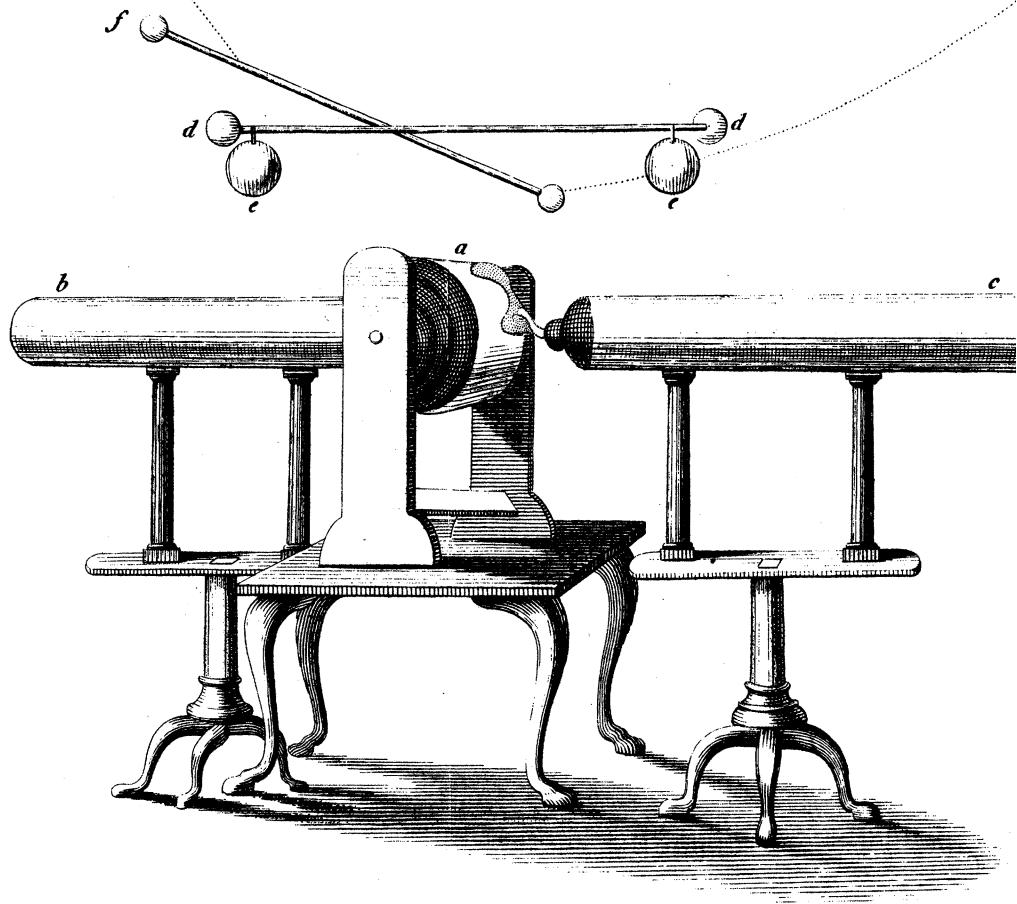
From either the prime conductor, or from the anti-conductor, I suspend a metal ball which can swing like the pendulum of a clock; I then place on a level with it, at the distance of four or five inches from it, another ball fixed and connected with the earth; as soon as the cylinder begins to turn, the swinging ball begins to be attracted, and strikes with considerable force against the fixed one, emitting a spark or flash at the same time.

In such position if a point be put the vibrations of the swinging ball will immediately begin to lessen, and it soon becomes intirely at rest, no flash or spark happening from the instant the point is put there.

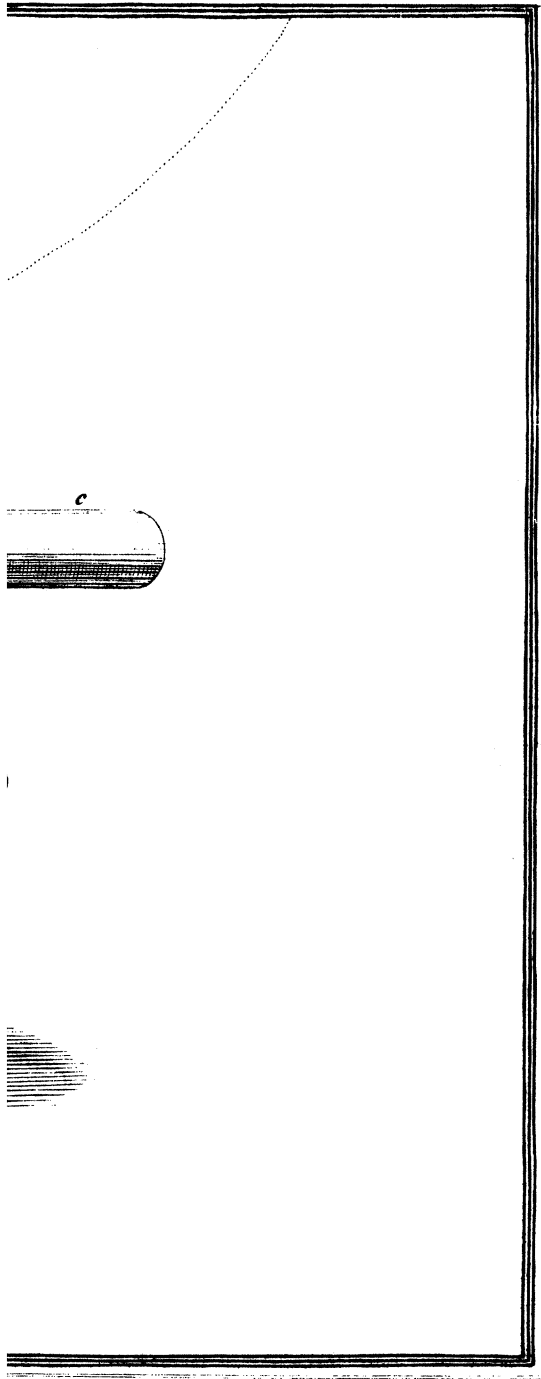
9. On one of the knobs or balls at the end of the pole *dd*, I put a point turned downwards towards the conductor, and as soon as the cylinder moves it is thrown upwards or repelled, and the opposite knob or ball adheres to the conductor under it; but when points are put on both knobs and turned downwards or towards the conductors, the pole *dd* will remain unmoved, notwithstanding all the possible friction which can be given by turning the cylinder.

10. To render these experiments more analogous to the natural phenomena of lightning and rain descending from the clouds, I place a vessel of water insulated, and as the clouds (fig. 2.) being charged pass along the  
frame,

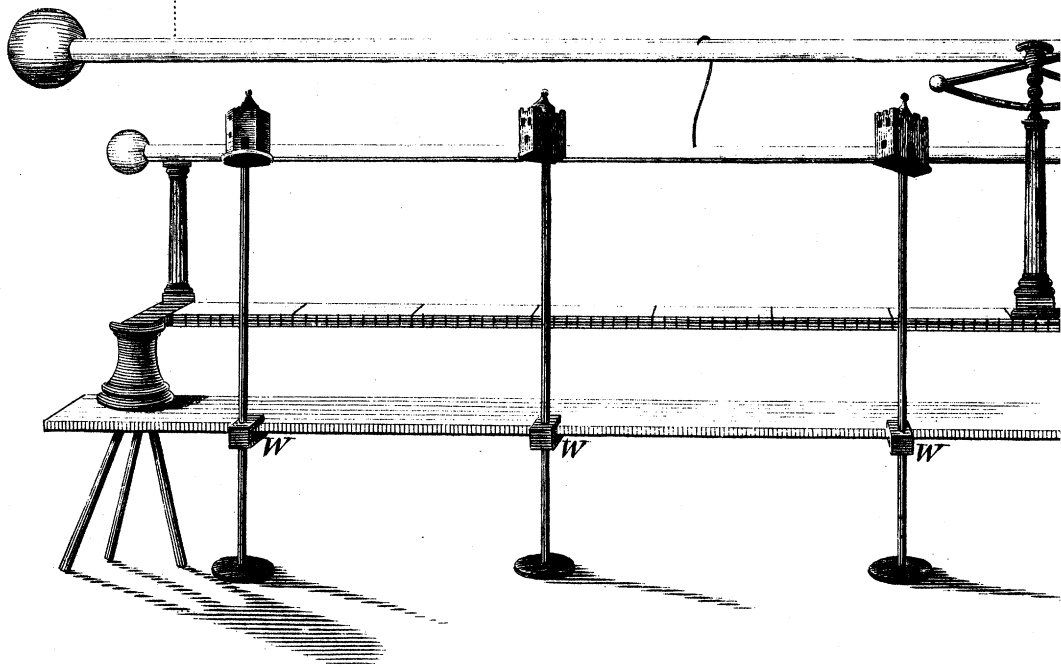
*Fig: 1*

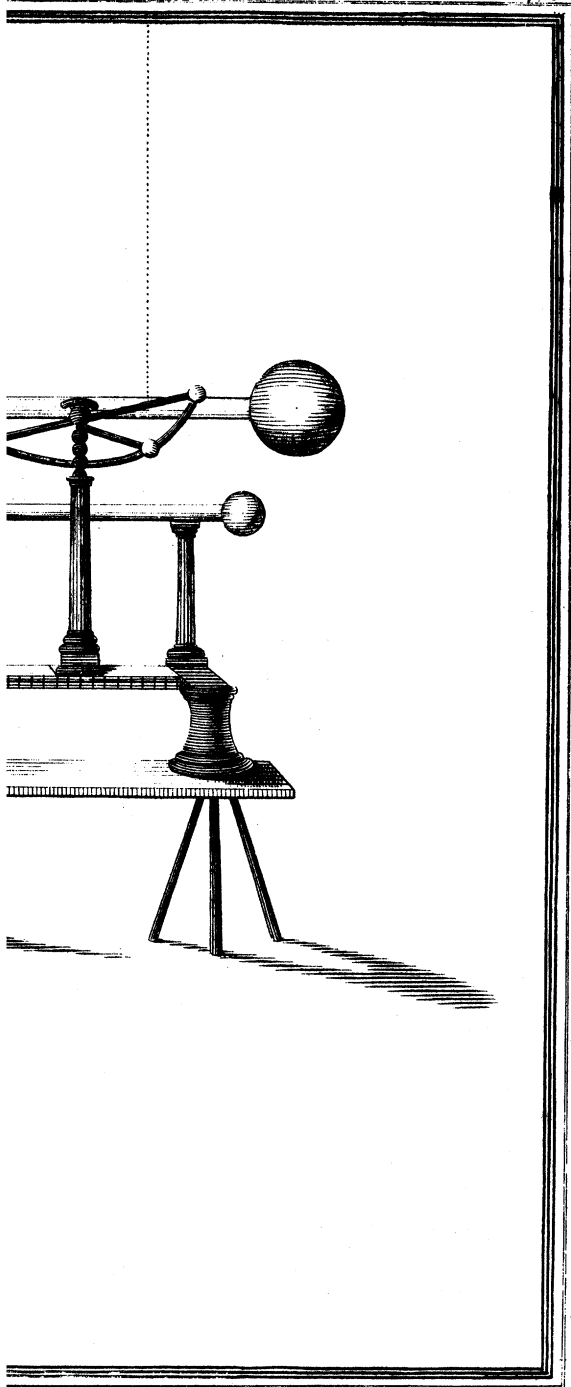






*Fig: 2*





frame, they revolve over another cloud, which is introduced in the place of the middle house: all the houses being taken away through this cloud, the water in the insulated vessel is made to pass and to descend in a stream. When a ball is interposed between this cloud and the revolving ones, there will be frequent flashes upon it; but when, instead of a ball, a point is put there, the electric matter passes off gradually and silently without any flash.

Thus, SIR, I humbly apprehend, the whole current of these experiments tends to shew the preference of points to balls, in order to diminish and draw off the electric matter when excited, or to prevent it from accumulating; and consequently the propriety or even necessity of terminating all conductors with points, to make them useful to prevent damage to buildings from lightning. Nay the very construction of all electrical machines, in which it is necessary to round all the parts, and to avoid making edges and points which would hinder the matter from being excited, will, I imagine, on reflection, be another corroborating proof of the result of the experiment themselves.

I am, &c.



Fig: 1

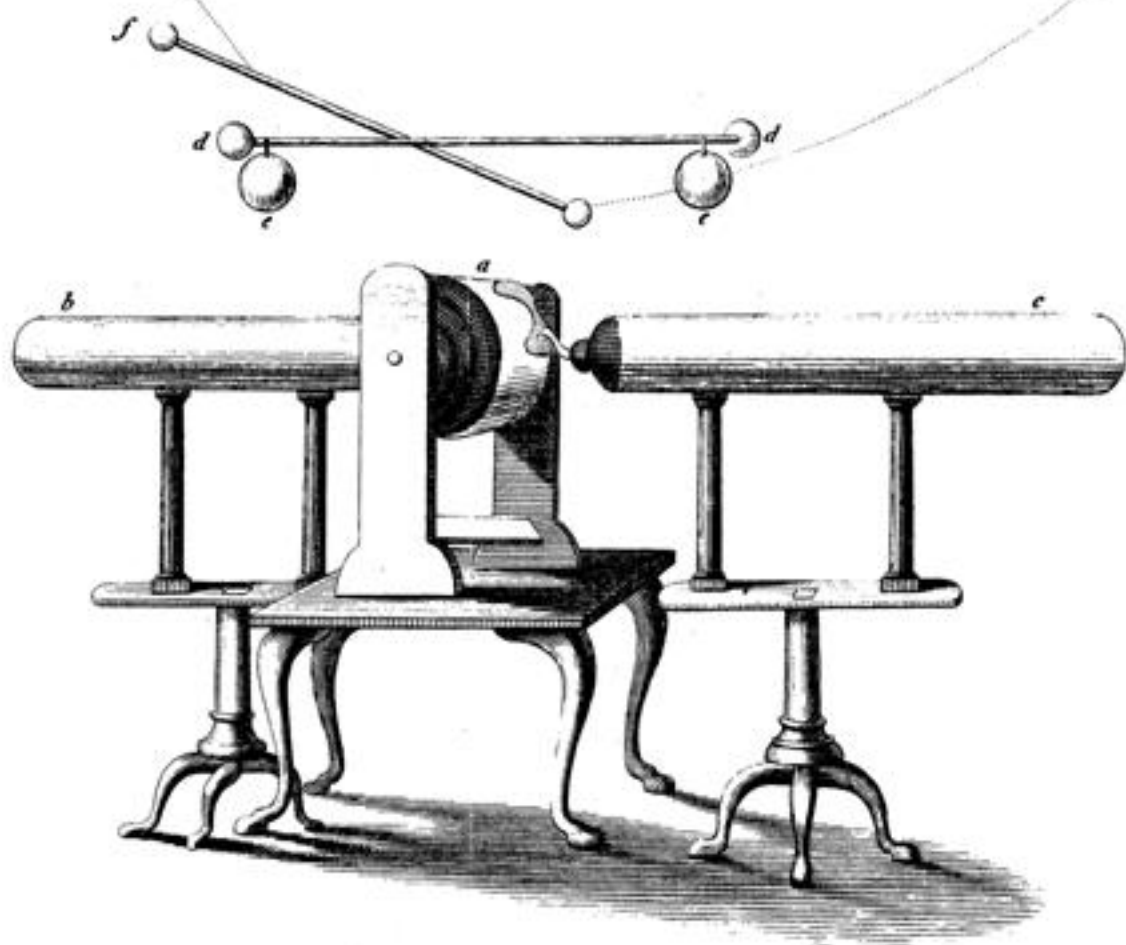


Fig: 2

