

IX. *An Account of some Electrical Experiments, by Mr. William Swift, in a Letter to John Glen King, D. D. F. R. S.*

REV. SIR,

Greenwich,
Jan. 26, 1778.

Read Jan. 29. 1777. I BEG leave to lay before you an account of an electrical apparatus, which I have contrived, to shew the different effects of points and balls at the upper terminations of conductors, to secure houses and magazines of powder from damage by lightning. I have represented the clouds, which are added to my machine, by interposing three feet of water insulated, instead of continuing the metal from the prime conductor; this I apprehend to be analogous to the natural clouds, though it is not in the least necessary for the experiments I am first going to mention, the results of which are not affected by one method more than the other.

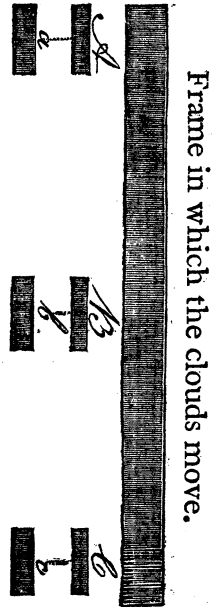
The clouds being charged slide on a frame with a graduated edge; and, as they pass the length of the frame, they make five revolutions round their own axis; for they are represented by a semi-circle, the radius of which is eighteen inches, consequently the extent of it

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is nearly four feet and a half, and is formed with materials well covered with metal. I place three houses, standing in the state of nature (not connected with the cushion) at a certain distance from the frame, and equally distant from each other, as may be seen in the sketch A, B, C, each house has a conductor, and is connected with magazines of powder, *a*, *b*, *c*; the reason for making the clouds a semi-circle is, that when turned back they may be charged from the machine, without affecting, or being affected by, the points or balls on the tops of the



houses A, B, and C; and, by means of their motion round their own axes, I can increase or diminish at pleasure the velocity, which is ascertained by the graduated edge of the frame. I fix an electrometer on one of the conductors of the machine, and put points for the upper terminations of the conductors of the houses.

Having thus prepared the machine, the semi-circular cloud being turned back, that is, within; the machine is charged till the index of the electrometer rises upwards of 90° ; the cloud being then put in motion, as it slides along the frame, revolves over the house A, with its length of $4\frac{1}{2}$ feet; in its passage it empties itself, the elec-

trometer falling to 0, but not the least explosion is perceived. The cloud then turning back in its progressive motion in the frame, is charged again while it passes on to B; at which point, by means of its motion round its axis, it revolves over the conductor B; it empties itself, the electrometer falls, and no explosion is perceived: the same thing happens in the passage over the house c.

The machine remaining in the position as before, I place balls of a quarter of an inch diameter, at the upper terminations of the conductors of the houses A, B, C, and with these balls, the experiments proceed almost as before; that is, the matter passes off with a little hissing noise, and now and then it gives a slight explosion, the smallness of these balls differing little from points; but when I place balls of three-quarters of an inch diameter instead of the small ones, the cloud, every time it passes over them, makes one or more explosions, and fires the magazines *a, b, c*; and, notwithstanding that, the index of the electrometer does not descend above 20° , and starts up again as suddenly as it fell.

If balls are safer at the upper ends of conductors than points, it should follow, that the larger the balls are, the greater the security; but from all these experiments I never found a shock with a point, and not always with a very small ball: but the electrical matter passes off

filently with the points, and so entirely, that the electrometer falls to 5° . With balls a quarter of an inch diameter, indeed, it passes off with a little hissing noise, but this seldom amounts to a shock: but with balls three-quarters of an inch diameter an explosion constantly happens, and the magazines are fired.

To put this matter still more out of doubt, I place a ball of nine inches diameter on one of the conductors, and the explosion is very violent, always more certain; and yet the machine does not discharge itself, for the electrometer falls not more than 20° .

The next experiment I make with the water conductor is, placing the houses A, B, C, in a negative state, by connecting them with the cushion of the machine, or with the outside of a battery: when the cloud is charged and passes over the houses, with points at the upper end of their conductors, there is no explosion; the points seem to draw off all the electrical matter during the passage of the clouds of four feet and a half long: but when, in this position of the houses, balls of three-quarters of an inch diameter are placed instead of points, there is a small explosion, and a considerable *residuum* of the matter is left in the battery. I then change the insulated water for wire to complete the circle: on the passage of the clouds over the houses there is a confi-

derable explosion, whether points or balls are the upper terminations of the conductors of the houses; but no *residuum* is left in the battery.

Hence appears the difference of effect, whether the houses stand in a state of nature, or in a negative state; and whether the conductors be made complete with wire, or water insulated.

I have by sixteen years practice been convinced how difficult it is to draw general conclusions from any electrical experiments, and therefore it becomes me to propose my conjectures with the greatest diffidence; but, I apprehend, the result of many experiments shew that points at the upper termination of conductors gradually diminish or draw off the electrical matter, so as to prevent any damage to the buildings on which they are placed, by preventing a violent explosion; and that, on the contrary, balls, though perhaps they will repel the electrical matter in some degree, yet from that very circumstance, probably, the explosion, when it happens, is violent, and attended with danger.

I am, &c.

