CLASSICS OF SCIENCE: Franklin Plays With Electricity

A letter describing the famous kite experiment, one of the decisive experiments in the history of electricity, is followed by Franklin's accounts of some shocking parlor tricks with electricity which made him the life of the party. The "phial" or "electric bottle" is, of course, the Leyden Jar.

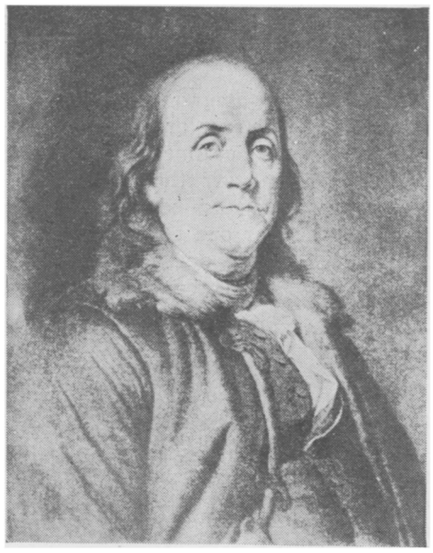
NEW EXPERIMENTS AND OBSERVATIONS ON ELECTRICITY. Made at Philadelphia in America. By Benjamin Franklin, Esq; and Communicated in Several Letters to Peter Collinson, Esq; of London. Part I. The Third Edition. London: 1760.

Letter X. from Benjamin Franklin, Esq; of Philadelphia.

Oct. 19, 1752.

As frequent mention is made in the newspapers from *Europe,* of the success of the *Philadelphia* experiment for drawing the electric fire from clouds by means of pointed rods of iron erected on high buildings, *&c.* it may be agreeable to inform the curious that the same experiment has succeeded in *Philadelphia,* though made in a different and more easy manner, which is as follows:

Make a small cross of two light strips of cedar, the arms so long as to reach to the four corners of a large thin silk handkerchief when extended; tie the corner of the handkerchief to the extremities of the cross, so you have the body of a kite; which being properly accommodated with a tail, loop, and string, will rise in the air, like those made of paper; but this being of silk, is fitter to bear the wind and wet of a thunder gust without tearing. To the top of the upright stick of the cross is to be fixed a very sharp-pointed wire, rising a foot or more above the wood. To the end of the twine, next the hand, is to be ty'd a silk ribbon, and where the silk and twine join, a key may be fastened. This kite is to be raised when a thunder gust appears to be coming on, and the person who holds the string must stand within a door, or window, or under some cover, so that the silk ribbon may not be wet; and care must be taken that the twine does not touch the frame of the door or window. As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, and the loose filaments of the twine will stand out every way, and be attracted by an approaching



BENJAMIN FRANKLIN

finger. And when the rain has wet the kite and twine, so that it can conduct the electric fire freely, you will find it stream out plentifully from the key on the approach of your knuckle. At this key the phial may be charged; and from electric fire thus obtained, spirits may be kindled, and all the other electric experiments be performed, which are usually done by the help of a rubbed glass globe or tube; and thereby the sameness of the electric matter with that of lightening completely demonstrated. B. F.

The Electric Kiss

As the vessel is just upon sailing, I cannot give you so large an account of *American* Electricity as I intended: I shall only mention a few particulars more,—We find granulated lead better to fill the phial with, than water, being easily warmed, and keeping warm and dry in damp air.—We fire spirits with the wire of the phial.—We light candles, just blown out, by drawing a spark among the smoke between the wire and snuffers.—We represent lightning, by passing the wire in the dark over a china plate that has gilt flowers, or applying it to gilt frames of looking-glasses, &c.—We electrise a person twenty or more times running, with a touch of the finger on the wire, thus: He stands on wax. Give him the electrised bottle in his hand. Touch the wire with your finger, and then touch his hand or face; there are sparks every time.—We increase the force of the electrical kiss vastly, thus: Let *A* and *B* stand on wax; give one of them the electrised phial in hand; let the other take hold of the wire; there will be a small spark; but when their lips approach they will be struck and shock'd. The same if another gentleman and lady, *C* and *D,* standing also on wax, and joining hands with *A* and *B,* salute, or shake hands.—We suspend by fine silk thread a counterfeit spider, made of a small piece of burnt cork, with legs of linnen thread, and a grain or two of lead stuck in him to give him more weight. Upon the table, over which he hangs, we stick a wire upright as high as the phial and wire, two or three inches from the spider; then we animate him by setting the electrified phial at the same distance on the other side of him; he will immediately fly to the wire of the phial, bend his legs in touching it, then spring off; and fly to the wire in the table; thence again to the wire of the phial, playing with his legs against both in a very entertaining manner, appearing perfectly alive to persons unacquainted. He will continue this motion an hour or more in dry weather.

"The Conspirators"

The magical picture is made thus. Having a large metzotinto with a frame and glass, suppose of the KING (God preserve him) take out the print, and cut a pannel out of it, near two inches distant from the frame all round. If the cut is through the picture 'tis not the worse. With thin paste, or gum-water, fix the border that is cut off on the inside of the glass, pressing it smooth and close, then fill up the vacancy by gilding the glass well with leaf gold or brass. Gild likewise the inner edge of the back of the frame all round except the top part, and form a communication between that gilding and the gilding behind the glass: then put in the board, and that side is finished. Turn up the glass, and gild the fore side exactly over the back gilding, and when it is dry, cover it by pasting on the pannel of the picture that hath been cut out, observing to bring the correspondent parts of the border and picture together, by which the picture will appear of a piece as at first, only part is be- (*Turn to next page*)

Franklin and Electricity—*Continued*

hind the glass, and part before.—Hold the picture horizontally by the top, and place a little moveable gilt crown on the king's head. If now the picture be moderately electrified, and another person take hold of the frame with one hand, so that his fingers touch its inside gilding, and with the other hand endeavour to take off the crown, he will receive a terrible blow, and fail in the attempt. If the picture were highly charged, the consequence might perhaps be as fatal as that of high-treason; for when the spark is taken through a quire of paper laid on the picture, by means of a wire communication, it makes a fair hole thro' every sheet, that is, thro' 48 leaves, (though a quire of paper is thought good armour against the push of a sword, or even against a pistol bullet) and the crack is exceeding loud. The operator, who holds the picture by the upper end, where the inside of the frame is not gilt, to prevent its falling, feels nothing of the shock, and may touch the face of the picture without danger which he pretends is a test of his loyalty.—If a ring of persons take the shock among them, the experiment is called, *The Conspirators.*

On the principle that hooks of bottles, differently charged, will attract and repel differently, is made an electrical wheel, that turns with considerable strength. A small upright shaft of wood passes at right angles through a thin round board, of about twelve inches diameter, and turns on a sharp point of iron fixed in the lower end, while a strong wire in the upper end passing thro' a small hole in a thin brass plate, keeps the shaft truly vertical. About thirty *radii* of equal length, made of sash-glass cut in narrow strips, issue horizontally from the circumference of the board, the ends most distant from the center being about four inches apart. On the end of every one, a brass thimble is fixed. If now the wire of a bottle electrified in the common way, be brought near the circumference of this wheel, it will attract the nearest thimble, and so put the wheel in motion; that thimble, in passing by, receives a spark, and thereby being electrified is repelled, and so driven forwards; while a second being attracted, approaches the wire, receives a spark, and is driven after the first. . . .

"The Golden Fish"

From the before-mentioned law of electricity, that points, as they are more or less acute, draw on and throw off the electrical fluid with more or less power, and at greater or less distances, and in larger or smaller quantities in the same time, we may see how to account for the situation of the leaf gold suspended between two plates, the upper one continually electrified, the under one in a person's hand standing on the floor. When the upper plate is electrified, the leaf is attracted and raised towards it, and would fly to that plate, were it not for its own points. The corner that happens to be uppermost when the leaf is rising, being a sharp point, from the extream thinness of the gold, draws and receives at a distance a sufficient quantity of the electrical fluid to give itself an electrical atmosphere, by which its progress to the upper plate is stopt, and it begins to be repelled from that place, and would be driven back to the under plate, but that its lowest corner is likewise a point, and throws off or discharges the overplus of the leaf's atmosphere, as fast as the upper corner draws it on. Were these two points perfectly equal in acuteness, the leaf would take place exactly in the middle space, for its weight is a trifle, compared to the power acting on it: But it is generally nearest the unelectrified plate, because, when the leaf is offered to the electrified plate at a distance, the sharpest point is commonly first affected and raised towards it; so that point, from its greater acuteness, receiving the fluid faster than its opposite can discharge it at equal distances, it retires from the electrified plate, and draws nearer to the unelectrified plate, till it comes to a distance where the discharge can be exactly equal to the receipt, the latter being lessened, and the former encreased; and there it remains as long as the globe continues to supply fresh electrical matter. This will appear plain, when the difference of acuteness in the corners is made very great. Cut a piece of *Dutch* gold (which is fittest for these experiments on account of its greater strength) into [this] form: the upper corner a right angle, the two next obtuse angles, and the lowest a very acute one; and bring this on your plate under the electrified plate, in such a manner as that the right-angled part may be first raised (which is done by covering the acute part with the hollow of your hand) and you will see this leaf take place much nearer to the upper than the under plate; because without being nearer, it cannot receive so fast at its right-angled point, as it can discharge at its acute one. Turn this leaf with the acute part uppermost, and then it takes place nearest the unelectrified plate; because, otherwise it receives faster at its acute point than it can discharge at its right-angled one. Thus the difference of distance is always proportioned to the difference of acuteness. Take care in cutting your leaf to leave no little ragged particles on the edges, which sometimes form points where you would not have them. You may make this figure so acute below and blunt above, as to need no under plate, it discharging fast enough into the air. When it is made narrower . . . we call it the *Golden Fish,* from its manner of acting. For if you take it by the tail, and hold it at a foot or greater horizontal distance from the prime conductor, it will, when let go, fly to it with a brisk but wavering motion, like that of an eel through the water; it will then take place under the prime conductor, at perhaps a quarter or half an inch distance, and keep a continual shaking of its tail like a fish, so that it seems animated. Turn its tail towards the prime conductor, and then it flies to your finger, and seems to nibble it. And if you hold a plate under it at six or eight inches distance, and cease turning the globe, when the electrical atmosphere of the conductor grows small, it will descend to the plate and swim back again several times with the same fish-like motion, greatly to the entertainment of spectators. By a little practice in blunting or sharpening the heads or tails of these figures, you may make them take place as desired, nearer, or farther from the electrified plate.

Benjamin Franklin (1706-1790), the great American printer, publisher, author, athlete, linguist, legislator, diplomat, scientist and inventor, was responsible for organizing among other things police and fire departments and the Pennsylvania militia, the University of Pennsylvania, the American Philosophical Society, street paving and lighting, a city hospital and the Post Office Department. His researches on static electricity are classics of their period in the development of that science.

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