

XVIII. *A Letter from Thomas Ronayne, Esq; to Benjamin Franklin, LL. D. F. R. S. inclofing an Account of some Observations on Atmospherical Electricity; in regard of Fogs, Mists, &c. with some Remarks; communicated by Mr. William Henley.*

S I R,

Read April 30, 1772. **I**N conformity to the desire of some friends, I have drawn up the following observations on atmospherical electricity, which I beg leave to lay before you; and shall think the trouble I have had, in prosecuting the necessary experiments, sufficiently compensated, if it shall appear to you that they contain any thing new or curious; in which case, you are at liberty to dispose of them in whatever manner you shall think proper.

I am, S I R,

With very respectful consideration,

Your most obedient servant,

Cecil-Street,
Feb. 15, 1772.

Tho^s Ronayne.

VOL. LXII.

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SOME

* SOME years ago I discovered, by Mr. Canton's electrometer, described in the *Philos. Transactions*, Vol. XLVIII. p. 783. that the air of Ireland is, during the winter season, in almost a constant state of positive electricity; which, however, is so weak, that, in order to observe it satisfactorily, I have always found it necessary to have the cork-balls suspended from threads of a middling fineness, six or seven inches in length, quite streight, and to avoid, as much as possible, any interruption from the wind.

I have likewise had frequent recourse to the following contrivance, by which I was enabled, within doors, to pursue my inquiries with greater accuracy and advantage: having procured a slender tapering piece of wood, about five feet long, to the smaller end of which an electrometer was affixed, by means of a small hook; I placed it out from an open garret window, and fastened the other end with a small hasp to one of the jambs: I had also at hand another piece of wood, in the ends of which, a small glass tube and a stick of sealing-wax had been inserted. Either of these was occasionally excited, and applied near the cork-balls, in order to determine more precisely the kind of electricity with which they might happen to be affected; and I was always careful in

* I commenced my experiments on the air in the year 1761, and those on the clouds in the year 1762. I continued them unremittingly, as opportunity offered, till the year 1770, when my occasions brought me to England. I have repeated my experiments, with regard to the common air, in different places here, and find it the same as that in Ireland.

making

making my experiments on that side of the house where the wind had least power.

I have found the air, in winter, at a proper distance from buildings, trees, masts of ships, &c. very sensibly electrified, during a frosty or foggy state of the weather; and in mists too, but in a less degree: I have also discovered small signs of it in calm and cloudy weather.

The air, in summer, never shewed any sign of electricity, except when a fog happened in the cool of the evening, or at night; in which case, I always discovered manifest marks of electricity, sensibly weaker than those observed in winter fogs, but precisely of the same kind, that is, *positive*.

I have often examined the state of the air, at the time of an Aurora borealis, and could not discover any indication of electricity, except when a fog had appeared at the same time; in which case, the electricity has been, in every respect, the same as that of a fog at any other time. Once, indeed, during an Aurora borealis on a remarkable serene night, I discovered some signs of a very weak *positive* electricity.

As the electricity of the air is generally *positive* (I never knew an exception but one, which presented itself during a fog on a winter day, that proved uncommonly warm), is it not reasonable to believe, that cold electrifies the atmosphere *positively*? and, if so, may not one be led to imagine, that heat electrifies it *negatively*? But this I only offer as a conjecture, not being able to advance any thing decisive on the subject, and knowing that one sort of electricity may

often be productive of the other, as is plain from Dr. Franklin's experiments.

If cold electrifies the air *positively* in this climate (which seems extremely probable), may it not electrify it *negatively* at and about the place of our antipodes? Does not a consideration of the effects discovered in the Tourmalin favour this surmise?

The electricity of the air, in frosty, foggy or misty weather, is not strong enough to yield any spark, even by insulating a sharp pointed wire in it, which, however, attracts very light bodies at a small distance; whilst, on the contrary, that of the clouds generally affords considerably strong sparks.

When a fog becomes very thick, the cork-balls approach; but when it returns to its former state, they open again at their first distance; and I have observed that, when it rained in foggy weather, the balls closed, and opened again on the fog's appearance anew, after the rain had ceased: there is, however, a certain degree of density necessary in a fog, in order that the balls might exert their greatest divergency.

Most, if not all, fogs partake of a smell much like that of an excited glass tube, and, indeed, so does the common air very frequently.

As fogs sometimes appear in a very moist state of the air, I was for some time at a loss to account on what principle they could retain their electricity; but having at length remarked, that electrified bodies, insulated with sealing-wax, preserved their electricity for a time in very damp air, I concluded that moisture is but a very slow conductor.

Having,

Having, on the contrary, observed that bodies, insulated with dried silk, had lost their electricity in a very short time, I attempted to render it a non-conductor, by having varnished it over with oil of turpentine, balsam of sulphur, and such like, but did not succeed; for silks so treated soon became a conductor, and increased considerably in weight, if the air happened not to be very * dry; so much indeed, that I think ordinary silk, from its power of absorbing moisture from the air, may well serve as an occasional hygrometer, either by being put into a balance, or by having an electrified body insulated with it.

When the density of fogs, floating near the earth, increases considerably, the balls always approach; but when they are situated high in air, the reverse generally happens. I had an opportunity of remarking a struggle between breezes from the north-west and south-east at the same time, in which the one seemed sometimes to prevail, and afterwards the other. This contention was succeeded by a smoky haziness, which, like a fog, occasioned the balls to open: as the haziness † thickened, they opened.

* Even glass attracts moisture to its surface, which makes it a conductor of electricity, and, consequently, not so convenient as sealing-wax.

† An electrical body, when contracted in its dimension, will have its electricity increased, as appears by Dr. Franklin's curious experiment with the chain and silver can. I also have discovered, from repeated trials, that a piece of flannel, silk, &c. excited, and suddenly twisted, not only struck at a greater distance than before, but sometimes emitted pencils of fire into the air. May we not hence infer why the electricity of vapour, &c. (when not in contact with the earth) increases by condensation?

wider,

wider, and still wider when it dissolved into rain, but their repelling power became greatest in proportion as the drops increased.

The electrometer placed out from a garret window (p. 138.), has been frequently useful to me, in determining the nature of an approaching cloud, whose electricity, although generally strong, was for the most part uncertain, having been sometimes *positive*, and at other times *negative*. But, as the wind or rain were frequent impediments to the accuracy of my experiments, the following methods of making observations, with success, under shelter, occurred to me.

I have sometimes stood, in an upper room, on a cake of wax, holding in my right hand, out at the window, a long slender piece of wood, round which a wire projecting a few inches had been twisted, and in my left hand an electrometer: an assistant had excited glass or wax in readiness.

At other times, I have made use of a tapering tube of tin, twenty feet long, ending in a point; the greatest part of it stood out high in the air, and the thick end, from which an electrometer hung, was supported inside the window, sometimes with silk cords, and at other times with strong sticks of sealing-wax, sustained at either end by hooks of iron-wire.

By either of these means I have often discovered, that what seemed to me a single cloud, produced, in its passing over, several successive changes, from *positive* to *negative*, and from *negative* to *positive* electricity, the balls coming together each time, and remaining in contact a few seconds, before they repelled each other again.

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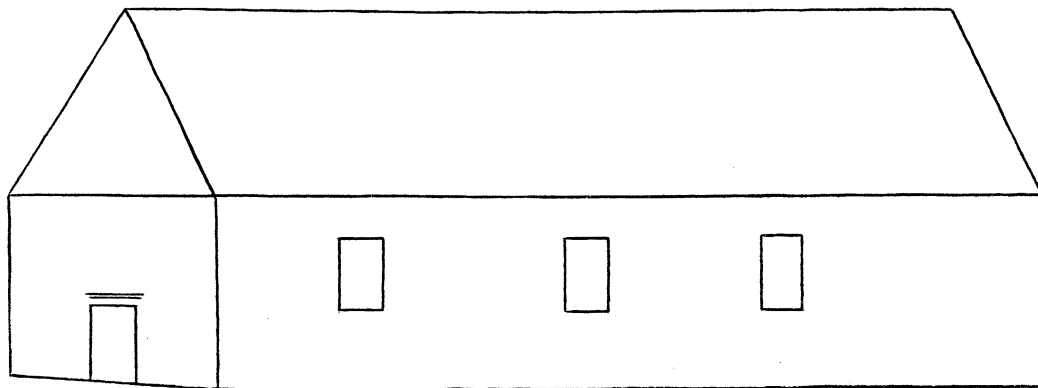
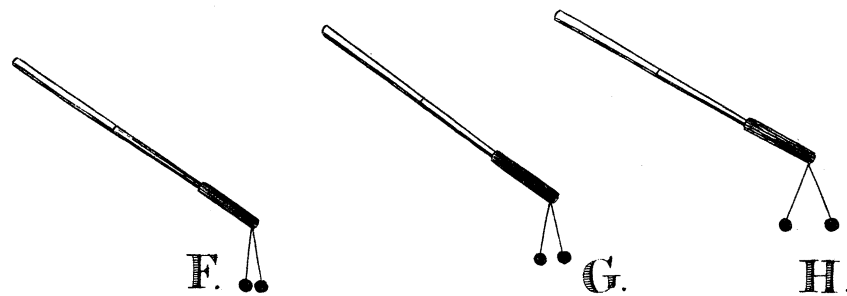
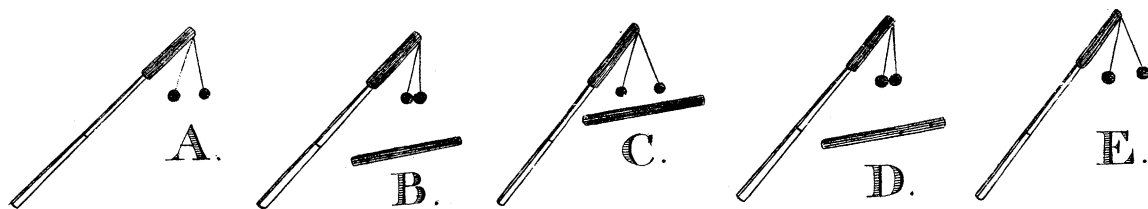
The permanence of either kind of electricity in the clouds, or the length of time in which neither can be discovered, is uncertain ; sometimes the same electricity has returned, and at other times has been succeeded by the contrary ; whilst either generally came on, and went off gradually. But changes were often made, very suddenly, by a flash of lightning, especially if the thunder-storm happened to be in the zenith. A branch of it, over-head, has frequently occasioned stronger electricity than I could discover, when the greatest part of the sky had been overcast ; which, perhaps, might be accounted for, from this consideration, that one kind of electricity acting alone, must exert more powerful effects than when counteracted by the other.

I once observed in a thunder-storm, during which I saw no lightning, that the balls, which hung from the tin tube, repelled and attracted each other, very rapidly, for the space of ten or twelve seconds ; at the same time, Mr. Canton's electrometer, which I held at such a distance from the tube, as to have its balls opened to the distance of an inch, continued quiet in that state, and were not affected convulsively like the others. Hence I imagined, that the same kind of electricity went off, and came on, without being changed *in contrarium* ; for when that circumstance happened, they were very evidently affected in the same manner. And here I must observe, that I have found it more easy to discover the kind of electricity present in the tube, by approaching excited wax to the balls of an electrometer, which I held at a proper distance from the tube, than by applying it near the balls which hung from the tube ;
for

for they, in the general, diverged so much, that I found it very difficult to have in readiness a small tube of glass, or wax sufficiently excited to affect them.

It has sometimes happened that the balls of the tin tube, &c. perfectly at rest, have, in consequence of a flash of lightning, suddenly repelled each other, and immediately after closed. As this circumstance has frequently happened, when the air was in a damp state, I have sometimes imagined that the equilibrium between the earth and lower clouds had been quickly restored, on receiving the electricity of the higher ones; and, at other times, have supposed that it might be owing to the lateral effect of the explosion.

If two or more persons, at a sufficient distance from each other, would correspond, by signals, viz. a red flag for *positive*, and a blue one for *negative* electricity, we should probably obtain, in due time, more satisfactory certainty with regard to the electricity of the clouds, thunder, &c. than has hitherto been given, or is, perhaps, possible for any one man to acquire, without the aid of wires or chains, produced from different apparatuses, placed at different distances from each other.



Mr. Ronayne having received the following Letter from Mr. Henly, which corroborates and confirms the observations mentioned in his paper, it was thought proper to print them together in this volume.

October 16, 1771, $\frac{1}{4}$ past 5, P. M.

I Find a fog (not very thick), soon after its appearance, strongly electrical. The balls open $\frac{1}{2}$ or $\frac{3}{4}$ inch A, [See Tab. VIII.], and close at the approach of excited wax, when brought within 10 inches of them B: if the wax is brought within 3 or 4 inches, they diverge again, in consequence thereof C: as the wax is withdrawn, they converge again, D, till it gets beyond the distance of its influence, when they begin to diverge again; and, as the wax is withdrawn still farther, they continue to open, in consequence of the electricity in the fog, till they reach their original distance from each other E. There is very little disturbance by the wind, and the little there is, only wafts them in a small degree, but they keep separate. If they are held near the tiling, or brick-work, of a neighbouring house, they close, F; but begin to diverge again, at the distance of 3 or 4 feet from it, G; and their divergence increases, as they recede from the building, till they separate $\frac{1}{2}$ or $\frac{3}{4}$ inch, as at first, H.

MEMORANDUM.

October 3, 1771, I tried the electricity of a thick fog, and (in at least twenty different trials) found the balls separated from $\frac{1}{4}$ to $\frac{3}{4}$ inch distance. Whenever I brought them near the building, or approached them with a stick of excited wax, they closed ; and opened again, on removing them.

W. Henly.