

XIII. *A Letter from Mr. Benjamin Wilfon, F. R. S. to the Rev. Tho. Birch, D. D. Secret. R. S.*

Dear Sir,

Read Mar. 22, 1759. **T**HE inclosed letter contains some electrical experiments and observations, which seem to merit the attention of the Royal Society. I wish therefore you would lay it before them; and at the same time signify, that I have seen all the experiments carefully made, and that the several facts therein contained are faithfully related. I am,

S I R,

Your most obedient humble Servant,

Queen-street, London,
22 March, 1759.

B. Wilfon.

A Letter from Edward Delaval, M. A. and Fellow of Pembroke-Hall, Cambridge, to Mr. Benjamin Wilfon, F. R. S. containing some Electrical Experiments and Observations.

S I R,

Read Mar. 22, 1759. **I** Send you a few electrical experiments and observations; and desire your opinion, how well they establish a convertibility, I believe hitherto unnoticed in many substances, from conductors into non-conductors of the electric fluid.

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I have filled several small glass tubes with the dry powders of calcined metals, *viz.* cerufs, lead ashes, minium, calx of antimony, &c. Into each end of every tube I put a piece of iron wire, which communicated with the calx, and fastened them with wax: so that the electric fluid, not being able to escape by means of the glass, must either pass thro' the calx, or not at all. Upon hanging one of the wires, bent for the purpose, to the electrified bar, and holding the other in my hand, I observed that no electric matter did pass the calx, the snaps issuing all the while from the bar, or from that wire which was in contact with the bar*.

Animal and vegetable solids also, when reduced to ashes, and interposed in the same manner between two pieces of wire, do, I find, as effectually intercept the electric stream, as the metallic calces.

From these experiments you see, that animal, vegetable, and metallic bodies, tho' such known conductors of the electric fluid while in their intire state, are easily changed into resistors or non-conductors of it.

I was led to attempt this change from its having been observed, that dry mould would not conduct the electric fluid: and from thence I suspected, that one class of the non-conductors must owe its property to an electrical virtue that would be found to reside in the calx, or earth of the chymists, after it is divested of the unctuous inflammable matter, which

* Since I wrote this letter, I have been informed, that part of this first experiment, relating to metallic calces, has been made before by Dr. Watson. See the note Phil. Trans. vol. xlv. p. 107.

constitutes another of the chymical principles called sulphur; in like manner as this sulphur is constantly found highly electrical in all bodies where it abounds in a solid form, *viz.* resins, wax, &c.

These experiments appear to verify my supposition: for all the above-mentioned substances, which were thus changed into non-conductors, consist either wholly, or in a great measure, of earth freed from the unctuous inflammable particles; the metals not being calcineable without a degree of heat that must dissipate all their sulphur, as is evident from their not being reducible again into their metallic form without the admixture of some unctuous matter; and the same dissipation of their sulphur must take place in the animal and vegetable substances, before they become white ashes.

I shall not at present attempt an account, why bodies consisting of either of these substances separately are electric, tho' it appears to me deducible from some doctrines of Sir Isaac Newton; but only propose a thought concerning the reason why these two principles, calx and sulphur, which are known to unite in the composition of almost all bodies, should, notwithstanding they are electric when separate from each other, be yet found non-electric when united in one body.

It must be remembered, that there is a remarkable and well-known opposition in the electrical effects of these two classes; the earthy one (as glass and stones) electrifying *plus*, and the sulphureous one *minus*. Does it not seem then a thing to be expected, in a body compounded of both, that the opposite powers of these ingredients should counterbalance
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and destroy the effects of each other, and the body in which the positive and negative ones equally prevail, become neutral, or non-electric ?

I have not scrupled to rank those known positive electrics, glass and transparent stones, under that class of bodies which consists of calx or earth ; because all vitrifications must proceed from previous calcinations, and all calces may be vitrified in the focus of large burning-glasses. The transparent stones also consist of little more than pure earth, free of the least mixture of oil, if we may judge of others by the chymical resolution of crystal.

There is another process, natural and without fire, which is supposed to destroy the sulphureous substance of metals, *viz.* when they are corroded, and moulder in the open air. Accordingly, with the same apparatus in which I tried the calcinations by fire, I examined the common rust of iron, and flake-white, which is the rust of lead, and find them equally converted into non-conductors in the open air.

That this change, in metals particularly, is not owing to, or promoted by, the circumstance of mere pulverization, is evident, not only because the above-mentioned calces are equally strong electrics when formed into hard masses with a thin paste of flour and water, and afterwards dried, but most clearly because the finest filings or powders of metals conduct as readily as the intire substances do. I have glass tubes armed as above, and filled with the preparations called powder of tin, &c. which conduct as well as a wire when it is not discontinued.

But notwithstanding this change will not succeed

in metallic substances upon mere pulverization, yet it seems to follow in most other hard bodies.

Having dried a piece of Portland stone, I found it conducted perfectly well; but upon powdering, and sealing it up in one of the tubes with the wire ends, as above, it became a perfect resister, or non-conductor, like the metallic calces.

I have tried the same experiment on a variety of other bodies, particularly gum arabic and allum; and have reason to believe it will succeed in all bodies that can be pulverized in the mortar.

These last experiments seem to confirm Sir Isaac Newton's doctrine of a *medium* surrounding all bodies, which you have applied to the solution of electric phænomena, and are very analogous to the experiments you made with a *chain*, in order to shew that the resistance to the passage of the electric fluid may be increased by increasing the number of surfaces.

Another very extraordinary means of making this change in bodies, which abound in calx or earth, is by fire: not by the intense one that calcines, but by a moderate heat; their most perfect resistance, or non-conducting property, being when their heat is just tolerable to our hands.

I have some of the same Portland stone, wrought into plates nearly as thin as window-glass, which I heat to a proper degree, and then coat on both sides with metal, in order to make the Leyden experiment. When the stone is hot enough to singe paper, it conducts as perfectly as when cold; but on cooling a little, it begins not to conduct, and affords small shocks, which gradually increase in strength for about ten minutes; at which time it is about its most perfect

fect state, and remains so near a quarter of an hour : after that time the shocks gradually decrease as the stone grows cooler, till at last they quite cease, and it returns to its conducting state again : but this state appears before the stone is quite cold.

Experiments of this kind succeed in all bodies abounding in calx or earth, as stones, dried clay, wood when rotten or burnt in the fire till the surface becomes black.

Among other substances, I tried a common tobacco-pipe, part of which near the middle I heated to a proper degree, and then applied one end of it to the electrified bar, while the other was held in the hand ; and I observed that the electric fluid passed no farther along the pipe than to the heated part.

To these changes brought about with sudden violence, I must add the universal change going on in all animal and vegetable solids, as they are growing dry. Not only their ashes resist the passage of the electric fluid, but they of themselves arrive at this state while yet hard and intire ; and that much sooner than one would imagine ; for I have bones and hard wood that perfectly resist the passage, tho' yet capable of yielding a bright flame, but scarce a visible smoke : so that besides an evaporation of their moisture, but a partial progress can have been made in the discharge of their sulphur.

I submit to your judgment, how much this convertibility may contribute to a farther knowlege of the laws of electricity. I am, Sir,

Your most humble Servant,

Edward Delaval.

Old Palace-Yard,
March 15, 1759.